SECTION 40 05 15

PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Society for Testing and Materials (ASTM):
      a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
   2. Manufacturers' Standardization Society (MSS):
      a. SP 58, Pipe Hangers and Supports - Materials, Design and Manufacture.
      b. SP 69, Pipe Hangers and Supports - Selection and Application.
      c. SP 89, Pipe Hangers and Supports - Fabrication and Installation Practices.
   3. B31.3, Process Piping.

1.2 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Drawings of piping support system, locating each support, brace, hanger, guide, component, expansion joint, and anchor on the piping. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number. Indicate point load reactions from the pipe supports on supporting structure in vertical, lateral and longitudinal directions.
   2. If computer piping stress analyses are used, submit piping isometric drawings with nodal numbers consistent to the analyses.
   3. Catalog information of piping supports
   4. Details of the piping supports for custom designed items.
   5. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

1.4 DESIGN REQUIREMENTS

A. General:
   1. Maximum Support Spacing and Minimum Rod Size:
      a. Copper Piping:
         1) Maximum Support Spacing: 1.19 mm, with 25.4 mm and smaller pipe supported every 1.5 m.
         2) Minimum Hanger Rod Sizing: 6.25 mm.

b. Plastic Piping:
   1) Maximum support spacing: As recommended by manufacturer for flow temperature in pipe.
   2) Minimum Hanger Rod Sizing: 6.25 mm with 50 mm and smaller pipe, and 9.5 mm with 75 mm and larger pipe.

c. Stainless Steel Piping:

SST Pipe Size	Maximum Support/Hanger Spacing	Minimum Rod Size Single Rod Hangers
25 mm	2.4 m	6.25 mm

B. Framing Support System:
   1. Beams: Size such that beam stress does not exceed 172,000 kPa and maximum deflection does not exceed 1/240 of span.
   2. Column Members: Size in accordance with manufacturer's recommended method.
   3. Support Loads: Calculate using weight of pipes filled with water.
   4. Maximum Spans:
      a. Other Pipelines and Special Situations: May require supplementary hangers and supports.

C. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

D. Vertical Sway Bracing: 3 m maximum centers, or as shown.

E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show that they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 PRODUCTS

2.1 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.

B. Special support and hanger details are shown for cases where standard catalog supports are inapplicable.

2.2 HANGERS

A. Clevis Type: MSS SP 58 and SP 69, Type 1 or 6.
   1. Anvil; Figure 104 or 260.
   2. B-Line; Figure B3198 or B3100.

B. Hinged Split-Ring Pipe Clamp: MSS SP 58 and SP 69, Type 6 or 12.
   1. Anvil; Figure 104.
   2. B-Line; Figure B3198H.

C. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

D. Attachments:
   1. I-Beam Clamp: Concentric loading type, MSS SP 58 and SP 69, Type 21, 28, 29, or 30, which engage both sides of flange.

2.3 FLANGE SUPPORTS

A. Bolted type support.

B. Adjustable pipe stanchion, single or double pipe supports.

C. MSS SP-69, Type 37.
   1. Tolco; Figure 314.
   2. Standon; Model; S89.

2.4 SADDLE SUPPORTS

A. Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
   1. Nonadjustable Saddle: MSS SP 58 and SP 69, Type 37 with U-bolt.
      a. Anvil; Figure 259.
      b. B-Line; Figure B3090.

2.5 WALL BRACKETS

A. Welded Steel Bracket: MSS SP 58 and SP 69, Type 33 (heavy-duty).
   1. Anvil; Figure 199.
   2. B-Line; Figure B3067.

B. One-Hole Clamp: Anvil; Figure TBA

C. Channel Type:
   1. Unistrut.
   2. Anvil; Power-Strut.
   3. B-Line; Strut System.
   4. Aickinstrut (FRP).

2.6 PIPE CLAMPS

A. Riser Clamp: MSS SP 58 and SP 69, Type 8.
   1. Anvil; Figure 261.
   2. B-Line; Figure B3373.

2.7 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, 1-1/2-inch wide, minimum FRP.

B. Members and Connections: Design for all loads with safety factor of 5.

C. Pipe clamps: two piece clamps for all pipes unless otherwise noted.

D. Manufacturers:
   1. B-Line; Strut System.
   2. Unistrut.
   3. Anvil; Power-Strut.
   4. Aickinstrut (FRP System).

2.8 ACCESSORIES

A. Insulation Shields:
   1. Type: Galvanized steel or stainless steel, MSS SP 58 and SP 69, Type 40.
   2. Manufacturers and Products:
      a. Anvil; Figure 167.
      b. B-Line; Figure B3151.

B. Vibration Isolation Pads:
   1. Type: Neoprene Waffle.
   2. Manufacturers and Products:
      a. Mason Industries; Type W.
      b. Korfund; Korpad 40.

2.9 INTERMEDIATE PIPE GUIDES

A. Piping 150 mm and Smaller:
   1. Type: Pipe clamp with oversized pipe sleeve to provide minimum 3.2 mm clearance.
   2. Manufacturers and Products:
      a. B-Line; B3148 or B3180.
      b. Anvil; Figure 103.

2.10 PIPE ALIGNMENT GUIDES

A. Type:
   1. Piping 150 mm and Smaller: Spider or sleeve type.

B. Manufacturers:
   1. Flexonics.
   2. Anvil.
   3. B-Line.

2.11 PIPE ANCHORS

A. Type: Anchor chair with U-bolt strap.

B. Manufacturers and Products:
   1. Anvil; Figure TBA
   2. B-Line; Figure B3147A or B3147B.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
   1. Install support systems in accordance with MSS SP 69 and MSS SP 89, unless shown otherwise.
   2. Support piping connections to equipment by pipe support and not by equipment.
   3. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
   4. Support no pipe from pipe above it.
   5. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
   6. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
   7. Install lateral supports for seismic loads at all changes in direction.
   8. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
   9. Repair mounting surfaces to original condition after attachments are made.

B. Standard Pipe Supports:
   1. Horizontal Suspended Piping:
      a. Single Pipes: Adjustable swivel-ring, split-ring, or clevis hangers.
      b. Grouped Pipes: Trapeze hanger systems.
      c. Furnish galvanized steel protection shield and oversized hangers for insulated pipe.
      d. Furnish precut sections of rigid insulation with vapor barrier at hangers for insulated pipe.
   2. Horizontal Piping Supported From Walls:
      a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
      b. Stacked Piping:
         1) Wall mounted framing system and clips acceptable for piping smaller than 75 mm minimal diameter.
         2) Piping clamps that resist axial movement of pipe through support not acceptable.
      c. Wall mounted piping clips not acceptable for insulated piping.
   3. Horizontal Piping Supported From Floors:
      a. Stanchion Type:

1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
2) Use yoked saddles for piping whose centerline elevation is 450 mm or greater above floor and for exterior installations.
3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.

b. Floor Mounted Channel Supports:
1) Use for piping smaller than 75 mm nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
2) Attach channel framing to floors with anchor bolts.
3) Attach pipe to channel with clips or pipe clamps.

4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
5. Standard Attachments:
a. To Concrete Ceilings: Concrete inserts.
b. To Steel Beams: I-beam clamp or welded attachments.
c. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
6. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

C. Intermediate and Pipe Alignment Guides:
1. Provide pipe alignment guides (or pipe supports that provide same function) at expansion joints and loops.
2. Guide piping on each side of expansion joint or loop at 4- and 14-pipe diameters from each joint or loop.
3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

D. Accessories:
1. Insulation Shield: Install on insulated nonsteel piping. Oversize rollers and supports.
2. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.
3. Dielectric Barrier:
a. Install between carbon steel members and copper or stainless steel pipe.
b. Install between stainless steel supports and nonstainless steel ferrous metal piping.
4. Electrical Isolation: Install 6.4 mm by 75 mm neoprene rubber wrap between submerged metal pipe and oversized clamps.

END OF SECTION

SECTION 40 27 00

PROCESS PIPING – GENERAL

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:
   1. American National Standards Institute (ANSI):
      a. B1.20.1, Pipe Threads, General Purpose (Inch).
      b. B16.5, Pipe Flanges and Flanged Fittings.
      c. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   2. American Society of Mechanical Engineers (ASME):
      a. B31.3, Process Piping.
      b. B31.9, Building Services Piping.
   3. American Society for Testing and Materials (ASTM):
      a. B32, Standard Specification for Solder Metal.
      b. B75, Standard Specification for Seamless Copper Tube.
      c. B88, Standard Specification for Seamless Copper Water Tube.
      d. D1330, Standard Specification for Rubber Sheet Gaskets.
      e. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
      f. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
      g. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
      h. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
      i. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.

1.2 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:
   1. Process Piping: ASME B31.3.
   2. Building Service Piping: ASME B31.9, as applicable.

1.3 SUBMITTALS

A. Shop Drawings:
   1. Manufacturer’s data on materials, construction, end connections, ratings, overall lengths and live lengths (as applicable).
   2. Design calculations and details on fabricated branches and non manufactured tees and elbows. Calculations sealed by a professional engineer registered in the province of Manitoba.

PART 2 PRODUCTS

2.1 PIPING

A. As specified on Piping Data Sheet(s) and Piping Schedule located at the end of this section as Supplement.

B. Diameters Shown:
   1. Standardized Products: Nominal size.

2.2 JOINTS

A. Flanged Joints:
   1. Flat-faced carbon steel or alloy flanges when mating with flat-faced cast or ductile iron flanges.
   2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

B. Threaded Joints: NPT taper pipe threads in accordance with ANSI B1.20.1.

C. Flexible Mechanical Compression Joint Coupling:
   1. Stainless steel, ASTM A276, Type 305 bands.
   2. Manufacturers:
      a. Pipeline Products Corp.
      b. Fernco Joint Sealer Co.

2.3 VENT AND DRAIN VALVES

A. Pipeline 50 mm Diameter and Smaller: 13 mm vent, 25 mm drain unless shown otherwise.

B. Pipelines 65 mm Diameter and Larger: 19 mm vent, 25 mm drain unless shown otherwise.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Upon delivery immediately remove rust spots and stains on stainless steel piping by means as specified.

D. Provide the following minimum nondestructive inspection and testing procedures as indicated on the piping schedule :
   1. 100 percent visual inspection on all joints.
   2. Perform hydrostatic test to confirm the absence of a leak.

3.2 PREPARATION

A. Inspect pipe and fittings before installation, clean ends thoroughly, remove foreign matter and dirt from inside, and ensure that no dirt or other foreign matter enters the pipe during assembly.

3.3 INSTALLATION-GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. All pipe joints shall be restrained.

D. All submerged bolts and nuts shall be of stainless steel 316 unless otherwise indicated.

E. Apply protective paste to all bolt threads at field joints.
   1. Manufacturer:
      a. Denso North America Inc.

F. Flanged Joints:
   1. Install perpendicular to pipe centerline.
   2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
   3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
   4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
   5. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
   6. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
   7. Threaded flanged joints must be shop fabricated and delivered to jobsite with flanges in-place and properly faced.
   8. Manufacturer:
      a. Same as pipe manufacturer.
      b. Victaulic flange adapter

G. Threaded and Coupled Joints:
   1. Conform to ANSI B1.20.1.
   2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
   3. Countersink pipe ends, ream and clean chips and burrs after threading.
   4. Make connections with not more than three threads exposed.

5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

H. Soldered Joints:
1. Use only solder specified for particular service.
2. Cut pipe ends square and remove fins and burrs.
3. After thoroughly cleaning pipe and fitting of oil and grease using solvent and emery cloth, apply noncorrosive flux to the male end only.
4. Wipe excess solder from exterior of joint before hardened.
5. Before soldering, remove stems and washers from solder joint valves.

I. PVC and CPVC Piping:
1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.

J. Polypropylene Tubing:
1. PVC Fittings, refer to Section 40 27 00.10, Polyvinyl Chloride (PVC) Pipe and Fittings.

3.4 INSTALLATION-EXPOSED PIPING

A. Piping Runs:
1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 40 05 15, Piping Support Systems.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Provide flanges or unions as specified for the particular piping system on both sides of sleeved or cast-in-place pipe sections through interior walls, ceilings and floors.

F. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

G. Piping clearance, unless otherwise shown:
1. Over Walkway and Stairs: Minimum of 2200 mm, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 1000 mm, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
3. From Adjacent Work: Minimum 25 mm from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

H. Installation of Primary Measuring Elements:
1. Install primary elements and accessories supplied under Division 26, including but not limited to the following:
   a. orifice, venturi and magnetic flow meters
   b. bubbler, level meters
   c. pressure/vacuum indicators, switches and transmitters
   d. flow and level switches
   e. temperature sensors, indicators, switches and transmitters
   f. valve positioners, pneumatic booster relays, I to P and P to I converters
2. Install units in locations shown. Attention is directed to suggest mounting details, flow schematics and circuit diagrams on the Electrical Drawings.
3. Provide reducers, weldolets, tapped saddles, victaulic flanges, shut-off valves, pneumatic tubing, flushing connections, drains, bolts, nuts, washers and gaskets necessary to complete the installation.
4. Provide and install pipe couplings for pressure sensors and pressure switch sensors on piping systems where indicated. Use tapped saddles when connecting to piping systems with wall thickness less than that required for tapping size. Back weld pipe couplings installed on steel or stainless steel pipes.
5. Provide suitable flexible connectors from the pipe couplings to instruments such as pressure switches and pressure gauges to eliminate vibrations and provide a stainless steel lever operated ball valve. Mount pressure switches on separate supports.
6. Provide necessary reducers and fittings and install level and flow switches where indicated.
7. Provide pipe couplings and install wells for temperature sensors on piping system where indicated.
8. Pipe couplings, tapped saddles, valves, flexible connectors and fittings must be of material similar to that of the piping system and have pressure-temperature ratings equivalent to that of the piping to which they are connected.

9. Couplings, valves, wells, weldolets, tapped saddles, flexible connectors and fittings, etc. must be suitable for installing primary elements supplied under Section - Instrumentation and Control.

3.5 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Application and Installation: As specified in Section 40 27 01, Process Piping Specialties.

3.6 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines only where shown.

3.7 SUPPLEMENTS

A. Piping Schedule.

B. Data Sheets.

Number		Title
-08		Stainless Steel Pipe and Fittings-General Service
-09A		Stainless Steel Pipe, Tubing and Fittings-Special Service
-10		Polyvinyl Chloride (PVC) Pipe and Fittings
-13		Copper and Copper Alloy Pipe, Tubing, and Fittings
-30		Polypropylene Tubing and Fittings

END OF SECTION

PIPING SCHEDULE LEGEND

SERVICE

BWS	Water – Backwash Supply
BWW	Water – Backwash Waste
CA	Air – Compressed
CRW	Water – Clarifier Discharge
CS	Caustic Soda
DRA	Water – Drainage
DHW	Water – Domesitc Hot
FEC	Ferric Chloride
FIN	Water – Filter Influent
FW	Water – Filtered
HP	Hydrogen Peroxide
OF	Water – Overflow
OZG	Ozone Off-Gas
OZO	Air – Ozonated
OZW	Water – Ozonated
PLS	Polymer Solution – Filter Aid
PSW	Water – Plant Service
RW	Water – Raw
SCA	Sulphuric Acid
SBS	Sodium Bisulphite
SDR	Water – DAF Recycle
SLU	Sludge

EXPOSURE

EXP	Exposed
SUB	Submerged

MATERIAL

CU	Copper
PP	Polypropylene
PV01	Schedule 80 Polyvinyl Chloride
SS01	316L Stainless Steel
SS02	316 Stainless Steel

PRESSURE TEST

H	Hydrostatic
NA	Not Applicable

PIPING SCHEDULE

Service	Size(s) (mm)	Exposure	Piping Material	Piping Data Sheet Number	Design Temperature (deg C)	Type, where H = Hydrostatic, P = Pneumatic	Remarks
BWS	25, 38	EXP	PV01	10	20	H	
BWW	50	EXP	PV01	10	20	H	
CA	6, 12,19	EXP	CU	13	20	P (1000 kPa)	
CRW	25, 38, 50	EXP	PV01	10	20	H	
CS	6	EXP	PP	30	20	NA	
DRA	25, 38, 50, 75, 100, 150	EXP	PV01	10	20	H	
DHW	25	EXP	CU	13	60	H	
FEC	6	EXP	PP	30	20	NA	
FIN	25	EXP	PV01	10	20	H	
FW	25, 38, 50	EXP	PV01	10	20	H	
HP	6	EXP	PP	30	20	NA	
OF	50, 100	EXP	PV01	10	20	H	
OZG	12, 19	EXP	SS01	09A	20	P (150 kPa)	316L tubing
OZG	25, 32	EXP	SS02	08	20	P (150 kPa)	
OZO	12	EXP	SS01	09A	20	P (150 kPa)	316L tubing
OZW	25, 38, 50	EXP	PV01	10	20	H	
PLS	6	EXP	PP	30	20	NA	
PSW	12	EXP	CU	13	20	H	
PW	25, 32	EXP	CU	13	20	H	
RW	150, 75, 25	EXP	PV01	10	20	H	
SBS	6	EXP	PP	10	20	NA	

Service	Size(s) (mm)	Exposure	Piping Material	Piping Data Sheet Number	Design Temperature (deg C)	Type, where H = Hydrostatic, P = Pneumatic	Remarks
SCA	6	EXP	SS01	09A	20	NA	316L tubing
SDR	50	EXP, SUB	SS02	08	20	P (800 kPa)	
SLU	75	EXP	PV01	10	20	H	

SECTION 40 27 00.08

STAINLESS STEEL PIPE AND FITTINGS-GENERAL SERVICE

Item	Size	Description
Pipe	50 mm & smaller	Schedule 40S: ASTM A312/A312M, Type 316 seamless, pickled and passivated.
Joints	50 mm & smaller	Flanged at equipment as required or shown.
Fittings	50 mm & smaller	Threaded Forged: 1,000 CWP, ASTM A182/A182M, Grade F316L.
Branch Connections	50 mm & smaller	Tee or reducing tee in conformance with Fittings above.
Flanges	50 mm & smaller	Forged Stainless Steel: ASTM A182/A182M, Grade F316L, ASME B16.5 or B16.47 Class 150 or Class 300, slip-on or weld neck. Raise face for Class 150 and Class 300.
Unions	50 mm & smaller	Threaded Forged: ASTM A182/A182M, Grade F316, 13800 kPag WOG, integral ground seats, AAR design meeting the requirements of ANSI B16.11, bore to match pipe.
Bolting	All	Forged Flanges: Type 316 stainless steel, ASTM A320/A320M Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.
Gaskets	All Flanges	Flanged, Water Service: 5 mm thick, unless otherwise specified, Santoprene thermoplastic NSF61. Blind flanges shall be gasketed covering entire inside face with gasket cemented to blind flange.
Thread Lubricant	50 mm & smaller	Teflon tape.

END OF SECTION

SECTION 40 27 00.09A

STAINLESS STEEL PIPE, TUBING AND FITTINGS-SPECIAL SERVICE

Item	Size	Description
Tubing	6 mm	ASTM A312/A312M Type 316L seamless, soft annealed, 1.5 mm wall thickness minimum.
	12 mm & 19 mm OD	ASTM A312/A312M Type 316L seamless, soft annealed, 2 mm wall thickness minimum.
Tubing Joints	All	Flareless compression fitting
Tubing Fittings	All	Flareless Compression Type Forged: ASTM A182/A182M, Grade F316L, Parker-Hannifin Ferulok, Swagelok.
Tubing Branch Connections	All	Compression type tees or reducing tees in accordance with Tubing Fittings above.

END OF SECTION

SECTION 40 27 00.10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	Size	Description
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, 57 kg ANSI B16.1 drilling
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts. With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts and ASTM A563 Grade A heavy hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 3 mm thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 3 mm ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.
Solvent Cement	All	As recommended by the pipe and fitting manufacturer conforming to ASTM D2564.
Thread Lubricant	All	Teflon Tape.

END OF SECTION

SECTION 40 27 00.13 COPPER AND COPPER ALLOY PIPE, TUBING, AND FITTINGS	
Item	Description
Tubing	Seamless, conforming to ASTM B88 as follows: No. 1 water (exposed) Type L, hard drawn Domestic hot water Type L, hard drawn Compressed air service Type L, hard drawn
Fittings	All Services: Commercially pure wrought copper, socket joint, conforming to ASTM B75, dimensions conforming to ANSI B16.22.
Flanges	All Services: Commercially pure wrought copper, socket joint, conforming to ASTM B75, faced and drilled Class 150 ANSI B16.24 standard.
Bolting	All Services: ASTM A307, carbon steel, Grade A hex head bolts and ASTM A563 Grade A hex head nuts.
Gaskets	1.5 mm thick nonasbestos compression type, full face, Cranite, John Manville.
Solder	All Services: 95-5 wire solder (95 percent tin, 5 percent antimony), conforming to ASTM B32 Grade 95TA. Do not use cored solder.

END OF SECTION

SECTION 40 27 00.30 POLYPROPYLENE TUBING AND FITTINGS	
Item	Description
Tubing	Chemically inert, non contaminating white polypropylene tubing. Suitable for a 250 psig working pressure at 23 degrees Celsius.
Fittings	White polypropylene compression fittings with Baun-N O-rings for positive seal. Suitable for 250 psig working pressure at 52 degrees Celsius. Fittings shall be Parflex Fast & Tite.

END OF SECTION

SECTION 40 27 01

PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.1 SUBMITTALS

A. Action Submittals:
   1. Manufacturer's data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable).

B. Informational Submittals:
   1. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide required piping specialty items, whether shown or not shown on Drawings, as required by applicable codes and standard industry practice.

B. Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.

2.2 PIPE SLEEVES

A. Modular Mechanical Seal:
   1. Type: Interconnected synthetic rubber links shaped and sized to continuously fill annular space between pipe and wall sleeve opening.
   2. Fabrication:
      a. Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.
      b. Pressure plates shall be reinforced nylon polymer.
   3. Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening and to withstand a hydrostatic head of 12 metres of water.
   4. Manufacturer: Thunderline Corp., Link-Seal Division.

PART 3 EXECUTION

3.1 GENERAL

A. Provide accessibility to piping specialties for control and maintenance.

3.2 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Applications:
   1. Existing Walls: Rotary drilled holes.
   2. Fire-Rated or Smoke-Rated Walls, Floors or Ceilings: Insulated and encased pipe sleeves.

END OF SECTION

SECTION 40 27 02

PROCESS VALVES AND OPERATORS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:
   1. American Society of Mechanical Engineers (ASME):
      a. B16.5, Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard.
   2. American Society for Testing and Materials (ASTM):
      a. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   3. American Water Works Association (AWWA):
      a. C511, Reduced-Pressure Principle Backflow Prevention Assembly.
      b. C512, Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.

1.2 SUBMITTALS

A. Action Submittals:
   1. Shop Drawings:
      a. Product data sheets for each make and model. Indicate valve Type Number, applicable Tag Number, and facility name/number or service where used.
      b. Complete catalog information, descriptive literature, specifications, identification of materials of construction, and cross-sectional details.
      c. Complete valve schedules using the forms at the end of this Section.
      d. Submit the following data complete, grouped together, and separated by divider, for each set of valves with the same combination of features and accessories:
         1) Dimensional outline drawing showing valve body, trim, actuator, and accessories.
         2) Identification of materials of construction, cross-sectional views and details; for valves, components, and accessories.
         3) Power and control wiring diagrams, including terminals and numbers.
         4) Complete motor nameplate data.
         5) Sizing calculations for open-close, throttling and modulating valves.
         6) Valve pressure and temperature ratings.
         7) List of Configuration Parameters: Include the following for each piece of equipment and/or component which contains adjustable or programmable settings:
            a) List of switchable settings, or programmable settings complete with:

(1) Switch/parameter tag No. or I.D. or address.
(2) Range of possible settings.
(3) Factory default setting.
(4) Blank column for recording final field setting.

b) Description of each adjustable parameter c/w description of each allowable value.

B. Information Submittals:
1. Tests and inspection data.
2. Operation and Maintenance Data as specified in Section 01 78 23, Operation and Maintenance Data.
3. ANSI Class 300 and 600 Valves: Full compliance with API standards.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves to include operator, actuator, handwheel, chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and accessories, as required, for complete operation from the intended operating level.

B. Valves to be suitable for intended service. Renewable parts not to be of a lower quality than specified.

C. Valve same size as adjoining pipe, unless otherwise called out on Drawings or in Supplements.

D. Valve ends to suit adjoining piping.

E. Valve to open by turning counterclockwise, unless otherwise specified.

2.2 VALVES

A. Ball Valves:
1. Type V300 Ball Valve, 50 mm and Smaller, for General Water and Air Service:
a. Two-piece end entry type, standard port, bronze body and end piece, hard chrome-plated bronze or brass ball, PTFE seats and stem packing, blowout-proof stem, zinc-coated steel hand lever operator with vinyl grip, rated 4140 kPa WOG/CWP, 1035 kPa SWP.
b. Manufacturers and Products:
1) NPT Threaded Ends:
a) Crane; Series 9211
b) Watts; Series B6080
c) Kitz-58
d) M.A. Stewart B-3
2) Soldered Ends:
a) Crane; Series 9212
b) Watts; Series B6081

c) Kitz-59
d) M.A. Stewart B-2F

2. Type V306 Stainless Steel Ball Valve, 50 mm and Smaller:
   a. Two piece, full port, ASTM A276 GR 316 or ASTM A351/A351M GR CF8M stainless steel body, ball, and end piece, NPT threaded ends, reinforced PTFE seats, PTFE packing, blowout proof stainless steel stem, stainless steel lever operator with vinyl grip, rated 6900 kPa WOG/CWP, 1035 kPa SWP.
   b. Manufacturers and Products:
      1) M.A. Stewart G2
3. Type V320 Stainless Steel Ball Valve, 6 mm – 12 mm:
   a. 3-Piece High-Pressure Ball, 316 stainless steel body, 316 stainless steel ball and stem, tube fittings, PTFE seats, Fluorocarbon FKM O-ring, Phenolic Handle, Max. Temperature Pressure Rating 232°C at 860 kPa.
   b. Manufacturers and Products:
      1) Swagelok; SS-83TS4, SS-83TS8
4. Type V330 PVC Ball Valve, 50 mm and Smaller:
   a. Rated minimum 1035 kPa at 22.8 degree C, with ASTM D1784, Type I, Grade 1 polyvinyl chloride body, ball, and stem, end entry, double union design, solvent-weld socket ends, PTFE seat, Teflon O-ring stem seals, to block flow in both directions.
   b. Manufacturers and Products:
      1) Chemline; Type 21
5. Type V331 PVC Ball Valve, 75 mm and 100 mm:
   a. Rated 1035 kPa at 22.8 degree C , with ASTM D1784 Type I, Grade 1 polyvinyl chloride full port body, PTFE seat, Viton O-ring stem, face and carrier seals, end entry design with dual union, solvent-weld socket ends, or single union ball valve with flanged ends drilled to ANSI B16.1.
   b. Manufacturers and Products:
      1) Chemline; Type 21
6. Type V332 PVC Ball Valve, 150 mm:
   a. Rated 1035 kPa at 22.8 degree C, with ASTM D1784 Type I, Grade 1 polyvinyl chloride full port body, PTFE seat, Viton O-ring stem, face and carrier seals, end entry design with dual union, solvent-weld socket ends, or single union ball valve with flanged ends drilled to ANSI B16.1.
   b. Manufacturers and Products:
      1) Chemline; High Capacity 6” Ball Valve

B. Needle Valves:
1. Type V401 Needle Valve for Ozone Off-gas:
   a. Needle Valve 3mm to 25 mm:
      1) Integral or union bonnet, stainless steel 316 body and stem, PTFE or PEEK packing.
      2) Lubricant free.
         a) Manufactures and Products:
            (1) Hy-Lok; NV Series, SV Series, or GB Series
2. Type V402 Needle Valve for Water Supply to Ozone Generator:
   a. Needle Valve 12 mm:

1) Integral or union bonnet, stainless steel 316 body and stem, PTFE or PEEK packing.
2) Lubricant free.
a) Manufactures and Products:
(1) Hy-Lok; NV Series, SV Series, or GB Series

3. Type V403 Needle Valve for Air Service:
a. 6 mm Brass, tube to tube straight needle valve.
1) Manufacturer and products
a) Watts; No.106-C
b) Parker; 4Z-V4LK-B

C. Check Valves:
1. Type V600 Check Valve, 50 mm and Smaller:
a. All bronze, threaded cap, threaded or soldered ends, swing type replaceable bronze disc, rated 862 kPa SWP, 1380 kPa WOG/CWP.
b. Manufacturers and Products:
1) NPT Threaded Ends:
a) Watts; Series CVY
b) Crane; Fig. 37
2) Soldered Ends:
a) Watts; Series CVYS
2. Type V603 Check Valve, 25 mm to 50 mm:
a. Stainless Steel 316 L body, NPT threaded ends, swing type 316 disk and holder, PTFE gaskets, rated 4826 kPa.
b. Manufacturers and Products:
1) Crane Aloyco; 2370 to 2374
3. Type V630 PVC Ball Check Valve 100 mm and Smaller:
a. ASTM D1784, Type I, Grade 1 polyvinyl chloride body, dual union socket weld ends, rated 1035 kPa at 22 degree C, and Viton seat and seal.
b. Manufacturers and Products:
1) Chemline; Series BT-A-OXX-V-S
4. Type V633 PVC Wafer Check Valve 150 mm:
a. ASTM D1784, Type I, Grade 1 polyvinyl chloride body, rated 1035 kPa at 20 degree C, and Viton seat and seal, 316 stainless steel spring.
b. Manufacturers and Products:
1) Chemline, WP Series.

D. Self-Contained Automatic Valves:
1. Type V730 Pressure-Relief Valve 50 mm and Smaller:
a. Direct diaphragm, spring controlled, PVC body, spring case, Viton seat PTFE bonded EPDM diaphragm.
b. Capable of opening when upstream pressure reaches a maximum set point.
c. Size/Rating: 25 mm, maximum of 0.28 L/s, with inlet pressure of 93 kPa (gauge). Outlet pressure set at 90 kPa (gauge).
d. Manufacturer and Product:
1) Chemline, SB10
2. Type V746 Combination Air Release Valve 25 mm to 400 mm:

a. Suitable for water service, combines the operating features of both an air and vacuum valve and air release valve. Air and vacuum portion to automatically exhaust air during filling of system and allow air to re-enter during draining or when vacuum occurs. The air release portion to automatically exhaust entrained air that accumulates in system.
b. Rated 1035 kPa working pressure, cast iron or ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512.
c. Valve single body or dual body, air release valve mounted on air and vacuum valve, isolation valve mounted between the dual valves. 25 mm through 75 mm valves with NPT threaded inlet and outlet, 100-mm and larger valves with ANSI B16.1 Class 125 flanged inlet and cover outlet.
d. Manufacturers and Products:
1) Val-Matic Valve; Model 201-204 & 101-104
2) GA Industries Figures 950 to 954

3. Type V747 Back Pressure Relief Valve 6mm:
a. Polypropylene, PTFE and Viton construction, 52 kPa and 1035 kPa pressure range.
b. Manufacturers and Products:
1) Chemline.

4. Type V748 Pressure Relief Valve 6mm:
a. 316L stainless steel, threaded male and NPTF ends, 690 kPa and 1724 kPa pressure range, FFKM seal.
b. Manufacturers and Products:
1) Parker Veriflo

2.3 OPERATORS AND ACTUATORS

A. Manual Operator:
1. General:
a. Operator force not to exceed 18 kilograms under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 18 kilograms.
b. Operator self-locking type or equipped with self-locking device.
c. Position indicator on quarter-turn valves.
d. Worm and gear operators one-piece design worm-gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threaded steel reach rods with internally threaded bronze or ductile iron nut.

2. Exposed Operator:
a. Galvanized and painted handwheels.
b. Lever operators allowed on quarter-turn valves 100 mm and smaller.
c. Cranks on gear type operators.
d. Chain wheel operator with tiebacks, extension stem, floor stands, and other accessories to permit operation from normal operation level.
e. Valve handles to take a padlock, and wheels a chain and padlock.

2.4 ACCESSORIES

A. Tagging: 38 mm diameter heavy brass or stainless steel tag attached with No. 16 solid brass or stainless steel jack chain for each valve operator, bearing the valve tag number shown on the Valve Schedule.

PART 3 EXECUTION

3.1 INSTALLATION

A. Confirmation of Dimensions:
1. Confirm with the valve manufacturers, the face to face dimensions of all valves as well as the dimensions of the various valve operators.
2. In the event that the face to face dimensions or other details vary from that shown on drawings or listed above, the Contractor shall be responsible to modify the connecting pipe lines to suit the valves supplied.
3. Essentially, center-lines of shafts shall remain as show on the drawings provided operators have suitable clearance from all other equipment.

B. Flange Ends:
1. Flanged valve boltholes shall straddle vertical centerline of pipe.
2. Clean flanged faces, insert gasket and bolts, and tighten nuts progressively and uniformly.

C. Screwed Ends:
1. Clean threads by wire brushing or swabbing.
2. Apply joint compound.

D. PVC and Valves: Install using solvents approved for valve service conditions.

E. Valve Orientation:
1. Install operating stem vertical when valve is installed in horizontal runs of pipe having centerline elevations 1476 mm or less above finished floor, unless otherwise shown.
2. Install operating stem horizontal in horizontal runs of pipe having centerline elevations between 1476 mm and 2057 mm above finish floor, unless otherwise shown.

F. Orientation of valve position Indication: Install valve operators whether manual or electric, to clearly indicate whether the valve is open, closed or partially open from a point no less than 3 m away and visible from a position compatible with normal plant operation.

G. Orientation of Electric Actuators: Orient electric actuators to satisfy the following:
1. Direct viewing and access of actuator controls and monitoring devices such as handwheels, pilot lights, and pushbuttons, when:
a. Valve is installed in horizontal runs of pipe having centerline elevations 1476 mm or less above the finished floor, or

b. When valve is installed in vertical runs of pipe with centre of valve body at elevations 1476 mm or less above the finished floor,
c. Unless otherwise shown.

2. Limit interference with structures and with any other equipment or piping.
3. Show valve position indicator from operating position.

H. Limit Switches:
1. Set limit switches to indicate valve positions or equipment status as required and indicated on Drawings.
2. Provide stem-mounted stainless steel devices and hardware to actuate limit switches.
3. Arrange limit switch contacts to close when valve is fully open, unless otherwise noted.

I. Install a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

J. Install safety isolation valves on pumps, tanks, compressed air, contactors and filter columns, as shown in the Contract Drawings.

K. Locate valve to provide accessibility for control and maintenance.

3.2 TESTS AND INSPECTION

A. Valve may be either tested while testing pipelines, or as a separate step.

B. Test that valves open and close smoothly under operating pressure conditions. Test that two-way valves open and close smoothly under operating pressure conditions from both directions.

C. Inspect air and vacuum valves as pipe is being filled to verify venting and seating is fully functional.

D. Count and record number of turns to open and close valve; account for any discrepancies with manufacturer’s data.

E. Set, verify, and record set pressures for all relief and regulating valves.

F. Automatic valves to be tested in conjunction with control system testing. Set all opening and closing speeds, limit switches, as required or recommended by the Contract Administrator.

3.3 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are part of this Specification.
1. Process Mechanical Manual Valve Schedule (75 mm and larger).
2. Process Mechanical Manual Valve Schedule less than 75 mm.

END OF SECTION

PROCESS MECHANICAL MANUAL VALVE SCHEDULE (75 mm and larger)

P&ID Number	Tag Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
WX-P0001	HV-X101A	Ball	V332	150	RW	Exposed	
WX-P0001	HV-X101B	Ball	V332	150	RW	Exposed	
WX-P0001	HV-X101C	Ball	V332	150	RW	Exposed	
WX-P0001	CV-X101A	Check	V633	150	RW	Exposed	
WX-P0002	HV-X210A	Ball	V331	75	DRA	Exposed	
WX-P0002	HV-X210B	Ball	V331	75	DRA	Exposed	
WX-P0002	HV-X210C	Ball	V331	75	DRA	Exposed	
WX-P0002	ARV-X220 (existing)	ARV for Saturator			SDR	Exposed	Supplied by City with Saturator Vessel.

General Notes:

The schedule provided is for the contractor convenience and shall not be taken as complete. The contractor shall review the project drawings and process and instrumentation drawings for work scope and valves not listed in this Table.

PROCESS MECHANICAL MANUAL VALVE SCHEDULE LESS THAN 75 mm (GENERAL SCHEDULE)

P&ID Number	Tag Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
WX-P0001	HV-X100C	Ball	V330	25	RW	Exposed	
WX-P0001	HV-X100D	Ball	V330	25	RW SAMPLE	Exposed	
WX-P0001	HV-X101D	Ball	V330	25	DRA	Exposed	
WX-P0001	ARV-X101	Combo. Air	V746	25	RW	Exposed	
WX-P0001	HV-X102A	Ball	V330	25	RW	Exposed	
WX-P0001	ARV-X102	Combo. Air	V746	25	RW	Exposed	
WX-P0002	HV-X200A	Ball	V330	50	DRA	Exposed	
WX-P0002	HV-X201A	Ball	V306	50	SDR	Exposed	
WX-P0002	HV-X201B	Ball	V306	50	SDR	Exposed	
WX-P0002	CV-X201A	Check	V603	50	SDR	Exposed	
WX-P0002	HV-X210D	Ball	V330	25	DRA FLUSH LINE	Exposed	
WX-P0002	HV-X210E	Ball	V306	50	SDR	Exposed	
WX-P0002	HV-X211A	Ball	V330	50	DRA	Exposed	
WX-P0002	HV-X220A	Ball	V306	50	SDR	Exposed	
WX-P0002	HV-X220B	Ball	V306	50	SDR	Exposed	
WX-P0002	HV-X220C	Ball	V306	25	SDR	Exposed	
WX-P0002	HV-X220D	Ball	V306	25	SDR TO MAIN DRAIN HEADER	Exposed	
WX-P0002	HV-X221A	Ball	V300	19	CA	Exposed	
WX-P0002	HV-X221B	Ball	V300	6	CA	Exposed	
WX-P0002	CV-X221	Check	V600	19	CA	Exposed	Might be existing. Confirm before

P&ID Number	Tag Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
							purchasing.
WX-P0002	HV-X300A	Ball	V330	25	CRW BYPASS	Exposed	
WX-P0002	HV-X301A	Ball	V330	50	CRW	Exposed	
WX-P0002	HV-X301B	Ball	V330	25	CRW	Exposed	
WX-P0002	CV-X301A	Check	V630	25	CRW	Exposed	
WX-P0002	HV-X302A	Ball	V330	50	CRW	Exposed	
WX-P0002	HV-X302B	Ball	V330	25	CRW	Exposed	
WX-P0002	CV-X302A	Check	V630	25	CRW	Exposed	
WX-P0003	HV-X300B	Ball	V330	38	OZW	Exposed	
WX-P0003	HV-X301C	Ball	V330	25	CRW	Exposed	
WX-P0003	HV-X301D	Ball	V330	25	CRW	Exposed	
WX-P0003	HV-X302C	Ball	V330	25	CRW	Exposed	
WX-P0003	HV-X302D	Ball	V330	25	CRW	Exposed	
WX-P0003	HV-X320A	Ball	V330	50	OZW	Exposed	
WX-P0003	HV-X320B	Ball	V330	50	OZW	Exposed	
WX-P0003	HV-X320C	Ball	V330	38	OZW	Exposed	
WX-P0003	HV-X320D	Ball	V330	50	DRA	Exposed	
WX-P0003	HV-X321A	Ball	V330	25	CRW	Exposed	
WX-P0003	HV-X321B	Ball	V320	12	OZO	Exposed	
WX-P0003	HV-X321C	Ball	V330	38	OZW	Exposed	
WX-P0003	HV-X321D	Ball	V330	38	DRA	Exposed	
WX-P0003	HV-X322A	Ball	V330	25	CRW	Exposed	

P&ID Number	Tag Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
WX-P0003	HV-X322B	Ball	V320	12	OZO	Exposed	
WX-P0003	HV-X322C	Ball	V330	38	OZW	Exposed	
WX-P0003	HV-X322D	Ball	V330	38	DRA	Exposed	
WX-P0004	HV-X400A	Ball	V330	25	FIN BYPASS	Exposed	
WX-P0004	HV-X401A	Ball	V330	25	OZW	Exposed	
WX-P0004	HV-X401B	Ball	V330	25	FIN	Exposed	
WX-P0004	CV-X401A	Check	V630	25	FIN	Exposed	
WX-P0004	HV-X411A	Ball	V330	25	FIN	Exposed	
WX-P0004	HV-X411B	Ball	V330	25	FIN	Exposed	
WX-P0004	HV-X411C	Ball	V330	50	DRA	Exposed	
WX-P0004	HV-X411D	Ball	V330	38	FW	Exposed	
WX-P0004	HV-X411E	Needle	V403	6	CA	Exposed	
WX-P0004	HV-X411F	Ball	V330	25	BWS	Exposed	
WX-P0004	HV-X411G	Ball	V320	6	-	Exposed	
WX-P0004	HV-X411H	Ball	V320	6	-	Exposed	
WX-P0004	HV-X412A	Ball	V330	25	FIN	Exposed	
WX-P0004	HV-X412B	Ball	V330	25	FIN	Exposed	
WX-P0004	HV-X412C	Ball	V330	50	DRA	Exposed	
WX-P0004	HV-X412D	Ball	V330	38	FW	Exposed	
WX-P0004	HV-X412E	Needle	V403	6	CA	Exposed	
WX-P0004	HV-X412F	Ball	V330	25	BWS	Exposed	
WX-P0004	HV-X412G	Ball	V320	6	-	Exposed	

P&ID Number	Tag Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
WX-P0004	HV-X412H	Ball	V320	6	-	Exposed	
WX-P0005	HV-X413A	Ball	V330	25	FIN	Exposed	
WX-P0005	HV-X413B	Ball	V330	25	FIN	Exposed	
WX-P0005	HV-X413C	Ball	V330	50	DRA	Exposed	
WX-P0005	HV-X413D	Ball	V330	38	FW	Exposed	
WX-P0005	HV-X413E	Needle	V403	6	CA	Exposed	
WX-P0005	HV-X413F	Ball	V330	25	BWS	Exposed	
WX-P0005	HV-X413G	Ball	V320	6	-	Exposed	
WX-P0005	HV-X413H	Ball	V320	6	-	Exposed	
WX-P0005	HV-X414A	Ball	V330	25	FIN	Exposed	
WX-P0005	HV-X414B	Ball	V330	25	FIN	Exposed	
WX-P0005	HV-X414C	Ball	V330	50	DRA	Exposed	
WX-P0005	HV-X414D	Ball	V330	38	FW	Exposed	
WX-P0005	HV-X414E	Needle	V403	6	CA	Exposed	
WX-P0005	HV-X414F	Ball	V330	25	BWS	Exposed	
WX-P0005	HV-X414G	Ball	V320	6	-	Exposed	
WX-P0005	HV-X414H	Ball	V320	6	-	Exposed	
WX-P0006	HV-X402A	Ball	V330	25	OZW	Exposed	
WX-P0006	HV-X402B	Ball	V330	25	FIN	Exposed	
WX-P0006	CV-X402A	Check	V630	25	FIN	Exposed	
WX-P0006	HV-X410A	Ball	V330	50	FW	Exposed	
WX-P0006	HV-X415A	Ball	V330	25	FIN	Exposed	

P&ID Number	Tag Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
WX-P0006	HV-X415B	Ball	V330	25	FIN	Exposed	
WX-P0006	HV-X415C	Ball	V330	50	DRA	Exposed	
WX-P0006	HV-X415D	Ball	V330	38	FW	Exposed	
WX-P0006	HV-X415E	Needle	V403	6	CA	Exposed	
WX-P0006	HV-X415F	Ball	V330	25	BWS	Exposed	
WX-P0006	HV-X415G	Ball	V320	6	-	Exposed	
WX-P0006	HV-X415H	Ball	V320	6	-	Exposed	
WX-P0006	HV-X416A	Ball	V330	25	FIN	Exposed	
WX-P0006	HV-X416B	Ball	V330	25	FIN	Exposed	
WX-P0006	HV-X416C	Ball	V330	50	DRA	Exposed	
WX-P0006	HV-X416D	Ball	V330	38	FW	Exposed	
WX-P0006	HV-X416E	Needle	V403	6	CA	Exposed	
WX-P0006	HV-X416F	Ball	V330	25	BWS	Exposed	
WX-P0006	HV-X416G	Ball	V320	6	-	Exposed	
WX-P0006	HV-X416H	Ball	V320	6	-	Exposed	
WX-P0007	HV-X211B	Ball	V330	50	DRA	Exposed	
WX-P0007	HV-X400B	Ball	V330	25	DRA	Exposed	
WX-P0007	HV-X403A	Ball	V330	38	BWS	Exposed	
WX-P0007	HV-X403B	Ball	V330	25	BWS	Exposed	
WX-P0007	HV-X403C	Ball	V330	25	DRA	Exposed	
WX-P0007	PRV-X403	PRV	V730	25	DRA	Exposed	
WX-P0007	CV-X403A	Check	V630	25	BWS	Exposed	

P&ID Number	Tag Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
WX-P0007	HV-X410B	Ball	V330	50	DRA	Exposed	
WX-P0007	HV-X417A	Ball	V330	25	FIN	Exposed	
WX-P0007	HV-X417B	Ball	V330	25	FIN	Exposed	
WX-P0007	HV-X417C	Ball	V330	50	DRA	Exposed	
WX-P0007	HV-X417D	Ball	V330	38	FW	Exposed	
WX-P0007	HV-X417E	Needle	V403	6	CA	Exposed	
WX-P0007	HV-X417F	Ball	V330	25	BWS	Exposed	
WX-P0007	HV-X417G	Ball	V320	6	-	Exposed	
WX-P0007	HV-X417H	Ball	V320	6	-	Exposed	
WX-P0007	HV-X418A	Ball	V330	25	FIN	Exposed	
WX-P0007	HV-X418B	Ball	V330	25	FIN	Exposed	
WX-P0007	HV-X418C	Ball	V330	50	DRA	Exposed	
WX-P0007	HV-X418D	Ball	V330	38	FW	Exposed	
WX-P0007	HV-X418E	Needle	V403	6	CA	Exposed	
WX-P0007	HV-X418F	Ball	V330	25	BWS	Exposed	
WX-P0007	HV-X418G	Ball	V320	6	-	Exposed	
WX-P0007	HV-X418H	Ball	V320	6	-	Exposed	
WX-P0008	ARV-X501	Pres. Relief	V748	6	SCA	Exposed	
WX-P0008	HV-X501A – HV-X501C	Ball	V320	6	SCA	Exposed	
WX-P0008	ARV-X502 – ARV-X504	Pres. Relief	V747	6	FEC, HP, SBS	Exposed	
WX-P0008	HV-X502A –	Ball	V330	6	FEC, HP, SBS	Exposed	

P&ID Number	Tag Number	Valve Type	Valve Type Number	Size (mm)	Service Type	Valve Location	Remarks
	HV-X502C; HV-X503A – HV-X503E; HV-X504A – HV-X504C.						
WX-P0009	ARV-X505 – ARV-X508	Pres. Relief	V747	6	PLS, CS	Exposed	
WX-P0009	HV-X505A – HV- X505B; HV- X506A – HV- X506B; HV- X507A – HV- X507D; HV- X508A – HV- X508D.	Ball	V330	6	PLS, CS	Exposed	
WX-P0010	HV-X331C	Needle	V401	25	MAKE-UP AIR	Exposed	
WX-P0010	HV-X330C, HV-X331A, HV-X331B.	Needle	V401	19, 12	OZG	Exposed	
WX-P0010	HV-X330F, HV-X 330G.	Needle	V401	12	OZO	Exposed	
WX-P0010	HV-X330D, HV-X 330E.	Ball	V320	12	OZO	Exposed	
WX-P0010	HV-X330B	Ball	V300	25	TO DRAIN	Exposed	
WX-P0010	HV-X330A	Needle	V402	12	SERVICE WATER	Exposed	
WX-P0010	CV-X331	Check	V603	25	MAKE-UP AIR	Exposed	

SECTION 40 42 13

PROCESS PIPING INSULATION

PART 1 GENERAL

1.1 SUBMITTALS

A. Action Submittals: Shop Drawings: Manufacturer's descriptive literature.

B. Informational Submittals: Maintenance information.

PART 2 PRODUCTS

2.1 PIPE INSULATION

A. Type 1:
1. Material: Flexible elastomeric pipe insulation, closed cell structure in accordance with ASTM C534.
2. Temperature Rating: Minus 40 degrees C to 82 degrees C.
3. Nominal Density: 96 kg/m^3.
4. Conductivity in accordance with ASHRAE 90.1 and minimum of 24 degrees C per ASTM C177 or ASTM C518.
5. Minimum water vapor transmission of 5.75 ng/Pa.s.m^2 per ASTM E96.
6. Joints: Manufacturer's adhesive.
7. Flame Spread Rating: Less than 25 per ASTM E84.
8. Manufacturers and Products:
   a. Rubatex; Insul-Tube 180 or Insul-sheet 1800.
   b. Armstrong; Armaflex AP.

2.2 FITTING INSULATION

A. Type 1: Same as pipe.

2.3 INSULATION AT PIPE HANGERS AND SUPPORTS

A. Refer to Section 40 05 15, Piping Support System.

B. Type 1:
1. Copper and Nonmetallic Pipe 50 mm and Smaller and Steel Pipe 40 mm and Smaller: Use insulation shields.
2. Larger Sizes: Use insulation saddles or Type 3 rigid insulation insert 250 mm long.

C. Type 2: UL rated, preformed rigid pipe insulation inserts of thickness equal to adjoining insulation, 250 mm in length, with factory applied, vinyl-coated and embossed vapor barrier jacket with self-sealing lap.

2.4 INSULATION FINISH SYSTEMS

A. Type F1—PVC:
1. Polyvinyl chloride (PVC) jacketing, white, for straight run piping and fitting locations, temperatures to 70 degrees C.
2. Manufacturers and Products:
a. Knauf; Proto.
b. Johns Manville; Zeston.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
1. Install in accordance with manufacturer's instructions and as specified herein.
2. Install insulation after piping system has been pressure tested and leaks corrected.
3. Apply insulation over clean finish painted and dry surfaces.
4. Do not allow insulation to cover nameplates or code inspection stamps.
5. Run insulation continuously through pipe hangers and supports, wall openings, ceiling openings, and pipe sleeves, unless otherwise shown.
6. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
7. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.

B. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.

C. Placement:
1. Install insulation and a vapor barrier on at a minimum of 2 meters on piping or ductwork before an exterior wall or roof penetration.
2. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.
3. Insulate valves and fittings with sleeved or cut pieces of same material.
4. Seal and tape joints.

D. Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.

END OF SECTION

SECTION 40 80 01

PROCESS PIPING LEAKAGE TESTING

PART 1 GENERAL

1.1 SUBMITTALS

A. Informational Submittals:
   1. Testing Plan: Submit prior to testing and include at least the information that follows.
      a. Testing dates.
      b. Piping systems and section(s) to be tested.
      c. Test type.
      d. Method of isolation.
      e. Calculation of maximum allowable leakage for piping section(s) to be tested.
   2. Certified Test Report.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 PREPARATION

A. Notify Contract Administrator in writing 5 days in advance of testing. Perform testing in presence of Contract Administrator.

B. Pressure Piping:
   1. Prior to test, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
   2. New Piping Connected to Existing Piping:
      a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to Contract Administrator.
      b. Test joint between new piping and existing piping by methods that do not place entire existing system under test load, as approved by Contract Administrator.
   3. Items that do not require testing include: Equipment seal drains, tank overflows to atmospheric vented drains, tank atmospheric vents.
   4. Test Pressure: As indicated on Piping Schedule.

C. Test section may be filled with water and allowed to stand under low pressure prior to testing.

3.2 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Fluid: Clean water of such quality to prevent corrosion of materials in piping system.

B. Exposed Piping:
   1. Perform testing on installed piping prior to application of insulation.
   2. Maximum Filling Velocity: 0.076 meter per second, applied over full area of pipe.
   3. Vent piping during filling. Open vents at high points of piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
   4. Maintain hydrostatic test pressure continuously for 60 minutes, minimum, and for such additional time as necessary to conduct examinations for leakage.
   5. Examine joints and connections for leakage.
   6. Correct visible leakage and retest as specified.

3.3 PNEUMATIC TEST FOR PRESSURE PIPING

A. Do not perform on:
   1. PVC pipe.

3.4 FIELD QUALITY CONTROL

A. Test Report Documentation:
   1. Test date.
   2. Description and identification of piping tested.
   3. Test fluid.
   4. Test pressure.
   5. Remarks, including:
      a. Leaks (type, location).
      b. Repair/replacement performed to remedy excessive leakage.
   6. Signed by Contractor and Contract Administrator to represent that test has been satisfactorily completed.

END OF SECTION