PART 1 - GENERAL

1.1 GENERAL

.1 This Section describes the pipe materials, fittings, appurtenances, installation and testing of the process mechanical systems.

.2 This Section is to be read in conjunction with the provided bidder information. Provide the design of piping supports, pipe guides, expansion joints and details and structural attachments shown on the Drawings indicate the level of quality that will be considered acceptable.

.3 The Project will be comprised of a variety of process piping. It is the Contractor's responsibility to assess and evaluate the provided Bid information (e.g. process and instrumentation drawings, process control narrative) and size and select the appropriate pipe work equipment for each respective application. The Contractor must provide design justification (i.e. process calculation) for choice.

.4 The Contractor shall provide the necessary submittals and ensure the proper registration of piping systems and system components as required by authorities having jurisdiction, AWWA, API and ASME requirements.

.5 Four piping systems designed to contain radioactive fluids, the system shall be:

.1 Designed for Drainage.

.2 Designed to avoid siphoning radioactive fluids out of shielded areas.

.3 Designed to minimize hold-up of liquids and entrained solids.

.4 Designed for flushing or rinsing to remove residual radioactive materials.

1.2 MEASUREMENT AND PAYMENT

.1 Payment for provision of all items specified in this Section shall be by Lot Price. No separate payment will be made for work specified in the Contract Documents. All costs incurred by Contractor in meeting with the requirements of this Section shall be included in the bid price for the Work.

1.3 DEFINITIONS AND INTERPRETATIONS

.1 Pressure terms used in this and other related sections are defined as follows:

1.3 DEFINITIONS AND INTERPRETATIONS (Cont'd)

.1 (Cont'd)
- .1 Operating Limits: The minimum and maximum pressure at which the piping system operates for sustained periods of time.
- .2 Test pressure: The hydrostatic pressure used to determine system compliance.

.2 Unless otherwise specified or shown, the interface between piped commodities common to process/mechanical and yard piping is below grade and 0.45 m from the exterior face of a building or tunnel wall.

.3 Pipe and appurtenance location terms used in this and other related sections are defined as:
- .1 Tunnels, Pumphouse and Buildings: Within an environmentally controlled enclosure where temperature is maintained above 5 degrees Celsius.
- .2 Exposed, Aboveground: Outside or within an enclosure which is not environmentally controlled so that the temperature is maintained above 5 degrees Celsius. For the purpose of defining exterior protection systems, this definition is extended to vertical piping to a point of 0.5 m below finished ground level.
- .3 Underground (or buried): Placed in soil and not tied to structures.
- .4 Below Structures: Below concrete slabs such as tanks, channels, buildings, pipe chases, foundation slabs, etc., but not including roadways or walkway structures.
- .5 Submerged: Regularly or occasionally immersed in liquid; inside tanks and/or channels, and within 3.0 m above maximum water level of open tankage. Includes pipe and appurtenances within manholes, vaults and chambers.

1.4 REFERENCE STANDARDS

.1 American Petroleum Institute (API):
- .1 API STD 609-09, Butterfly Valves, Double Flanged, Lug and Wafer-Type.

.2 American Society of Mechanical Engineers (ASME):
- .1 ASME A13.1-07, Scheme for the Identification of Piping Systems.
- .2 ASME B1.20.1-06, Pipe Threads, General Purpose.
- .3 ASME B16.1-10, Gray Iron Pipe Flanges and Flanged Fittings, Classes 25, 125, and 250.

1.4 REFERENCE STANDARDS (Cont'd)

.2 (Cont'd)

.4 ASME B16.3-11, Malleable Iron Threaded Fittings Class 150 and 300.

.5 ASME B16.5-09, Pipe Flanges and Flanged Fittings NPS ½ through NPS 24 Metric/Inch Standard.

.6 ANSI/ASME B16.9, Factory-Made Wrought Steel Butt Welding Fittings.

.7 ASME B16.10-09, Face-to-Face and End-to-End Dimensions of Valves ***Addenda Service No Longer Issued***.

.8 ASME B16.11-11, Forged Steel Fittings, Socket Welding and Threaded.

.9 ASME B16.12-09, Cast Iron Threaded Drainage Fittings.

.10 ASME B16.15-11, Cast Copper Alloy Threaded Fittings, Classes 125 and 250 ***Includes Interpretations through 2011***.

.11 ASME B16.18-12, Cast Copper Alloy Solder Joint Pressure Fittings.

.12 ASME B16.22-01, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.13 ASME B16.26-11, Cast Copper Alloy Fittings for Flared Copper Tubes.

.14 ASME B31.1-12, Power Piping ***Includes Interpretation Volume 46***.

.15 ASME B31.3-10, Process Piping.

.16 ASME B31.9-11, Building Services Piping.

.17 ASME B36.10M-04, Welded and Seamless Wrought Steel Pipe.

.18 ASME B36.19M-04, Stainless Steel Pipe.

.19 ASME BPVC IX-10, Sectio IX - Qualification Standard for Welding and Brazing Procedures, Welders, Brazers and Welding and Brazing Operators ***Includes Interpretation Vol 61***.

.3 American Water Works Association (AWWA):

.1 AWWA C105/A21.5-010, Polyethylene Encasement for Ductile-Iron Piping Systems.

.2 AWWA C110/A21.10, Ductile-Iron and Gray-Iron Fittings.

.3 AWWA C111A21.11-07, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 AWWA C115/A21.15-11, Flanged Ductile-Iron with Ductile-Iron or Grey-Iron Threaded Flanges.

.5 AWWA C151/A21.51-09, Ductile-Iron Pipe, Centrifugally Cast.

.6 AWWA C200-05, Standard for Steel Water Pipe, 6 inch (150 mm) and Larger.

1.4 REFERENCE STANDARDS (Cont'd)

.3 (Cont'd)

.7 AWWA C203-08, Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.

.8 AWWA C205-12, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch (100 mm) and Larger -Shop Applied.

.9 AWWA C206-11, Field Welding of Steel Water Pipe.

.10 AWWA C207-07, Steel Pipe Flanges for Waterworks Services - Sizes 4 inch (100 mm) Through 144 inch (3600 mm).

.11 AWWA C208-07, Dimensions for Fabricated Steel Water Pipe Fittings.

.12 AWWA C209-06, Cold-Applied Tape Coating for Special Sections, Connections, and Fittings for Steel Water Pipelines.

.13 AWWA C210-07, Liquid Epoxy Coating System for the Interior and Exterior of Steel Water Pipe.

.14 AWWA C214-07, Tape Coating Systems for the Exterior of Steel Water Pipelines.

.15 AWWA C219-11, Bolted, Sleeve-Type Couplings for Plain End Pipe.

.16 AWWA C301-07, Prestressed Concrete Pressure Pipe, Steel Cylinder Type.

.17 AWWA C303-08, Concrete Pressure Pipe Bar-Wrapped - Steel Cylinder Type,.

.18 AWWA C508-11, Swing-Check Valves for Waterworks Services, 2 inch (50 mm) through 24 inch (600 mm) NPS.

.19 AWWA C600-10, Installation of Ductile-Iron Water Mains and their Appurtenances.

.20 AWWA C606-11, Grooved and Shouldered Joints.

.21 AWWA C651-05, Disinfecting Water Mains.

.22 AWWA C900-08, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 inch (100 mm) through 12 inch (300 mm), for Water Transmission and Distribution.

.23 AWWA C906-07, Polyethylene (PE) Pressure Pipe and Fittings 4 Inches (100 mm) through 63 Inches (1600 mm), for Water Distribution and Transmission.

.24 AWWA M11-04, Steel Pipe - A Guide for Design and Installation.

.4 American Society for Testing and Materials (ASTM):

.1 ASTM A47/A47M-09, Standard Specification fpr Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless.

1.4 REFERENCE STANDARDS (Cont'd)

.4 (Cont'd)

.3 ASTM A74-09, Standard Specification for Cast Iron Soil Pipe and Fittings.

.4 ASTM A105/A105M-11a, Standard Specification for Carbon Steel Forgings,, for Piping Applications.

.5 ASTM A106/A106M-11, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service.

.6 ASTM A126-04, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

.7 ASTM A135/A135M-09, Standard Specification for Electric-Resistance-Welded Steel Pipe.

.8 ASTM A139/A139M-04, Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and Over).

.9 ASTM A167-99, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.

.10 ASTM A181/A181M-12, Standard Specification for Carbon Steel Forgings for General Purpose Piping.

.11 ASTM A182/A182M-12, Standard Specification for Forged or Rolled Alloy-Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.

.12 ASTM A193/A193M-12A, Standard Specification for Alloy Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.

.13 ASTM A194/A194M-12, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure and High Temperature Service or Both.

.14 ASTM A197/A197M-00, Standard Specification for Cupola Malleable Iron.

.15 ASTM A234/A234M-11A, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperatures Service.

.16 ASTM A240/A240M-12, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet and Strip for Pressure Vessels and General Applications.

.17 ASTM A269-10, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.18 ASTM A276-10, Standard Specification for Stainless Steel Bars and Shapes.

1.4 REFERENCE STANDARDS (Cont'd)

.4 (Cont'd)

.19 ASTM A285/A285M-12, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength.

.20 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength.

.21 ASTM A312/A312M-12, Standard Specification for Seamless, Welded and Heavily Cold Worked Austenitic Stainless Steel Pipe.

.22 ASTM A320/A320M-11A, Standard Specification for Alloy Steel and Stainless Steel Bolting for Low-Temperature Service.

.23 ASTM A351/A351M-12, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

.24 ASTM A380-06, Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.

.25 ASTM A395/A395M-99, Standard Specification for Ferritic Ductile Iron, Pressure-Retaining Castings for Use at Elevated Temperatures.

.26 ASTM A403/A403M-12, Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings.

.27 ASTM A409/A409M-09, Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High Temperature Service.

.28 ASTM A480/A480M-12, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

.29 ASTM A536-84, Standard Specification for Ductile Iron Castings.

.30 ASTM A563-07A, Standard Specification for Carbon and Alloy Steel Nuts.

.31 ASTM A1011/A1011M-12, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High Strength Low-Alloy with Formability, and Ultra-High Strength.

.32 ASTM A743/A743M-06, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Applications.

1.4 REFERENCE STANDARDS (Cont'd)

.4 (Cont'd)

.33 ASTM A774/A774M-09, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

.34 ASTM A778-01, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

.35 ASTM A967-05, Standard Specification for Chemical Passivation Treatment for Stainless Steel Parts.

.36 ASTM B32-08, Standard Specification for Solder Metal.

.37 ASTM B62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.

.38 ASTM B85/B85M-10, Standard Specification for Aluminum Alloy Die Castings.

.39 ASTM B88-09, Standard Specification for Seamless Copper Water Tube.

.40 ASTM B152/B152M-09, Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar.

.41 ASTM B564-11, Standard Specification for Nickel Alloy Forgings.

.42 ASTM C76-12, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

.43 ASTM C564-11, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.44 ASTM D638-10, Standard Test Method for Tensile Properties of Plastics.

.45 ASTM D792-08, Standard Test Methods for Specific Gravity and Density of Plastics by Displacement.

.46 ASTM D1248-12, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.

.47 ASTM D1457-92, PTFE Granular Moulding and RAM Extrusion Materials.

.48 ASTM D1599-99, Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing and Fittings.

.49 ASTM D1784-11, Standard Specification for Rigid PVC Compounds and Chlorinated PVC (CPVC) Compounds.

.50 ASTM D1785-12, Standard Specification for PVC Plastic Pipe, Schedules 40, 80, and 120.

.51 ASTM D2105-01, Standard Test Method for Longitudinal Tensile Properties of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Tube.

1.4 REFERENCE STANDARDS (Cont'd)

.4 (Cont'd)

.52 ASTM D2241-09, Standard Specification for PVC Pressure-Rated Plastic Pipe (SDR Series).

.53 ASTM D2412-11, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.

.54 ASTM D2466-06, Standard Specification for PVC Plastic Pipe Fittings, Schedule 40.

.55 ASTM D2467-06, Standard Specification for PVC Plastic Pipe Fittings, Schedule 80.

.56 ASTM D2513-12A, Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings.

.57 ASTM D2529-74,Bursting Strength/ Paperboard and Linerboard.

.58 ASTM D2564-04, Standard Specification for Solvent Cements for PVC Plastic Piping Systems.

.59 ASTM D2657-07, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.

.60 ASTM D2665-12, Standard Specification for Polyvinyl Chloride (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.

.61 ASTM D2774-12, Standard Practice for Underground Installation of Thermoplastic Pressure Piping.

.62 ASTM D2996-01, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fibre-Reinforced Thermosetting-Resin) Pipe.

.63 ASTM D3212-07, Standard Specification for Joints for Drain and Sewer Plastic Pipes using Flexible Elastomeric Seals.

.64 ASTM D3261-10A, Standard Specification for Butt Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing.

.65 ASTM D3350-12, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.

.66 ASTM D4024-12, Standard Specification for Machine Made "Fibreglass" (Glass-Fibre-Reinforced Thermosetting Resin) Flanges.

.67 ASTM D4101-11, Standard Specification for PolyPropylene Plastic Injection and Extrusion Materials.

.68 ASTM D4174-89, Standard Specification for Cleaning, Flushing, and Purification of Petroleum Fluid Hydraulic Systems.

.69 ASTM F441/F441M-09, Standard Specification for Chlorinated Poly (Vinyl Chloride)(CPVC)Plastic Pipe, Schedules 40 and 80.

1.4 REFERENCE STANDARDS (Cont'd)

.4 (Cont'd)
.70 ASTM F477-10, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
.71 ASTM F714-12, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on outside Diameter.
.72 ASTM F894-07, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

.5 Canadian Standards Association (CSA):
.1 CGA, Canadian Gas Association Standards.
.2 CAN/CSA B70, Cast Iron Soil Pipe, Fittings, and Means of Joining.
.3 CSA B105-93M - Code for Digester Gas and Landfill Gas Installations.
.4 CSA B139-8, Installation Code for Oil Burning Equipment.
.5 CSA B149.1-14, Natural Gas and Propane Installation Code.
.6 CSA B137Series-4, Thermoplastic Pressure Piping Compedium.
.7 CSA B1800-4, Thermoplastic Nonpressure Piping Compedium.
.8 CSA B52-05, Mechanical Refrigeration Code.
.9 CSA G40.21-87 Structural Quality Steels.
.10 CSA W59-03 Welded Steel Construction (Metal Arc Welding).
.11 CSA Z299.3-85, Quality Assurance Program-Category 3.

.6 Cast Iron Soil Pipe Institute:
.1 CISPI 301-09, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and vent Piping Applications.

.7 CPC, Canadian Plumbing Code.

.8 Expansion Joint Manufacturers Association, EJMA STDS-09, Edition No. 9.

.9 Fluid Sealing Association Technical Handbook, Rubber Expansion Joint Division.

.10 Military and Federal Specifications and Standards:
.1 MIL-H-13528-B, Hydrochloric Acid, Inhibited, Rust Removing.
.2 MIL-S-8660C, Silicone Compound Nato Code Number S-736.
.3 MIL-STD-810G, Environmental Engineering Considerations and Laboratory Test Methods.

1.4 REFERENCE STANDARDS (Cont'd)

.11 Manufacturers Standardization Society:
- .1 MSS SP-25-08, Standard Marking System for Valves, Fittings, Flanges and Unions.
- .2 MSS SP-42-09, Corrosion Resistant Gate, Globe, Angle and Check Valves with Flanged and Butt Weld Ends (Classes 150, 300 & 600).
- .3 MSS SP-43-08, Wrought and Fabricated Butt-Welding Fittings for Low Pressure, Corrosion Resistant Applications.
- .4 MSS SP-67-11, Butterfly Valves.
- .5 MSS SP-70-11, Gray Iron Gate Valves, Flanged and Threaded Ends.
- .6 MSS SP-71-11, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- .7 MSS SP-72-A, Ball Valves with Flanged or Butt-Welding Ends for General Service.
- .8 MSS SP-78-11, Gray Iron Plug Valves, Flanged and Threaded Ends.
- .9 MSS SP-80-08, Bronze Gate, Globe, Angle and Check Valves.
- .10 MSS SP-81-06A, Stainless Steel, Bonnetless, Flanged, Knife Gate Valves.
- .11 MSS SP-85-11, Gray Iron Globe and Angle Valves, Flanged and Threaded Ends.
- .12 MSS SP-88-10, Diaphragm Type Valves.
- .13 MSS SP-99-10, Instrument Valves.
- .14 MSS SP-108-12, Resilient-Seated Cast Iron - Eccentric Plug Valves.
- .15 MSS SP-110-10, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- .16 MSS SP-118-07, Compact Steel Globe Check Valves Flanged, Flangeless, Threaded & Welding Ends.
- .17 MSS SP-122-12, Plastic Industrial Ball Valves.

.12 National Association of Corrosion Engineers International:
- .1 NACE SP0178-2007, Fabrication Details, Surface Finish Requirements, and Proper Design Considerations for Tanks and Vessels to be lined for Immersion Service***Includes Weld Replica & Standard***.

.13 Society of Automotive Engineers:
- .1 SAE J1227-2013, Assessing Cleanliness of Hydraulic Fluid Power Components and Systems.

.14 Society for Protective Coatings (SSPC):
- .1 SSPC-SP3-82 Power Tool Cleaning.
- .2 SSPC-QP3-10 Certification Standard for Shop Application of Complex Protective Coating System.

1.4 REFERENCE STANDARDS (Cont'd)

.14 (Cont'd)

.3 SSPC PA Guide 3-82 Guide to Maintenance Repainting with Oil Base or Alkyd Painting Systems.

.4 SSPC-SP6-07/NACE No. 3-94, Commercial Blast Cleaning.

.5 SSPC-SP10-07/NACE No. 2-94, Near-White Metal Blast Cleaning.

.15 Plastics Pipe Institute's PPI Handbook of Polyethylene Piping, chapter 7 "Underground Installation of PE Piping" and chapter 5 "Specifications, Test Methods and Codes for Polyethylene".

.16 MP-9.2 Porcelain Enamel Continuity Testing Procedure.

1.5 SUBMITTALS

.1 For each piping system, submit documentation listing pipe, fittings, flexible connectors, expansion joints, linings, coatings, and valving to be used for each pipe size and category.

.2 Radiographic Weld Testing: Submit the name and qualifications of at least two independent firms for the radiographic weld testing to be undertaken by the Contractor if and as required by the applicable Code. The selected firm will be subject to the review and acceptance of the Departmental Representative.

.3 A copy of this Specification Section and all referenced sections with each paragraph check marked to show compliance or highlighted to indicate deviation.

.4 Submit copies of all original submittals and all related correspondence made as part of the regulatory submission required by all regulatory authorities.

.5 Product Samples: Where specified or when directed by the Departmental Representative, provide mill test results or product samples.

.6 Provide hanger, guide, anchor, support system design details including locations, load information, design calculations and illustrative drawings, stamped and signed by a Professional Engineer.

1.5 SUBMITTALS (Cont'd)

.7 For expansion joints submit Manufacturer's catalogue 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 pre-compression, stamped and signed by a Professional Engineer.

.8 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. Written procedures will be stamped and sealed by a Professional Engineer and qualified for welding design. For stainless steel welds exposed to process fluids, the weld procedure shall provide for maximizing the corrosion resistance of the final weld as well as providing the mechanical strength required.

.9 Radiographic weld test results.

.10 Prior to the commencement of welding, submit current and complete documentation of the welder's qualifications.

1.6 COORDINATION

.1 Process and Utility Piping Identification.

.2 Process and utility piping is identified in the drawings by a two component alpha-numeric code, (Line Label) as follows:
- .1 The first component of the code indicates the nominal line size.
- .2 The second component of the code identifies the process fluid being conveyed, (Commodity).
- .3 The process fluid (Commodity) codes are defined in the drawings.

.3 Routing: Coordinate piping installation routes and elevations with installation of sheet metal, process equipment, heating, ventilation, and air conditioning (HVAC), instrumentation, and electrical work.

.4 Pipe Sleeves: Coordinate with other divisions, prior to construction, to locate and place sleeves in cast-in-place concrete. Also, prior to construction of masonry building elements.

1.6 COORDINATION (Cont'd)

.5 Coordinate with Division 26 and Section 40 90 00 to provide correct piping configuration for primary instrumentation elements.

1.7 QUALITY ASSURANCE

.1 Welding Certification:

.1 All welders to be certified under the AWS or BS Code or Practice and API Pressure Vessels Safety Act and Regulations.

.2 All welders who work on this project shall provide the correct documentation.

.3 Welders working on stainless steel piping shall not work on welding of any other material.

.4 Tools used for stainless steel piping welding shall be new and marked for this use. These tools shall not be used for any other work. Tools shall not be made of materials that could contaminate the stainless steel surface.

.2 Weld Tests:

.1 All piping welds shall be 100% visually inspected by a registered inspector and any imperfections shall be made good as required by the applicable Code and to the satisfaction of the Departmental Representative.

.2 For piping required by the applicable Code to be subject to radiographic inspection, or for welds not found satisfactory during the Departmental Representative's visual inspection provide for one (1) full circumference radiographic inspection for every twenty (20) welded pipe-to-pipe and pipe-to-fitting joints. All sizes and types of pipe welds to be tested at locations identified by the Departmental Representative.

.3 Contractor to provide for one (1) full circumference radiographic inspection for every twenty (20) welded pipe-to-pipe and pipe-to-fitting joints. All sizes and types of pipe welds to be tested at locations identified by the Departmental Representative.

.4 Have radiographic test firm evaluate welds in accordance with ANSI/ASME B31.3 Process Piping Code Normal Service and prepare report summarizing results.

.5 Have radiographic weld test report, complete with results, submitted directly to Departmental Representative.

1.7 QUALITY ASSURANCE (Cont'd)

.2 (Cont'd)

.6 For each defective weld, three (3) additional radiographic inspections at locations identified by the Departmental Representative, will be required plus a radiograph of the repair.

.3 Regulatory Submissions:

.1 Complete all other submissions as by required other regulatory authorities.

1.8 CONFLICTS

.1 Review the Drawings prior to installation of piping, conduit services, and fixtures by this or any other Division. Identify any conflicts and cooperate with the Departmental Representative to determine the adjustments necessary to resolve these conflicts.

.2 Confirm the routing of each section of pipework with other services prior to commencement of installation. Advise the Departmental Representative of any conflicts with existing services or services yet to be installed. Where necessary, amend the routing of pipework to avoid conflict and confirm with the Departmental Representative.

1.9 SHIPMENT, PROTECTION AND STORAGE

.1 Deliver pipe, fittings, and specials to site using loading methods which do not damage pipe or coatings.

.2 Piping materials delivered to site will be clearly marked to indicate size, type, class/schedule and coatings.

.3 Until ready for incorporation in the Works, store on site as recommended by the piping materials manufacturer to prevent damage, undue stresses, or weathering.

.4 Store materials at least 200 mm above ground with sufficient supports to prevent undue bending.

.5 Protect non-ultraviolet (UV) light inhibited plastic from sunlight.

.6 Ship pipe expansion joints, anchors, guides and flexible connectors pre-assembled to the degree which is practical.

1.9 SHIPMENT, PROTECTION AND STORAGE (Cont'd)

.7 Provide shipping devices to maintain the face-to-face dimension of each expansion joint during shipment, storage and installation. Design and place shipping devices so as not to inhibit installation of the joints.

PART 2 - PRODUCTS

2.1 GENERAL

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

2.2 PIPE MATERIALS GENERAL

.1 Contractors to provide either stainless steel 316L Schedule 40 (ERW) or carbon steel (ERW)schedule 40 (Epoxy coated).

.2 All pipe materials to be new, free from defects and conforming to the reference standards identified.

.3 Where any standard referenced has been superseded prior to tender, the contractor shall comply with the new standard.

2.3 PIPE SIZES

.1 Specify pipe size for every service.

2.4 FITTINGS

.1 General:

.1 Provide eccentric reducers in horizontal lines with the flat side on top, unless shown otherwise.

.2 Provide concentric reducers in vertical lines unless indicated otherwise.

.3 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 3 piece construction unless otherwise shown or specified.

.4 Provide fittings in concrete cylinder pipe fabricated from metal plate, cement lined and coated, and in accordance with AWWA C301. Dimensions to AWWA C208.

.2 Steel Pipelines:

2.4 FITTINGS (Cont'd)

.2 (Cont'd)
.1 75 mm in diameter or greater: 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.
.2 Less than 75 mm in diameter: provide threaded malleable iron fittings, conforming to ANSI B16.3.
.3 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.
.4 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 shall equal the lining and coating of the steel pipeline system.
.5 Standard radius elbows to dimensions of ANSI B16.5 may be provided on clean water grooved-joint piping systems only.

.3 Stainless Steel Pipelines:
.1 Less than 75 mm diameter: Provide fittings of the same class as the pipe, conforming to ASTM A403 and ANSI B16.11.
.2 Equal to or greater than 75 mm diameter: Fabricate fittings using similar materials and classes as the pipe and conform to ASTM A774 (scale removed).

.4 Ductile Iron Pipelines:
.1 For flanged piping systems, provide fittings that conform to ANSI B16.1 and in grooved end or mechanical joint ductile iron pipelines to AWWA C110.

2.4 FITTINGS (Cont'd)

.4 (Cont'd)
.2 For ductile iron grooved-joint pipelines, provide ductile iron grooved-joint fittings which have an outside diameter equal to the 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 pipeline system.

.5 PVC Pipelines:
.1 Provide ductile iron fittings that conform to AWWA C110 or provide PVC to CSA B137.3, of the same material and class as the pipe.

.6 Fibreglass Reinforced Polymer (FRP) Pipelines:
.1 Provide fittings of the same material and class as the pipe.
.2 Provide adhesive kits suitable for the selected FRP material.
.3 Provide a UV resistant barrier or gelcoat to protect outdoors and exposed piping from UV degradation.

.7 Copper Pipelines:
.1 Provide copper fittings in conforming to ANSI B16.26.
.2 Couplings for copper connection system shall be manufactured from ductile iron conforming to ASTM A536.

.8 Polyethylene Pipelines:
.1 Provide fittings in the same material and class as the pipe.
.2 Thermal butt fusion joints to ASTM D2774.

.9 Buried Pipeline:
.1 For buried piping and piping inside carrier pipes, refer to Division 2.

2.5 GROOVED PIPING SYSTEM - IPS CARBON STEEL

.1 General:
.1 All grooved components shall be of one manufacture and approved for use by the authorities, agencies, codes and standards named in the specifications.
.2 All manufacturers shall be certified to ISO 9001 standards.

.2 Grooved Couplings:

2.5 GROOVED PIPING SYSTEM - IPS CARBON STEEL (Cont'd)

.2 (Cont'd)
.1 Grooved Couplings shall be manufactured from ductile iron conforming to ASTM A536.
.2 All grooved couplings to be designed with angle pads to provide a rigid joint unless otherwise noted.
.3 Where expansion/contraction or Angular Deflection is designed into pipe system flexible couplings shall be used.

.3 Grooved Fittings: All grooved fittings to be manufactured from ductile iron conforming to ASTM A536, forged steel conforming to ASTM A234 or carbon steel conforming to ASTM A53.

.4 Bolted Mechanical Branch Connections: Branch connections may be provided by bolted, mechanical branch connections manufactured from ductile iron conforming to ASTM A536 complete with synthetic rubber gaskets approved for line service.

.5 Flange Adapters: For connection to ANSI Class 125/150 or Class 250/300 flanged components, grooved flange adapters manufactured from ductile iron conforming to ASTM A536 or malleable iron conforming to ASTM A47 may be used.

.6 Noise and Vibration Attenuation: Where it is necessary to suppress noise or vibrations in piping system, three Victaulic Flexible Grooved couplings may be installed in close proximity to the source of noise/vibration in lieu of Elastomeric Flexible "Arch Type" connectors or Flexible Metal Hose connectors.

2.6 GROOVED PIPING SYSTEM - STAINLESS STEEL

.1 General:
.1 All grooved components shall be of one manufacture and approved for use by the authorities, agencies, codes and standards named in the specifications.
.2 All approved manufacturers shall be certified to ISO 9001 standards.

.2 Grooved Couplings:
.1 Grooved Couplings shall be manufactured from Stainless Steel conforming to ASTM A351, ASTM A743 or ASTM A744.

2.6 GROOVED PIPING SYSTEM - STAINLESS STEEL (Cont'd)

.2 (Cont'd)
.2 Grooved couplings to be designed with angle pads to provide a rigid joint unless otherwise noted. Note: In some applications painted or galvanized ductile iron couplings may be used to joint stainless steel pipe. Confirm with Supplier.
.3 Where Expansion/Contraction or Angular Deflection is designed into piping system flexible couplings shall be used.

.3 Grooved Fittings: All grooved fittings to be manufactured from Stainless Steel conforming to ASTM A312, ASTM A403 or ASTM A774.

2.7 GROOVED PIPING SYSTEM - AWWA DUCTILE IRON

.1 General:
.1 All grooved components shall be of one manufacture and approved for use by the authorities, agencies, codes and standards named in the specifications.
.2 All approved manufacturers shall be certified to ISO 9001 standards

.2 Grooved Couplings:
.1 Grooved couplings shall be manufactured from ductile iron conforming to ASTM A536. Gaskets shall be Grade "M" Flush Seal Halogenated Butyl for water service.
.2 For connecting components of IPS dimension to components of AWWA dimension, grooved transition couplings may be used. Gaskets shall be Grade "M" Flush Seal Halogenated Butyl for water service.

.3 Grooved Fittings: Grooved fittings shall be manufactured from ductile iron conforming to ASTM A395, Grade 65-45-12 or ASTM A536, Grade 65-45-12 or cast iron conforming to ASTM A48, Class 30-A.

.4 Flanged Adapters: For connection to ANSI Class 125/150 or Class 250/300 flanged components, grooved flange adapters manufactured from ductile iron conforming to ASTM A395 or ASTM A536 may be used.

2.8 GROOVED PIPING SYSTEM - COPPER TUBING

.1 General:
.1 All grooved components shall be of one manufacture and approved for use by the authorities, agencies, codes and standards named in the specifications.

2.8 GROOVED PIPING SYSTEM - COPPER TUBING (Cont'd)

.1 (Cont'd)
.2 All approved manufacturers shall be certified to ISO 9001 standards.

.2 Grooved Couplings:
.1 Grooved couplings shall be manufactured from ductile iron conforming to ASTM A536.
.2 All grooved couplings to be designed with angle pads to provide a rigid joint unless otherwise noted.
.3 Couplings shall be complete with Flush Seal gaskets or equivalent.

.3 Grooved Fittings: All grooved fittings to be manufactured from wrought copper conforming to ASTM B75, C12200 or ASTM B152, C1100 or cast bronze per ASTM B584.

.4 Flange Adapters: For connection to ANSI Class 125/150 or Class 300 flanged components, grooved flange adapters manufactured from ductile iron conforming to ASTM A536.

2.9 GASKETS

.1 For flat faced flanges, use full-face gaskets. For Van Stone, lap joint and raised-face flanges, use full face or ring type gaskets. Conform to ASTM B16.21.

.2 Use gasket materials for flanged connections suitable for the temperature, pressure, and corrosivity of the fluid conveyed in the pipeline durometer.

.3 Unless otherwise specified, minimum Gasket Material Thickness for full face gaskets:
.1 Up to 250 mm pipe diameter; 1.6 mm thick.
.2 Greater than 250 mm pipe diameter; 3.2 mm thick.

.4 Unless otherwise specified, minimum gasket material thickness for raised face ring gaskets:
.1 Up to 100 mm pipe diameter; 1.6 mm thick.
.2 Greater than 100 mm pipe diameter; 3.2 mm thick.

.5 Grooved type gaskets:
.1 Select material as recommended by the Manufacturer for the service conditions indicated.
.2 Unless otherwise specified; for epoxy lined piping systems for solids carrying liquids, provide end-seal type gaskets.

2.9 GASKETS (Cont'd)

.5 (Cont'd)

.3 Unless otherwise specified, provide flush seal type gaskets for all other grooved joint systems.

2.10 BOLTS AND NUTS

.1 Provide hex head bolts and nuts. Threads to be ANSI B1.20.1, standard coarse thread series.

.2 For general indoor service, use bolts conforming to ASTM A307, Grade A; nuts conforming to ASTM A563, Gr.A.

.3 Provide stainless steel bolts, nuts and washers for exposed, submerged, buried and concrete encased service; bolts conforming to ASTM A193, Gr.B8, C1.1; nuts conforming to ASTM A194, Gr.8. Provide these also for connections above normal water level but which may be subjected to direct contact with splashed water.

.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.

2.11 STRUCTURAL ELEMENTAL PENETRATIONS

.1 Structural element penetrations are shown and referenced to a detail or Process/Mechanical Standard Details. Where a structural element penetration is not referenced, conform to the Standard Detail relevant to the type of structure, exposure and type of pipe.

.2 Provide pipe sleeves capable of supporting the loads applied during placement of concrete or during blockwork erection. Century Line high density polyethylene (HDPE) sleeves with water stop collar may be used where applicable.

2.11 STRUCTURAL ELEMENTAL PENETRATIONS (Cont'd)

.3 Supply wall or floor penetrations into submerged areas, under slab areas, and where shown with a 6 mm thick water stop flange at least 50 mm larger than the pipe or pipe sleeve outside diameter (o.d.). Continuously weld the water stop flange, both sides, onto the pipe or pipe sleeve. Fill annular space between the sleeve and pipe, where a sleeve is used, with non shrink grout in accordance with Division 3. Form reglets between the grout and the concrete and between the grout and the pipe, on "wet" sides of the wall penetration. Fill reglet with sealant.

.4 For structural concrete wall and floor penetrations of non-insulated pipe between dry areas, furnish a sleeve which has an internal diameter at least 50 mm larger than the o.d. of the pipe. For pipes 75 mm and less furnish a pipe sleeve 25 mm larger than the o.d. of the pipe.

.5 For masonry wall penetrations of non-insulated pipe, furnish a sleeve which has an internal dimension of at least 50 mm larger than the pipe o.d. For pipes 75 mm and less furnish a pipe sleeve 25 mm larger than the o.d. of the pipe.

.6 A Standard Detail is shown for segmented modular pipe seals. Where this detail is used for the penetration of a wall separating a dry area from an underground area, tighten the bolts from the inner face and fill the outer annular space with grout. Use stainless steel bolts and nuts in penetrations through walls separating underground or exterior areas from any other area. If seepage occurs during the warranty period, the Contractor is responsible for repair and/or replacement, at no cost to the Departmental Representative. Do not use this type of wall penetration below maximum ground water level elevation.

2.12 INTERIOR FINISHES (LINING)

.1 General:

.1 Provide products with factory applied linings 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.

2.12 INTERIOR FINISHES (LINING) (Cont'd)

.1 (Cont'd)
.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 Unless otherwise specified, finish fittings in the same manner as the pipe run.

.2 Epoxy:
.1 Where specified in the detailed pipe specification sheets, apply epoxy to the internal surface of piping in accordance with AWWA C210.
.2 Factory sandblast, solvent clean, white metal blast, inorganic zinc prime, and double epoxy liner.

.3 Asphaltic Varnish:
.1 Provide asphaltic varnish as the standard finish for ductile iron and cast iron pipe, in accordance with AWWA C151.

.4 Cement Mortar Lining:
.1 Where specified in the detailed pipe specification sheets, apply cement mortar lining and an asphaltic seal to the internal surface of ductile iron piping in accordance with AWWA C104.
.2 Where specified in the detailed pipe specification sheets, apply cement mortar lining and an asphaltic seal to the internal surface of steel piping in accordance with AWWA C205.

.5 Glass Lining:
.1 Where specified in the detailed pipe specification sheets, apply glass lining to pipe interior in two 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 naturation temperature above 750 C.
.4 Finished lining will be:
.1 200 to 300 µ thick.
.2 Density of 2.5 to 3.0 grams/cm3.
.3 Hardness in excess of 5.0 on the MOHS scale.
.4 Capable of withstanding 175°C shock thermal without crazing, blistering, or spalling.

2.12 INTERIOR FINISHES (LINING) (Cont'd)

.5 (Cont'd)

.4 (Cont'd)

.5 No visible loss of surface gloss after immersion in 8% sulphuric acid solution at 65°C for a period of ten minutes.

.6 No more than 0.01% 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 The glass lining shall provide continuous coverage when tested by a low voltage wet sponge holiday detector, with only isolated voids permitted due to casting anomalies and which represent less than 0.01% of the total glassed surface. Testing procedure and acceptance criteria shall be in accordance with "MP-9.2, Porcelain Enamel Continuity Testing".

.1 Purpose: Proper application of the Porcelain Enamel Coating provides beneficial long term characteristics of lubriOwner, adherence, and resistance to corrosion and high temperature. Currently, there is no test method, either destructive or non-destructive, which directly measures these characteristics. Rather, the Industry has developed a testing method utilizing a Holiday Detector, which determines the continuity of the glass lining and indicates the relative quality of the process. This method is commonly referred to as "Spark Test".

.2 Test Description:

.1 Equipment: The equipment to locate holidays (pinholes, voids, ridges, etc.) in the non-conducting Porcelain Enamel Lining. It functions by applying a 67.5 V potential across the glass lining. Any pinholes or other holidays in the glass lining will close the circuit and produce an audible signal from the detector for any resistance less than 10000 OHMS. The current is applied through a circular sponge which has been wetted using water containing approximately 1% of a wetting agent such as Kodak "Photo Flo".

2.12 INTERIOR FINISHES (LINING) (Cont'd)

.6 (Cont'd)

.2 (Cont'd)

.2 Procedure: For testing long pipe sections, the diameter of the wetted sponge shall exceed the diameter of the pipe so that the sponge is in full circumferential contact with the Porcelain Enamel Lining of the pipe. The sponge is attached to a rod which allows the sponge to be pushed through at least 50% of the pipe. Any discontinuities will result in an audible signal which will be recorded with regard to position along the pipe. Testing is performed from both ends of the pipe.

.3 Special techniques are required at the exposed pipe ends which are not enameled. If, due to excess water on the sponge, the electric current short circuits to the end of the pipe resulting in an audible signal (typically within 3" of the end), the test personnel shall also make a visual inspection to determine if discontinuities exist.

.3 Acceptance Criteria: The pipe or fittings as tested by the procedure shall be rejected from shipment if testing reveals more than isolated voids due to casting irregularities which represent more than 0.01% of the total glassed surface (no more than 1-2 pinholes per fitting or an average of 5 or less per 20 ft pipe spool). Rejected pipe shall be evaluated for additional coating with Porcelain Enamel or for total reblasting, reprocessing, and retesting.

2.13 EXTERIOR FINISHES - (COATINGS) SHOP APPLIED

.1 Provide products with factory applied coatings and finishes as specified.

.2 Yellow Jacket:

.1 HDPE jacket extruded over a mastic base.

.2 Manufacture, test, inspect and report procedures to meet or exceed CSA-Z299.3 (Quality Assurance Program - Category 3).

.3 Prior to mastic application, sandblast pipe in conformance with requirements or 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.

2.13 EXTERIOR FINISHES - (COATINGS) SHOP APPLIED (Cont'd)

.2 (Cont'd)

.5 HDPE has the following minimum properties: Ultimate tensile strength, 21 MPa; Tensile elongation at break, 600%; 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.

2.13 EXTERIOR FINISHES - (COATINGS) SHOP APPLIED

.2 (Cont'd)

.7 Minimum HDPE thickness will be as follows:

Nominal Pipe Diameter (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

.8 All flaws up to three (3) per pipe will 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.

.9 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.

.10 Tape Wrap: shop applied tape wrap may be used as an alternative to Yellow Jacket. Two or three layer methods can be used, meeting or exceeding the application and performance requirements of AWWA C214.

.3 Epoxy:

.1 Apply epoxy to the exterior of piping in accordance with AWWA C210.

2.14 EXTERIOR FINISHES - (COATINGS) FIELD APPLIED

.1 General:

.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:

2.14 EXTERIOR FINISHES - (COATINGS) FIELD APPLIED (Cont'd)

.2 (Cont'd)
.1 For welded joints on Yellow jacketed pipe and as other indicated locations apply tape to buried pipe and fittings. Use Polyken, Tec-Tape or Denso tape, 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; in accordance with AWWA C217.

.3 Shrink Sleeve:
.1 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 Epoxy:
.1 Apply epoxy to the exterior of piping in accordance with AWWA C210.

2.15 GALVANIZING

.1 Where piping is to be galvanized, hot dip zinc coat to CSA G164 with a minimum coating of 550 g/m^2.

.2 All carbon steel parts, such as elements of flanges, anchors, guides and supports shall be galvanized, hot dip zinc coat to CSA G164 with a minimum coating of 550 g/m^2. Elements welded to components that do not lead themselves to hot dip galvanizing shall be thoroughly cleaned and cold zinc galvanized to similar coat thickness. Surface preparation for cold galvanizing shall meet specifications of the manufacturer of the cold galvanizing product. Product shall meet two thousand (2000) hours resistance test to salt spray (ASTM B-117).

2.16 GROUT

.1 Non-shrink grout: conform to Non-ferrous grout: pre-mixed, non-shrink, Master Builders 713, Sika M-Bed, CPD Non Shrink Grout, Steel C1 Grout, minimum 35 MPa compressive strength.

2.17 CONCRETE

.1 Provide concrete for concrete surround placed around buried pipe, and fill placed over buried pipe, in accordance with Section 03 30 00 and as shown.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Prior to installation, inspect and field measure to ensure that previous work is not prejudicial to the proper installation of piping.

.2 Make all minor modifications to suit installed equipment and structural element locations and elevations.

.3 Advise the Departmental Representative of all modifications. Do not commence work on the related piping until all modifications have been reviewed by the Departmental Representative.

.4 Include any piping modifications in the shop drawings submitted prior to fabrication or installation.

3.2 PIPE HANDLING

.1 Inspect each pipe and fitting prior to installation. Do not install damaged pipe or pipe with damaged protective coatings. Do not use sections of large diameter, thin walled stainless steel piping that may have been deformed out of roundness or dimpled. Such damaged sections shall be discarded.

.2 Remove all foreign matter from inside of pipe prior to installation.

.3 Repair pipe with damaged protective coatings with material similar to the original in accordance with the Manufacturer's written directions and to the satisfaction of the Departmental Representative.

.4 Damaged glass lining cannot be repaired. Damaged pipe shall be replaced.

.5 Use proper implements, tools, and facilities for the proper protection of the pipe. Exercise care in the installation so as to avoid damage to pipe or coatings.

.6 When lifting sections of large diameter, thin wall piping onto the supports use methods that will prevent damage or deformation. Lift evenly at several places to ensure that the piping deflection between lifting points does not exceed 6.3 mm.

3.3 SLEEVES

.1 Unless otherwise noted or approved by the Departmental Representative, provide sleeves where piping passes through a wall, floor or ceiling.

.2 Locate and place sleeves prior to construction of cast-in-place elements and prior to the construction of concrete and masonry building elements.

3.4 INSTALLATION OF PIPE UNDERGROUND/ BURIED AND BELOW STRUCTURES

.1 Trenching and backfill for buried pipe: conform to Division 31.

.2 Pipe laying and bedding: conform to Division 31.

.3 Unless otherwise shown, protect pipe laid below structures with a concrete surround having a minimum coverage of 100 mm all around the pipe; extend concrete surround to undisturbed ground.

.4 For concrete surround, comply with the following:

.1 Install pipe in straight alignment. Do not exceed 10 mm variance from the true alignment in any direction.

.2 Ensure the pipe alignment stays true during and after placement of concrete surround.

.3 Ensure that the method used to prevent pipe uplift during placement of concrete surround results in a level invert and crown.

.4 Maintain pipe circular cross section.

.5 Provide lean concrete to within 150 mm of the underside of the slab or footing for backfill over pipe laid below structures, except as detailed otherwise.

.6 Place concrete in accordance with Section 03 30 00.

.5 Provide yellow jacket or tapewrap on all fittings and flanged, grooved, plain end and welded joints underground and below structures.

.6 Unless otherwise specified or shown, for underground piping, provide groove joints or flex coupled joints at 6 m on centre.

.7 Use anti-seize compound with all stainless steel nuts and bolts.

3.4 INSTALLATION OF PIPE UNDERGROUND/ BURIED AND BELOW STRUCTURES (Cont'd)

.8 Prior to installation provide a manufacturer's representative, from the HDPE pipe manufacturer, for a minimum of one (1) day to instruct personnel on installation procedures of HDPE pipe.

3.5 INSTALLATION

.1 Fabricate and install pressure piping in interior building spaces in accordance with the ASME pressure vessel code. Fabricate and install domestic hot and cold water piping, sanitary piping and storm drainage piping in accordance with authorities having jurisdiction.

.2 Make adequate provision in piping and pipe support systems for expansion, contraction, slope, and anchorage. Supports, bracing, and expansion joints shown in the drawings are schematic only. The Contractor is responsible for the design, supply, and installation of the piping system in general accordance with the indicated requirements.

.3 Install pipe support system to adequately secure the pipe and to prevent undue vibration, sag or stress.

.4 Install expansion joints where shown and at other locations as necessary to allow for piping expansion and contraction.

.5 Provide temporary supports as necessary during construction to prevent overstressing of equipment, valves or pipe.

.6 Accurately cut all piping for fabrication to field measurements. Process air piping sections shall be measured and cut at 15 to 20°C. If the installation in the field takes place at lower outdoor temperatures, provide circulation of hot air inside the piping to expand the material such that flanges can be bolted. Expansion joints for process air piping shall be blocked at their natural length at 15 to 20°C and such that they will not deflect excessively during handling and installation. These blocks shall be removed prior to pressure testing.

3.5 INSTALLATION (Cont'd)

.7 Install pipes in straight alignment. For large diameter (500 ND and greater), thin walled (6.4 mm and less) stainless steel piping provide laser alignment of all pipe supports. Lateral and vertical misalignment between any three (3) consecutive supports shall not exceed the pipe wall thickness.

.8 For piping other than large diameter, thin walled stainless steel, do not exceed 10 mm in 10 m variance from the true alignment, in any direction.

.9 Fabricate and assemble pipe runs so that the pipework is not stressed to achieve the desired alignment and that no stresses are transferred to equipment or equipment flanges. The "springing" of pipework to ensure alignment is not permitted. Undo and subsequently remake all pipework connections to ensure that springing does not occur. Take care not to damage equipment, valves or flanges.

.10 Slope instrument air piping to condensate traps. Provide condensate traps as recommended by the manufacturer of the instrument air compressor.

.11 Do not cut or weaken the building structure to facilitate installation.

.12 In parallel pipe runs, offset flanges and/or grooved joint fittings by a minimum of 200 mm.

.13 In vertical pipe runs of diameter greater than 250 mm, provide 200 mm long spool piece on lower side of each valve.

.14 Provide aluminum watertight drip trays under pipe carrying corrosive commodities crossing over cable trays. The drip trays will be 300 mm wider and 600 mm longer than the piping area over the cable tray. Fit with 12 mm drains that extend to within 150 mm of the floor, near a floor drain.

.15 Refer to structural drawings for support, guide and anchor details. Where an FRP band is called for on either side of a support, guide or anchor, provide the FRP of sufficient size for a 110 kN force.

3.6 MILD STEEL WELDING

.1 Use manual shielded metallic arc (SMAW), submerged arc (SAW), or inert gas shield arc (GMAW) or gas tungsten arc (GTAW) welding.

.2 Welding procedures shall conform to CSA Z183.

.3 Bevel plain pipe ends prior to welding.

.4 Clean and dry welding surfaces thoroughly prior to welding, in an area not less than 0.3 m wide on each side around the welding line.

.5 Do not proceed with welding when metal temperatures fall below minus 18° C. Apply supplemental heat when metal temperatures are below 0° C, to heat the metal to 20° C.

.6 Maintain flanges, pipes, fittings, etc. in alignment during welding. Ensure that no part of the weld is offset by more than 20% of the pipe wall thickness.

.7 Make tack welds of material equal to the root pass. Tack welds which have not cracked may be incorporated in the root pass.

.8 Ensure the first bead obtains full root penetration with a minimum of weld material projecting within the pipe.

.9 For butt welds of pipe diameters less than 200 mm use a minimum of two (2) passes. For larger pipe use three passes - minimum.

.10 For lap joints, weld joint in two (2) passes minimum.

.11 Between passes, visually inspect bead for pinholes or other defects. Repair any defects prior to the placement of the next pass.

.12 Clean all flux, slag and other foreign material from the weld prior to applying a successive bead, and on completion of the weld.

.13 Do not start successive passes at the same point.

.14 Completely fill the joint with weld, and have a reinforcement greater than 1.5 mm and less than 3.0 mm, with no undercutting at the weld edges.

3.6 MILD STEEL WELDING (Cont'd)

.15 Provide a smooth surface for coating application to exterior surfaces of pipe. Grind or buff all welds to a minimum radius of 6 mm on all edges and corners. Adhere to latest edition of NACE RP0178.

.16 Contractor to provide access to all external welds in fabricated spool pieces for grinding purposes. This will ensure that the coating application on welds can be properly ground to achieve proper coating application. Provide maximum of 400 mm distance from any weld.

.17 Repair linings and coatings after welding.

3.7 STAINLESS STEEL WELDING

.1 Conform to reviewed stainless steel pipe welding procedures, which have been stamped and signed by a Professional Engineer registered in the Province of Ontario.

.2 Remove all scale, rust and any other surface deposits from the entire pipe and fittings before welding. Be particularly thorough with the internal surface preparation.

.3 For all stainless steel pipe intended to convey liquids, use inert gas backing (GMAW or GTAW) for field and shop welds. For these services, solar flux will not be allowed.

.4 Ensure the first bead obtains full root penetration with a minimum of weld material projecting within the pipe.

.5 Grind or buff all welds to a minimum radius of 6mm on all edges and corners to achieve a smooth surface, eliminate any pockets and eliminate any protruding root passes. Adhere to latest edition of NACE RP0178. If material thickness will not allow 6mm radius, make radius one half of material thickness.

.6 Ensure the OD weld (weld cap) is free of excessive weld cap and free of discoloration due to welding. Ensure all ID welds (root pass) or OD welds exposed to corrosive fluids/environments are ground flush and have no discoloration.

.7 Passivation:

3.7 STAINLESS STEEL WELDING (Cont'd)

.7 (Cont'd)

.1 Passivate the inside of all stainless steel piping after completion of all piping and supports welding. Any welding after passivation will require passivation of the entire piping section again. A piping section is the length between flanges.

.2 Comply with ASTM A380, Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems, and ASTM A967, Standard Specification for Chemical Passivation Treatment for Stainless Steel Parts, latest edition.

.3 Use fine grit carbide sandpaper to remove any discoloration, such as bluish due to overheating.

.4 Thoroughly clean the interior of the pipe and ensure there are no oil or grease deposits or particulate (such as from the sandpaper) using trisodium phosphate (TSP) solution per Manufacturer's recommendation. Thoroughly rinse with tap water.

.5 Acid pickle using a solution of 20% nitric acid and 2% hydrofluoric acid in chloride-free water. Treat for no less than two (2) hours at 20°C to 40°C. Do not work at less than 20°C. An equivalent pickling paste shall be used for air piping not designed to be filled with water. Follow the manufacturer's written instructions. Rinse thoroughly with chloride-free water (distilled or de-ionized) until the rinse water shows less than 0.1 mg/L of fluoride. Rinse thoroughly with chloride-free water (distilled or de-ionized) brought to pH 10 using ammonia (preferred). Alternatively caustic soda or soda ash may be used to increase the final rinse water pH, but the maximum concentration of chloride allowed in this solution is 1 mg/L. Note that chloride concentration in commercially available caustic soda and soda ash may be too high for this use. Completely drain and leave drying in warm air (not less than 20°C at the outlet end) overnight.

3.7 STAINLESS STEEL WELDING (Cont'd)

.7 (Cont'd)

.6 Collect all acids, caustics and rinses and take all necessary precautions to prevent spills on the ground. Neutralize as needed, for example blending acid and caustic wastes and using pebble or ground limestone, lime or other suitable material. Dispose of the neutralized waste as indicated by the Departmental Representative at the closest primary effluent channel. Note that the Departmental Representative may limit the volume that may be discharged over any period of time.

.7 Process air piping may not be filled with water unless laid flat on the ground or otherwise supported every 5 m and on each side of sliding supports.

.8 Provide adequate ventilation that will blow any fumes away from the worker. This individual shall wear adequate protection per MSDS and clean, thick cloth socks over footwear.

3.8 GROOVED PIPING SYSTEM - INSTALLATION

.1 All grooved products shall be installed according to Manufacturer's written installation instructions.

.2 Carbon steel pipe may be either Cut Grooved or Roll Grooved as appropriate for pipe and service specified.

.3 Schedule 5 and 10 stainless steel pipe shall be roll grooved using "RX" rolls in accordance with manufacturer's written installation instructions.

.4 Ductile iron pipe shall utilize "Radius Cut Grooves". Grooves shall conform to either "Rigid" or "Flexible" cut groove dimensions as specified for application. Pipe shall have wall thickness of Class 53 pipe or greater.

.5 Copper piping shall be Roll Grooved in accordance with manufacturer's written installation instructions.

3.9 TESTING

.1 Give the Departmental Representative twenty four (24) hours notice prior to testing.

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

3.9 TESTING
(Cont'd)

.3 Complete any required weld tests.

.4 Interior of stainless steel piping shall be bright metal with no discoloration. Any discoloration, such as bluish tint at welds, will require spot pickling and passivation using paste containing nitric acid and hydrofluoric acid, followed by rinsing and drying as indicated previously.

.5 Spot check the interior of the stainless steel piping and weld areas as indicated by the Departmental Representative. Use 5% copper sulphate solution. After ten (10) minutes at not less than 15°C there shall be no observable deposit of metallic copper. Otherwise, pickling and passivation shall be repeated for the entire piping section. Carefully wipe off copper sulphate solution with several damp pieces of cloth.

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

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

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

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

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

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

.12 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 Departmental Representative of such failure.

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

3.9 TESTING (Cont'd)

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

.15 Release pressure safely, flush and drain liquid pipes after pressure tests. Release pressure safely and purge if needed all gas pipes after pressure tests.

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

.17 Dispose of flushing water in manner approved by the Departmental Representative, which causes no damage to buildings or siteworks.

3.10 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 L/hr/mm pipe diameter/100 m of pipe length for buried piping, unless otherwise specified.

.6 Test drains in accordance with authorities having jurisdiction.

3.11 PRESSURE TESTING OF GAS, AIR AND VAPOUR LINES

.1 Hydrostatically or pneumatically pressure test, as shown in the table below, all lines normally used for the conveyance of gas, air, and/or vapour in accordance with Process Piping Code B31.3 procedures for testing pressure piping (and CAN/CSA B149.6 for buried digester gas piping - not applicable for this project). Pneumatically test all instrument air lines in accordance with ISA-RP7.1.

3.11 PRESSURE TESTING OF GAS, AIR AND VAPOUR LINES (Cont'd)

.2 For gas and air lines to be hydrostatically tested, check support system to ensure it is capable of withstanding loads imparted by test method. Provide any additional supports necessary in a manner acceptable to the Departmental Representative. At the Departmental Representative's request, provide calculations indicating design of temporary support system.

.3 Other than for chlorine and sulphur dioxide piping systems, use the following test medium:

Pipe Size Specified	Testing Medium	Test Pressure
50 mm and smaller	500 kPa or less	Air or Water
50 mm and smaller	Greater than 500 kPa	Water
Greater than 50 mm	500 kPa or less	Air or Water
Greater than 50 mm	Greater than 500 kPa	Water

.4 Test pressures are identified in the detailed piping specification sheets.

.5 Zero leakage rate for insulated systems, and systems tested with water is required at the specified test pressure through the test period. Prior to commencing test using air, ensure air will be at ambient temperature and specified test pressure.

.6 Do not exceed 5% of the specified test pressure as the allowable leakage ate over the test period for other systems tested with air. Provide feed air pressure regulator with gauge and pressure safety valve with ring pressure set at not more that 20 kPag above the test pressure and adequately sized for both the compressor capacity and any condition that could result in pressure increases.

3.11 PRESSURE TESTING OF GAS, AIR AND VAPOUR LINES (Cont'd)

.7 Wet all joints using a mixture of soap and water in systems tested with air. Remake all joints which display leakage and retest. For stainless steel piping, repeat cleaning and passivation procedure indicated above for the entire piping section, then test for adequate passivation in the re-worked area.

.8 Test natural gas piping in accordance with CAN/CSA B139-1.

END OF SECTION