

1 General

1.1 DESCRIPTION

- .1 This Section of the specifications refers to the installation of equipment, piping, fittings, valves and all piping specialties and supporting devices provided under this contract within the lift station confines. Also included are the equipment, valve and commodity identification legends for all piping systems to be installed within the stormwater tank and lift station.
- .2 Control valves and other in-line equipment, specified in Division 40, to be installed under this Section.
- .3 All piping components listed in Section 40 20 20 - Detailed Piping Specifications take priority over this section.

1.2 REFERENCE STANDARDS

- .1 Do work in accordance with the authorities having jurisdiction, including but not limited to, the latest edition of the following codes and standards deemed to be part of this specification.
- .2 Conform to the latest revision of the following reference standards:
 - .1 ANSI A13.1, Scheme for the Identification of Piping Systems.
 - .2 ANSI/AWWA A21.10/C110, Ductile-Iron and Grey-Iron Fittings, 3 Inch Through 48 Inch, for Water and Other Liquids.
 - .3 ANSI/AWWA A21.11/C111, Rubber-Gasket Joints for Ductile-Iron and Grey Iron Pipe and Fittings.
 - .4 ANSI/AWWA A21.15/C115, Flanged Ductile-Iron and Grey-Iron Pipe with Threaded Flanges.
 - .5 ANSI/AWWA A21.16/C116, Protective Fusion Bonded Epoxy Coatings for Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Supply Service.
 - .6 ANSI/AWWA A21.5/C105, Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids.
 - .7 ANSI/AWWA A21.50/C150, Thickness Design of Ductile Iron Pipe.
 - .8 ANSI/AWWA A21.51/C151, Ductile-Iron Pipe, Centrifugally Cast in Metal Moulds or Sand-Lined Moulds, for Water and Other Liquids.
 - .9 ANSI B1.1, Unified and American Screw Threads.
 - .10 ANSI B1.20.1, Pipe Threads, General Purpose.
 - .11 ANSI B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

- .12 ANSI B16.3, Malleable Iron Threaded Fittings Class 150 and 300.
- .13 ANSI B16.4, Cast Iron Threaded Fittings, Class 125 and 250.
- .14 ANSI B16.5, Pipe Flanges and Flanged Fittings.
- .15 ANSI B16.9, Factory-Made Wrought Steel Butt Welding Fittings.
- .16 ANSI B16.11, Forged Steel Fittings, Socket Welding and Threaded.
- .17 ANSI B16.12, Cast Iron Threaded Drainage Fittings.
- .18 ANSI B16.15, Pipe Flanges and Flanged Fittings, Classes 150 and 300.
- .19 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .20 ANSI B16.21, Non-Metallic Flat Gaskets for Pipe Flanges.
- .21 ANSI B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .22 ANSI B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
- .23 ANSI B31.9, Building Services Piping.
- .24 ANSI B32, Solder Metal.
- .25 ANSI B36.10M, Welded and Seamless Wrought Steel Pipe.
- .26 ANSI/ASME B16.25, Buttwelding Ends.
- .27 ANSI/ASME B31, Code for Pressure Piping.
- .28 ANSI/ASME B31.3, Process Piping.
- .29 API 5L, Specification for Line Pipe.
- .30 ASTM A74, Cast Iron Soil Pipe and Fittings.
- .31 ASTM A105/A105M, Forgings, Carbon Steel, for Piping Components.
- .32 ASTM A135, Electric-Resistance-Welded Steel Pipe.
- .33 ASTM A563, Carbon and Alloy Steel Nuts.
- .34 ASTM B88, Seamless Copper Water Tube.
- .35 ASTM C76, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- .36 ASTM C443, Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
- .37 ASTM D1457, PTFE Moulding and Extrusion Materials.
- .38 ASTM D1784, Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- .39 ASTM D1785, Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- .40 ASTM D2000, Classification System for Rubber Products in Automotive Applications.
- .41 ASTM D2241, Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR).
- .42 ASTM D2466, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.

- .43 ASTM D2467, Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- .44 ASTM D2564, Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.
- .45 ASTM D2665, Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- .46 AWWA C206, Field Welding of Steel Water Pipe.
- .47 AWWA C207, Steel Pipe Flanges for Waterworks Services - Sizes 4 Inch Through 144 Inch.
- .48 AWWA C217, Cold Applied Petrolatum Tape and Petroleum Wax Tape Coatings for Exterior of Special Sections, Connections and Fittings for Buried or Submerged Steel Water Pipelines.
- .49 AWWA C600, Installation of Ductile-Iron Water Mains and their Appurtenances.
- .50 AWWA C606, Grooved and Shouldered Joints.
- .51 AWWA C900, Polyvinyl Chloride (PVC) Pressure Pipe, 4 Inches Through 12 Inches, for Water.
- .52 AWWA M11, Steel Pipe - A Guide for Design and Installation.
- .53 CAN/CSA-B149.1 Natural Gas and Propane Installation Code.
- .54 CSA B64 Series CSA Standards on Vacuum Breakers and Backflow Preventers.
- .55 CSA B137.3, Rigid PVC Pipe for Pressure Applications.
- .56 CSA CAN3-Z299.3, Quality Verification Program Requirements.
- .57 CSA B242 Groove and Shoulder Type Mechanical Pipe Couplings.
- .58 CSA W178, Certification of Welding Inspectors.
- .59 EJMA STDS, Standards of Expansion Joint Manufacturers' Association, Edition No. 6.
- .60 Fluid Sealing Association Technical Handbook, Rubber Expansion Joint Division.
- .61 SSPC-P3, Canadian Government Standards Board.
- .62 SSPC-SP6, Canadian Government Standards Board.
- .63 SSPC-SP10, Canadian Government Standards Board.
- .64 Air-Conditioning and Refrigeration Institute (ARI).
- .65 Air Movement and Control Association (AMCA).
- .66 Department of Environment of the Province of Alberta.
- .67 Gas Protection Branch Regulations of the Province of Alberta.
- .68 National Fire Protection Association (NFPA).
- .69 National Plumbing Code of Canada (NPC).
- .70 NSF International.

- .71 Plumbing and Drainage Regulations of the Province of Alberta.
- .72 Pressure Vessels Act of the Province of Alberta.
- .73 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
- .74 The American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE).

1.3 OPERATING AND MAINTENANCE DATA

- .1 Provide as specified in Division 1.

1.4 SUBMITTALS FOR REVIEW

- .1 Provide as specified in Division 1.
- .2 Submit document listing pipe, fittings, flexible connectors, linings, coatings, and valving to be used for each pipe system.
- .3 Radiographic weld testing: Submit the name and qualifications of at least two (2) independent firms for the radiographic weld testing to be undertaken by the Contractor. The selected firm will be subject to the review and acceptance of the Departmental Representative.
- .4 Manufacturer's affidavit of compliance with specified AWWA standards for valves, pipe, fittings, linings, and coatings.
- .5 Design, select, locate and provide piping supports, pipe guides, seismic bracing, expansion joints and anchors required for final piping layout. Typical details and acceptable attachments shown on the drawings are provided only for general guidance.
- .6 Provide the necessary submittals and ensure the proper registration of piping systems and system components as required by the regulatory authorities having jurisdiction.

1.5 SUBMITTALS FOR INFORMATION ONLY

- .1 For all pipe, submit spool drawings, to indicate the assembly details, the welds, flanges, valve placement, cathodic protection, seismic restraint system, expansion joints, guides, anchors, hangers, supports, and the provisions for thrust restraint, as well as any other pertinent details.
- .2 Submit piping layout drawings by plant area which indicate location and placement of valves, fittings and other appurtenances for all piping, greater or equal to 150 mm diameter, in that area. Indicate location and clearances from structures and other utilities (ductwork, conduit, electrical tray, etc.)
- .3 Submit copies of all original submittals and all related correspondence made as part of the regulatory submissions required by regulatory authorities.

- .4 Product Samples: Where specified or when directed by the Departmental Representative, provide mill test results or product samples.
- .5 Provide hanger, expansion joint, guide, anchor, support and seismic restraint system design details including locations, load information, design calculations and illustrative drawings, stamped and signed by a Professional Engineer registered in the Province of Alberta.
- .6 For expansion joints submit manufacturer's catalog data, shop drawings and assembly drawings confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details. Submit calculations to substantiate expansion joint selection and amount of precompression, stamped and signed by a professional Engineer registered in the Province of Alberta.
- .7 Welding: Prior to commencing any welding of stainless steel pipe, prepare and submit to the Departmental Representative a written description of welding techniques including but not limited to materials, methods, and quality control. Identify differences in shop and field techniques. Indicate in the submission that the welding technique has been reviewed for each commodity and certify that the technique is acceptable for the intended service condition. Written procedures to be stamped and sealed by a Professional Engineer registered in the Province of Alberta and qualified for welding design.
- .8 Radiographic weld test results.
- .9 Provide qualifications of a certified weld inspector as per CWB standards.
- .10 Submit current and complete documentation of the welder's qualifications prior to the commencement of welding.

1.6 SHIPMENT AND PROTECTION

- .1 Ship, handle and store the Goods to prevent damage.
- .2 Damaged items will not be permitted as part of the Goods, except in cases of minor damage that have been satisfactorily repaired and are acceptable to Departmental Representative.
- .3 Clearly tag Goods, stating size, type, coating and mating parts, if applicable.
- .4 Store Goods on-site until ready for incorporation in the work using methods recommended by Manufacturer to prevent damage, distress or weathering.

1.7 PIPE MATERIALS - GENERAL

- .1 All pipe materials to be new, free from defects and conforming to applicable reference standards.

- .2 Where any standard referenced has been superseded prior to bidding, the Contractor shall comply with the current standard.

1.8 PIPE SIZES

- .1 Where the pipe size is not specified, provide pipe with the sizes required by the National Plumbing Code of Canada (NPC). Small piping not described by the NPC or otherwise specified herein shall be 12 mm nominal diameter.

1.9 JOINTS - GENERAL

- .1 Connect piping using joints not readily disassembled only where shown and where not otherwise specified. Provide joints which may be disassembled 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 For carbon steel piping less than 75 mm nominal diameter, butt-weld or use threaded couplings. Use unions where disassembly is required.
- .3 For steel piping equal to or greater than 75 mm nominal diameter, where not specified or shown otherwise, butt-weld according to ASME Boiler and Pressure Vessel Code or furnish slip-on flanges, conforming to ANSI B16.5, Class 150. Unless indicated otherwise on the drawings or detail specifications, where disassembly is required, use flanges.
- .4 For stainless steel tubing use stainless steel compression fittings.
- .5 For schedule rated stainless steel pipe smaller than 75 mm nominal diameter, socket weld pipe. Where disassembly is required, use threaded unions.
- .6 For thin wall or schedule rated stainless steel pipe equal to or greater than 75 mm nominal diameter, butt-weld pipe unless otherwise shown or specified.
- .7 For copper or brass piping, use soldered couplings. Where disassembly is required, use compression unions.
- .8 For ductile iron piping, where not shown or otherwise specified, and for other piping where specified or shown, use grooved joints in accordance with AWWA C606.
- .9 Where not shown or otherwise specified, use solvent weld joints for PVC and FRP piping. Provide flanges or unions where disassembly is required.
- .10 The contractor is to consult with PVC pipe manufacturer's representative to ensure the most current socket welding solvent and application methods are used.

2 Products

2.1 GAS PIPELINE

- .1 Natural gas piping shall be ASTM A53, Schedule 40, seamless.

2.2 PLUMBING PIPING

- .1 Solder to be minimum lead free to ASTM B32. Solvent weld for PVC to ASTM D2564. Solvent weld for ABS: to ASTM D2235.
- .2 Domestic water piping above ground to be type L hard drawn copper with cast brass or wrought copper solder type fittings. Solder to be lead-free used with non-corrosive flux.
- .3 Domestic water piping below ground within the building where indicated to be polyethylene pressure pipe to CAN/CSA B137.1 type PE 3406, series 160. Domestic water piping below grade outside the building to be polyethylene pressure pipe to ASTM F 714, type PE 3408, series DR 11. Joints to be thermal butt fusion joined, to ASTM D 2657.
- .4 Pipe supports shall be compatible with the piping material being supported. Piping shall be hung with rod and clevis hangers or clamped to channels that are fastened to the structure. Pipe straps will not be acceptable.

2.3 FLANGES

- .1 Unless otherwise noted, make flanges on steel pipe Class 150, conforming to ANSI B16.5. Companion flanges for connection to cast iron or ductile iron equipment flanges shall be refaced to be flush with the companion flange (flat face).
- .2 Make flanges on stainless steel piping stainless steel slip-on, rolled-angle Van-Stone type, with a galvanized steel back-up ring drilled to ANSI B16.1, Class 125. Make the angle ring thickness equal or greater than the pipe or fitting to which it is welded. For submerged joints, make the backup ring stainless steel. For digester gas services, make the flanges Lap-joint type with galvanized steel Lap-joint flange and in accordance with CAN/CGA B105. For instrument air services, make the flanges Lap joint type with a galvanized steel Lap-joint flange. For submerged joints, make the Lap-joint flange stainless steel.
- .3 Provide Class 125 flanges on cast or ductile pipe, conforming to ANSI B16.1.
- .4 General requirements for flanges are as follows:
 - .1 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.

- .5 Do not use slip-on flanges that are attached to a pipe by means of set screws and gaskets.

2.4 SOLDERED COUPLINGS

- .1 Soldered couplings for copper pipe conform to ANSI B16.26. Solder to be lead free conforming to ASTM B32 and the National Plumbing Code of Canada (NPC).

2.5 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 Conform to ASTM A182 or ASTM A276, Class 150, for threaded connections to stainless steel pipe, threadlets to be shop welded to the pipe at the locations specified.
- .4 Provide threaded-end to flanged-end adaptors where required to connect to flanges.

2.6 COMPRESSION COUPLINGS

- .1 Furnish compression couplings for stainless steel tubing of the same material as the pipe, capable of withstanding the maximum pressure to which the pipe is subjected.
- .2 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 GROOVED JOINT COUPLINGS

- .1 Fabricate grooved joint couplings of ductile iron to ASTM A536, and in accordance with AWWA C606. Provide cut grooves in pipe and fittings in accordance with AWWA C606. Rolled grooves and roll-groove type joints are not acceptable.
- .2 Steel Pipe: 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 product is: Victaulic Style 77. Use rigid style couplings in all other applications. Acceptable product is: Victaulic Style 07 Zero-Flex.
- .3 Ductile Iron Pipe: Provide pipe with rigid cut grooves for exposed services, and flexible cut grooves for buried services. Acceptable coupling product is Victaulic Style 31.
- .4 Where grooved joint piping systems connect to equipment or to flanged valves, meters, or other sensing devices; use grooved joint flanges or flange adapters. Acceptable product is: Victaulic Flange adaptors. 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.

2.8 FLEXIBLE COUPLINGS

.1 Flexible Couplings - Type I:

.1 Flexible sleeve type couplings: cylindrical centre ring, two (2) follower rings, two (2) resilient gaskets, and connecting bolts. Acceptable products are:

- .1 Dresser Style 38.
- .2 Ford Meter Box FC1.
- .3 Robar 1408.
- .4 Rockwell Type 411.
- .5 Viking Johnson Quick-Fit.

.2 Flanged flexible sleeve type couplings: flanged cylindrical centre ring, a companion flange, one (1) follower ring, one (1) resilient gasket, and connecting bolts. Acceptable products are:

- .1 Dresser Style 128.
- .2 Ford Meter Box FCA.
- .3 Robar 7808.
- .4 Rockwell Type 913.
- .5 Viking Johnson Quickfit Flange Adapter.

.3 Transition flexible sleeve type couplings: Cylindrical centre ring, two (2) follower rings two (2) resilient gaskets, and connecting bolts. Acceptable products are:

- .1 Dresser Style 62.
- .2 Robar 1408.
- .4 Centre ring: steel, shop coated for corrosion protection.
- .5 Gaskets: fabricated of material suitable to the service conditions.
- .6 For submerged, buried or below structure applications, use stainless steel bolts, nuts and washers.
- .7 Provide the necessary amount and appropriate size of restraining rods and gussets as recommended by the manufacturer.
- .8 Type 1 - Restrained; use a flexible sleeve-type coupling with restraining rods, and gussets welded to the pipe to AWWA M11. Provide sufficient restraint to resist pressure equal to twice the system test pressure.

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

2.9 IRON PIPE JOINTS

- .1 Unless shown or specified otherwise, for ductile iron pipe within buildings or above ground, refer to groove joint couplings.

2.10 EXPANSION JOINTS

- .1 Design and fabricate expansion joints in accordance with EJMA standards and to meet the requirements of this Division.
- .2 Provide expansion joints as shown and in accordance with this Division. Unless otherwise specified provide elastomer spool type expansion joints.
- .3 Ensure corrugated type expansion joints are capable of a minimum 10,000 pressure, temperature and deflection cycles, not concurrent.
- .4 For metal expansion joints of the metal bellows type, in systems handling gases, air, water or other liquids, provide liners to produce a smooth flow path, reduce vibration and reduce noise through the expansion joint.
- .5 Provide sufficient bends and expansion joints to allow for thermal movement of piping from 0°C to maximum service temperature.
- .6 Provide factory precompressed expansion joints where required to suit installation temperature.
- .7 Formed Bellows Type, Low Temperature:
 - .1 For up to 150°C, fabricate with 321 stainless steel corrugations, rated for the design pressure and temperature. Factory pressure and leak test at the design temperature.
 - .2 Determine expansion joint design to meet the requirements of movement specified (axial, lateral, and angular). Utilize a minimum safety factor of 1.35 for movement in anchor to anchor pipe run length over entire temperature range.
 - .3 For expansion joints with specified lateral movements greater than 3.0 mm, provide expansion joints with control rings and control rods or alternate method to equally distribute lateral movement among each corrugation and prevent squirm or buckling of the corrugations. Control rings shall be nickel-iron rated for 1000 kPa at 150°C. Required lateral movements are as listed on the drawings or specified.
 - .4 Provide limit rods which are full load rated in the event of anchor failure and to protect expansion joint from excessive axial movement.
 - .5 Unless otherwise specified, provide Van Stone flanges with galvanized steel backing flanges drilled to ANSI B16.5 for all expansion joints without limit rods.
 - .6 Provide fixed forged steel flanges on expansion joints requiring limit rods.

- .7 Acceptable manufacturers are:
 - .1 American BOA.
 - .2 Senior Flexonics.
 - .3 Hyspan Precision Products.
- .8 Steel Expansion Compensator Type:
 - .1 Provide steel compensator type expansion joints in steel pipe systems of 65 mm diameter and less where specified and for all systems with expansion/contraction potential.
 - .2 Use 2-ply stainless steel bellows with carbon steel shroud and end fittings. Compensators to be rated for 1.2 MPa maximum working pressure and 400°C.
 - .3 Acceptable products are:
 - .1 Senior Flexonics Model H.
 - .2 Hyspan Series 8500.
 - .3 Keflex 7Q.
- .9 Bronze Expansion Compensator Type
 - .1 Provide bronze compensator type expansion joints in copper pipe systems of 50 mm diameter and less where specified and for all systems with expansion/contraction potential.
 - .2 Use multi-ply phosphor bronze or stainless steel bellows with copper tube end fittings. Compensators to be rated for 1.0 MPa and 205°C.
 - .3 Acceptable products are:
 - .1 American BOA.
 - .2 Senior Flexonics Model HB.
 - .3 Hyspan Series 8500.
 - .4 Keflex 7Q.
- .10 Elastomer General:
 - .1 Select materials suitable for service commodity, temperature and pressure. Conform to the requirements of the Fluid Sealing Association, Rubber Expansion Joint Division.
 - .2 Provide control rods on expansion joint connectors to prevent excessive axial elongation and to accept the static pressure thrust in the piping system. Manufacturer to determine number and sizes of control rods.
 - .3 Provide elastomer cover of the same material as the elastomer tube liner. For service temperatures between 80°C and 120°C, use chlorobutyl or EPDM for the elastomer tube. For temperatures below 80°C, use EPDM, Neoprene or Buna N tube elastomer.

.4 For single arch or single spherical rubber expansion joints in piping up to and including 200 mm diameter, make expansion joint face-to-face dimension. 150 mm, nominal. For pipe greater than 200 mm and less than or equal to 300 mm, make expansion joint face-to-face dimension 200 mm, nominal.

.11 Elastomer Spool Type:

.1 Unless otherwise specified, provide spool, resilient arch type expansion joints.

.2 Construct of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body.

.3 Provide backup or retaining rings of galvanized steel construction. Make retaining rings a nominal 10 mm thick, split type.

.4 Use filled arch type expansion joints on all piping systems conveying fluids containing solids and at connection to Process Air blowers.

.5 Acceptable manufacturers are:

.1 Senior Flexonics.

.2 Garlock.

.3 Mercer.

.4 Techniquip.

.12 Elastomer Spherical Moulded Type:

.1 Construct of multiple plies of nylon tire cord fabric and elastomer suitable for specified commodity, temperature and pressure.

.2 Provide galvanized steel floating flanges, such that no metal parts come in contact with the fluid.

.3 Acceptable manufacturers are:

.1 Senior Flexonics.

.2 Garlock.

.3 Mercer.

.4 Techniquip.

.5 Proco.

.13 Tied Universal Expansion Joint:

.1 Provide steel tied universal assembly type expansion joints in steel pipe systems as specified in this Division where specified and for all systems with expansion/contraction potential.

.2 Use a dual stainless steel bellows arrangement with a minimum of three (3) tie rods.

- .3 The tie rods must contain the pressure thrust force and limit the joint motion axially and laterally. A minimum of 10,000 cycles is required for the lateral offset movement.
- .4 Expansion joints to be rated for 1034 kPa maximum working pressure and 400 degrees Centigrade.
- .5 Acceptable manufacturers are:
 - .1 American BOA.
 - .2 Hyspan Precision Products - Series 1512R.
 - .3 Senior Flexonics.
- .14 Dual Expansion Joint:
 - .1 Provide steel externally pressurized dual expansion joint type in steel pipe systems where specified and for all systems with expansion/contraction potential.
 - .2 Use 304 stainless steel, 3-ply laminated bellows attached to internal and external guide rings.
 - .3 Use 304 stainless steel collar rings slipped over and welded to the bellows neck.
 - .4 Vent internal guide ring to minimize the effects of flashing.
 - .5 A minimum of 10,000 cycles is required at full compression.
 - .6 Provide drain port, flanged ends, and lifting lug.
 - .7 Expansion joints to be rated for 1034 kPa maximum working pressure and 400 degrees C.
 - .8 Acceptable manufacturers are:
 - .1 American BOA.
 - .2 Hyspan Precision Products - Series 3500.
 - .3 Senior Flexonics.

2.11 FLEXIBLE HOSE CONNECTORS

- .1 Where other types of flexible expansion joints are not shown or specified, provide flexible hose connectors within 2 m pipe length of rotating equipment suction, discharge and ancillary service connection. Do not provide flexible connectors on sump pump connection piping.
- .2 Provide flexible hose connectors with live lengths suitable for a line pressure equal to the test pressure of the pipe and for 12.5 mm lateral movement each side of the pipe centreline.
- .3 Provide one (1) union for pipe diameters ≤ 65 mm or floating flange for pipe diameter > 65 mm, per flexible connector as appropriate to minimize the possibility of torque damage during installation.

- .4 Provide flexible hose connectors capable of minimum of 10,000 cycles at the manufacturer's published minimum intermittent centreline bend radius and maximum working pressure.
- .5 The design standard for flexible hose connectors on piping systems up to and including 50 mm diameter is Senior Flexonics Type 461 helically corrugated hose connectors.
- .6 Acceptable manufacturers for flexible hose connectors on piping systems up to and including 50 mm diameter are:
 - .1 American BOA.
 - .2 Flex-Weld.
 - .3 Senior Flexonics.
- .7 The design standard for flexible hose connectors on piping systems larger than 50 mm diameter is Senior Flexonics Type 401 M corrugated flexible metal hose connectors.
- .8 Acceptable manufacturers for flexible connectors on piping systems larger than 50 mm diameter are:
 - .1 American BOA.
 - .2 Flex-Weld.
 - .3 Senior Flexonics.

2.12 EQUIPMENT CONNECTIONS

- .1 Unless specified otherwise provide the following pipe ends for equipment connections. See below for Dissimilar Metal Connections.

	Equipment End: Tubing/Various	Equipment End: Brass or Bronze Female Thread	Equipment End: Cast Iron or Steel Female Thread
Piping Material	Pipe End Diameter Range		
a) Stainless Steel: Tubing	6 - 25 mm Nut and Double Ferrule Type Connectors or Adaptors as Required Rating: Class 1000	10 - 65 mm 150 mm SS Threaded Nipple and Union Rating: Class 250	10 - 65 mm 150 mm SS Threaded Nipple and Union Rating: Class 250
b) Stainless Steel: Gauge & Schedule 10S		10 - 65 mm Socket Weld Nipple and Union Rating: Class 3000	10 - 65 mm Socket Weld Nipple and Union Rating: Class 3000

	Equipment End: Tubing/Various	Equipment End: Brass or Bronze Female Thread	Equipment End: Cast Iron or Steel Female Thread
Piping Material	Pipe End Diameter Range		
c) Stainless Steel: Schedule 40S		10 - 65 mm 150 mm SS Threaded Nipple and Union Rating: Class 250	10 - 65 mm 150 mm SS Threaded Nipple and Union Rating: Class 250
d) Steel: Standard Wt. and Schedule 40		10 - 65 mm 150 mm Galvanized Threaded Nipple and Union Rating: Class 250	10 - 65 mm 150 mm Galvanized Threaded Nipple and Union Rating: Class 250
e) Steel: Schedule 80		10 - 65 mm Threaded Nipple and Union Rating: 3000 kPa	10 - 65 mm Threaded Nipple and Union Rating: 3000 kPa
f) Ductile Iron			
g) Cast Iron			
h) Copper		10 - 65 mm 150 mm Copper Threaded Nipple and Union Rating: Class 250	10 - 65 mm 150 mm Copper Threaded Nipple and Union Rating: Class 250
i) PVC: Schedule 40			
j) PVC: Schedule 80		10 - 65 mm 150 mm PVC Nipple and Union Rating: Schedule 80	10 - 65 mm 150 mm PVC Nipple and Union Rating: Schedule 80
k) HDPE		10 - 65 mm 150 mm Galvanized Steel Nipple and Grooved Joint, Transition Coupling	10 - 65 mm 150 mm Galvanized Steel Nipple and Grooved Joint, Transition Coupling

	Equipment End: Cast Iron Flanged	Equipment End: Steel/Stainless Flanged	Equipment End: Steel/Stainless Plain End
Piping Material	Pipe End Diameter Range		
a) Stainless Steel: Tubing			

	Equipment End: Cast Iron Flanged	Equipment End: Steel/Stainless Flanged	Equipment End: Steel/Stainless Plain End
Piping Material	Pipe End Diameter Range		
b) Stainless Steel: Gauge & Schedule 10S	>65 mm Rolled Angle Van Stone or Lap-Joint Flange, as specified Rating: Class 125 FF	>65 mm Rolled Angle Van Stone or Lap-Joint Flange, as specified Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 R For Flange Adaptor and Van Stone Flange Rating: Class 150 RF
c) Stainless Steel: Schedule 40S	>65 mm Rolled Angle Van Stone Flange Rating: Class 125 FF	>65 mm Rolled Angle Van Stone Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 R For Flange Adaptor and Van Stone Flange Rating: Class 150 RF
d) Steel: Standard Wt. and Schedule 40	10 - 65 mm Threaded Steel Flange Rating: Class 125 FF >65 mm Steel Flange Rating: Class 125 FF	10 - 65 mm Threaded Steel Flange Rating: Class 150 RF >65 mm Steel Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF
e) Steel: Schedule 80	10 - 65 mm Threaded Steel Flange Rating: Class 125 FF 65 mm Steel Flange Rating: Class 125 FF	10 - 65 mm Threaded Steel Flange Rating: Class 150 RF >65 mm Steel Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF
f) Ductile Iron	>65 Grooved End to Flanged Adaptor Rating: Class 125 FF	>65 Grooved End to Flanged Adaptor Rating: Class 150 RF	
g) Cast Iron	>65 Grooved End to Flanged Adaptor Rating: Class 125 FF	>65 Grooved End to Flanged Adaptor Rating: Class 150 RF	
h) Copper	10 - 65 mm Threaded Copper Flange Rating: Class 125 FF	10 - 65 mm Threaded Copper Flange Rating: Class 150 RF	
i) PVC: Schedule 40	>65 PVC Van Stone Flange Rating: Class 125 FF	>65 PVC Van Stone Flange Rating: Class 150 RF	
j) PVC: Schedule 80	>65 mm PVC Flange (Sch.80) Rating: Class 125 FF	>65 mm PVC Flange (Sch.80) Rating: Class 150 RF	

	Equipment End: Cast Iron Flanged	Equipment End: Steel/Stainless Flanged	Equipment End: Steel/Stainless Plain End
Piping Material	Pipe End Diameter Range		
k) HDPE	Stub End and Ductile Iron Backup Ring Rating: Class 125 FF	Stub End and Steel Backup Ring Rating: Class 150 RF	
	Equipment End: Steel or Stainless Welding End	Equipment End: Fibreglass Flanged	Equipment End: PVC Female Thread
Piping Material	Pipe End Diameter Range		
a) Stainless Steel: Tubing			10 - 65 mm 150 mm SS Threaded Nipple and Union Rating: Class 250
b) Stainless Steel: Gauge & Schedule 10S	Butt Welded (SS Equip. End)	Rolled Angle Van Stone or Lap-Joint Flange, as specified Rating: Class 150 RF	10 - 65 mm Socket Weld Nipple and Union Rating: Class 3000
c) Stainless Steel: Schedule 40S	Butt Welded (SS Equip. End)		10 - 65 mm 150 mm SS Threaded Nipple and Union Rating: Class 250
d) Steel: Standard Wt. and Schedule 40	Butt Welded (Steel Equip. End)		10 - 65 mm 150 mm Galv. Threaded Nipple and Union Rating: Class 250
e) Steel: Schedule 80	Butt Welded (Steel Equip. End)		10 - 65 mm Threaded Nipple and Union Rating: 3000 kPa
f) Ductile Iron g) Cast Iron h) Copper i) PVC: Schedule 40			150 mm PVC Nipple and Union Rating: Schedule 80
j) PVC: Schedule 80			150 mm PVC Nipple and Union Rating: Schedule 80
k) HDPE			

2.13 FITTINGS

- .1 For steel pipelines 75 mm nominal diameter or greater, fittings to conform to ANSI B16.9, ANSI B16.11 or ANSI B16.5. Provide fittings with a wall thickness equal to or greater than the pipe. In steel pipelines less than 75 mm nominal diameter provide threaded malleable iron fittings, conforming to ANSI B16.3.
- .2 Provide long radius steel grooved-joint fittings conforming to ANSI B16.9 in steel grooved-joint pipeline systems. Grooved joint adapters may be welded to fitting ends; dimension and cut the groove of the adapter in accordance with the coupling manufacturer's recommendations; materials and inside diameter to be the same as the pipe; grind the interior weld smooth and meet the lining manufacturer's recommendations.
- .3 For steel grooved-joint pipe of diameters of 150 mm and less, the Contractor may provide ductile iron grooved-joint fittings which have an outside diameter equal to the steel pipe diameter. Provide ductile iron to ASTM A536, dimensioned to 1.5 diameter radius bends, and cut grooving dimensions to AWWA C606 IPS dimensions. The lining and coating of the ductile iron fittings must equal the lining and coating of the steel pipeline system.
- .4 Standard radius elbows to dimensions of ANSI B16.9 may be provided on clean water grooved-joint piping systems only, unless otherwise indicated.
- .5 Provide butt welding fittings in stainless steel pipelines less than 75 mm of the same class as the pipe, conforming to ASTM A403 and ANSI B16.9. Provide socket welding fittings in stainless steel pipelines less than 75 mm nominal diameter to Cl. 3000, same material as the pipe, and ANSI B16.11. Fabricate fittings in stainless steel pipelines equal to or greater than 75 mm in diameter using similar materials and classes as the pipe and conform to ASTM A774.
- .6 Provide fittings in flanged ductile iron pipelines that conform to ANSI B16.1 and in grooved end or mechanical joint ductile iron pipelines to AWWA C110.
- .7 Provide ductile iron fittings in PVC pipelines that conform to AWWA C110 or provide PVC to CSA B137.3, of the same material and class as the pipe.
- .8 Provide fittings in FRP pipelines of the same material and class as the pipe.
- .9 Provide copper fittings in copper pipelines conforming to ANSI B16.26.
- .10 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.
- .11 Provide concentric reducers in vertical lines unless indicated otherwise.
- .12 Provide long radius elbows unless otherwise shown. Provide smooth flow carbon or stainless steel elbows 350 mm and less, to ANSI B16.9. Provide mitered elbows

greater than 350 mm, to AWWA C208 unless otherwise shown or specified. Use three (3) piece construction unless otherwise shown or specified.

2.14 GASKETS

- .1 For flat faced flanges, use full-face gaskets. For raised-face flanges, use ring type gaskets. Conform to ASME B16.20 and B16.21.
- .2 Ring Type:
 - .1 Style CG:
 - .1 Utilizes an external ring which accurately centers gasket on flange face: provides additional radial strength to prevent gasket blowout and acts as a compression stop. A general purpose gasket suitable for use with flat face and raised face flanges.
 - .2 Approved Product:
 - .1 Flexitallic.
- .3 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosivity of the fluid conveyed in the pipeline. Refer to detailed pipe specifications for recommended gasket material. Material designations used in the detailed pipe specification sheets are as follows:
 - .1 EPDM: ethylene-propylene-diene-terpolymer 70 durometer.
 - .2 Bl. Neoprene: neoprene (black) 70 durometer.
 - .3 Nitrile: nitrile (Buna N).
 - .4 SBR: Styrene-butadiene (red).
 - .5 Natural rubber: natural rubber.
 - .6 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400), and neoprene binder: 1.7 MPa (ASTM F152), 0.2 mL/h Leakage Fuel A (ASTM F37).
 - .7 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400) and SBR binder: 1.7 MPa (ASTM F152), 0.1 mL/h Leakage Fuel A (ASTM F37).
 - .8 Gylon - Type 1: Garlock Style 3500, 1.35 MPa (ASTM F152), 0.22 mL/h Leakage Fuel A (ASTM F37).
 - .9 Gylon - Type 2: Garlock Style 3510, 1.35 MPa (ASTM F152), 0.04 mL/h Leakage Fuel A (ASTM F37).
 - .10 CPE - Chlorinated Polyethylene.
- .4 Unless otherwise specified, minimum gasket material thickness for full face gaskets:
 - .1 75 to 250 mm pipe diameter; 1.6 mm thick.
 - .2 Greater than 250 mm pipe diameter; 3.2 mm thick.

- .5 Unless otherwise specified, minimum gasket material thickness for raised face ring gaskets:
 - .1 75 to 100 mm pipe diameter; 1.6 mm thick.
 - .2 Greater than 100 mm pipe diameter; 3.2 mm thick.
- .6 Grooved joint gasket materials to be as recommended by the manufacturer for the service conditions indicated. Unless otherwise specified, provide flush seal type gaskets for all grooved joint systems. Acceptable product: Victaulic Flush-Seal.

2.15 BOLTS AND NUTS

- .1 Provide hex head bolts, nuts and washers. Threads to be ANSI B1.1, standard coarse thread series.
- .2 For general service, use bolts, nuts and washers conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A. For general interior service, use bolts, nuts and washers conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr. A.
- .3 Provide stainless steel bolts, nuts and washers for submerged, buried and concrete encased service; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8. For exposed (exterior), submerged, buried and concrete encased service, provide stainless steel bolts, nuts and washers; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr. 8.
- .4 Provide hot dip galvanized bolts, nuts and washers for use with hot dip galvanized Van Stone flange back-up rings and lap-joint flange back-up rings.
- .5 Provide hex nuts equal to or less than 25 mm. Greater than 25 mm, provide heavy hex.

2.16 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.

2.17 DISSIMILAR METAL CONNECTIONS

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

2.18 CATHODIC PROTECTION

- .1 Provide cathodic protection of piping, pipe fittings and appurtenances where specified.

2.19 HEAT TRACING

- .1 Provide heat tracing for all piping and appurtenances where specified.

2.20 INSULATION

- .1 Provide insulation where specified.

2.21 INTERIOR FINISHES

- .1 Provide products with factory applied coatings and finishes unless otherwise noted. Fittings and pipe of any one pipe system to be lined by the same manufacturer.
- .2 Do not shop coat the internal surface of stainless steel or plastic piping.
- .3 Provide No. 1 or No. 2B standard finish for gauge stainless steel pipe, as specified in ASTM A480. Finish heavier pipe to No. 1 mill finish or better, as specified in ASTM A480.
- .4 Provide asphaltic varnish as the standard finish for ductile iron and cast iron pipe, in accordance with AWWA C151. Do not apply to exterior of pipe which is to be painted.
- .5 Coal Tar Epoxy: where specified, apply coal tar epoxy to the internal surface of piping in accordance with AWWA C210, to a minimum dry film thickness of 350 microns, including interior coating at field-weld joints.
- .6 Cement Mortar Lining: where specified, apply cement mortar lining and an asphaltic seal to the internal surface of ductile iron piping in accordance with AWWA C104; and to the internal surface of steel piping in accordance with AWWA C205.
- .7 Glass Lining:
 - .1 Apply glass lining to pipe interior in two (2) coats.
 - .2 Sandblast interior pipe surfaces prior to lining application to white metal finish in accordance with SSPC-10.
 - .3 After application of first and each subsequent coat, expose to maturation temperature above 750°C.
 - .4 Finished lining to be:
 - .1 200 to 300 microns thick.
 - .2 Density of 2.5 to 3.0 grams per cubic centimetre.
 - .3 Hardness in excess of 5.0 on the MOHS scale.

- .4 Capable of withstanding 175°C thermal shock without crazing, blistering, or spalling.
- .5 No visible loss of surface gloss after immersion in 8% sulphuric acid solution at 65°C for a period of ten (10) minutes.
- .6 No more than 0.05 percent exposure of the base metal due to defects in the glassed surface.
- .5 Provide sample to Departmental Representative for use as a comparison guide.
- .6 Acceptable products modified to meet this specification are:
 - .1 Vitco.
 - .2 Waterworks.
 - .3 Alternate approved by Departmental Representative.
- .8 Epoxy Lining
 - .1 Surface Preparation:
 - .1 Shop primed surfaces: SSPC SP-1 (solvent cleaning). Clean damaged shop coatings to SSPC SP-3 (power tool cleaning) and re-prime.
 - .2 Ferrous Metal: SSPC SP6 (commercial blast cleaning). Clean surfaces to SSPC SP-1 (solvent cleaning) and apply two (2) coats of sealer as recommended by coating manufacturer to 1 mil thickness.
 - .3 Non-Ferrous and galvanized metal: SSPC SP-1 (solvent cleaning).
 - .2 Application
 - .1 Ferrous Metal: primer to be epoxy type compatible with finish coat. Apply as per manufacturer's instructions.
 - .2 Non-Ferrous and galvanized metal: paint with vinyl-acid wash prior to application of primer as per manufacturer's instructions.
 - .3 Apply one (1) coat primer to manufacturer's recommended dft.
 - .4 Apply one (1) or more finish coats to manufacturer's recommended dft.
 - .5 Total system thickness: minimum 250 microns (10mils) dft.

2.22 EXTERIOR FINISHES - SHOP APPLIED

- .1 Provide products with factory applied coatings and finishes as specified in the detailed pipe specification sheets.
- .2 Yellow Jacket:
 - .1 High density polyethylene (HDPE) jacket extruded over a mastic base.
 - .2 Manufacture, test, inspect and report procedures to meet or exceed CAN3-Z299.3 (Quality Assurance Program - Category 3).

.3 Prior to mastic application, sandblast pipe in conformance with requirements of SSPC SP6.

.4 Adhesive consists of a rubberized asphalt mastic, non-hygroscopic, formulated for use with Yellow Jacket. Apply to prepared surfaces in thickness exceeding 0.175 mm.

.5 HDPE to have following minimum properties: Ultimate tensile strength, 21 MPa; Tensile elongation at break, 600 percent; Shore "D" hardness, 60; and Brittleness temperature -50°C.

.6 Apply HDPE by extruding over adhesive in an even thickness to provide a smooth continuous outer sheath, free of pinholes, bubbles, wrinkles, blisters, cracks, or mechanical damage. Minimum HDPE thickness will be as follows:

Nominal Pipe Size (mm)	Minimum HDPE Thickness (mm)
20	0.55
25	0.55
30	0.60
40	0.65
50	0.70
65	0.70
75	0.70
100	0.75
150	0.90
200	1.00

.7 All flaws (up to three (3) per pipe) to be repaired by cutting out each damaged area and applying sealant lined 200 mm diameter patch or heat shrink sleeve not exceeding 400 mm in length. Overlap undamaged area by a minimum of 75 mm around cut out section.

.8 Where the number of flaws or damaged areas per pipe exceeds three (3) or any flaw is too large to be repaired with a patch or sleeve, the pipe will be rejected.

- .3 Tape Wrap: shop applied tape wrap may be used as an alternative to Yellow Jacket. Two (2) or three (3) layer methods can be used, meeting or exceeding the application and performance requirements of AWWA C214.
- .4 Coal Tar Epoxy: apply coal tar epoxy to the exterior of piping in accordance with AWWA C210.

2.23 EXTERIOR FINISHES - FIELD APPLIED

- .1 Use field applied finishes only for: short lengths of metal pipe in a piping system where the length of pipe which requires coating is less than 3.0 m unless otherwise specified; to repair shop-applied exterior finishes; to make up cutback distances at joints; and for fittings, couplings, valves and other appurtenances.
- .2 Tape Wrap:

- .1 For welded joints on Yellow Jacketed pipe and at other indicated locations apply tape to buried pipe and fittings. Use Polyken, Polyguard 600 or Denso Clad consisting of primer and tape applied to minimum thickness of 0.90 mm in accordance with AWWA C209.
- .2 For flanged or coupled joints and for fittings use petrolatum primer, mastic and tape; Tec-Tape or Denso, in accordance with AWWA C217.
- .3 Shrink Sleeve: as an alternative to tape wrap, shrink sleeves are acceptable if material and method of installation is reviewed and accepted by the Departmental Representative prior to use.
- .4 Coal Tar Epoxy: apply coal tar epoxy to the exterior of piping in accordance with AWWA C210.

2.24 GALVANIZING

- .1 Where piping is to be galvanized, hot dip zinc coat to CSA G164 with a minimum coating of 550 g/m².

2.25 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. Tomco, THK.
- .3 For water service, sizes as shown. Acceptable products are:
 - .1 For 25 mm or less nominal diameter hose, two (2) lug, malleable iron, female NPT: Dixon Air King.
 - .2 For 38 mm and 50 mm nominal diameter hose, two (2) four (4) lug, malleable iron, female NPT: New Line Dixon Air King.
 - .3 For 75 and 100 mm nominal diameter or greater; quick-acting, dual clip: Rite-pro, Dixon.

2.26 FLUSHING CONNECTIONS

- .1 Provide flushing connections on all piping for the conveyance of sludge, scum, grit or other liquid containing solids greater than 0.5 percent. Locate flushing connections adjacent to all isolation valves, on dead end branches, at tees and 90 degree elbows, and at intermediate locations which limit the distance between flushing connections to less than 30 m. Show flushing connections on piping submittals.

2.27 PURGE CONNECTIONS

- .1 Provide purge connections on all gas lines. Locate adjacent to both sides of all isolation valves and spectacle flanges, and at any other locations shown in the drawings. Purge points shall be a minimum of 20 mm nominal diameter NPS pipe, fitted with a shut-off valve which shall be capped.

2.28 MECHANICAL BRANCH CONNECTIONS

- .1 Provide mechanical branch connections as required for flushing connections and pipe tappings. Provide branch connection recommended by the manufacturer for the service and pipe installed. Acceptable products are:
 - .1 Gruvlock Clamp T.
 - .2 Ford Service Saddles (F/FS).
 - .3 Victaulic Mechanical T.

2.29 ACCESS DOORS

- .1 Provide access doors to concealed mechanical equipment for operating, inspecting and servicing.
- .2 Flush mounted, 600 x 600 mm size for body entry and 300 x 300 mm for hand entry, unless noted otherwise.
- .3 Doors to open 90° have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .4 Finishes:
 - .1 General: prime coated steel.
 - .2 Special areas such as tiled or marble surfaces: stainless steel.
- .5 Acceptable product: Buensod, Le Hage, Zurn.

2.30 DRAIN VALVES

- .1 Locate at all low points and section isolating valves unless otherwise specified.
- .2 Minimum 50 mm nominal diameter, size unless otherwise specified: straight pattern bronze with hose end male thread and complete with cap and chain.

2.31 DRIVES, GUARDS AND LUBRICATION ACCESSORIES

- .1 Select variable and adjustable pitch sheaves unless otherwise specified.
- .2 Provide motor driven equipment using three (3) or more belts with fixed sheaves.

- .3 Fit reinforced belts in sheave matched to drive. Multiple belts on unit to be matched set.
- .4 Use cast iron or steel sheaves secured to shafts with removable keys.
- .5 Standard adjustable pitch drive sheaves having + 10% range to be used on motors from 0.25 kW to 7.5 kW. Use mid-position of range for specified RPM.
- .6 For drives larger than 7.5 kW, sheaves to be split tapered bushing and keyway having a fixed pitch, unless specifically required for item concerned. Provide sheave of correct size for balancing.
- .7 Minimum drive rating to be 1.5 times nameplate rating of motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .8 Motor slide rail adjustment plates to allow for centerline adjustment.
- .9 Provide guards for exposed drives.
- .10 Guards for drives to have:
 - .1 Expanded metal screen welded to 25 mm steel angle frame.
 - .2 18 Ga. galvanized sheet metal tops and bottoms.
 - .3 Removable sides for servicing.
 - .4 40 mm diameter holes on both shaft centers for insertion of a tachometer.
- .11 Secure guards to driven machine, foundations or floors with heavy angle supports and anchor bolts.
- .12 Do not short circuit vibration isolators.
- .13 Provide means to permit lubrication, use of speed counters, or other maintenance and testing operations, with the guard in place.
- .14 Install belt guards to permit movement of motors for adjusting belt tension.
- .15 For flexible couplings, provide removable "U" shaped guards fabricated from 12 Ga. galvanized steel frame with 18 Ga. expanded mesh face.
- .16 Provide protective screen on both inlet and outlet of exposed fan blades. Screen to be fabricated from 20 mm mesh minimum galvanized expanded metal such that the net free area of openings is not less than 80% of the original opening.
- .17 Provide oil gauges, grease cups, oil cups or grease gun fittings at all points requiring lubrication. Extend all fittings as required to be fully accessible without requiring any disassembly or removal of guards.

2.32 DIELECTRIC COUPLINGS

- .1 Wherever pipes of dissimilar metals are joined.
- .2 Insulating unions for pipe sizes 50 mm and smaller and insulating flanges for pipe sizes larger than 50 mm.

2.33 AIR RELEASE VALVES

- .1 Air release valve suitable for stormwater application (seage type) given the following requirements:
 - .1 Stainless steel materials per AISI Type 304.
 - .2 HDPE material float construction.
 - .3 EPDM rubber for seals.
 - .4 1035 kPa pressure rating.
 - .5 ANSI B16.5 Class 150 flange connection.
- .2 Acceptable manufacturer and model:
 - .1 Vent-o-mat: 150RGX61031

3 Execution

3.1 VALVES AND EQUIPMENT IDENTIFICATION

- .1 Valves and equipment are identified on the drawings.
 - .1 Valves are identified in the following manner:

Symbol	Valve
AR	Air Release Valve
ARV	Air Release/Vacuum Valve
AVV	Air Vacuum Valve (Anti-Siphon)
BA	Ball Valve
BV	Butterfly Valve
CHV	Check Valve
FCV	Flow Control Valve
PV	Plug Valve
SG	Slide/Sluice Gate Valve
PR	Pressure Relief Valve
PLV	Plug Valve
 - .2 Equipment is to be identified in the following manner:

PR.001

Equipment Symbol
Sequence Number

i.e. Pressure relief valve, sequence number1.

Symbol	Equipment
AC	Air Lift Compressor
BF	Back Flow Preventer
BL	Blower
EP	Effluent Pumps
EL	Exhaust Louvre
FD	Floor Drain
FE	Flow Element
FL	Upflow Sand Filter
GD	Gas Detector
GR	Grinder
IL	Intake Louvre
IP	Irrigation Pumps
MD	Motorized Damper
MH	Manhole
MS	Mechanical Screen
MUA	Make-Up Air Unit
MX	Mixer
P	Pump
PD	Pulsation Dampener
PR	Pressure Relief Valve
QC	Quick Connect
RD	Roof Drain
RI	Roof Intake Hood
SG	Slide/Sluice Gate
SL	Stop Log
SN	Screen
SR	Supply Register
SS	Service Sink
SV	Solenoid Valve
TK	Tank
TP	Transfer Pump
UH	Unit Heater
UV	UV Bank

3.2 PIPING INSTALLATION

.1 General:

- .1 Conform to requirements of ANSI/ASME B31 code for pressure piping.
- .2 Install straight, parallel and close to walls and ceilings, with specified pitch. Use standard fittings for direction changes.
- .3 Install groups of piping parallel to each other, spaced to permit application of insulation, identification, and service access, on trapeze hangers.
- .4 Install eccentric reducers in horizontal piping to permit drainage and eliminate air pockets.

- .5 Where pipe sizes differ from connection sizes of equipment, install reducing fittings close to equipment. Reducing bushings are not permitted.
- .6 Install flanged or welded nozzles, branch connections, welding outlets, adapters and taps, true and faced at right angles to the axis of the pipe. Do not extend connection inside of pipe.
- .7 Make pipe ends round and true, suitable for weld connection.
- .8 Prepare pipe ends in accordance with ASME B16.25 for butt welding.
- .9 Copper pipe and tubing to be free from surface damage. Replace damaged pipe or tubing.
- .10 Ream ends of pipe and tubes before being made up.
- .11 Lay copper tubing so that it is not in contact with dissimilar metal and will not be kinked or collapsed.
- .12 Use non-corrosive lubricant or teflon tape applied to male thread only.
- .13 Groove pipe ends, cut square, seating surface clean and free from indent and score marks.
- .14 Install dielectric fittings wherever piping of dissimilar metals are joined.
- .15 Install flanges or unions to permit removal of equipment without disturbing piping systems, as required by piping standard.
- .16 Clean ends of pipes or tubing and recesses of fittings to be brazed or soldered. Assemble joints without binding.
- .17 Support piping during construction to prevent abnormal stresses on the pipe works.
- .18 Install pipe supports where indicated on the drawings or as required.
- .19 Install pipe hangers as required.
- .2 Flanges Bolting to Valves:
 - .1 Do not weld adjacent flanges on butterfly valves when the valve is in place.
 - .2 Remove valve prior to welding.
 - .3 Clean gasket surfaces, flange faces and butt welding connections.
 - .4 Protect connecting surfaces.
- .3 Bolted Connections:
 - .1 Clean pipe ends and gaskets.
 - .2 Lubricate gaskets with soapy water and bolts with thread lubricant.
 - .3 Tighten bolts progressively by crossover method and not in rotation around the joint.
 - .4 Tighten bolts to the torque recommended by the manufacturer.

.5 Use properly sized wrenches for bolt tightening to prevent rounding of nut and bolt heads.

.4 Branch Connections: branch connections to be in accordance with the following for ANSI 150, 300, 600, 900 and 1500 ratings:

		BRANCH									
MAIN	20	25	40	50	65	75	100	150	200	250	
20	T										
25	RT	T									
40	RT	RT	T								
50	C	TH	RT	T							
65	C	RT	RT	RT	T						
75	C	C	C	RT	*RT	T					
100	C	C	C	*W	*RT	RT	T				
150	C	C	C	*W	*RT	W	RT	T			
200	C	C	C	*W	*W	W	W	RT	T		
250	C	C	C	*W	*W	W	W	RT	RT	T	
300	C	C	C	*W	*W	W	W	RT	RT	RT	
350	C	C	C	*W	*W	W	W	RT	RT	RT	
400	C	C	C	*W	*W	W	W	RT	RT	RT	
450	C	C	C	*W	*W	W	W	W	RT	RT	
500	C	C	C	*W	*W	W	W	W	RT	RT	
600	C	C	C	*W	*W	W	W	W	W	W	

		BRANCH				
MAIN	300	350	400	450	500	600
300	T					
350	RT	T				
400	RT	RT	T			
450	RT	RT	RT	T		
500	RT	RT	RT	RT	T	
600	RT	RT	RT	RT	RT	T

Legend:

T	-	Straight Tee
RT	-	Reducing Tee
TH	-	Thredolet
C	-	Coupling
W	-	Weldolet
*		For Class 150 - A1 line class, including A1A and A1B, but not A1C, piping 65 mm size and under to be screwed connections. The branch connections will, therefore, be TH (thredolet).

3.3 VALVES INSTALLATION

.1 Storage of Valves:

- .1 Store valves in cool and clean location, away from moving vehicles or other objects.
- .2 Prevent dirt and debris entering the valve internals.
- .3 Protect the valve seats against painting.
- .4 Store valves with their handwheels, operator shafts and operators in an upright position.
- .2 Handling Valves:
 - .1 Do not place chains, cables and ropes through valve ports or attached to operators or handwheels.
 - .2 Use sling either around valve body or with bolts or rods through the flange holes.
- .3 Installation of Valves:
 - .1 Installation of valves to be by competent personnel and in strict accordance with manufacturer's instructions.
 - .2 Inspect pipe and remove all foreign debris or objects that may prevent closing of valves prior to the installation of any valves.
 - .3 Install butterfly valves with their operating shafts in the vertical position unless otherwise directed by the Departmental Representative.

3.4 PROTECTION OF OPENINGS

- .1 Protect equipment and system openings from dirt, dust and other foreign materials.
- .2 Thoroughly clean piping, ducts and equipment of dirt, cuttings, and other foreign substances prior to being put into operation.

3.5 V-BELT DRIVES

- .1 Tension all belt drives to manufacturer's recommendations before start-up and after first 100 hours of operation, using calibrated belt tensioning gauge.

3.6 EQUIPMENT PIPING CONNECTIONS

- .1 Where equipment connections are a different size from the piping serving it all associated isolating valves and fittings to be the larger pipe size unless specifically indicated otherwise on the drawings. This rule to also apply in the case of control valves.

3.7 EQUIPMENT LUBRICATION

- .1 All equipment placed in operation prior to the completion of the contract to be maintained and adequately lubricated in accordance with the manufacturer's instructions.

- .2 All equipment to be lubricated in accordance with the manufacturer's instructions prior to acceptance of any system.
- .3 Oil level gauges, grease cups and grease fittings for all machinery bearings, etc., to be provided as recommended by the manufacturer. Locate oil level gauges for easy viewing.
- .4 All bearings to be flushed out and refilled with new change of oil prior to final acceptance.
- .5 Protect bearings and shafts during installation. Grease shafts and sheaves to prevent corrosion.

3.8 SLEEVES

- .1 Provide individual metal sleeves for all pipes, tubes or ducts penetrating all walls and floor slabs. Grout tightly in place for full depth of wall or slab.
- .2 Standard sleeves to be 22 Ga. galvanized sheet steel with lock seam joints.
- .3 Use cast iron or steel pipe sleeve with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
- .4 Sizes:
 - .1 Refer to mechanical drawings for details.
 - .2 Provide 6 mm clearance all around, between sleeves and pipe or between sleeve and insulation.
- .5 Terminate sleeves flush with surface of concrete and masonry and above floors.
- .6 For pipes passing through roofs, use cast iron sleeves with caulking recess and flashing clamp device. Anchor sleeves in roof construction; caulk between sleeve recess and pipe; fasten roof flashing to clamp device; make water-tight, durable joint.
- .7 Voids around Pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with oakum and PC-4 caulking compound between sleeve and pipe.
 - .2 Where sleeves pass through walls or floors, caulk space between sleeve and insulation or between sleeve and pipe with dry oakum. Seal space at each end of sleeve with waterproof, fire retardant, non-hardening mastic.
 - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .4 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint.

- .8 Where pipes and ducts pass through walls and floors having a fire separation rating, pack the space with approved caulking material and seal in accordance with CAN/CGSB 19.13-M87.

3.9 ESCUTCHEONS AND PLATES

- .1 Install on pipes passing through finished walls, floors and ceilings.
- .2 Use chrome or nickel plated brass, solid type with set screws for ceiling or wall mount.
- .3 Inside diameter to fit around finished pipe. Outside diameter to cover opening or sleeve.
- .4 Where sleeve extends above finished floor, escutcheons or plates to clear sleeve extension.
- .5 Secure to pipe or finished surface but not to insulation.

3.10 VIBRATION ISOLATION

- .1 Installation:
 - .1 Install vibration isolation equipment in accordance with manufacturer's instructions and adjust mounting to level equipment.
 - .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping and ducting passage through walls and floors do not transmit vibrations.
 - .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
 - .1 Up to 100 mm nominal diameter: first three (3) points of support; 150 mm to 200 mm nominal diameter: first four (4) points of support; 250 mm nominal diameter and larger: first six (6) points of support.
 - .2 First point of support to have static deflection of twice deflection of isolated equipment, but not more than 50 mm.
 - .4 Where isolation is bolted to the floor avoid short circuiting of sound pads by using vibration isolation washers.
 - .5 Block and shim level all bases so that ductwork and piping connections can be made to a rigid system at the operating level before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.11 CUTTING AND PATCHING

- .1 Minimize cutting and patching required. Set sleeves and mark openings in concrete forms and masonry structure prior to the placement of concrete or masonry.

END OF SECTION

1 General

1.1 DESCRIPTION

- .1 This section contains detailed piping and associated manual valve specifications.

1.2 PIPING IDENTIFICATION

- .1 The drawings designate the size and line service specification of pipe to be supplied by the Contractor in the following manner:

.1 Line Identification: Line identification is placed on each line in the following manner:

150 - SW - A1 - C - F - 105

Where:

150	Line Size
SW	Commodity
A1	Piping Line Code
C	Internal Lining
F	External Pipe Coating
1	Plant Component (if required)
05	Line Number (if required)

e.g. 150 mm line size, sanitary waste, steel -1900 kPa rating, internal epoxy lined, external epoxy coated, component 1, line No. 05.

- .2 Commodity Symbols for Service Identification as part of this Contract:

SYMBOL	COMMODITY
SW	Sanitary Waste
DR	Drain
PW	Potable Water
ST	Stormwater

- .3 Line Codes: The following is a description of the general line code classifications. For specifics, refer to the appropriate pipe or line code sheet.

Pipe or Line Codes	Flange Ratings	Basic Material	Maximum Design Pressure	Maximum Design Temp.	Suitable Services
A1	ANSI 150	Steel	1900 kPa	40°C	FE, OF, LW, DR, PE, SE, SW, PW

.2 Special Treatment Code

SYMBOL	DESCRIPTION
(A)	Cement mortar lining
(B)	Internal hot applied coal tar lining
(C)	Internal epoxy lined
(D)	Yellow jacket coated
(E)	External hot applied coal tar lining
(F)	External epoxy coated
(G)	Insulation c/w jacket (high temperature)
(H)	Flexible elastomeric insulation

2 Products

2.1 PIPING

SERVICE: SW	LINE CODE: A1
PRIMARY FLANGE RATING: CLASS 150 ANSI B16.5	DESIGN PRESSURE: 1030 kPa
TEMPERATURE (MAX): 40°C	CORROSION ALLOWANCE: 1.3 mm

ITEM	SIZES	GENERAL DESCRIPTION
Pipe	1050 mm and larger	ASTM A139 Grade B, ASTM A283 Grade D, ASTM A570 Grade 33, or AWWA C200-91 <u>1050 mm nominal size</u> Pipe outside diameter: 1067 mm Minimum wall thickness: 9.5 mm <u>1200 mm nominal size</u> Pipe outside diameter: 1238 mm Minimum wall thickness: 9.5 mm
	650 mm to 900 mm	Steel, ASTM A53 Grade B, or AWWA C200.91 seamless or welded, 9.5 mm wall.
	75 mm to 600 mm	Steel, ASTM A53 Grade B, seamless or welded, standard wall.
	40 mm to 65 mm	Steel, ASTM A53 Grade B, seamless or welded, Sch. 40.
	30 mm or smaller	Steel, ASTM A53 Grade B, seamless or welded, Sch. 80.

SERVICE: SW	LINE CODE: A1
PRIMARY FLANGE RATING: CLASS 150 ANSI B16.5	DESIGN PRESSURE: 1030 kPa
TEMPERATURE (MAX): 40°C	CORROSION ALLOWANCE: 1.3 mm

ITEM	SIZES	GENERAL DESCRIPTION
Fittings	650 mm to 900 mm	Steel, ASTM A234 Grade WPB, butt weld, 9.5 mm wall.
	75 mm to 600 mm	Steel, ASTM A234 Grade WPB, standard weight, butt weld. Dimensions to ANSI B16.9.
	65 mm or smaller	Steel, ASTM A197 Class 300, malleable iron, screwed.
Flanges	650 mm to 900 mm	Steel, AWWA C207 Class D, slip-on, flat faced with serrated finish.
	75 mm to 600 mm	Steel to ANSI B16.5 Class 150, or AWWA C207 Class D, slip-on or weld-neck, raised face.
		Flanges mated to equipment with cast iron flat faced flanges or rubber seated butterfly valves to be flat faced.
		Flanges for use on grooved pipe to be Victaulic Style 741.
NOTE: Flanges attached to fittings to be weld neck type equal in material, dimensions and rating to the Class E flange.		
Bolts	All sizes	ASTM A193 Grade B7 hex head.
Nuts	All sizes	ASTM A194 Grade 2H, hex head semi-finished.
Flange Gaskets	75 mm to 250 mm	Black neoprene, ring type for RF flanges, full face for FF flanges, 2 mm thick.
	300 mm to 450 mm	Black neoprene, ring type for RF flanges, full face for FF flange, 3 mm thick.
	500 mm & larger	Black neoprene, ring type for RF flanges, full face for FF flange, 6 mm thick.

SERVICE: SW	LINE CODE: A1
PRIMARY FLANGE RATING: CLASS 150 ANSI B16.5	DESIGN PRESSURE: 1030 kPa
TEMPERATURE (MAX): 40°C	CORROSION ALLOWANCE: 1.3 mm

ITEM	SIZES	GENERAL DESCRIPTION
Unions	75 mm & larger	Use flanges.
	65 mm & smaller	Class 300, malleable iron, ground joint, bronze to iron seat.
Pipe Couplings	65 mm & smaller	Use unions.
	75 mm & larger	Coupling type complete with harness to be as shown on the drawings and to suit outside diameter of pipe. Flexible couplings to be Dresser Style 38.
Victaulic Couplings	25 mm to 350 mm	Victaulic Style 07, zero flex standard weight, or Victaulic Style 77 standard weight as noted on drawings.
	350 mm to 500 mm	Victaulic AGS Style WO7, zero flex or Victaulic AGS Style W77 standard weight
Victaulic Gasket	All Sizes	Type "E" standard seal ring to AWWA standards.
Thread Compound	As required	Teflon tape.

2.2 FLOW METER

- .1 The existing flow meter in the meter chamber is to be replaced with a new electromagnetic meter.
- .2 Flow meter to be 150 mm internal diameter and designed by the manufacturer for wastewater applications.
- .3 Flow meter to be installed as per the manufacturer's instructions.
- .4 Unless otherwise specified by the manufacturer's written documentation the flow meter will be installed a minimum of 5 pipe diameters downstream and 2 pipe diameters upstream of of any elbow, tee, or valve.

- .5 For additional flow meter information refer to Section 40 91 23 Field Instruments.

3 Execution

- .1 Not Used.

END OF SECTION

1 General

1.1 DESCRIPTION

- .1 This Section specifies requirements for the supply, installation and testing of manually operated process valves used for isolation, manual throttling and bypass, and for specialty valves not requiring electric, hydraulic, pneumatic, and capillary or self-actuation.
- .2 This specification applies to the two check valves and two plug valves in the wet well as well as the three plug valves in the meter chamber.
- .3 For detailed valve information refer to individual material specifications listed in Section 40 20 20 - Detailed Piping Specifications and the data sheets included in Sections 40 20 21.4 - Check Valves and 40 20 21.5 - Plug Valve.
- .4 Comply with the requirements of Division 1 - General Requirements.
- .5 Valve Identification:
 - .1 Process and yard piping valves are identified on the drawings by valve symbols. Refer to the drawings for lists of valve symbols and labels.
 - .2 All the equipment/systems shall be tagged with designations shown on the Process Schematic, P-003.
- .6 Operators
 - .1 Supply valves with standard operators as detailed herein unless otherwise noted.

1.2 REFERENCE STANDARDS

- .1 Where applicable, conform to the following reference standards.
 - .1 American Water Works Association (AWWA):
 - .1 AWWA C500 Metal-Seated Gate Valves.
 - .2 AWWA C504 Rubber Seated Butterfly Valves.
 - .3 AWWA C507 Ball Valves.
 - .4 AWWA C509 Resilient - Seated Gate Valves.
 - .5 AWWA C517 Eccentric Plug Valves.

1.3 SUBMITTALS FOR REVIEW

- .1 Submit the following information in accordance with the requirements of Division 1:
 - .1 Catalogue cuts and/or shop drawings for each type of valve indicating valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.

- .2 A Detailed Valve Specification Sheet or Specialty Valve Data Sheet for all valves. Indicate with check marks where valve supplied meets requirements specified and with written amendments where product differs from the specification.

1.4 SUBMITTALS FOR INFORMATION ONLY

- .1 Submit the following:
 - .1 Operating and Maintenance data for incorporation in operation and maintenance manual, as specified in the Contract Documents. Include complete description of operation together with detailed drawings, a complete list of replacement and repair parts, and parts manufacturer's identifying numbers.
 - .2 Affidavits and registration numbers described below in Quality Assurance.

1.5 QUALITY ASSURANCE

- .1 Where applicable, provide Canadian Registry Number (CRN) designated by the Province of Alberta for each valve type.
- .2 Valves are to be marked in accordance with MSS SP-25.

1.6 SHIPMENT, PROTECTION AND STORAGE

- .1 Deliver valves to site using loading methods that do not damage casings or coatings.
- .2 Clearly tag valves, stating size, type, coatings and mating parts.
- .3 Store on-site until ready for incorporation in the work using methods recommended by manufacturer to prevent damage, undue stresses, or weathering.

2 Products

2.1 GENERAL

- .1 Provide valves of the same type, size range and service from a single manufacturer.
- .2 Provide new, unused valves for the work.
- .3 Valve materials to be free from defects or flaws, with true alignment and bores.
- .4 Unless otherwise indicated, valves shall be the same size as the pipe run in which they are to be installed.
- .5 Clearly mark valve bodies in raised lettering to indicate the valve type, rating, and where applicable, the direction of flow. Conform to MSS SP25.
- .6 Provide padlockable lockout feature on manual isolation and shut-off valves as indicated.

- .7 Valves to open counter-clockwise.

2.2 DRAWINGS

- .1 Process schematics indicate major process valves required for the process to operate as intended.
- .2 Detailed process drawings, process standard drawings and service piping schematics indicate the valves on the process schematics plus other valves required for isolation.
- .3 In pipe runs carrying sludge or scum tap bottom of pipe at low point of runs and install short nipple and valve.
- .4 Provide valves and taps on top of pipe at high point in all liquid pipe runs greater than 60 m length where the change in slope exceeds four (4) percent.

2.3 VALVE ENDS

- .1 In pipe runs less than 65 mm diameter provide valves with female threaded ends, unless indicated otherwise. Threads to conform to ANSI B1.20.1.
- .2 Valves in pipe runs equal to or greater than 65 mm diameter to be flanged unless indicated otherwise.
- .3 For cast iron body valves, drill flanges to Class 125 pattern conforming to ANSI B16.1. For steel body valves, flanges to be Class 150 pattern or Class 300 pattern conforming to ANSI B16.5 or as noted.
- .4 Do not use grooved joint valve ends.
- .5 Use flanged joints for buried and exterior valves. Flanges to be compatible with pipe and jointing technique used.
- .6 Use flanged joints for buried butterfly valves.
- .7 Lug style wafer body valves shall have tapped holes, suitable for the bolt spacing of the pipe flanges placed on either side.
- .8 Wafer body valves shall have positioning holes, suitable for the bolt spacing of the pipe flanges placed on either side.

2.4 MANUAL OPERATORS

- .1 Provide valves with manual operators unless specifically indicated otherwise.
- .2 For hand wheels, clearly show direction of opening in raised lettering and symbols.
- .3 Hand wheel operator diameters to conform to the appropriate AWWA standards.

- .4 Hand wheel diameter to conform to the following:

Nominal Valve Size (mm)	Minimum Hand Wheel Diameter (mm)
12	50
20	50
25	60
38	75
50	85
65	105
75	200
100	250
150	300
200	350
250	400
300	450
350	450
400	550
450	600
500	600
600	600

- .5 Maximum rim pull on a hand wheel not to exceed 300 N when one side of the valve is at test pressure and the other side is at atmospheric pressure. Provide gear operator where a shaft mounted hand wheel would require greater than this force to operate.
- .6 Conform to the following minimum requirements unless different operators are shown in the Drawings, Schedules or these minimum requirements conflict with Section 2.4.5.
- .1 Gate Valves: less than 300 mm, hand wheel, equal to or greater than 300 mm, gear operator.
 - .2 Knife Gate Valves: less than 300 mm, hand wheel, equal to or greater than 300 mm, gear operator.
 - .3 Globe and Needle Valves: less than 200 mm, hand wheel, equal to or greater than 200 mm, gear operator.
 - .4 Plug Valves: less than 300 mm, hand wheel; equal to or greater than 300 mm, gear operator.
- .7 Provide 50 mm square operating nuts.
- .8 Supply stem extensions and valve boxes for buried valves. Provide two (2) operating tees.

- .9 Lever operator lengths to conform to the appropriate AWWA standards.
- .10 Quarter turn lever operators to be perpendicular to the pipe run when the valve is closed.
- .11 Lever operators on ball valves to be two (2)-position. Provide butterfly valves with ten (10) position-latching levers except where used to balance airflows. Where used to balance airflows provide infinite position, screw down levers.
- .12 Maximum pull at the end of the lever arm not to exceed 300 N when one (1) side of the valve is at test pressure and one side is at atmospheric pressure. Provide a gear operator where greater than this force would be required to operate the valve with a lever.
- .13 Conform to the following minimum requirements unless different operators are scheduled or shown in the drawings or these minimum requirements conflict with Section 2.4.12.
 - .1 Ball Valves: less than 150 mm, lever operator, greater than or equal to 150 mm, gear operator.
 - .2 Butterfly Valves: less than 250 mm, lever operator, greater than or equal to 250 mm, gear operator.
- .14 Gear operator to be worm gear type, equipped with a hand wheel and a visual indicator of the valve position. Equip operators with adjustable, self-locking mechanical stop-limiting devices designed to hold the valve in any intermediate position between full open and full closed to prevent over travel of the disc/ball in the open and closed positions. Gear operators to be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.
- .15 Manual operators for butterfly plug and gate valves for buried service to include an AWWA operating nut and be gasketed and grease packed for submerged operation at water pressures to 700 kPa. Operators for exposed service to be gasketed for weatherproof service. Gear boxes to be placed above ground and liquid surfaces.
- .16 Gear and manual operators for submerged service to be permanently lubricated and sealed for operation at water pressures to 700 kPa.
- .17 Provide chain wheel gear operators for manual valves on lines 75 mm and greater, mounted over 2.0 m above the operating floor or platform. Chain wheels to be vertical. Design the operator so that a force of 150 N is sufficient to open the valve when one (1) side of the valve is at test pressure and the other side is at atmospheric pressure. The chain pulley to mesh positively with the chain. Chain to extend from valve operator to operating height 1.2 m above the floor or as directed by the Departmental Representative. Exact dimensions to be field determined. Provide approved chain hooks where required to prevent chain from hanging within traffic paths.

2.5 VALVE STEM EXTENSIONS

- .1 Provide valve stem extensions where:
 - .1 additional clearance is required for pipe insulation,
 - .2 valve operation without the extension is difficult,
 - .3 and in manholes.
- .2 Where angle valve stem extensions are employed, they shall be angle geared. Universal joint types are not permitted.

2.6 PROTECTIVE COATINGS

- .1 Unless specified otherwise, provide valves coated in accordance with standard manufacturer's coating.

2.7 SPARE PARTS

- .1 Provide a list of all spare parts that would be expected to be required under normal conditions for a period of five (5) years. At the Departmental Representative's request, provide a price for these parts.

2.8 BALL CHECK VALVE – BCV

GENERAL						
			OPERATING LIMITS		DESIGN LIMITS	
TYPE OF VALVE	SYMBOL	TYPE OF COMMODITY	PRESSURE (kPag)	TEMP. (°C)	PRESSURE (kPag)	TEMP. (°C)
Check Valve	BCV	Sanitary Waste	0-250	5-30	1030	35
TYPICAL SERVICE						
Ball check valve for wastewater or sewage						
VALVE MATERIALS			VALVE DESCRIPTION			
ITEM	MATERIAL		Reference Document		ANSI 5087A	
Body	Cast Iron		Size Range		75 mm to 600 mm	
Ball	Metal ball coated with NBR rubber		Rating		Class 125	
Seats	Rubber O-ring to Ductile Iron Body		Valve Ends		Flanged, FF	
			Type of Disc		N/A	
			Operator		N/A	
			Actuator		Abrasion Resistant	
			Lining		Epoxy	
			Coating		Epoxy	
NOTES						
ACCEPTABLE PRODUCTS						
	HDL or approved equivalent					

2.9 PLUG VALVE – PLV

GENERAL						
			OPERATING LIMITS		DESIGN LIMITS	
TYPE OF VALVE	SYMBOL	TYPE OF COMMODITY	PRESSURE (kPag)	TEMP. (°C)	PRESSURE (kPag)	TEMP. (°C)
Plug Valve	PLV	Sanitary Waste	0-250	5-30	1030	35
TYPICAL SERVICE						
Plug valve for utility water, stormwater or wastewater						
VALVE MATERIALS			VALVE DESCRIPTION			
ITEM	MATERIAL		Reference Document		MSS SP-078	
Body	Semi-steel		Size Range		75 mm to 600 mm	
Plug	Cast Iron/Ductile Iron (see plug coating)		Rating		Class 150	
Seats	Welded Nickel		Valve Ends		Flanged, FF	
Seals	O-Rings, Buna-N		Type of Plug		Eccentric, port area not less than 100% of pipe area	
Shaft	Steel		Operator		Gearbox suitable for submerged duty and Handwheel	
Bearings	Stainless Steel		Actuator		N/A	
Shut-Off	Bi-directional		Lining		Abrasion Resistant Epoxy	
			Coating		Epoxy	
			Plug Coating		Resilient, Buna-N, chlorosulfonyl polyethylene	
ACCEPTABLE PRODUCTS						
DeZurik Eccentric	Valmatic		Pratt Ballcentric Plug			

3 Execution

3.1 PREPARATION

- .1 Valve and piping arrangement indicated in the drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in piping to allow for discrepancies between valve dimensions shown and those supplied for the work.
- .2 Field measure and check all equipment locations, pipe alignments, and structural installation prior to installation of valves. Ensure that valve locations and orientations

provide suitable access to manual operators and that sufficient space and accessibility is available for pneumatic and electric actuators.

- .3 Where conflicts are identified, inform the Departmental Representative and initiate the necessary piping modifications at no cost to the Owner.
- .4 Valves that have been removed will be disposed of in accordance with direction provided by Departmental Representative.

3.2 VALVE INSTALLATION

- .1 In horizontal pipe runs, other than in locations where space does not permit, mount all valves except for butterfly valves and trunnion ball valves with a vertical operating shaft with the actuator at the top. In no case install a valve with the operator shaft pointing down.
- .2 Mount butterfly valves and trunnion ball valves with shaft in a horizontal orientation.
- .3 Do not over torque bolts to correct for misalignment when joining valves to pipe or fittings.
- .4 Support valves in position using temporary supports until valves are fixed in place.
- .5 Permanently support valves to prevent transmission of loads to adjacent pipe work and/or equipment.
- .6 Where valves are installed in PVC pipe work greater than 100 mm diameter, support valves independently and brace against operating loads and torque to prevent transmission of stresses to adjacent pipe work.
- .7 Generally pipe supports and hangers are not shown unless for indication purposes only.
- .8 Install gate valves in the closed position.
- .9 Install valves that are bubble tight in one direction to seal in a direction opposite to normal flow unless otherwise noted or directed by the Departmental Representative.
- .10 Unless otherwise specified, install single seated plug valves and knife gate valves with the seat downstream. Install at tank connections with seat away from tank. Install on pump discharge and suction lines with seat adjacent to the pump.
- .11 Install all valves in accordance with manufacturer's recommendations.
- .12 Protect valves installed below grade with a shrink sleeve or polyethylene sheath attached to the pipe with tape wrap.

3.3 VALVE TESTING

- .1 Operate valves under simulated and/or real process conditions to ensure operation as intended.
- .2 Valves to be pressure tested in conjunction with the pipes in which the valves are installed.

END OF SECTION

1 General

1.1 UNIFORMITY OF INSTRUMENTS

- .1 All valves specified in this Section to be by the same manufacturer.
- .2 All actuators to be by the same manufacturer.

1.2 REFERENCES

- .1 Reference: CEC C22.1-09.

1.3 DRAWINGS AND DESIGN

- .1 The Drawings are intended to show the major details of the control and instrumentation work but it is the Contractor's responsibility to examine the electrical, mechanical, structural, and architectural drawings before beginning the Work and report to the Departmental Representative any discrepancies or interferences which may occur.
- .2 Control and instrumentation system layouts shown on the Drawings are generally diagrammatic and the locations of equipment are approximate. Exact routing of conduits, cables, wiring, tubing and air headers to be governed by the mechanical, structural, and architectural conditions which prevail.
- .3 The Departmental Representative reserves the right to change the location of any piece of equipment without extra payment therefore, providing only that the change is requested before installation and that the new location is within 1.5 m of the original location.

2 Products

2.1 INSTRUMENTS

- .1 Refer to Instrument Index and Instrument Specification Sheets included in this Section.

3 Execution

3.1 ACCEPTANCE OF WORK

- .1 On completion of the Work, all control and instrument systems to be completed, calibrated, tested, and ready for use, with all equipment operating satisfactorily.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 The Contractor to be responsible for the correct installation and assembly of all items of equipment. Manufacturer's instructions to be carefully read and rigidly adhered to in the installation. Any damage resulting from failure to observe the manufacturer's instructions or as a result of proceeding with the Work without complete knowledge of a particular component, will be the Contractor's responsibility. The Contractor to make good any loss or damage resulting from malpractice.

3.3 COORDINATION OF THE WORK

- .1 Other trades will be installing equipment which may affect the arrangement of tubing, conduits, and equipment. The Contractor to notify other trades of all openings, anchors, hangers or other provisions for the installation of his Work in ample time so that proper provision can be made. Failure to comply with this requirement on the part of the Contractor will not relieve him of the cost of cutting openings, installing brackets, etc., at a later period and subsequent patching.

3.4 MOUNTING OF INSTRUMENTS, CONTROLS AND ACCESSORIES

- .1 Instruments to be installed in accordance with the Drawings. Instruments shall be rigidly supported, level and plumb, and in such a manner as to provide accessibility, protection from damage, isolation from heat, shock and vibration, and freedom from interference with other equipment, piping and electrical work.
- .2 Instruments not to be installed until heavy construction Work adjacent to the instruments has been completed, the building envelope is closed, and the temperature controlled.
- .3 Instrument devices including accessories to be located where they will be accessible from structural platforms, permanent ladders, or grade. Locally mounted indicating instruments to face toward, and within reading distance of a normal operating area.
- .4 Sufficient clearance to be allowed for removal of equipment such as level displacers and floats, rotameter floats, control valve diaphragms and plugs.
- .5 Field located items of instrumentation to be mounted on building columns and walls where such building columns or walls are accessible. Pipe stands and/or other means of support to be provided where the mounting on columns or walls is not practical.

3.5 CLEAN-UP

- .1 On completion of his Work, the Contractor to remove debris from the Site, repair any damage done by himself to the Work of others and leave his own installation in a clean and neat condition to the satisfaction of the Departmental Representative.
- .2 In the event that a final inspection cannot be completed because of an excessive deficiency list or that the plant cannot be placed into continuous operation because of deficient or defective Work, the Contractor may be charged by the Departmental

Representative for the additional engineering services, re-inspection and later start-up assistance.

3.6 PAINTING

- .1 Painted surfaces on material supplied or installed under this Contract which are damaged in any way, i.e., by welding, scraping, cutting, delivery, etc., to be thoroughly cleaned, primed with a rust inhibiting primer and repainted to the original colour unless directed otherwise by the Departmental Representative. The finished job to meet or exceed the original painting Specification.

3.7 CABLE, CONDUIT AND CONDUCTOR INSTALLATION

- .1 Refer to Division 26 for conduit and conductor installation and precautions during construction.

INSTRUMENT CALIBRATION RECORD					
Instrument Tag:		Description:			
Service:		Location:			
Make:		Model:			
Instrument Range:		Instrument Span:			
Input Signal: _		Output Signal: _			
INPUT SIGNAL		OUTPUT SIGNAL			
		Before Calibration		After Calibration	
Engineering Units	% Scale	Output	% Error	Output	% Error
	0%				
	25%				
	50%				
	75%				
	100%				
	75%				
	50%				
	25%				
	0%				
<div style="margin-bottom: 10px;">Settings:</div> <div style="margin-bottom: 10px;">Calibrated By: (sign)(print)</div> <div style="margin-bottom: 10px;">Company:</div> <div style="margin-bottom: 10px;">Date:</div> <div>Notes:</div>					

END OF SECTION