PROCESS PIPE JOINTS AND EQUIPMENT CONNECTIONS

1. GENERAL

1.1 Description

.1 This section describes acceptable methods for jointing and connecting piping to equipment and appurtenances.

.2 Refer to the general piping requirements of Section 15050. Use the general requirements specified in this section and Section 15050 integrally with the more specific requirements listed in Section 15055.

1.2 Submittals

.1 With the submittals required in Section 15050, provide a list of joining and connecting techniques used in the performance of the work.

1.3 Coordination

.1 Coordinate the jointing techniques with the piping requirements and ensure that the connection techniques match the requirements of the equipment and ancillary devices to which piping must attach.

1.4 Quality Assurance

.1 Refer to Section 15050 for welding quality assurance requirements.

1.5 Shipment, Protection and Storage

.1 Refer to Division 01 and Section 15050 for Shipment and Storage.

2. PRODUCTS

2.1 Function

.1 Provide for the joining of the pipe materials, fittings, and appurtenances as described below, for the piping systems shown.

2.2 General

.1 Connect piping using joints not readily disassembled only where shown and where not otherwise specified. Provide joints which may be disassembled as indicated on the drawings, and at the minimum, within 1.0 m of any connection to equipment, on both sides of structural penetrations, within 0.6 m of all threaded end valves, and at the spacing specified in the detailed piping specification sheets.

.2 Where new pipe crosses a new or existing structural expansion joint and the pipe is supported from each side of the structure, provide a flexible coupling in pipe to allow for differential settlement. Select flexible connection suitable for pipe material.

2.3 Welding Materials

.1 Use welding materials conforming to CSA W48.1.

.2 Provide electrodes compatible with the material welded and which deposit metal with strength and corrosion resistance properties at least equivalent to the base metal.

.3 Provide proper storage for welding rod. Provide rod ovens in cold or inclement weather.

2.4 Dissimilar Metal Connections

.1 Where dissimilar metals are to be connected, furnish dielectric fittings and/or isolating flanges.

2.5 Carbon Steel Piping

.1 Less than 75 mm in diameter: butt-weld or use threaded couplings. Use unions where disassembly is required.

.2 Equal to or greater than 75 mm in diameter: where not specified or shown otherwise, butt-weld according to ASME Boiler and Pressure Vessel Code or furnish flanges, conforming to ANSI B16.5, Class 150. Where disassembly is required, flanges are sufficient.

.3 Companion flanges for connection to cast iron or ductile iron equipment flanges shall be refaced to be flush with the companion flange.

.4 Where grooved joint fittings are shown for use in steel piping systems, meet the following requirements:

.1 Use flexible style couplings for all buried service pipe, all pipe greater than 300 mm in diameter, for pipe less than 300 mm in diameter in rack mounted piping assemblies, and for grooved joints adjacent to pump or blower suction and discharge where grooved joints are used for noise and vibration control. Acceptable products are: Gustin-Bacon 100 or Victaulic Style 77.

.2 Use rigid style couplings in all other applications. Acceptable products are: Gustin-Bacon 120 Rigi-Grip or Victaulic Style 07 Zero-Flex.

.3 With the Engineer's prior acceptance, flange assemblies may be substituted for above ground steel piping which is not lined where rigid style couplings are shown or specified. Note any such substitutions in the submittals prior to fabrication.

2.6 Copper or Brass Piping

.1 Use soldered couplings. Where disassembly is required, use compression unions.

.2 Use soldered couplings conforming to ANSI B16.26. Use lead free solder conforming to ASTM B32 and the National Plumbing Code.

.3 In potable water systems, use lead free solder conforming to ASTM B32 and National Plumbing Code.

.4 Solder used in DWV systems will be 50/50 type.

.5 Furnish compression couplings for copper and brass tubing of copper, suitable for the maximum pressure of the pipe, conforming to ANSI B16.26.

2.7 Polyethylene (HDPE) Piping

.1 Refer to pipe manufacturer's specifications for product information and installation instruction.

.2 HDPE pipe joined by method of thermal butt fusion should conform to ASTM D 2657.

.3 Provide bell and spigot type joints conforming to ASTM D3212.

.4 Provide pipe, pipe support and restraints to withstand stresses induced by joint design.

.5 Provide pipe, pipe supports and restraints to withstand the stresses incurred during placement of concrete surround.

2.8 Flanges

.1 General requirements for flanges are as follows:

.1 Provide compatible flanges for mating to equipment or valves.

.2 Provide flat-faced flanges on each side of butterfly valves.

.3 For steel piping, provide weld neck flanges on both sides of wafer or lug body valves.

.4 A Lap-joint flange on digester gas services or Van-Stone flange on schedule 10S stainless steel piping systems is acceptable.

.2 Do not use slip-on flanges that are attached to a pipe by means of set screws and gaskets (uni-flange, etc.)

2.9 Threaded Couplings

.1 Make screwed joints using American Standard threads to ANSI B1.20.1.

.2 Use Teflon tape as thread lubricant for threaded joints.

.3 Provide threaded-end to flanged-end adapters where required to connect to flanges.

2.10 Grooved Joint Couplings

.1 Fabricate grooved joint couplings of ductile iron to ASTM A536, and in accordance with AWWA C606.

.2 For ductile iron pipe, provide cut grooves in pipe and fittings in accordance with AWWA C606. Rolled grooves and roll-groove type joints are not acceptable.

.3 For steel pipe, provide cut grooves in pipe and fittings in accordance with AWWA C606. Alternatively, rolled grooves and roll-groove type joints may be used on bare steel pipe. Rolled grooves and roll-groove type joints are not acceptable on steel pipe that is internally lined.

.4 Cut or rolled grooved joints are not acceptable in stainless steel piping less than schedule 40S, carbon steel piping less than schedule 40, and PVC piping less than schedule 80. Provide suitable end pipe piece for grooving as needed if piping wall is thinner.

.5 For all grooved joints, grind or buff edges to a minimum radius of 6mm. Coordinate with coupling manufacturer to ensure proper fit.

.6 In grooved joint piping systems requiring end-seal type gaskets, provide grooved joint couplings and grooved pipe in accordance with gasket manufacturers recommendations. Acceptable manufacturers: Gustin-Bacon, Victaulic.

.7 Where grooved joint piping systems connect to equipment or to flanged valves, meters, or other sensing devices; use grooved joint flanges or flange adapters. Flange adapters have been used to develop the piping layout shown in the drawings unless specifically noted otherwise. Acceptable products are: Tyler Groove to Flange Fittings or Victaulic Flange adapters. Where the Contractor chooses to use grooved joint flanges rather than the indicated adapters, piping modifications required to suit this change are the responsibility of the Contractor. Make full allowance for piping disassembly and access to the face of equipment.

2.11 Flexible Couplings - Type I

.1 Unless specifically shown otherwise use Type I flexible couplings where a flexible coupling is shown or required.

.2 Type I General Requirements:

.1 Centre ring: steel, shop coated for corrosion protection.

.2 Gaskets: fabricated of material suitable to the service conditions.

.3 For submerged, buried or below structure applications, use stainless steel bolts, nuts and washers and provide center ring with epoxy coating

.4 Provide the necessary amount and appropriate size of restraining rods and gussets as recommended by the manufacturer.

.5 Type 1 - Restrained; use a flexible sleeve-type coupling with restraining rods, and gussets welded to the pipe. Provide sufficient restraint to resist pressure equal to twice the system test pressure.

.6 Do not use Type 1 flexible couplings in pipe systems which undergo thermal expansion and contraction; also, do not use these couplings at structural joints.

.3 Flexible Couplings - Type IA

.1 Flexible sleeve type couplings: cylindrical centre ring, two follower rings, two resilient gaskets, and connecting bolts.

.2 Acceptable products are:

Dresser Style

.2 Ford Meter Box

3 Robar

.4 Rockwell

.5 Viking Johnson.

.4 Flexible Couplings - Type IB

.1 Flanged flexible sleeve type couplings: flanged cylindrical centre ring, a companion flange, one follower ring, one resilient gasket, and connecting bolts.

.2 Acceptable products are:

.1 Dresser

.2 Ford Meter Box

.3 Robar

.4 Rockwell

.5 Viking Johnson.

.5 Flexible Couplings - Type IC

.1 Transition flexible sleeve type couplings: Cylindrical centre ring, two follower rings two resilient gaskets, and connecting bolts.

.2 Acceptable products are:

.1 Dresser

.2 Robar.

2.12 Flexible Couplings - Type II

.1 Flexible pipe couplings: progressive sealing, capable of two degrees angular deflection in all directions, leakproof.

.2 Acceptable manufacturers:

.1 Straub

.2 Young Nam Company (YNC).

.3 Casing: 304 or 316 stainless steel.

.4 Lockparts: Steel, shop coated for corrosion protection. 304 stainless steel for buried or submerged services.

.5 Gaskets: fabricated of material suitable to the service conditions.

3. EXECUTION

3.1 Mild Steel Welding

.1 Refer to Section 15050 for mild steel welding requirements.

3.2 Stainless Steel Welding

.1 Refer to Section 15050 for stainless steel welding requirements.

3.3 Threaded Joints

.1 Conform to the requirement of ANSI B31.3 Process Piping Code.

.2 Ream the end of all pipes to remove all burrs and cuttings when fabricating threaded joints.

.3 Clean out pipe and repair linings and coatings prior to joining.

.4 Apply Teflon tape to male threads and join pipe. Use both Teflon tape and Teflon sealing compound on stainless steel pipe threads. Do not use extra tape to make up for slack in the joint.

.5 Provide joints at spacings noted in Section 15055 to allow for pipe disassembly.

3.4 Flanged Joints

.1 Clean flanges and gaskets prior to connection.

.2 Lubricate gaskets with soapy water and apply anti-seize compound to the bolts.

.3 Bring flanges into close parallel and lateral alignment.

.4 Tighten bolts progressively. Proceed from side to side of the flange.

.5 Washers may not be used to take up excess bolt length.

.6 Provide approximately two full threads bolt projection beyond nuts.

.7 When joining steel to cast iron flanges, take care to avoid damage to the cast iron flange. Ensure both flanges are flat-faced and use full face gaskets.

.8 Align flanges which connect piping to mechanical equipment to close parallel and lateral alignment prior to tightening bolts. Do not place undue strain on the equipment.

.9 Provide flanges at spacings noted in the drawings and in Section 15055 to allow for pipe disassembly.

.10 Allow a minimum of 150 mm to face or 200 mm to edge of flange from wall, floor or ceiling unless otherwise shown on the drawings.

.11 On gauge stainless steel piping, consider the flange assembly weight in the design of the piping supports.

3.5 Grooved Pipe Joints

.1 Groove all pipes to be joined by this method in accordance with the manufacturer's recommendations.

.2 Repair linings and coatings after grooving.

.3 Where connecting grooved joint pipe to flanged equipment or valves, use a transition coupling a minimum of 150 mm in length with a Class 125 FF flange at one end and a grooved joint at the other, unless otherwise specified or shown.

.4 Alternately, use split flanges fabricated specifically for grooved joint pipe to connect to flanged equipment, valves, meters, or sensing devices. Provide restraint on joints to prevent valve body rotation when the operator is torqued.

.5 Provide joints at spacing noted in Section 15055 to allow for pipe disassembly.

.6 Allow a minimum of 150 mm to face or edge of grooved joint coupling from wall, floor or ceiling unless otherwise shown.

.7 On epoxy lined piping systems and in accordance with the coupling manufacturer's recommendations, continue the epoxy lining around the ends of each pipe to the edge of the cut groove; provide the same on each fitting.

.8 On glass lined piping systems and in accordance with the coupling manufacturer's recommendations, continue the lining around the ends of each pipe to the edge of the cut groove; provide the same on each fitting. Alternately a glass lining patch kit or mastic similar to Sikaflex 1A is acceptable on the glass lined pipe ends to the outside groove.

END OF SECTION

DETAILED PROCESS PIPING SPECIFICATION SHEETS

1. GENERAL

1.1 Work Included

.1 The piping specification sheets on the following pages detail the requirements for each type of process pipe included in the work.

.2 The piping materials are listed on the specification sheets.

2. PRODUCTS

2.1 Process Piping Commodity Summary

Table 1: Process Fluids and Pipe Materials

Abbreviation	Process Commodity	Pipe Material
TDW	Treated Water (Potable)	Mild Steel, EW or ERW
TWS	TW Supply (Potable)	Mild Steel, EW, or ERW
TWR	TW Return (Potable)	Mild Steel, CW or ERW
DR	Drain	PVC

END OF SECTION

PROCESS PIPELINE APPURTENANCES

1.1 GENERAL

1.2 Description

.1 This section describes process pipeline appurtenances to be installed integrally with the piping.

.2 Refer to the general piping requirements of Section 15050. Use the general requirements specified in this section and Section 15050 integrally with the more specific requirements listed in Section 15055.

1.3 Submittals

.1 Provide shop drawings for each type of pipeline appurtenance in accordance with the requirements of Division 01 and Section 15050.

.2 Show the materials of construction, a cutout indicating the interior workings of the unit, and illustrations of the method of installation.

1.4 Coordination

.1 Coordinate the appurtenances with the piping layout and arrangement. Ensure that the appurtenances are mounted in locations suitable for their intended function and where they are accessible for maintenance personnel.

1.5 Quality Assurance

.1 Refer to Section 15050 for welding quality assurance requirements.

1.6 Shipment, Protection and Storage

.1 Refer to Division 01 and Section 15050 for Shipment and Storage.

2. PRODUCTS

2.1 Function

.1 Provide the pipe appurtenances as described below, for the piping systems shown.

2.2 Instrument Air Connections

.1 Provide instrument air connections to each instrument with a run of 12 mm stainless steel tubing from the nearest instrument air header to within close proximity of each device requiring instrument air.

.2 Terminate each tubing run with a 12 mm ball valve (stainless steel) within 1500 mm horizontal distance of the device and 1500 mm off the floor. Group multiple valves neatly together with a common orientation.

.3 Refer to Division 17 for connection from that termination to the device from the downstream side of the valve. A list of devices requiring instrument air is provided in the Instrument Specification Sheets.

.4 Provide a vertical riser connection at the header to avoid condensate entrainment. From the top of the riser, slope the tubing generally down to the device.

2.3 Strainers

.1 Air and Gas Strainers

.1 Provide strainers with Y-pattern, cast iron body, with 40 mesh Moel screens packed with Everdur wool. For copper piping, provide bronze bodies.

.2 Fit air line strainers with a brass blowoff cock.

.3 Acceptable manufacturers are:

.1 Armstrong

.2 Mueller.

.2 Steam and Water Strainers

.1 Provide steam and water strainers with Y-pattern unless otherwise specified.

.2 Provide carbon steel body for steam strainers, cast iron body for water strainers, and bronze bodies for copper piping systems.

.3 Provide 304 stainless steel screens and tapped and plugged blowoff connections. Screen perforations shall be 0.5 mm for steam service and 1.15 mm for water service.

.4 Acceptable manufacturers are:

.1 Armstrong

.2 Mueller.

2.4 Quick Disconnects

.1 Provide quick disconnects which are not disconnectable under pressure. Unless otherwise shown or specified, provide products listed below.

.2 For air service, acceptable products are:

.1 Dixon Air King

.2 Tomco, 12 mm diameter.

.3 For water service, provide products to Owner standard; two lug, malleable iron, female NPT. Sizes as shown. Acceptable products are: For water service, provide products to Owner standard. Sizes as shown. Acceptable products are:

.1 For hose 25 mm or less in diameter, two lug, malleable iron, female NPT: Dixon Air King

.2 For 38 mm and 50 mm diameter hose, two lug, malleable iron, female NPT: New Line

.3 For 75 and 100 mm diameter; quick-acting, dual clip: Rite-pro, Dixon.

2.5 Mechanical Branch Connections

.1 Provide mechanical branch connections as required for flushing connections and pipe tappings as shown in the Standard Details.

.2 Provide branch connection recommended by the manufacturer for the service and pipe installed.

.3 Acceptable products are:

.1 Gruvlock Clamp T

.2 Ford Service Saddles (F/FS)

.3 Victaulic Mechanical T

.4 Robar 2706 Service Saddles.

2.6 Hoses

.1 Provide hoses rated for 600 kPa, complete with quick connect fittings as per standard details and as called for on the general arrangement drawings.

3. EXECUTION

3.1 Pipeline Appurtenances

.1 Provide manual air vents at the high points of each reach of pipeline and where shown, consisting of a ball valve and copper tubing return. Take air vents to the nearest floor with the valve mounted in a location accessible from floor level and no greater than 1.2m above the floor. For piping systems conveying fluids containing solids, use 50mm line with a non-lubricated ball valve fitted with quick disconnects. For a high point vent required on an extended run of constant elevation pipe, locate the vent at the downstream end of the run close to the downward elbow.

.2 Provide manual drains at the low point of each reach of pipeline and where shown. Pipe drains to a sump, gutter, floor drain, or other collection point with a valve mounted in a location accessible from floor level and no greater than 1.2 m above the floor. Provide threaded ball valves for drain valves of the size shown. When drains cannot be run to collection points, route them to a point of easy access and attach quick disconnects of the size specified. For pumps that do not come with integral drains, provide 25 mm drain connections with threaded manual ball valves inside pump isolation valves.

.3 Unless otherwise shown or specified, install gauge taps on the suction and discharge of all pumps, fans, blowers, compressors, and vacuum pumps. Attach gauge taps with a threaded nipple and valve, as shown, attached by a threaded nipple to the pipeline, duct or equipment.

.4 Install flushing and purge connections as described in Part 2 and as shown. Install sample lines and connections as shown.

3.2 Testing

.1 Give the Engineer 24 hours notice prior to testing.

.2 Do not insulate or conceal work until piping systems are tested and accepted.

.3 Complete any required weld tests.

.4 Supply all water, air and inert gases required for pressure testing.

.5 Supply all pumps, compressors, gauges, etc. required for testing.

.6 Install air threadolets, air relief valves and line fitting valves as necessary to complete testing. Remove after testing and plug the threadolets.

.7 Cap or plug all lines which are normally open ended. Remove on completion of testing.

.8 Provide all temporary thrust restraints necessary for testing. Remove upon completion of testing.

.9 Test all underground lines prior to backfilling. Do not place concrete surround until lines are tested.

.10 Test all existing piping where it connects to new piping to the first valve in the existing piping. Repair any failures in existing piping which occur as a result of the test after informing the Engineer of such failure.

.11 Isolate all low pressure equipment and appurtenances during testing so as not to place any excess pressure on the operating equipment.

.12 Where defective material or equipment is identified, repair or replace using new material.

.13 Flush and drain liquid pipes after pressure tests. Purge all gas pipes after pressure tests.

.14 Dispose of flushing water in manner approved by the Engineer, which causes no damage to buildings or siteworks.

3.3 Pressure Testing of Liquid Lines

.1 Hydrostatically test all lines normally used for the conveyance of liquid using water as the test medium.

.2 Test pressures and durations shall be as specified in the detailed specification sheets.

.3 Ensure all lines are filled with water. Bleed air from all high spots using the taps provided specifically for that purpose.

.4 Zero leakage is permitted throughout the specified test period for all exposed piping, buried insulated piping, and any liquid chemical lines.

.5 Show evidence of leakage rates below 0.01 litre per hour per mm pipe diameter per 100m of pipe length for buried piping, unless otherwise specified.

.6 Test drains in accordance with the National Plumbing Code.

3.4 Cleaning and Flushing

.1 After installation and prior to testing, perform initial cleaning of process and utility lines. Clean piping greater than 150 mm and less than 600mm by passing a tightly fitting cleaning ball or swab through the pipeline, unless specified otherwise. Lines greater than 600 mm may be cleaned manually or with a cleaning ball or swab. Give lines smaller or equal to 150mm an initial flush or purge.

.2 After initial cleaning, connect the piping systems to related process and mechanical equipment. Insert temporary screens, provided with visible locator tabs, in the suction of pumps and compressors in accordance with the following table:

Suction Diameter, mm	Maximum screen opening, mm
0 - 25	1.5
30-75	6.25
80-150	12.5
>150	25

.3 Maintain the screens during testing, flushing/purging, initial startup, and the initial operating phases of the commissioning process. In special cases and with the Engineer's acceptance, screens may be removed for performance tests.

.4 Unless specified otherwise, flush liquid systems after testing, with clean water and screens in place. Maintain flushing for a minimum period of 15 minutes and until no debris is collected in the screens.

.5 Remove the screens and make the final connections after the screens have remained clean for a minimum of 24 consecutive hours of operation. Screens in solids handling systems are exempt; remove prior to placing the system in service.

.6 In air or gas systems with pipe sizes less than or equal to 150 mm, purge with air and/or inert gases before testing. Upon completion of testing and cleaning, drain and dry the piping with a dry air stream. Satisfy ANSI/ISA-S7.3 standards for instrument air systems.

.7 Brush clean steel pipe exterior to SSPC-P3 standard prior to painting. Also refer to Section 09900.

3.5 Disinfection

.1 Disinfect lines intended for potable water service after testing in accordance with AWWA C651.

END OF SECTION

PROCESS PIPE HANGERS AND SUPPORTS

1. GENERAL

1.1 Work Included

.1 Supply and installation of hangers and supports for all process piping systems specified in Section 15050. This section does not include pipe support for fire sprinkling systems, pipe anchors, guides or seismic restraints.

.2 Engage a competent engineer to be responsible for the final aspects of the piping support system design, including details and spacing of all supports. The support system will ensure that the weight of the pipework and the need for lateral and vertical support are considered fully. Contractor to provide a complete piping system design as described in Section 15050.

1.2 Related Work

.1 Section 11005 – General Process Provisions

.2 Section 11020 – Process Equipment Installation

.3 Section 15050 – Piping Systems.

1.3 Submissions

.1 Submit the following for information in accordance with Division 01:

.1 In piping layout drawings specified in Section 15050, indicate hanger and support locations and provide legend summarizing load information and hanger and support component selection at each location.

1.4 Service Conditions

.1 The intent of the drawings has been to indicate general arrangements and typical spacings for pipe systems, but does not relieve the Contractor of the responsibility for the design and supply of a complete and adequate support system.

.2 Provide hangers and supports specified in this Section to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this Section established pipe support classifications based on the operating temperature of the piping contents.

.3 Pipe support classifications:

.1 Hot Systems:

- A-1: 40°C - 230°C
- A-2: 230°C - 400°C

- A-3: Over 400°C.

.2 Ambient systems:

- B-1: 15°C - 49°C.

.3 Cold systems:

- C-1: 0.5°C - 15°C
- C-2: -40°C - 0°C.

1.5 Hanger and Support Selection

.1 Piping supports are generally not shown on the process mechanical layout drawings. Therefore, select pipe hangers and supports as specified in this Section. Typical support details and structural attachments shown on the drawings indicate the level of quality that will be considered acceptable. Where specific supports are illustrated on the process mechanical or structural drawings or where a specific standard detail is noted on the drawings, provide that type of support for that particular pipeline.

.2 Piping insulation thickness is specified in Section 15059.

.3 Review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

.4 Hangers and supports shall withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consideration shall be given to following conditions:

.1 Weights of pipe, valves, fitting, insulating materials, suspended hanger components, and normal fluid contents.

.2 Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.

.3 Reaction forces due to the operation of safety or relief valves.

4 Wind, snow or ice loadings on outdoor piping.

.5 Size hangers and supports to fit the outside diameter of pipe, tubing, or where specified, the outside diameter of insulation.

.6 Where negligible movement occurs at hanger locations, use rod hangers for suspended lines, whenever practical. Use bases, brackets or structural cross members for piping supported from below.

.7 Hangers for the suspension of pipe and tubing sizes, 65 mm and larger shall be capable of vertical hanger component adjustment under load.

.8 Provide the supporting systems to allow for free or intended movement of the piping including its movement in relation to that of connected equipment.

.9 Design the system to support the operating loads with a safety factor of 4.0.

.10 Where there is horizontal movement at a suspended type hanger location, select hanger components to allow for swing. The vertical angle of the hanger rod shall not, at any time, exceed 4 degrees.

.11 No contact is allowed between a pipe and hanger or support components of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing with copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.

.12 Do not support piping from masonry wall construction.

.13 Do not use existing pipes and supports to support new piping unless otherwise specified.

.14 Do not attach pipe support components to equipment or pressure vessels unless otherwise specified.

.15 Use stock hanger and support components wherever practical.

.16 Provide supplementary structural members, where structural bearings are not in suitable locations.

.1 Make provision for expansion, contraction, slope and anchorage.

.2 Where necessary, pipe support systems shall withstand the additional load of electrical or instrumentation trays. Coordinate with other divisions. Design and provide support system accordingly.

2. PRODUCTS

2.1 Acceptable Manufacturers

.1 The following manufacturer's products to provide the specified features and to meet specified operating conditions:

.1 B-Line

.2 Grinnell

.3 Powerstrut

.4 Superstrut

.5 Unistrut.

2.2 Support Spacing

.1 Maximum support spacing shall be as listed in the following table:

Pipe Size Nominal (mm)	Maximum Spacing (m) Iron	PVC	Steel or Stainless Steel
30 and under	2.1	1.4	2.1
30 to 40	2.7	1.5	2.1
40 to 50	3.0	1.6	2.1
60 to 75	3.6	1.8	3.0
100	4.2	2.5	3.7
150	5.2	3.0	4.3
200	5.8	3.5	4.6
250	6.4	4.0	4.9
300	6.7	4.2	5.2
350	6.7		5.8
400	6.7		6.1
500	6.7		6.7
600 and greater	6.7		6.7

.2 Provide additional supports at any valves or other heavy piping element.

2.3 Materials

.1 Non-Corrosive Environments (Tunnels and Buildings):

.1 Unless otherwise specified, pipe hangers and supports, structural attachments, fittings and accessories are hot-dipped galvanized after fabrication.

.2 Provide cadmium plated hardware (nuts, bolts, washers, threaded rods).

.3 Touch up cadmium and galvanized material with zinc rich coating where the material has been cut. Exposed bare steel is not acceptable.

.2 Exterior, Submerged or Corrosive Environments:

.1 Pipe hangers, supports, structural attachments, fittings, accessories and hardware are all stainless steel.

.2 Any areas that may be considered corrosive and are in question should be reviewed with the Engineer in advance of securing the materials

.3 Provide AISI, Type 304 stainless steel concrete inserts.

2.4 Pipe Hangers and Supports

.1 Type 1 - Clevis Pipe Hanger: Provide carbon steel clevis hangers with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24 with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24.

.3 Cast and ductile iron pipe - B-Line B3102, Grinnell Figure 590, Superstrut C-710 or Unistrut No. 24.

.4 Copper pipe (uninsulated) - shall be B-Line B3104 CT, Grinnell Figure CT-65, Superstrut C-710 or Unistrut No. 51.

.5 Copper pipe (insulated) - B-Line B3100, Grinnell Figure 260, Superstrut C-710 or Unistrut No. 24, with insulation shield.

.6 Plastic pipe - B-Line B3100, Grinnell Figure 260 or Unistrut No. 56.

.2 Type 2 - "J" Pipe Hanger: Provide carbon steel hangers with configuration and components equivalent to MSS Type 5. Use only on uninsulated pipe, with configuration and components as follows:

.1 Steel pipe - B-Line B3690, Grinnell Figure 67, Superstrut C-711 or Unistrut J1205-J1280 Series.

.2 Copper and plastic pipe - B-Line B3690 (Plasticoat) Grinnell Figure 67 (plastic coated), Superstrut C-711P or Unistrut J 1205N-J1280N series.

.3 Type 3 - Double Bolt Pipe Clamp: Provide carbon steel pipe clamps, with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3144 or Grinnell Figure 295, with insulation shield. Insulation shield is optional for hot and ambient systems.

.2 Steel pipe (uninsulated - B-Line B3144 or Grinnell Figure 295.

.3 Copper pipe (insulated only) - B-Line 3144 or Grinnell Figure 295, with insulation shield.

.4 Type 4 - Adjustable Roller Hanger: Provide cast iron rollers, carbon steel yoke and cross bolt with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3110, Grinnell Figure 181 or Superstrut C-729, with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3110, Grinnell Figure 181 or Superstrut C-729.

.3 Copper pipe (insulated only) - B-Line B3110, Grinnell Figure 181 or Superstrut C-729, with insulation shield.

.4 Plastic pipe - B-Line B3110, Grinnell Figure 181 or Superstrut C-729.

.5 Type 5 - Single Pipe Roll: Provide cast iron rollers and sockets, and steel cross rods with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3114, Grinnell Figure 171 with insulation shield.

.2 Steel pipe (uninsulated) - B-Line B3114, Grinnell Figure 171.

.3 Plastic pipe - B-Line B3114, Grinnell Figure 171.

.6 Type 6 - Framing Channel Pipe Clamp: Provide steel pipe clamps with hot dipped galvanized finish and material thickness as listed below:

.1 Steel pipe (uninsulated) - B-Line 2007, Powerstrut PS1100, or Unistrut P1009 Series:

Pipe Diameter mm	Thickness mm
10 and 12	1.6
20 to 32	2.0
38 to 75	2.8
90 to 125	3.2
150 to 200	3.6

.2 Steel pipe (insulated); as per 2.4.6.1 with insulation shield.

.3 Copper (uninsulated) and plastic pipe, B-Line B2033 Series, Powerstrut PS1200 or Unistrut P2024C and P2024PC Series B-Line. Provide a copper-plated, plastic coated or lined with a dielectric material on pipe clamps.