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DIVISION 11

GENERAL PROCESS PROVISIONS

1. GENERAL

1.1 Intent

.1 Provide complete, fully tested, and operational process systems to meet requirements described herein and in complete accord with applicable codes and ordinances.

.2 Contract Documents and Drawings of this Division are diagrammatic and approximately to scale unless stated otherwise. They establish scope, material, and installation quality, and are not detailed installation instructions.

.3 Follow manufacturer's recommended installation instructions and procedures for equipment, supplemented by requirements of Contract Documents.

.4 Install equipment generally in locations and routes shown, with minimum interference with other services or free space. Remove and replace improperly installed equipment to the satisfaction of the Contract Administrator at no extra cost.

.5 Install equipment to provide access and ease of maintenance.

.6 Connect to equipment specified in other Sections and to equipment supplied and installed by other contractors or by the City. Uncrate equipment, move in place and install complete; start-up and test.

1.2 Regulations

.1 All Work carried out under this Division shall be in full accordance with all applicable Codes, Regulations, Bylaws, and Ordinances and nothing in the Drawings and Specifications shall remove this responsibility.

1.3 Permits, Fees and Inspections

.1 Apply for all permits, supply all test certificates and pay all fees to authorities having jurisdiction regarding the installation and inspection of the complete process systems, installed under this Contract.

1.4 Existing Conditions and Other Trades

.1 Visit the Site to determine existing conditions affecting the Work of this Division. Failure to do so shall not remove the responsibility for the effects of such conditions on the Work.

.2 Examine all Drawings and become fully familiar with the Work of other trades in all Divisions under this Contract.

.3 Cooperate with all other trades. Pay particular attention to the proximity of the Work to all electrical cables, control conduits, and utilities. Maintain maximum clear ceiling heights throughout. Provide connections of sizes as shown on the Drawings for connection by other trades.

1.5 Materials

.1 Materials and equipment installed shall be new, full weight, and of quality specified. Use same brand or manufacturer for each specific application.

1.6 Scope of Work

.1 Refer to Section 01010 for the Scope of Work. The Work requires the supply and installation of such components as are necessary to construct complete functional and operational systems for all Sections of the Work.

.2 Consideration will not be granted for any alleged misunderstanding of the extent of the Work to be performed. Submitting a Bid shall convey full agreement to all items and conditions specified, indicated on the Drawings, and required by the nature of the Site.

1.7 Discrepancies and Omissions

.1 These Specifications shall be considered as an integral part of the Drawings, which accompany them, and neither the Drawings nor Specifications shall be used alone. Any items or subject omitted from one but which is mentioned or indicated in the other shall be considered as properly and sufficiently specified and shall therefore be provided.

.2 Should the Contractor find discrepancies or omissions in the Contract Documents, or be in doubt as to the intent thereof, he shall immediately obtain clarification from the Contract Administrator.

1.8 Transportation and Hoisting

.1 Assume responsibility for transportation, hoisting, warehousing, and demurrage for all equipment and materials to be furnished and installed under this Division.

1.9 Definitions and Interpretations

.1 Where the term “Provide” is used herein, it shall be understood to include labour, materials, and services necessary to supply, install, and make functional the items or Work referenced.

.2 Where the term “Instructions” or “As Instructed” or “Where Instructed”, etc. is used herein, it shall be understood to mean as instructed in writing by the Contract Administrator.

.3 Where the term “Listed” is used herein, it shall be understood to mean that the materials or equipment have been tested in accordance with applicable standards and methods, have been approved and listed for the intended use by a testing authority which itself has been approved by the authorities having jurisdiction.

.4 Where the term “Approved,” “Approval”, etc. is used herein, it shall be understood to mean approved by Authorities having jurisdiction as conforming to Codes, Standards, Bylaws, etc.

.5 Where the term “Acceptable” or “Acceptance”, etc. is used herein, it shall be understood to mean acceptable to the Contract Administrator as conforming to the requirements of the Contract Documents.

.6 Where the term "Submit for Review" is used herein, it shall be understood to mean submit to the Contract Administrator.

.7 Where the term "Subject to Review" etc. is used herein, it shall be understood to mean Work shall be laid out for review by the Contract Administrator. No Work shall proceed until written instructions have been obtained from the Contract Administrator. Submit further information, Shop Drawings, samples, etc. as specified and/or as may be reasonably requested by the Contract Administrator.

.8 Where the term "Accessible" is used herein, it shall be understood to mean readily approachable by person or tools as required and where obstacles may be removed and replaced without cutting or breaking out materials.

.9 Where working pressure or pressure ratings are specified or shown on the Drawings for valves, piping, fittings, equipment, etc., these items shall be suitable for operating at specified pressures and corresponding temperature unless noted otherwise.

1.10 Shop Drawings

.1 Refer to Section 01300 for the general requirements for Shop Drawings.

.2 For specific requirements for Shop Drawings for various pieces of equipment, refer to the relevant specific Sections describing the equipment.

.3 Shop Drawings shall be complete; capable of illustrating fully that the product to be supplied is in accordance with the Specifications; including design considerations, materials, and accessories and spare parts. Include wiring diagrams for power supply and control schematics for all electrically powered and/or controlled equipment.

.4 Shop Drawings, which are not considered complete, will be returned to the Contractor "Not Reviewed" or "Rejected". It is the responsibility of the Contractor prior to submittal to ensure that they are in accordance with the requirements of the Specifications.

.5 Submit Shop Drawings in an expedient fashion in accordance with the Contract requirements and allowing sufficient time for review and implementation prior to Contract completion.

.6 Shop Drawings of equipment supplied under other contracts will be made available to the Contractor to assist in the installation.

1.11 Coordination

.1 Coordinate locations of openings, housekeeping pads, and anchor bolts with other Divisions.

.2 Coordinate the connection of the services of other Divisions to the equipment and material supplied under this Division.

1.12 Minor Changes

.1 Equipment and materials shall be located and arranged generally as shown on the Drawings. However, minor changes may be required to suit the precise requirements of the actual equipment or materials supplied, or to avoid conflict between services.

.2 Prior to the installation of the relevant equipment or materials, the Contractor shall advise the Contract Administrator of the requirement for any minor changes (including box-outs and coring) and shall undertake such minor changes as instructed by the Contract Administrator. Such changes shall be undertaken at no extra cost except where the connection or arrangement is modified in length, or alignment, or position, by more than 1 m; or if the change involves the addition of more than two fittings greater than 150 mm in diameter.

1.13 Housekeeping Pads

.1 Housekeeping pads are required for all pieces of equipment unless otherwise noted. Dimensions shown on the Drawings are for guidance only. Housekeeping pads shall be at least 100 mm larger than the equipment base plates a minimum of 100 mm deep, unless greater or lesser depths are required to support the equipment at the proper elevation. The final housekeeping pad dimensions shall be based on the dimensions of the actual equipment to be installed, and the manufacturer's recommendations.

.2 The Contractor shall coordinate the location and installation of all the housekeeping pads, to be done by other Divisions.

1.14 Metric Conversion

.1 All units in this division are expressed in SI units.

.2 Submit all Shop Drawings and maintenance manuals in SI units.

.3 On all submittals (Shop Drawings etc.) use the same SI units as stated in the Specifications.

.4 Equivalent Nominal Diameters of Pipes - Metric and Imperial:

mm	inches	mm	inches	mm	inches
3	1/8	65	2-1/2	375	15
6	1/4	75	3	450	18
10	3/8	100	4	500	20
13	1/2	125	5	600	24
20	3/4	150	6	750	30
25	1	200	8	900	36
30	1-1/4	250	10	1050	42
40	1-1/2	300	12	1200	48
50	2				

.1 Where pipes are specified with metric dimensions and Imperial sized pipes are available, provide equivalent nominal Imperial sized pipe as indicated in the table, and provide at no extra cost adapters to ensure compatible connections to all metric sized fittings, equipment, and piping.

.2 When CSA-approved SI metric pipes are provided, the Contractor shall provide at no extra cost adapters to ensure compatible connections between the SI metric pipes and all new and existing pipes, fittings, and equipment.

1.15 Cutting and Patching

.1 Provide holes and sleeves, cutting and fitting required for mechanical Work. Relocate improperly located holes and sleeves.

.2 Drill for expansion bolts, hanger rods, brackets, and supports.

.3 Obtain written approval from the Contract Administrator before cutting or burning structural members.

.4 Patch building where damaged from equipment installation, improperly located holes, etc. Use matching materials as specified in the respective Section.

1.16 Substantial and Total Performance

.1 Prior to Substantial Performance Inspection, provide complete list of items, which are deficient at the time of the Substantial Performance Inspection.

.2 Perform the following items prior to Substantial Performance Inspection.

.1 Make systems capable of operation with alarm controls functional and automatic controls in operation generally, but not necessarily finally calibrated.

.2 Make necessary tests on equipment including those required by authorities. Obtain certificates of approval.

.3 Complete valve tagging and identify equipment. Paint equipment and piping, and install escutcheons.

.4 Lubricate equipment as per manufacturer's instructions.

.5 Mail warranty forms to manufacturer. Provide copy of original warranty for equipment which has warranty period longer than one year.

.6 Submit O&M Manuals as in accordance with Section 01300.

.3 Prior to Total Performance Inspection, provide declaration in writing that deficiencies noted at time of Substantial Performance Inspection have been corrected and the following items completed prior to the Total Performance Inspection:

.1 Complete final calibration of controls.

.4 The Contractor shall provide qualified personnel in appropriate numbers to operate the facility until Substantial Performance is declared.

1.17 Equipment Protection and Clean-Up

.1 Protect equipment and materials in storage on-site during and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.

.2 Protect equipment with crates and polyethylene covers.

.3 Thoroughly clean both existing and new piping, ducts and equipment of dirt, cuttings, and other foreign substances.

.4 Ensure that existing equipment is carefully dismantled and not damaged or lost. Do not reuse existing materials and equipment unless specifically indicated.

1.18 Temporary Usage

.1 Usage by the City of any process device, apparatus, machinery, or equipment prior to Total Performance being issued is not to be construed as acceptance.

1.19 Painting and Identification

.1 Coordinate colour coding of piping and equipment with that of the existing plant. All piping and equipment is to be painted.

.2 Legend and direction of flow arrows shall consist of adhesive backed labels, yellow colour, with minimum 20 mm high black lettering equal to Brady System B-500, vinyl cloth labels for non-insulated surfaces; and Brady B 946 for insulated surfaces.

.3 Identify piping with labels, colour bands, and flow arrows. Provide identification at 15 m maximum intervals, before and after pipes pass through walls, at all sides of tees, behind access doors and in equipment rooms as required.

1.20 Acceptable Products and Acceptable Manufacturers

.1 The first product specified in a product list is considered the "Design Standard" unless noted otherwise. The Design Standard product has been used as the basis for design. Dimensions, operating protocol, basic materials, etc. of the Design Standard have been incorporated in the design.

.2 Where one or more Acceptable Products or Acceptable Manufacturers have been listed for an item of equipment, these are accepted as equivalent in concept to the Design Standard, if a Design Standard is listed. Incorporation of equipment options to satisfy the intent of the Specifications such that the process system would function as intended with the Design Standard is the responsibility of the Contractor. Modifications to the equipment services, supports, structure, etc., to suit Acceptable Products shall be the responsibility of the Contractor.

.3 It remains the responsibility of the Contractor to ensure the products supplied are equal to the specified products in every respect, operate as intended, and meet the performance Specifications and physical dimensions of the specified product.

.4 The Contractor shall be fully responsible for any additional Work or materials, to accommodate the use of equipment from the acceptable manufacturers and suppliers' list.

.5 Submit within 14 days of Contract award a copy of the list underlining the name of the manufacturer whose price was carried in the Bid. If no manufacturer's names are submitted, it will be assumed that the price carried in the Bid was that of the specified manufacturer or, where the specified product is generic, the first acceptable manufacturer listed for each item and equipment.

1.21 Delivery Schedule

.1 The Contractor is to coordinate the equipment and material delivery schedule with the suppliers of the equipment and materials supplied under this Contract to suit the construction schedule. The dates for delivery shall be identified within 20 working days of Contract award.

1.22 Delivery

.1 The Contractor shall be responsible for unloading the equipment and materials supplied under this Contract and shall examine all packages on delivery, compare with the shipping list, and inform the supplier, the Contract Administrator and the carrier of any visible damages or defects. The Contractor shall arrange with the supplier to have the supplier replace any damaged or defective items.

1.23 Storage

.1 The Contractor shall provide temporary buildings and covered space for storage at the Site of all equipment prior to installation. The location of such buildings will be subject to acceptance by the Contract Administrator and the City.

.2 Pipe and any other materials shall be stored in a manner which prevents rust, deformation, weathering, or any other physical deterioration. Covered space shall be provided by the Contractor if necessary to provide for this protection.

.3 The Contractor shall adhere to the manufacturers' storage recommendations.

.4 Heated covered storage space shall be provided by the Contractor for sensitive items of equipment such as motors and pumps, as well as other equipment or supplies specified in this Division or other Divisions.

1.24 Spare Parts and Special Tools

.1 If spare parts or special tools are to be provided with any equipment specified, the specific parts or tools will be listed in the relevant Specification Section and are to be supplied with the equipment.

.2 Where the operation of the equipment for a period of two years would require that some specific spare parts are likely to be required, but are not listed in the Specification, the Contractor shall so inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified spare parts shall be identified.

.3 Where special tools are required for the maintenance or operation of a specific item of equipment, but are not listed, the Contractor shall so inform the Contract Administrator. Costs, delivery periods, and any other information relevant to the procurement of the identified special tools shall be provided.

.4 This clause does not relieve the Contractor of the responsibility to provide, at no cost, any spare parts required during the warranty period to repair malfunctioning or failed equipment. At the end of the maintenance period, the spare parts inventory shall be replenished to allow for the above.

END OF SECTION

PROCESS EQUIPMENT INSTALLATION

1. GENERAL

1.1 Description

.1 Installation, including the supply of anchor bolts, and testing of equipment supplied by others and supplied under other Sections in Division 11.

1.2 Definitions and Interpretations

.1 Testing: in this Division, testing is defined as the operation of a specific item of equipment under actual or simulated conditions for the purpose of ensuring the equipment satisfies its basic design criteria. Testing shall be conducted by the Contractor. All materials, labour, power and equipment required to conduct the tests shall be the Contractor's responsibility. The manufacturer is to provide technical assistance to the Contractor for the installation, testing, start-up, and commissioning of the equipment supplied. Refer to Section 01650.

.2 Commissioning: in this Division, Commissioning is defined as the operation of equipment systems under actual and/or simulated conditions for the purpose of ensuring the system performs its intended functions. Refer to Section 01670.

1.3 Submissions

.1 Check all the Shop Drawings relative to the equipment and materials, dimensions, measurements, size of members, type of materials, controls, list of equipment being supplied, names of manufacturers, and other details to affirm that they are correct and conform to the requirements and intent of the Contract.

.2 Where the Shop Drawings are submitted with coordination information missing, such as dimensions of structures, the Contract Administrator will return the submission as soon as practicable marked "Revise and Resubmit."

2. PRODUCTS

2.1 Equipment Schedule

.1 Unless indicated otherwise, supply and install all equipment listed on the Equipment Schedule, detailed on the equipment specification sheets, or shown on the Drawings.

.2 Determine the extent of equipment to be supplied from the Specifications, list of equipment and materials and manufacturer's Drawings covering the equipment. Furnish and install all additional materials necessary to complete the installation.

.3 Incorporate all ancillary devices in the installation including those providing for cooling water, seal water, lubricant supply, process drains, electrical connection, and instrumentation and control requirements.

2.2 Mounting Requirements

.1 Provide all supports, anchorage, and mounting of all equipment in accordance with the manufacturer's recommendations, the National Building Code, and industry standard requirements, unless otherwise specified.

.2 Design and provide all elements required to resist the calculated forces described herein or required by the element manufacturer.

.3 Design anchorage for all equipment bases, supports, and foundations in accordance with National Building Code for Seismic Zone 0.

.4 For rotating equipment, where specified, submit design notes and calculations for anchorage, signed and sealed by a Professional Engineer registered in the Province of Manitoba.

3. EXECUTION

3.1 Coordination

.1 Coordinate the Work specified under this Section with the Work of other Sections to produce a complete and workmanlike job.

.2 Coordinate the routing of electrical and control wiring and conduit with Division 16.

3.2 Preparation

.1 Before commencing installation of the Work, inspect and take field measurements and ensure that Work conducted previously in the area is not prejudicial to the proper installation of the Work.

.2 Refer to the equipment specifications and specification sheets for assistance in determining the form in which equipment is to be shipped and the extent of field assembly required.

.3 Dimensions shown on the Contract Documents for equipment bases, piping connections, etc., are approximate. Correct to suit the exact dimensions of the equipment provided for each application. Arrange any necessary modifications to piping connections, pipework, or other ancillaries at no cost and after acceptance by the Contract Administrator.

.4 Schedule the visits to the Site of the manufacturer's representative for the times and periods specified in other sections. Cooperate in his supervision of the installation and start-up. Follow all reasonable instructions of the manufacturer's representative. Should the Contractor require the manufacturer' representative to attend for longer or more frequent periods, he shall arrange this, at his own expense, with the manufacturer.

3.3 Installation of Equipment

.1 Install all equipment specified in other Sections, detailed on the equipment specification sheets, and shown on the Drawings.

.2 Dimensions shown on the Contract Documents for equipment bases, piping connections, etc., are approximate. Correct to suit the exact dimensions of the equipment provided for each application. Arrange any necessary modifications to piping connections, pipework, or other ancillaries at no cost and after acceptance by the Contract Administrator.

.3 Supply and install all necessary shims, gaskets, etc., required to complete the installation.

.4 Provide for the use of all necessary lifting and loading equipment and all tools required to complete the installation.

.5 Comply with the specific requirements for installation noted in other Sections of this Specification and with the instructions of the manufacturer. Where there is a conflict in these requirements, identify the conflict to the Contract Administrator and proceed as directed.

3.4 Equipment Bases and Anchorage

.1 Equipment will be mounted on housekeeping pads in accordance with 11005 1.13.

.2 For rotating equipment of 7.5 kW or above and for equipment requiring structural anchoring, set anchor bolts in advance. Where required, set anchor bolts in sleeves to permit minor adjustment during installation. Use machine base templates where shown.

.3 Where equipment is supplied with a plate steel base, provide access holes in the top of the plate and use a pour grade, non-shrink, non-metallic grout as specified in the structural concrete Specifications to fill the entire void under the base.

.4 Fixings to concrete structures shall be by adhesive anchors suitably designed for the application.

3.5 Alignment

.1 Set and align all rotating equipment in accordance with the more stringent requirements of either the manufacturer's requirements or the following:

.1 Level base, use machinists level on all machined bases.

.2 Align couplings to satisfy the following criteria:

Coupling Speed	Allowable Angular Misalignment	Allowable Parallel Misalignment
Under 100 rpm, below 50 hp	4' 00"	0.25 mm
Under 100 rpm, 50 hp and over	3' 00"	0.12 mm
100 to 600 rpm	2' 00"	0.12 mm
600 to 1800 rpm	1' 00"	0.10 mm
1800 to 3600 rpm	0' 35"	0.05 mm

.3 Check for soft foot, maximum permissible 0.002 mm.

.2 Where equipment undergoes a substantial differential temperature rise (30°C between driver and driven unit), provide precision benchmarks in foundation and on equipment and perform alignment at operating temperatures.

.3 Demonstrate to the Contract Administrator and manufacturer's representative the final alignment.

3.6 Lubricants

.1 Extend any inaccessible lubrication points and lubricant drains to convenient locations.

.2 Remove storage lubricant and provide the initial fill of new lubricants for the equipment. Lubricant grade to be as recommended by the manufacturer.

.3 Provide a Lubrication Schedule for all process equipment. Include the following:

.1 Equipment name and number

.2 Date(s) of lubrication

.3 Lubricant type installed

.4 Frequency of lubrication

3.7 Vibration Survey

.1 Conduct a vibration survey under normal operating conditions for all equipment with a motor size exceeding 37 kW and for smaller units where specified.

.2 Use a calibrated vibration sensor, accepted by the Contract Administrator, and capable of measuring unfiltered vibration velocities and peak-to-peak amplitudes. Select a sensor capable of measuring velocities at a precision of 0.1 mm/s and an accuracy of plus or minus 0.2 mm/s.

.3 Monitor vibration in all three dimensions at the head and tail end of both the driver and driven units, at intermediate bearing points, and at other critical locations which may be identified by the Contract Administrator.

.4 Record the vibration velocities for each item of rotating equipment and submit a report to the Contract Administrator detailing the findings. Include a description of the measuring equipment, identification of equipment on which vibration monitoring was completed, description of conditions under which the test was conducted, and a listing of all of the collected data.

.5 Unless specified otherwise, use unfiltered velocities as the vibration criteria. Unfiltered velocities less than 5 mm/sec shall be considered acceptable. Undertake corrective action where unfiltered velocities exceed 5 mm/sec.

3.8 Noise Survey

.1 Conduct a noise survey for all equipment over 37 kW and for smaller units where specified.

.2 Use a calibrated noise meter, accepted by the Contract Administrator, and capable of measuring noise in the A Scale at a precision of 0.5 dBA and an accuracy of 1.0 dBA.

.3 Measure noise levels at an elevation similar to the major noise emitter from the equipment (bearing housing, muffler, etc.) and at a horizontal distance of 1.0 m.

.4 Record the noise levels for each item of equipment and submit a report to the Contract Administrator detailing the findings. Include a description of the measuring equipment, identification of equipment on which noise level monitoring was completed, description of conditions under which the test was conducted, and a listing of all of the collected data.

.5 Equipment is to operate at a noise level less than 85 dBA, when measured in free field at 1.0 m. Noise requirements may be more stringent in areas where more than one item of process equipment is intended to operate concurrently. Specific requirements for equipment that differ from 85 dBA are listed in the Sections related to those items of equipment.

.6 Noise abatement features (acoustic panels, acoustic insulation, etc.) are specified in other Sections.

.7 In any process area, recommend whatever measures necessary to maintain a composite noise level below 90 dBA. Where directed by the Contract Administrator, undertake those corrective actions.

3.9 Quality Assurance Forms

.1 Test all process equipment to ensure the equipment operates in accordance with the basic design criteria listed in the Specification Sections or equipment specification sheets. Complete the series of forms that attest to the proper installation and functioning of the equipment. Refer to Section 01650 and 01670 for the Forms.

END OF SECTION

PROCESS PIPING

1. GENERAL

1.1 Description

.1 This Section describes the pipe materials, fittings, appurtenances, installation and testing of the modified air supply pipes.

.2 Existing air supply pipe system was installed in 1960s and pipe material is not known.

.3 Use the general requirements specified in this Section integrally with the more specific requirements listed in Section 11055 – Detailed Piping Specification.

.4 Piping supports are generally not shown on the process Drawings. Provide the design of piping supports, pipe guides, expansion joints and anchors based upon final piping layout. Typical support details and structural attachments shown on the Drawings indicate the level of quality that will be considered acceptable.

.5 The Contractor must provide the necessary submittals and ensure the proper registration of piping systems and system components as required by the Manitoba Labour and Immigration.

.6 Standard of Acceptance: items specified by manufacturer's name and/or catalogue number form part of this Specification in order to define the standard regarding performance, quality of material and workmanship. When used in conjunction with a referenced standard, shall be deemed to supplement the standard.

.7 Work Not Included in this Section:

.1 The following items are specified under other Sections of these Specifications:

.1 The aeration pipes within the grit removal and pre-aeration tanks including droplegs and horizontal manifolds as specified in Section 11529 – Coarse Bubble Aeration Devices.

1.2 Definitions

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

.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 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°C.

.2 Exposed, Aboveground: outside or within an enclosure which is not environmentally controlled so that the temperature is maintained above 5°C. 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 or channels, and within 3.0 m above maximum water level of open tankage, including pipe and appurtenances within manholes, vaults, and chambers.

1.3 Reference Standards

.1 Conform to the most recent version of the following reference standards:

.1 ANSI/ASME A13.1, Scheme for the Identification of Piping Systems

.2 ANSI/ASME B1.20.1, Pipe Threads, General Purpose

.3 ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800

.4 ANSI/ASME B16.3, Malleable Iron Threaded Fittings Class 150 and 300

.5 ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings

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

.7 ANSI/ASME B16.11, Forged Steel Fittings, Socket Welding and Threaded.

.8 ANSI/ASME B16.12, Cast Iron Threaded Drainage Fittings

.9 ANSI/ASME B16.15, Cast Bronze Threaded Fittings, Classes 125 and 250

.10 ANSI/ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings

.11 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

.12 ANSI/ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes

.13 ANSI/ASME B31.3, Process Piping

.14 ANSI/ASME B36.10M, Welded and Seamless Wrought Steel Pipe

.15 ANSI/ASME B36.19M, Stainless Steel Pipe

.16 ASTM A47, Malleable Iron Castings

.17 ASTM A53, Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless

.18 ASTM A105/A105M, Forgings, Carbon Steel, for Piping Components

.19 ASTM A126, Grey-Iron Castings for Valves, Flanges, and Pipe Fittings

.20 ASTM A135, Electric-Resistance-Welded Steel Pipe

.21 ASTM A139, Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and Over)

.22 ASTM A167, Stainless Steel and Heat-Resisting Chromium-Nickel Steel Plate

.23 ASTM A181/181M, Forgings, Carbon Steel, for General Purpose Piping

.24 ASTM A234/A234M, Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

.25 ASTM A276, Stainless and Heat-Resisting Steel Bars and Shapes

.26 ASTM A307, Carbon Steel Bolts and Studs, 60 000 psi Tensile Strength

.27 ASTM A312/312M, Seamless and Welded Austenitic Stainless Steel Pipe

.28 ASTM A320/320M, Alloy Steel Bolting Materials for Low-Temperature Service

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

.30 ASTM A563, Carbon and Alloy Steel Nuts

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

.32 ASTM A778, Welded, Unannealed Austenitic Stainless Steel Tubular Products

.33 ASTM A967, Standard Specification for Chemical Passivation Treatment for Stainless Steel Parts

.34 ASTM B32, Standard Specification for Solder Metal

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

.36 CSA CAN3-Z299.3, Quality Verification Program Requirements

.37 EJMA STDS-93, Standards of Expansion Joint Manufacturers' Association, Edition No. 6

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

.39 MIL-H-13528B, Hydrochloric Acid, Inhibited, Rust Removing

.40 MSS SP25, Standard Marking System for Valves, Fittings, Flanges and Unions

.41 MSS SP43, Wrought Stainless Steel Butt Welding Fittings

.42 SSPC-P3, Canadian Government Standards Board

.43 SSPC-SP6, Canadian Government Standards Board

.44 SSPC-SP10, Canadian Government Standards Board

.45 TSSA, Technical Standards and Safety Association

.46 Provincial Building Code

.47 Provincial Plumbing Code

1.4 Design Requirements

.1 The design has been completed to the degree necessary for the Contractor to Bid. It is not fully detailed and will require the Contractor to undertake design of and responsibility for minor aspects for the piping systems to be installed.

.2 All process piping shall meet requirements of the Process Piping Code, B31.3, whether or not it falls within the Code scope. Manitoba Department of Labour and Immigration shall be the Code Authority whenever the piping system falls within the Code scope. The Contract Administrator shall be the Code Authority for process piping that does not fall within the Code scope.

.3 Piping and Instrumentation Drawings, piping schematics, and piping layout drawings are contained in the Drawings set. The Piping and Instrumentation Drawings (P&IDs) indicate all major pipework, valves, and appurtenances (other than cleanouts, purge points, etc.) The layout drawings indicate the design concepts and are intended to illustrate a constructible method for the piping systems. Some appurtenances, supports, guides and anchors, and expansion joints are not fully shown. The Contractor's design will complement and detail these Drawings.

.4 It is understood that some conflicts will arise that will require that the Contractor re-route some of his piping to allow for the installation of wiring, ventilation duct, or similar.

.5 The Contractor is required to engage a Professional Engineer registered in the Province of Manitoba to be responsible for the final aspects of the design. The components of the design that will be generated will be as follows:

.1 Final layout, illustrated using layout and isometric drawings.

.2 Piping flexibility and stress analysis proving that the allowable stresses prescribed by the Process Piping Code B31.3 are not exceeded under any prescribed combination of conditions, and indicating the forces and moments in each direction under each condition at each support, guide or anchor.

.3 Piping support system design, including details and spacing of all supports. The support system will ensure that the weight of the pipework and the need for lateral and vertical support are considered fully.

.4 Expansion and contraction design, including the layout and details for all necessary expansion joints needed to compensate for thermal expansion and contraction, structural movement, and the isolation of equipment.

.5 Thrust restraint design, including thrust restraint required due to any forces imposed during construction, pressure testing, normal operation, and/or surging, if applicable. The thrust restraint design shall include a minimum safety factor of 2.0 using the maximum thrust force that will be experienced during construction, pressure testing, normal operation, and/or surging, if applicable. This requirement applies to new piping systems as well as to existing piping systems that may be modified.

.6 The piping system shall have sufficient flexibility to prevent thermal expansion or contraction or movements of piping supports and terminals causing:

.1 Failure of piping or supports from overstress or fatigue

.2 Leakage at joints

.3 Detrimental stresses or distortion in piping and valves or in connected equipment or piping systems not designed by the Contractor, resulting from excessive thrusts and moments in the piping.

.6 Design documentation will be submitted to the Contract Administrator as necessary to indicate compliance with the requirements of the piping systems. The documentation will be signed and sealed by a Professional Engineer registered in the Province of Manitoba, who must provide evidence of experience with such systems.

.7 Note that for large diameter, thin walled (thickness less than 1 percent of diameter) piping comprehensive flexibility and stress analysis is required, even if the design met the exception granted under section 319.4.1(c) of the Process Piping Code B31.3.

1.5 Submittals

.1 For each piping system refer to Section 11055, 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

.1 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 Contract Administrator.

.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 For all pipes greater than or equal to 50 mm diameter, submit isometric drawings, to indicate the assembly details, the welds, flanges, valve placement, cathodic protection, expansion joints, guides, anchors, hangers, supports, and the provisions for thrust restraint, as well as any other pertinent details.

.5 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.)

.6 Submit copies of all original submittals and all related correspondence made as part of the regulatory submission required by the Manitoba Department of Labour and Immigration and any submissions required by other regulatory authorities.

.7 Product Samples

.1 Where specified or when directed by the Contract Administrator, provide mill test results or product samples.

.8 Provide hanger, guide, and anchor, support system design details including locations, load information, design calculations and illustrative drawings, signed and sealed by a Professional Engineer registered in the Province of Manitoba. Refer to Section 11052.

.9 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, signed and sealed by a Professional Engineer registered in the Province of Manitoba. Refer to Section 11053.

.10 Welding

.1 Prior to commencing any welding of stainless steel pipe, prepare and submit to the Contract Administrator 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 signed and sealed by a Professional Engineer registered in the Province of Manitoba and qualified for welding design. For stainless steel welds exposed to process fluids, the weld procedure should provide for maximizing the corrosion resistance of the final weld as well as providing the mechanical strength required.

.11 Radiographic weld test results

.12 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

.1 Refer to Section 11910 for process 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, or commodity, being conveyed.

.3 The commodity codes are defined in the Drawings.

.3 Detailed process pipe specifications are provided for each commodity in Section 11055.

.4 Routing

.1 Coordinate piping installation routes and elevations with installation of sheet metal, process equipment, HVAC, instrumentation, and electrical Work.

.5 Pipe sleeves

.1 Coordinate with other Divisions to locate and place sleeves in cast-in-place concrete and in masonry building elements prior to construction.

.6 Coordinate with Division 17 to provide correct piping configuration for primary instrumentation elements. For example, provide required minimum straight run of pipe upstream and downstream of flow meters. Coordinate with Division 17 for meter manufacturer's requirements.

1.7 Quality Assurance

.1 Welding certification

.1 All welders are to be certified under the Manitoba Department of Labour and Immigration and Regulations. As a minimum, welders will hold a Level B Journeyman Welder's Certificate.

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

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

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

.2 Weld tests

.1 All piping welds shall be 100 percent 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 Contract Administrator.

.2 For piping required by the applicable Code to be subject to radiographic inspection, or for welds not found satisfactory during the Contract Administrator's visual inspection provide for one full circumference radiographic inspection for every 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 Contract Administrator.

.3 Contractor to provide for one full circumference radiographic inspection for every 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 Contract Administrator.

.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 Contract Administrator.

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

.3 Regulatory submissions

.1 Complete all regulatory submissions as required by the Manitoba Labour and Immigration.

.2 Complete all other submissions as required by 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 Contract Administrator 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 Contract Administrator 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 Contract Administrator.

1.9 Shipment, Protection and Storage

.1 Refer to Section 01600 for Shipment and Storage.

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

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

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

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

.6 Protect non-UV light inhibited plastic from sunlight.

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

.8 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.

1.10 Warranty

.1 Contractor shall supply new materials and re-do the Work should materials be found to be defective or not in compliance with the Specifications, or should the workmanship be found to be inadequate or the Work was not performed in accordance with the Specifications and referenced standards, codes and regulations. This warranty shall remain in effect for the maximum period of time allowed under Law.

.2 Neither the Contract Administrator's inspections, checks, or any other tests or subsequent authorization to proceed with the Work, nor the Contract Administrator's waiving of the Contract Administrator's right to perform such tests, nor the Contract Administrator's decision not to solicit submission of material certificates or other quality assurance documentation relieve the Contractor from any degree of responsibility in regard to the Work or the corresponding warranty above. The Contractor agrees that the Contract Administrator's ability to fully assess the suitability of materials, procedures, worker qualifications and other relevant issues is limited. The Contractor bears full responsibility and is solely liable in these matters.

.3 The use of faulty materials or materials that do not meet the Specifications and referenced standards, codes and regulations shall constitute a hidden defect.

.4 Employment of labour not properly qualified, the performance of the Work not in accordance with the Specifications and the referenced standards, codes and regulations, and the use of inadequate of sub-standard workmanship shall constitute hidden defects.

2. PRODUCTS

2.1 Function

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

2.2 Pipe Materials - General

.1 All pipe materials to be new, free from defects and conforming to the reference standards identified in Section 11055.

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

2.3 Pipe Sizes

.1 Where the pipe size is not specified, provide pipe with the sizes required by the National Plumbing Code. For small piping not described by the National Plumbing Code, use 13 mm nominal diameter.

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 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

.1 75 mm 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 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 must 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).

2.5 Grooved Piping System, Stainless Steel Type 304

.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 Grooved Couplings

.1 Grooved couplings shall be manufactured from stainless steel conforming to ASTM A351, ASTM A743 or ASTM A744.

.2 Grooved couplings to be designed with angle pads to provide a rigid joint, unless, otherwise noted. Standard of Acceptance: Victaulic Style 489 (Victaulic Data Sheet 17.25). Note: in some applications painted or galvanized ductile iron couplings may be used to joint stainless steel pipe. Confirm with manufacturer.

.3 Where expansion, contraction or angular deflection is designed into piping system flexible couplings shall be used. Standard of Acceptance: Victaulic Style 77S and Victaulic Style 475 (Victaulic Data Sheet 17.03 and 17.14).

.3 Grooved fittings: all grooved fittings to be manufactured from stainless steel conforming to ASTM A312, ASTM A403 or ASTM A774. Standard of Acceptance: fittings manufactured by Victaulic (Victaulic Data Sheet 17.04).

2.6 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. Refer to the Detailed Pipe Specification Sheets for the recommended gasket material. Material designations used in the Detailed Pipe Specification Sheets are as follows:

.1 EPDM: ethylene-propylene-diene-terpolymer 70 durometer

.2 B1. Neoprene: neoprene (black) 70 durometer (not acceptable in stainless steel pipe systems)

.3 Nitrile: nitrile (Buna N)

.4 Natural rubber: natural rubber

.5 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400), and neoprene binder: 1.7 MPa (ASTM F152), 0.2 mL/h Leakage Fuel A (ASTM F37)

.6 Compressed synthetic fibres (Kevlar): ASTM F104 (F712400) and SBR binder: 1.7 MPa (ASTM F152). 0.1 mL/h Leakage Fuel A (ASTM F37)

.7 Gylon Type 1: Garlock Style 3500. 1.35 MPa (ASTM F152). 0.22 mL/h Leakage Fuel A (ASTM F37)

.8 Gylon Type 2: Garlock Style 3510. 1.35 MPa (ASTM F152). 0.04 mL/h Leakage Fuel A (ASTM F37)

.9 CPE - chlorinated polyethylene

.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 rings 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- and glass-lined piping systems for solids-carrying liquids, provide end-seal type gaskets.

.3 Unless otherwise specified, provide flush seal type gaskets for all other grooved joint systems. Acceptable Products: Gustin-Bacon Rigigrip, Victaulic Flush-Seal.

2.7 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, Grade A.

.3 Provide stainless steel bolts, nuts and washers for exposed, submerged, buried and concrete encased service; bolts conforming to ASTM A193, Grade B8, C1.1; nuts conforming to ASTM A194, Grade 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.

2.8 Interior Finishes (Linings)

.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.

.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.

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 Piping arrangements indicated on the Drawings have been established on the basis of the "Design Standard" listed in the specific process equipment sections. If the equipment to be provided is not the Design Standard, modify the piping arrangement as necessary at no additional expense to the City.

.4 Advise the Contract Administrator of all modifications. Do not commence Work on the related piping until all modifications have been reviewed by the Contract Administrator.

.5 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 directions and to the satisfaction of the Contract Administrator.

.4 Damaged glass lining cannot be repaired. Damaged pipe must 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 Installation

.1 Fabricate and install process and pressure piping in accordance with the Process Piping Code B31.3 and the Manitoba Department of Labour and Immigration. Fabricate and install domestic hot and cold water piping, sanitary piping, and storm drainage piping in accordance with the National Plumbing Code.

.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 a temperature between 15°C and 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°C to 20°C and such that they will not deflect excessively during handling and installation. These blocks shall be removed prior to pressure testing.

.7 Install pipes in straight alignment. For large diameter (500 nominal diameter 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 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.

3.4 Stainless Steel Welding

.1 Conform to reviewed stainless steel pipe welding procedures, which have been signed and sealed by a Professional Engineer registered in the Province of Manitoba, and to Section 05500.

.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 for field and shop welds (GMAW or GTAW). For these services, "Solar Flux" and similar products 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 6 mm 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 6 mm radius, make radius one half of material thickness.

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

.7 Passivation

.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 percent nitric acid and 2 percent hydrofluoric acid in chloride-free water. Treat for no less than two hours at 20ºC to 40ºC. Do not do the Work at less than 20ºC. An equivalent pickling paste shall be used for air piping not designed to be filled with water. Follow the manufacturer's 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 20ºC at the outlet end) overnight.

.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 City at the closest primary effluent channel. Note that the City may limit the volume that may be discharged over any period of time. Take measures to prevent freezing.

.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 Pickling and passivating may require the ingress of an individual into the process air pipe. A single individual may do so once the pipe has been installed. 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. Confined entry procedures shall apply. Footwear, other items or tools that could scratch the stainless steel surface shall not be carried into the pipe.

3.5 Grooved Piping System Installation

.1 All grooved products shall be installed according to manufacturer's 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 Schedule 10 stainless steel pipe shall be roll grooved using "RX" rolls in accordance with manufacturer's 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 installation instructions.

3.6 Testing

.1 Give the Contract Administrator 24 hours notice prior to testing.

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

.3 Complete any required weld tests.

.4 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 Contract Administrator. Use 5 percent copper sulphate solution. After 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 Contract Administrator 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.

.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 Dispose of flushing water in manner approved by the Contract Administrator, which causes no damage to buildings or Siteworks.

3.7 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. Pneumatically test all instrument air lines in accordance with ISA-RP7.1.

.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 Contract Administrator. At the Contract Administrator's request, provide calculations indicating design of temporary support system.

.3 Test medium:

Pipe Size Specified	Test Pressure	Test Medium
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 percent of the specified test pressure as the allowable leakage rate 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.

.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/CGA B139-1.

3.8 Cleaning and Flushing

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

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

Suction Diameter, mm	**Maximum Screen Opening, mm**
0 - 25	1.5
30-75	6.25
80-150	12.5
>150	25

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

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

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

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

.7 Brush clean steel pipe exterior to SSPC-P3 standard prior to painting. Also refer to Section 09900 and Section 11900.

END OF SECTION

PROCESS PIPE JOINTS AND EQUIPMENT CONNECTIONS

1. GENERAL

1.1 Description

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

.2 Refer to the general piping requirements of Section 11050. Use the general requirements specified in this Section and Section 11050 integrally with the more specific requirements listed in Section 11055.

.3 Work Not Included in this Section:

.1 The following items are specified under other Sections of these Specifications:

.1 The aeration pipes within the grit removal and pre-aeration tanks; including droplegs and horizontal manifolds as specified in section 11529 – Coarse Bubble Aeration Devices.

1.2 Submittals

.1 With the submittals required in Section 11050, provide a listing of joining and connecting techniques used in the performance of the Work.

1.3 Coordination

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

1.4 Quality Assurance

.1 Refer to Section 11050 for welding quality assurance requirements.

1.5 Shipment, Protection and Storage

.1 Refer to Section 01600 and Section 11050.

2. PRODUCTS

2.1 Function

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

2.2 General

.1 Connect piping using joints not readily disassembled only where shown and where not otherwise specified. Provide joints which may be disassembled as indicated on the Drawings, and at the minimum, within 1000 mm of any connection to equipment, on both sides of structural penetrations, within 600 mm of all threaded end valves, and at the spacing specified in the detailed piping specification sheets.

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

2.3 Welding Materials

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

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

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

.4 Keep stainless steel rods in marked containers, separate from other materials.

2.4 Dissimilar Metal Connections

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

2.5 Schedule Stainless Steel Pipe

.1 Less than 75 mm in diameter: socket-weld pipe. Where disassembly is required, use threaded unions.

.2 Equal to or greater than 75 mm in diameter: butt-weld pipe; where disassembly is required, use flanges.

.3 Flanged Connections:

.1 Make flanges on stainless steel piping stainless steel slip-on, rolled-angle collar 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. Stamped (pressed) collars are not acceptable.

2.6 Gauge Stainless Steel Pipe

.1 Less than 75 mm in diameter: socket-weld pipe. Where disassembly is required, use socket weld unions.

.2 Equal to or greater than 75 mm in diameter: butt-weld pipe; where disassembly is required, use flanges.

.3 Flanged Connections:

.1 Make flanges on stainless steel piping stainless steel slip-on, rolled-angle collar 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. Stamped (pressed) collars are not acceptable.

2.7 Flanges

.1 General requirements for flanges are as follows:

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

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

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

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

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

3. EXECUTION

3.1 Mild Steel Welding

.1 Refer to Section 11050 for mild steel welding requirements.

3.2 Stainless Steel Welding

.1 Refer to Section 11050 for stainless steel welding requirements.

3.3 Flanged Joints

.1 Clean flanges and gaskets prior to connection.

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

.3 Bring flanges into close parallel and lateral alignment.

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

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

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

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

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

.9 Provide flanges at spacings noted in the Drawings and in Section 11055 to allow for pipe disassembly.

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

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

PROCESS PIPE JOINTS AND EQUIPMENT CONNECTIONS

Table - Pipe Connections Types

Piping Material	Pipe Type	Diameter Range (mm)	Equipment End								
			Tubing/Various	Brass or Bronze Female Thread	Cast Iron or Steel Female Thread	Cast Iron Flanged	Steel/Stainless Flanged	Steel/Stainless Plain End	Steel or Stainless Welding End	Fibreglass Flanged	PVC Female Thread
Stainless Steel	Schedule 40S	10 to 65		Socket Weld Nipple and Union Rating: Class 250	Socket Weld Nipple and Union Rating: Class 250			Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating: Class 150 RF			Socket Weld Nipple and Union Rating: Class 250
		Greater than 65				Rolled Angle Van Stone Flange Rating: Class 125 FF	Rolled Angle Van Stone Flange Rating: Class 150 RF	Flexible Joint Flanged One End Rating: Class 150 RF or Flange Adaptor and Van Stone Flange Rating: Class 150 RF	Butt Welded (SS Equip. End)		

END OF SECTION

PROCESS PIPE GUIDES AND ANCHORS

1. GENERAL

1.1 Description

.1 This Section describes process pipeline guides and anchors to be installed integrally with the piping. These items are an integral component of the piping support system for which other requirements are described in Section 11050.

.2 Refer to the general piping requirements of Section 11050. Use the general requirements specified in this Section and Section 11050 integrally with the more specific requirements listed in Section 11055.

.3 Work not included in this Section:

.1 The following items are specified under other Sections of these Specifications:

.1 The aeration pipes within the grit removal and pre-aeration tanks; including droplegs and horizontal manifolds as specified in Section 11529 – Coarse Bubble Aeration Devices.

1.2 Submittals

.1 Provide Shop Drawings, signed and sealed by a Professional Engineer registered in the Province of Manitoba, for each type of pipeline support and anchor in accordance with the requirements of Section 01300 and 11050.

.2 Show the materials of construction and illustrations of the method of installation.

.3 Refer to Section 11050 for requirements for submittals for the support system that incorporates the pipe guides and anchors.

.4 Provide evidence that the manufacturer has at least five (5) installations of similar size and type in satisfactory service for a period of not less than five years.

1.3 Coordination

.1 Coordinate the guides and supports with the pipe support system. Ensure that the guides and supports are mounted in locations suitable for their intended function.

1.4 Quality Assurance

.1 Welding Requirements: refer to Section 11050 for welding quality assurance requirements.

.2 Alignment: for large diameter (500 mm and larger), thin walled (6.4 mm and less) stainless steel piping supports laser align such that lateral and vertical misalignments between three consecutive supports do not exceed the wall thickness.

1.5 Process Air Pipe Anchors and Guides

.1 The process air pipe anchor and guide manufacturer will be regularly engaged in the business of designing and fabricating pipe anchors and guides of the size and type specified and shown on the Drawings.

1.6 Shipment, Protection, and Storage

.1 Refer to Section 01600 and Section 11050.

2. PRODUCTS

2.1 Function

.1 Provide the pipe guides and anchors as described below, for the piping systems shown.

2.2 Process Air Pipe Guides and Anchors

.1 Provide PTFE lower bearing surfaces not less than 2.4 mm thick of 100 percent virgin material in accordance with ASTM D1457 and with a 25 percent content of glass fiber filling.

.2 Provide PTFE lower bearing surfaces mechanically secured and bonded to a substrate made of 10 gauge or 3.2 mm thick type 304 stainless steel with a 6.4 mm welding lip all around.

.3 Provide PTFE with minimum 20 MPa tensile strength, tested in accordance with ASTM D638; 200 percent elongation minimum, tested in accordance with ASTM D638; and 216 ± 0.03 relative density, tested in accordance with ASTM D792.

.4 Provide stainless steel components to ASTM A167; type 304. For submerged applications, provide Type 316 stainless steel.

.5 Provide stainless steel upper bearing surfaces with an annealed mirror finish in accordance with ASTM A480 and having a maximum surface roughness of 0.15 microns.

.6 Provide these filled Teflon to stainless steel slide bearings as manufactured by Amscot Structural Products, Piping Technology and Products, or approved equal, in accordance with B6 and with the dimensions shown on the Drawings.

.7 Use welding procedures which minimize distortion of the pipe guides and anchors, and avoid damage to the finished work or bonded materials. Stitch weld thin stainless steel.

.8 Finish members true to line, free from twists, bends, open joints, sharp corners and sharp edges.

.9 Provide fabrication tolerances as follows:

.1 Overall dimensions to within 3 mm.

.2 Machined surfaces to within 0.4 mm.

.3 Backing plates for sliding surfaces to within 0.8 mm.

.4 Deviation from flatness of PTFE surfaces to 0.2 mm maximum.

.5 Deviation from flatness of stainless steel surfaces intended for contact with PTFE to 0.0003 LH maximum.

.6 PTFE thickness to ±10 percent of the specified thickness.

.7 Parallelism of one sliding surface with respect to the mating sliding surface, as datum, to 0.2 percent of the longer side, maximum.

.8 Matching holes for bolts to register so that a gauge 2 mm smaller in diameter than the holes will pass freely through the assembled members at right angles to such members.

.9 Finished bolt holes to not more than 2 mm in diameter larger than the bolt diameter.

.10 Center-to-center distances between bolt holes to within 1 mm of the dimensioned distance.

.10 Drill or ream bolt holes.

.11 Provide vibration resistant type fasteners.

.12 Provide stainless steel sliding surfaces intended for contact with PTFE of one piece continuously welded around the perimeter to the back plate to prevent ingress of moisture. Provide the weld clean, sound, smooth, uniform, without overlaps, properly fused, and located outside the area of contact with PTFE.

.13 Machine or fine grind metal-to-metal contact surfaces. Machine sliding metal contact surfaces in the principal direction of movement. Machine after welding whenever possible.

.14 Provide metal surfaces in contact with PTFE with no openings or discontinuities, and a maximum surface roughness of three microns.

.15 Remove abrasive materials from finished surfaces and clean with a degreasing agent.

.16 Protect finished surfaces from contamination and mechanical damage.

3. EXECUTION

3.1 Process Air Pipe Guides and Anchors

.1 Unless written permission has been obtained from the manufacturer and from the Contract Administrator, do not dismantle the pipe guides after they have left the manufacturer's shop, in order to prevent contamination of the sliding surfaces.

.2 Use stainless steel shims to laser-align supports before installing the piping. Tighten J-bolts and grout using liquid, non-shrink, epoxy grout. Prevent ingress of grout into the annular space between the J-bolts and their pipe casing (the use of flexible sealant is allowed). Concrete base foundations for anchors and sliding supports shall be built with the top surface approximately 25 mm below aligned bottom of support plate. Allow for this much epoxy grout at each location.

.3 Construct of fabricate as indicated in the Drawings or use approved commercial systems as indicated above.

END OF SECTION

EXPANSION JOINTS

1. GENERAL

1.1 Description

.1 This Section describes expansion joint supply and methods for installation.

.2 Refer to the general piping requirements of Section 11050. Use the general requirements specified in this Section and Section 11050 integrally with the more specific requirements listed in Section 11055.

.3 The number and location of expansion joints detailed on Drawings is indicative only. Contractor to provide a complete piping system design as described in Section 11050.

.4 Work not included in this Section:

.1 The following items are specified under other Sections of these Specifications:

.1 The aeration pipes within the grit removal and pre-aeration tanks including droplegs and horizontal manifolds as specified in Section 11529 – Coarse Bubble Aeration Devices.

1.2 Submittals

.1 With the submittals required in Section 11050, provide a listing of the expansion joints used in the performance of the Work.

1.3 Coordination

.1 Coordinate the expansion joints with the piping requirements and ensure that the connection techniques match.

1.4 Quality Assurance

.1 Comply with the requirements of EJMA.

1.5 Shipment, Protection and Storage

.1 Refer to Section 01600 and Section 11050.

2. PRODUCTS

2.1 Function

.1 Expansion joints are used to compensate for thermal expansion and contraction in the piping system; to isolate equipment from stresses and vibration transmitted from the piping system; and to allow for seismic or long term settlement which could cause differential movement in adjacent piping or equipment.

2.2 Metal Clad Expansion Joints

.1 Design and fabricate expansion joints in accordance with EJMA standards and to meet the requirements of this Section.

.2 Provide expansion joints as necessary to allow for piping expansion and contraction. 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 -40°C to maximum service temperature.

.6 Provide factory precompressed expansion joints where required to suit installation temperature.

.7 For methanol piping provide CSA and ULC approved OPW stainless steel flexible connectors with convoluted stainless steel hose with 304 stainless steel wire braid.

.8 Formed Bellows Type, Low Temperature

.1 For up to 150°C

.2 Fabricate with 321 stainless steel corrugations, rated for the design pressure and temperature. Factory pressure and leak test at the design temperature.

.3 Design expansion joint 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.

.4 For expansion joints with specified lateral movements greater than 3.0 mm, except for the Process Air piping system, 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.

.5 Provide limit rods which are full load rated in the event of anchor failure and to protect expansion joint from excessive axial movement. Process Air piping system expansion joints do not require limit rods unless they are to accommodate movement of the supporting structures.

.6 Unless otherwise specified, provide Van Stone flanges with galvanized steel backing flanges drilled to ANSI B16.5 for all expansion joints without limit rods.

.7 Provide fixed forged steel flanges on expansion joints requiring limit rods.

.8 Acceptable manufacturers are:

.1 American BOA

.2 Senior Flexonics

.3 Hyspan Precision Products

.9 Formed Bellows Type, Medium Temperature

.1 For up to 425°C

.2 Fabricate with 321 stainless steel corrugations, rated for the design pressure and temperature. Factory pressure and leak test at the design temperature.

.3 Design expansion joint to meet the requirements of movement specified (axial, lateral, angular).

.4 Provide expansion joints with control rings, control rods and limit rods as described above, for low temperature formed bellows type.

.5 Use flanged steel plate end connections, drilled to ANSI B16.5.

.6 Acceptable manufacturers are:

.1 American BOA

.2 Senior Flexonics

.3 Hyspan Precision Products

.10 Formed Bellows Type, High Temperature

.1 For up to 700°C

.2 Fabricate with 321 stainless steel corrugations rated for the design pressure and temperature. Factory pressure and leak test at the design temperature.

.3 Design expansion joint to meet the requirements of movement specified (axial, lateral and angular). Provide expansion joints with control rings, control rods and limit rods as described above for low temperature formed bellows type.

.4 Use flanged stainless steel plate end connections, the same as the bellows, drilled to ANSI B16.5.

.5 Acceptable manufacturers are:

.1 American BOA

.2 Senior Flexonics

.3 Hyspan Precision Products

.11 Steel Expansion Compensator Type

.1 Provide steel compensator type expansion joints in steel pipe systems of 65 mm diameter and less for CWR, CWS, DHF, GLR, GLS, HRR and HRS systems only.

.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

.12 Bronze Expansion Compensator Type

.1 Provide bronze compensator type expansion joints in copper pipe systems of 50 mm diameter and less for DHF, DHR, RFH, RFL and RFS systems only.

.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

.13 Tied Universal Expansion Joint

.1 Provide steel tied universal assembly type expansion joints in steel pipe systems for HRR and HRS pipe systems.

.2 Use a dual stainless steel bellows arrangement with a minimum of three 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°C.

.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 for HRR and HRS pipe systems.

.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°C.

.8 Acceptable manufacturers are:

.1 American BOA

.2 Hyspan Precision Products - Series 3500

.3 Senior Flexonics

2.3 Elastomer Expansion Joints

.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.

.1 For service temperatures between 80°C and 120°C, use chlorobutyl or EPDM for the elastomer tube.

.2 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.

.5 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.

.5 Acceptable manufacturers are:

.1 Senior Flexonics

.2 Garlock

.3 Mercer

.4 Techniquip

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

.3 Acceptable Manufacturers:

.1 Senior Flexonics

.2 Garlock

.3 Mercer

.4 Techniquip

.5 Proco

2.4 Sliding Joints - Liquid Service

.1 Provide single end type sliding expansion joints able to allow longitudinal movement and radial stresses while maintaining pipe alignment. Provide through rods where necessary to maintain alignment.

.2 Limit longitudinal separation of the two pipe sections to 50 percent of the manufacturer's recommended maximum by a restraining flange affixed to the slip pipe with the bolts extending through this flange.

.3 Use packing material suitable for the service conditions.

.4 Acceptable products are:

.1 Dresser Style 63

.2 Ford Meter Box FEJ

.3 Robar 8808-1

.4 Rockwell 611

2.5 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 centerline.

.3 Provide one 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

3. EXECUTION

3.1 Expansion Joints

.1 Accurately align pipelines to receive expansion joints before installing the joint. Do not stretch, compress or offset the joint to fit the piping.

.2 Align and install each expansion joint in accordance with EJMA standards and with the manufacturer's written instruction; properly guide and anchor all expansion joints. No lateral movement is permitted on compensator type expansion joints.

.3 On rubber expansion joints, check bolt tightness, and tighten where necessary one week after commissioning.

3.2 Flexible Hose Connectors

.1 Accurately align pipelines to receive flexible connectors before installing the connectors. Do not stretch, compress, misalign or offset the connectors.

.2 Align and install each flexible connector in accordance with the manufacturer's instructions.

.3 Support, anchor and guide the piping so that the flexible connectors are not required to absorb any axial compression or elongation.

.4 Do not torque or twist the flexible connectors.

.5 Check bolt tightness and tighten where necessary, a maximum of one week after commissioning and periodically thereafter.

END OF SECTION

DETAILED PIPING SPECIFICATION

1. GENERAL

1.1 Work Included

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

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

1.2 Process Piping Commodity Summary

AIR	Process Air	304 Stainless Steel , Sch 40

2. PRODUCTS

2.1 Schedule

.1 Pages 3 to 4 following.

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DETAILED PIPING SPECIFICATION

AIR

GENERAL					
		OPERATING LIMITS		TEST CONDITIONS	
PROCESS FLUID	SYMBOL	PRESSURE (kPa)	TEMP. (°C)	PRESSURE (kPa)	DURATION
Process Air	**AIR**	0-70	-40 to 150	175	120 minutes See Note 6
PIPE					
LOCATION	SIZE (mm)	MATERIAL	WALL THICKNESS	SPECIFICATIONS	REMARKS
All	300	304 Stainless Steel	12 Gauge	ASTM A240 ASTM A778 with scale removed or ASTM 312	Note 7
COATINGS					
LOCATION	SIZE (mm)	MATERIAL		SPECIFICATIONS	REMARKS
Under walkway Grit Tank Room	>25	N/A		See drawings	Note 2
Exposed in Corridor Under Airblower Room	>25	N/A		See drawings	Note 8
LININGS					
LOCATION	SIZE (mm)	MATERIAL		SPECIFICATIONS	REMARKS
All	>25	N/A			
JOINTS					
LOCATION	SIZE (mm)	TYPE	MAXIMUM SPACING	SPECIFICATIONS	REMARKS
All	>25	Butt Welded Flanged	N/A See drawings	ANSI B16.9 ASTM 351, ASTM 403 or ASTM A774 with scale removed.	Note 7

DETAILED PIPING SPECIFICATION

AIR (cont'd)

FITTINGS AND APPURTENANCES

ITEM	SIZE (mm)	MATERIAL	RATING	SPECIFICATIONS	REMARKS
Van Stone Flanges, Rolled Angle,	>50	Same as pipe, with Galvanized Steel Back-Up Ring	Class 150	Pipe Material: ASTM A240 Flanges: ASTM 285 Fabrication: ASTM A351, A403 or A774 with scale removed Pattern: ANSI B16.9	Note 7
Threadolet	10 - 40	Same as Pipe			
Expansion Joints	>50	EPDM Flange, with Galvanized Steel Back-Up Ring	Same as Pipe		Note 4
Expansion Couplings	N/A	N/A	N/A	N/A	Not Acceptable
Flange Gaskets		Compressed Kevlar With Neoprene Binder Free of Carbon Black			Full face gaskets are allowed for Van Stone & raised face flanges over 100 mm ND.

VALVES

TYPE	SIZE (mm)	VALVE SPECIFICATION (SECTION 11105)	REMARKS
Butterfly	≥100	BF09	
Ball	100 and 200	BV08	
Check	≥75	N/A	
Globe	-	N/A	
Gate	-	N/A	
Mud	-	N/A	
Needle	<75	N/A	
Vee Ball	-	N/A	

NOTES

1. Not used
2. Not used
3. Fabricate mitered elbows from pipe sections, except as indicated in Section 11050.
4. Where the exposure is buried or submerged and when shown in the drawings, use stainless steel bellows type expansion joints.
5. Not used
6. Test pressure shall be applied and sustained for 120 min, then all joints shall be tested with soapy water.
7. Thoroughly remove all internal and external scale or other surface deposits from pipe and fittings before welding.
8. Provide stenciled warning on outdoor piping as follows: "WARNING – EXTREMELY HOT".

END OF SECTION

PROCESS PIPE HANGERS AND SUPPORTS

1. GENERAL

1.1 Work Included

.1 Supply and installation of hangers and supports for all process piping systems specified in Section 11050. This Section does not include pipe support for plumbing systems, HVAC systems, fire sprinkling systems, pipe anchors, guides, or seismic restraints.

.2 Engage a Professional Engineer to be responsible for the final aspects of the piping support system design, including details and spacing of all supports. The support system will ensure that the weight of the pipework and the need for lateral and vertical support are considered fully. Contractor to provide a complete piping system design as described in Section 11050.

1.2 Submissions

.1 Submit the following for information in accordance with Section 01300:

.1 In piping layout drawings specified in Section 11050, indicate hanger and support locations and provide legend summarizing load information and hanger and support component selection at each location.

1.3 Service Conditions

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

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

.3 Pipe support classifications:

.1 Hot Systems:

.1 A-1: 40°C - 230°C

.2 A-2: 230°C - 400°C

.3 A-3: Over 400°C

.2 Ambient systems:

.1 B-1: 15°C - 49°C

.3 Cold systems:

.1 C-1: 0.5°C - 15°C

.2 C-2: -40°C - 0°C

1.4 Hanger and Support Selection

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

.2 Piping insulation thickness is specified in Section 11059.

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

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

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

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

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

.4 Wind, snow, or ice loadings on outdoor piping.

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

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

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

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

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

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

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

.12 Do not support piping from masonry wall construction.

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

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

.15 Use stock hanger and support components wherever practical.

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

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

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

2. PRODUCTS

2.1 Acceptable Manufacturers

.1 The following Manufacturers' Products to provide the specified features and to meet specified operating conditions:

.1 B-Line

.2 Grinnell

.3 Powerstrut

.4 Superstrut

.5 Unistrut

2.2 Support Spacing

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

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

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

2.3 Materials

.1 Non-Corrosive Environments (Air Blower Room Basement):

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

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

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

.2 Exterior, Submerged, or Corrosive Environments (grit tank room):

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

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

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

2.4 Pipe Hangers and Supports

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

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

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

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

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

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

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

.2 Steel pipe (un-insulated) - B-Line B3144 or Grinnell Figure 295

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

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

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

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

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

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

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

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

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

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

.7 Type 7 - U-Bolt: Provide carbon steel U-bolts with configuration as follows:

.1 Steel pipe (uninsulated) - Grinnell Figure B-Line B3188 or Superstrut H-115

.2 Steel pipe (insulated) - Grinnell Figure 137, B-Line B3188 or Superstrut H-115 with insulation shield

.8 Type 8 - Adjustable Pipe Roll Support: provide cast iron rollers and sockets, and carbon steel cross rod and support rods with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3122 or Grinnell Figure 177 with insulation shield

.2 Steel pipe (un-insulated) - B-Line B3122 or Grinnell Figure 177

.9 Type 9 - Welded Pipe Stanchion: provide a carbon steel, standard schedule pipe stanchion, cut pipe to match contour of pipe elbow. Use only for ambient commodity systems.

.10 Type 10 - Pipe Stanchion saddle: provide carbon steel saddles and yokes as follows:

.1 Steel pipe (insulated) - B-Line B3900 or Grinnell Figure 259 with insulation shield.

.2 Steel pipe (un-insulated) - B-Line 3090 or Grinnell Figure 259.

.11 Type 11 - Offset Pipe Clamp: provide carbon steel pipe clamps with configuration and components as specified and to the most standard design manufactured by a pipe hanger component manufacturer:

.1 Steel pipe (insulated) - B-Line B3148 or Grinnell Figure 103 or with insulation shield

.2 Steel pipe (un-insulated) - B-Line B3148 or Grinnell Figure 103

.12 Type 12 - Riser Clamp: provide carbon steel riser clamps with configuration and components as follows:

.1 Steel pipe (insulated) - B-Line B3373 or Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82

.2 Steel pipe (uninsulated) - B-Line B3373 or Grinnell Figure 261, Superstrut C-720 or Unistrut No. 82

.13 Type 13 - Framing Channel Pipe Strap: provide carbon steel pipe strap with configuration as follows:

.1 Steel pipe (un-insulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series

.2 Steel pipe (insulated) - B-Line B2400 Series, Powerstrut PS3126, Superstrut C-708-U or Unistrut P2008 Series with insulation shield

.14 Rack and Trapeze Supports:

.1 Unless otherwise specified, provide steel trapeze and pipe rack components having a minimum thickness of 2.8 mm with a maximum deflection 1/240 of the span. Framing channel as specified in 2.4.16.5.

.2 Type 20 - Trapeze Pipe Support: trapeze pipe support cross members as specified in 2.4.16.5. Provide 41 mm square carbon steel flat plate fittings of stranded design manufactured by framing channel manufacturer, B-Line B202-2, Powerstrut PS619 or Unistrut P1062 Series.

.3 Type 21 - Pipe Rack Support: post- and cross-member framing channels, as specified in 2.4.16.5. Provide carbon steel pipe rack fittings of standard design manufactured by framing channel manufacturer. Provide gusset type, 90-degree fittings, B-Line B844, Grinnell PS3373 or Unistrut P2484. Post base fittings as specified in 2.4.15.14.

.15 Structural Attachments:

.1 Type A - Malleable Iron Concrete Insert: provide malleable iron concrete inserts; B-Line B3014, Grinnell Figure 282, or Unistrut M2808.

.2 Type B - Side Beam Bracket: provide malleable iron bracket Grinnell Figure 202 or B-Line B3062.

.3 Type C - Malleable Beam Clamp with Extension Piece: provide malleable iron clamp and extension pieces with steel tie rods; Grinnell Figure 218 with Figure 157 extension piece or B-Line B3054.

.4 Type D - Steel Beam Clamp with Eye Nut: provide forged steel beam clamps and eye nuts; Grinnell Figure 292, B-Line B3291 series.

.5 Type E - Steel channel clamp: provide malleable iron clamp and heel plates, and steel bolts and nuts; Grinnell Figure 226.

.6 Type F - Welded Beam Attachment: provide carbon steel beam attachments; B-Line B3083 or Grinnell Figure 66.

.7 Type G - Adjustable Beam Attachment: provide carbon steel beam attachments, B-Line B3082, Unistrut P1737, or Powerstrut PS2648.

.8 Type H - Double Channel Bracket: provide single channel attachment as specified in 2.4.16.5. Provide a carbon steel, double-framing, channel, cantilever bracket assembly; B-Line B297-12 through B297-36, Powerstrut PS809 or Unistrut P2542 series.

.9 Type J - Single Channel Bracket: provide single channel attachment as specified in 2.4.16.5. Provide a carbon steel, single-framing channel, cantilever bracket assembly; B-Line B198-6 through B198-24, Powerstrut PS661, or Unistrut P2231 through P2234.

.10 Type K - Wall Mounted Channel: provide 41 mm x 62 mm carbon steel framing channel; B-Line B12 or Unistrut P5500.

.11 Type L - Pipe Stanchion Attachment: provide minimum 12 mm thick carbon steel baseplate. Anchor bolt holes: 1.6 mm larger than bolt diameter. Provide non-shrink grout between the baseplate and upstand.

.12 Type M - Welded Steel Bracket: provide carbon steel brackets which comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket; Grinnell Figure 195. Heavy welded bracket to comply with MSS Type 33 and FEDSPEC Type 34; Grinnell Figure 199.

.13 Type N - Cast Iron Bracket: provide cast iron brackets; Grinnell Figure 213.

.14 Type P - Framing Channel Post Base: provide carbon steel post bases of stranded design manufactured by framing channel manufacture. Single channel: Unistrut P2072A, B-Line B280 Powerstrut PS3025. Double channel: Unistrut P2073A, B-Line B281 or Powerstrut PS3064.

.15 Type Q - Continuous Concrete Inserts: provide 300 mm long carbon steel concrete inserts; Unistrut P3253.

.16 Accessories:

.1 Weldless Eye Nut: provide forged steel eye nuts and comply with MSS and FEDSPEC Type 17; Grinnell Figure 290 or B-Line B3200.

.2 Welded Eye Rod: provide carbon steel eye rods with eye welded closed. Inside diameter of eye to accommodate a bolt diameter 3.2 mm larger than the rod diameter; Grinnell Figure 278 or B-Line B3211.

.3 Turnbuckle: provide forged steel turnbuckles; Grinnell Figure 230 or B-Line B3202.

.4 Framing Channels: provide 41mm x 62mm roll formed carbon steel framed channel, having a thickness of 2.7 mm. Channel to have a continuous slot along one side with in-turned clamping ridges. Single Channel: Unistrut P5500. Double Channel: Unistrut P5501.

.5 Anchor bolts to Section 05500.

2.5 Hanger Rods

.1 Rod material shall conform to ASTM A307 as a minimum, and shall be cadmium plated in non-corrosive interior spaces, stainless steel in exterior, submerged, or corrosive applications, threaded on both ends or continuous threaded and sized as specified.

.2 Hanger rod sizing, as a minimum shall be as follows:

Pipe Size Nominal (mm)	Hanger Rod Diameter (mm)
50	10
75	12
100	16
150	20
200	22
250	25
300	25
400	29
500	38
600	44

2.6 Base Elbows

.1 Where elbows change the run of a horizontal pipe to a vertical direction, supports shall be secured to the elbow.

.2 Dimensions for the supports

Pipe Size Nominal (mm)	Support Pipe Diameter (mm)	Base Plate (mm x mm)
100	50 Schedule 40	100 x 6
150	75 Schedule 40	125 x 6
200	100 Schedule 40	150 x 6
250	100 Schedule 40	150 x 6
300	150 Schedule 40	200 x 10
350	200 Schedule 40	250 x 10
400	200 Schedule 40	250 x 10
500	250 Standard Weight	300 x 10
600	300 Standard Weight	350 x 10
750	350 Standard Weight	400 x 10
1050	350 Standard Weight	400 x 10

.3 Gauge piping: in general, support elbow stanchions for gauge stainless steel piping shall be of the same diameter as the pipe.

2.7 Thermal Pipe Hanger Shield

.1 Provide thermal shields at hanger, support and guide locations on pipe requiring insulation. The shield consists of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer. The thermal shield is the same thickness as the piping system insulation. Use standard shield for hot systems and vapour barrier shield for cold systems. Use stainless steel band clamps to ensure against slippage between the pipe wall and the thermal shield.

.2 Standard Shield:

.1 Insulation:

.1 Hydrous calcium silicate, high density, waterproof

.2 Compressive strength: 700 kPa average

.3 Flexural strength: 500 kPa average

.4 R value: 2.16 at 37.8°C mean

.5 Temperature range: -7°C to 260°C

.6 Steel Jacket: galvanized steel, thickness as per Manufacturer's standards, supplied for the given pipe size

.7 Connection: provide butt connection shield to pipe insulation. Steel jacket and insulation to be flush with end.

.2 Vapour Barrier Shield:

.1 Insulation:

.1 Hydrous calcium silicate, high density, waterproof

.2 Compressive strength: 700 kPa average

.3 Flexural strength: 500 kPa average

.4 R value: 2.16 at 37.8°C mean

.5 Temperature range: -7°C to 260°C

.2 Steel Jacket: galvanized steel, thickness as per Manufacturer's standards, supplied for the given pipe size

.3 Connection: provide butt connection shield to pipe insulation. Insulation to extend 25 mm each side of steel jacket for vapourtight connection to pipe insulation vapour barrier.

3. EXECUTION

3.1 Hanger and Support Location

.1 Locate hangers and supports as near as possible to concentrated loads such as valve, flanges, etc. Locate hangers, supports, and accessories within the maximum span lengths specified on Drawings to support continuous pipeline runs unaffected by concentrated loads.

.2 Provide hangers and/or base supports within 1000 mm of each change in direction on each leg, on one side of each valve, and on the first spool piece or fitting extending from a piece of equipment.

.3 Locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.

.4 Ensure that where piping is connected to equipment, a valve, piping assembly, etc. that will require removal for maintenance, the piping will be supported in such a manner that temporary supports will not be necessary for this procedure.

.5 Support piping so that no pockets will be formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves, and fittings.

.6 Install spring hangers where required to offset expansion in horizontal runs which follow long vertical risers.

3.2 Installation

.1 Welded and bolted attachments to the building structural steel to be in accordance with the requirements of Section 05500. Unless otherwise specified, do not drill or burn holes in the building structural steel.

.2 Do not use hanger components for purposes other than for which they were designed. Do not use hanger components for rigging and erection purposes.

.3 Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

.4 Aluminum or galvanized steel clips shall be used to support piping from aluminum or steel structural members. Where metals of different type are to be connected, provide isolation to prevent galvanic corrosion.

.5 Use embedded anchor bolts instead of concrete inserts for support installation in areas below water surface or normally subjected to submerging.

.6 Install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Butt joint connections to pipe insulation shall be made at the tie of insulation installation in accordance with the Manufacturer's recommendation.

.7 All minor modifications to accommodate installed equipment and structural components are subject to review. Do not commence Work on related piping until written acceptance has been received.

.8 Include any piping support modifications on the Shop Drawings submitted prior to fabrication or installation.

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

.10 Hanger and support components in contact with plastic pipe shall be free of burrs and sharp edges.

.11 Rollers shall roll freely without binding.

.12 Finished floor beneath Type L structural attachments and framing channel post bases shall be roughed prior to grouting. Grout between base plate and floor shall be free of void of foreign material.

.13 Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

.14 Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 2100 mm above the floor.

.15 Review the Drawings prior to installation of piping, conduit, and fixtures by this or any other Division. Identify any conflicts and confirm the routing of each section of pipe prior to commencement of installation. Advise of any conflicts with existing services. Where necessary, amend the routing of pipework to avoid conflict and provide Shop Drawings showing proposed routing.

3.3 Adjustment

.1 Adjust hangers and supports to obtain required pipe slope and elevation. Use shims made of material compatible with the piping material. Adjust stanchions prior to grouting of baseplates.

END OF SECTION

PROCESS PIPING AND EQUIPMENT INSULATION

1. GENERAL

1.1 Scope

.1 Process piping and equipment insulation

.2 Adhesives, tie wires, tapes

.3 Recovering

1.2 Quality Assurance

.1 Install insulation employing skilled workers regularly engaged in this type of Work.

.2 Materials shall meet or exceed fire and smoke hazard ratings as stated in this Section and defined in applicable building codes.

1.3 Submittals

.1 Submit Shop Drawings which indicate complete material data, "K" value temperature rating, density, finish, recovery jacket of materials proposed for this project and indicate thickness of material for individual services.

1.4 Job Conditions

.1 Deliver material to Site in original non-broken factory packaging, labeled with manufacturer's density and thickness.

.2 Perform Work at ambient and equipment temperatures as recommended by the adhesive manufacturer. Make good separation of joints or cracking of insulation due to thermal movement or poor workmanship.

2. PRODUCTS

2.1 General

.1 Insulation Materials, Recovery Jackets, Vapour Barrier Facings, Tapes and Adhesives

.1 Composite fire and smoke hazard ratings shall not exceed 25 for flame spread and 50 for smoke developed rating when tested in accordance with CAN4-S102, NFPA 255 or ASTM E84.

.2 Provide insulating materials and accessories that withstand service temperatures without smouldering, glowing, smoking, or flaming when tested in accordance with ASTM C441.

.3 All insulation materials shall meet current Building Code Standards, and packages or containers of such materials shall be appropriately labeled.

.4 Insulate fittings and valve bodies with preformed removable insulated fittings.

2.2 Materials

.1 Cold piping interior: semi-rigid, pre-formed fibreglass or formed rigid mineral fibre pipe insulation, with factory applied paintable canvas vapour barrier jacket, factory moulded to conform with piping, "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: -40°C to 150°C.

.2 Hot piping interior: semi-rigid, pre-formed fibreglass or rigid mineral fibre pipe insulation, with factory applied paintable canvas general purpose jacket, factory moulded to conform to piping, "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: up to 200°C.

.3 Cold piping exterior: foamglass insulation with factory applied aluminum vapour barrier jacket, factory moulded to conform with piping. "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: -40°C to 150°C.

.4 Hot piping exterior: foamglass insulation with factory applied aluminum vapour barrier jacket, factory moulded to conform with piping. "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: -40°C to 150°C.

.5 Hot equipment flat surfaces: rigid mineral fibre insulation with factory applied paintable canvas general purpose jacket, factory moulded to conform to equipment. "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: 20°C to 200°C.

.6 Hot equipment curved surfaces: mineral fibre blanket with factory applied paintable canvas general purpose jacket, factory moulded to conform to equipment. "K" value: maximum 0.035 W/m°C at 24°C. Service temperature: 20°C to 200°C.

.7 Recovery jackets: 0.9 mm smooth aluminum sheet or paintable canvas for all new insulated piping.

.8 Cold and hot water piping up to 115°C: as an alternate to formed fibreglass pipe insulation, rigid phenolic closed cell foam insulation equal to Kingspan Koolphen K CFC-free rigid phenolic insulation may be used. Product shall meet ASTM-E-84 and ASTM-C-585-90 and ULC burn and smoke spread rating for non-combustible installations (ULC-S102, S127).

2.3 Buried Piping

.1 Provide insulation for all buried piping with a soil cover of less than 2500 mm in grassed areas or less than 3000 mm below roads, walkways, and access pads

2.4 Above-ground Piping

.1 Provide insulation for all pipe and equipment with an operating surface temperature in excess of 50°C. Use a minimum thickness of 25 mm. Use greater thicknesses as required to lower the outer skin temperature to below 40°C.

.2 Provide insulation for all piping where heat retention is required, at the locations indicated on the Drawings and for other piping systems where insulation is indicated on the process drawings.

.3 Provide insulation at pipe hangers and supports with factory applied vapour jacket and a self-sealing lap, manufactured specifically for use at support locations. It shall be a minimum of 200 mm long and of the same thickness as adjacent pipe insulation.

.4 Provide a suitable bonding agent to joint the preformed sections.

.5 On exterior piping, provide aluminum jacketing with a minimum thickness of 0.9 mm, unless indicated otherwise.

.6 Provide aluminum banding, 12 mm wide by a minimum of 0.5 mm thick with matching seals.

.7 Provide polypropylene jacketing at elbows, tees or other changes of direction and where indicated. Use the heat-shrink type jacketing, with a minimal thickness of 0.1 mm.

.8 On interior piping, provide paintable canvas jacketing, ULC listed, 0.27 kg/m^2 minimum.

3. EXECUTION

3.1 Preparation

.1 Do not install insulation and recovering before piping and equipment has been tested and approved.

.2 Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

3.2 Installation

.1 Ensure insulation is continuous through inside walls and floor penetrations. Pack around pipes with fireproof, self-supporting insulation material, properly sealed.

.2 Insulate piping and fittings as noted in the schedule below. Insulate valves unless otherwise noted. Do not insulate unions, flanges (except on flanged valves if valve must be insulated), Victaulic couplings, strainers, (except on chilled water lines), flexible connections and expansion joints. Terminate insulation neatly with plastic material trowelled on a bevel.

.3 Provide insulation on all process air pipes located in the building and tunnel areas. Use 50 mm thick fibreglass insulation over the entire length of the pipe run except over couplings, valves, and meters. Provide stainless steel bands over the insulation at a maximum of 300 mm centres.

.4 Unless indicated otherwise, do not insulate water body valves.

.5 Terminate insulation 100 mm on each side of all flanges and grooved joint couplings.

.6 Finish insulation neatly on hangers, supports, and other protrusions.

.7 Locate insulation or cover seams in least visible locations. Locate seams on piping in ceiling spaces on the underside of the pipe.

.8 Cover all insulated piping throughout with aluminum or paintable canvas recovery jacket secured with aluminum bands on 200 mm centres or screws on 150 mm centres, unless otherwise noted. Lap the joints a minimum of 75 mm. Align longitudinal seams in aluminum recovering to shed water. All bands and screws are to be accessible for service and removal.

.9 Cold piping: seal lap joints with 100 percent coverage of vapour barrier adhesive. Seal butt joints with 50 mm wide strips of vapour barrier sealed with vapour barrier adhesive. For fittings and valves, apply hydraulic insulating cement; or apply factory fabricated insulation half shells, seal all laps and joints.

.10 Flare out staples may be used to secure jacket laps on hot systems. Staples are to be applied on 100 mm centres.

.11 Hot piping: for fittings and valves, apply hydraulic insulating cement, or apply factory fabricated insulation half shells.

3.3 Process Pipe Insulation Installation Thickness Schedule

Piping or Equipment		Insulation Thickness (fibreglass) mm	Insulation Thickness (closed cell phenolic) mm	Recovery Jacket
Insulated Process Piping, as shown on Drawings	15 to 50 Over 50	25 * 50 *	25 * 25 *	As noted in 2.2

* Unless stated otherwise elsewhere in Sections 11050, 11055, 11100 or 11105, or on drawings.

END OF SECTION

PROCESS VALVES

1. GENERAL

1.1 Description

.1 This Section specifies the supply, installation and testing of valves used for isolation, manual throttling, and flow modulating of the air supply system at North End Water Pollution Control Center (NEWPCC).

1.2 Definitions

.1 Valve Identification: valves are identified in the Drawings by valve symbols. Refer to the Drawings for lists of valve symbols and labels.

.2 Actuators: valves are supplied with their standard operators as detailed in Part 2 unless otherwise noted in Section 11105 or Instrumentation Specification Sheets.

.3 Detailed Valve Specification Sheets:

.1 Detailed valve specification sheets are provided in Section 11105 for each type of valve which is:

.1 Identified in the Drawings with a valve symbol and/or,

.2 Described in Part 2 of this Specification Section.

.2 Where there is a conflict between valves described in this Section and other valves described in Division 15 and Division 17, conform to the most stringent requirements.

.4 Instrument Data Sheets for Modulating Control Valves: Division 17 specifies and takes responsibility for the supply and installation of electric and pneumatic control valves, complete with valve body, actuator, position indicator, and other ancillaries. Valve bodies for these products will comply with the requirements as specified in Section 11105 and this Section.

1.3 Submittals for Review

.1 Shop Drawings: submit the following information in accordance with Section 01300:

.1 Catalog cuts and/or Shop Drawings for each type of valve indicating the valve number, materials of construction, dimensions, head loss characteristics through the valve, operating torque and valve end configuration.

.2 An amended Detailed Valve Specification Sheet for all valves. Indicate with check marks where the valve supplied meets the requirements specified and with written amendments where the product differs from the specification.

.2 Operating and maintenance data for incorporation in O&M Manual, as specified in Section 01735. Include complete description of operation together with detailed drawings, a complete list of replacement and repair parts, and parts manufacturer's identifying numbers.

.3 Affidavits and registration numbers described below in Quality Assurance.

1.4 Quality Assurance

.1 Provide Canadian Registry Number (CRN) designated by the Province of Manitoba for each valve type.

.2 Provide affidavits of compliance, as required by AWWA C500 for gate valves.

.3 For butterfly valves to be installed below ground, provide affidavits of compliance with AWWA C504.

.4 Valves are to be marked in accordance with MSS SP-25.

1.5 Shipment, Protection and Storage

.1 Deliver valves to Site in accordance with Section 01600 and using loading methods which 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 the 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 on the Process and Instrumentation Drawings or specified in Division 17, 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 all sizes of the following valve types:

.1 Automated Control Valves (electric and pneumatic); FCV, LCV, PCV and XV only. Refer to the Drawings for abbreviation definitions.

.2 Specialty Valves; FV and PRV only. Refer to the Drawings for abbreviation definitions.

.3 Manual Isolation and Shut-off Valves; BF, BV, GL, GV, KV and PV only. Refer to Section 11105 for abbreviation definitions.

.7 Specific requirements for the materials, ratings and service conditions for each valve are listed in Section 11105.

.8 Valves to open counter-clockwise.

2.2 Drawings

.1 The process schematics indicate major process valves required for the process to operate as intended.

.2 The detailed process drawings and process standard drawings indicate the valves on the process schematics plus other valves required for isolation.

.3 Provide a ball isolation valve on the top of each drop pipe to replace existing butterfly valves for pre-aeration sections.

.4 Provide a butterfly isolation valve on the top of each drop pipe to replace existing butterfly valves for grit removal sections.

.5 Where a valve may be required for the process to function correctly or is required to satisfy fire and safety codes but it is not shown in the Drawings, inform the Contract Administrator and provide details and suggestions for remedial action. Do not commence piping in the related pipe run until obtaining the Contract Administrator's approval.

2.3 Valve Ends

.1 In pipe runs less than 75 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 75 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 in Section 11105.

.4 Do not use grooved joint valve ends.

.5 Use flanged joints for buried and exterior valves. The flanges are to be compatible with the 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.

.9 For gate valves, end flanges shall be integral with the gate valve body and be faced and drilled in accordance with ANSI B16.1, Class 125 flanges.

2.4 Manual Operators

.1 Provide valves with manual operators unless specifically indicated otherwise on the process schematic drawings, mechanical drawings, in Section 11105, Division 17, or the Instrumentation Specification Sheets.

.2 For handwheels, clearly show the direction of opening in raised lettering and symbols.

.3 Handwheel diameter to conform to the following:

Nominal Valve Diameter (mm)	Minimum Handwheel 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

.4 The maximum rim pull on a handwheel not to exceed 300 N when one side of the valve is at test pressure and the other side is at atmospheric pressure. Where a shaft-mounted handwheel would require greater than this force to operate, provide a gear operator. Unless different operators are scheduled or shown in the Drawings, conform to the following minimum requirements:

.1 Gate Valves: less than 300 mm, handwheel; equal to or greater than 300 mm, gear operator.

.2 Knife Gate Valves: less than 300 mm, handwheel; equal to or greater than 300 mm, gear operator.

.3 Globe and Needle Valves: less than 200 mm, handwheel; equal to or greater than 200 mm, gear operator.

.5 Match existing operating nuts. Provide 2 eight-point operating wrenches.

.6 Supply stem extensions and valve boxes for buried valves specified in the Drawings, Sections 11105, and in Clause 2.5 of this Section. Provide two operating tees.

.7 Lever operators to conform to the following dimensions:

Nominal Valve Diameter (mm)	Minimum Length of Lever (mm)
6	80
12	80
20	100
38	150
50	150
65	150
75	175
100	225
150	250
200	300
250	450
300	450

.8 Quarter-turn lever operators to be perpendicular to the pipe run when the valve is closed.

.9 Lever operators on ball valves to be 10-position. Provide butterfly valves with 10-position latching levers except where used to balance air flows. Where used to balance air flows provide infinite position, screw down levers.

.10 The maximum pull at the end of the lever arm not to exceed 300 N when one side of the valve is at test pressure and one side is at atmospheric pressure. Where greater than this force would be required to operate the valve with a lever, provide a gear operator. Unless different operators are scheduled or shown in the Drawings, conform to the following minimum requirements:

.1 Plug Valves and 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.

.11 Gear operator to be worm gear type, equipped with a handwheel and a visual indicator of the valve position. Equip operators with adjustable mechanical stop-limiting devices to prevent overtravel of the disc/ball in the open and closed positions and which are self-locking and designed to hold the valve in any intermediate position between full open and full closed. Gear operators shall be grease lubricated. Where gear operators are intended for direct bury or submergence, seal units with long life lubricant.

.12 Manual operators for butterfly 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 shall be gasketed for weatherproof service. Place gearboxes above ground and liquid surfaces.

.13 Gear and manual operators for submerged service to be permanently lubricated and sealed for operation at water pressures to 700 kPa.

2.5 Valve Stem Extensions

.1 Provide valve stem extensions where additional clearance is required for pipe insulation, where valve operation without the extension is difficult, and in manholes.

.2 Where angle valve stem extensions are employed, they shall be angle geared. Universal joint types are not permitted.

2.6 Insulation

.1 N/A

2.7 Protective Coatings

.1 Unless otherwise specified, provide valves coated in accordance with Section 11900.

2.8 Cathodic Protection

.1 Unless otherwise specified, provide cathodic protection to underground valves.

2.9 Spare Parts

.1 Provide one spare valve including the appropriate operator for each valve type and size.

.2 Provide a list of all spare parts which would be expected to be required under normal conditions for a period of five years. At the Contract Administrator's request, provide a price for these parts.

3. EXECUTION

3.1 Preparation

.1 The valve and piping arrangement indicated in the Drawings is based on typical dimensions for valves of the specified type. Make the necessary modifications in the piping to allow for discrepancies between the valve dimensions shown and those supplied for the Work.

.2 Prior to the installation of the valves, field measure and check all equipment locations, pipe alignments, and structural installation. Ensure that the valve location and orientation provides 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 Contract Administrator and initiate the necessary piping modifications at no cost to the City.

3.2 Valve Installation

.1 Install valves in conjunction with the piping described in Sections 11050 and with control valves and their appurtenances described in Division 17.

.2 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.

.3 Mount butterfly valves and trunnion ball valves with the shaft in a horizontal orientation.

.4 When joining valves to pipe or fittings, do not over-torque bolts to correct for misalignment.

.5 Support valves in position using temporary supports until valves are fixed in place.

.6 Permanently support valves to prevent transmission of loads to adjacent pipework or equipment.

.7 Where valves are installed in PVC pipework greater than 100 mm diameter, support valves independently and brace against operating loads and torque to prevent transmission of stresses to the adjacent pipework.

.8 Generally pipe supports and hangers are not shown unless for indication purposes only.

.9 Install gate valves in the closed position.

.10 Install valves which are bubble-tight in one direction to seal in a direction opposite to normal flow unless otherwise noted or directed by the Contract Administrator.

.11 Unless otherwise specified, install single-seated ball 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.

.12 Install all valves in accordance with the manufacturer's recommendations.

.13 Protect valves installed below grade with a shrink sleeve or polyethylene sheath attached to the pipe with tapewrap.

3.3 Valve Extensions

.1 Install valve stem extensions where necessary to provide clearance from insulation.

3.4 Insulation

.1 N/A

3.5 Valve Testing

.1 Operate valves under simulated or real process conditions to ensure they operate as intended.

.2 Pressure test the valves in conjunction with the pipes in which the valves are installed as specified in Section 11050.

END OF SECTION

DETAILED VALVE SPECIFICATION

1. GENERAL

1.1 Description

.1 This Section provides a summary of the valve body materials, valve performances and reference Specifications for use in the Work and should be read in conjunction with Sections 11050, 11055, and 11100. Furnish all valves in accordance with the requirements of this Section and those requirements of Sections 11050, 11055, and 11100. Where there is a conflict, conform to the most stringent requirements.

.2 This Specification Section is comprehensive; some commodities and valve types may not be applicable to the Work.

.3 Provide the valve type as indicated in the Drawings by the valve symbol shown. Match the symbol, commodity and line size to the Detailed Valve Specification Sheet.

.4 Valves identified in the Drawings with an equipment identification symbol or instrument identification symbol are specified in Sections 11100. Detailed Valve Specification Sheets referenced by other Sections are independent of this Section.

.5 Named Acceptable Products are shown to define basic materials and performance criteria required for each valve type. Modify valves as specified to meet the service requirements of the system and detailed specifications.

1.2 Definitions

.1 Abbreviations used in Detailed Valve Specification Sheets:

BF	Butterfly Valve
BV	Ball Valve,V Ported

2. PRODUCTS

2.1 Schedule

.1 Page 2 to 3 following.

3. EXECUTION

.1 Not used

DETAILED VALVE SPECIFICATION

BF09

GENERAL						
			OPERATING LIMITS		DESIGN LIMITS	
TYPE OF VALVE	SYMBOL	TYPE OF COMMODITY	PRESSURE (kPag)	TEMP. (°C)	PRESSURE (kPag)	TEMP. (°C)
Butterfly Valve	**BF 09**	Air	85	60-120	850	120

TYPICAL SERVICE
PA

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	
Body	Cast Iron / Ductile Iron	Size Range	100 mm
Disc	Nylon Coated Ductile Iron	Rating	850 CWP
Disc Trim	Bronze or Nickel (Note 1)	Body/Valve Ends	Lugged (Note 2)
Seats	EPDM (peroxide Cured)	Type of Disc	
Shaft	Stainless Steel (416)	Operator	Note 3, Note 6.
		Actuator	N/A
		Lining	
		Coating	

NOTES

1. Full bronze disc for valves below 300 mm or Nylon coated ductile iron disc.
2. Full lug, wafer style body for placement between two Class 125 flanges.
3. See Section 11100.
4. Provide valves for CWP 1400 kPag on IA, CA services.
5. EPDM seats to be peroxide cured to prevent hardening.
6. Operator to be manual lever lock handle complete with throttle plate every 10 degrees.

ACCEPTABLE PRODUCTS			
	Bray Series 31-119	DeZurik BRS	
Nibco LD2000	Grinnell Series 8000	Crane Resilient Seat	
Kitz 5112 or 5141	Victaulic Vic 300 Masterseal	Victaulic Vic series 763 (submerged service)	

DETAILED VALVE SPECIFICATION

BV08

GENERAL						
			OPERATING LIMITS		DESIGN LIMITS	
TYPE OF VALVE	SYMBOL	TYPE OF COMMODITY	PRESSURE (kPag)	TEMP. (°C)	PRESSURE (kPag)	TEMP. (°C)
Ball Valve (V-Ported)	**BV 08**	Air	85	60-120	1400	120

TYPICAL SERVICE
AIR

VALVE MATERIALS		**VALVE DESCRIPTION**	
ITEM	MATERIAL	Reference Document	Body Material: ASTM A351 (Note 2)
Body	Carbon Steel (Note 3)	Size Range	100 mm and 200mm
Ball	316 Stainless Steel – floating	Rating	CWP 1000 kPag
Packing	Reinforced PTFE	Body/Valve Ends	150# Flanged
Seats	Tek-fil Carbon/Graphite/TFM	Pattern	Regular reduced V-Port
Shaft	Stainless Steel (Note 1)	Operator (note: 3)	
		Actuator	Bray Actuator (note 3)
		Lining	
		Coating	

NOTES

1. Blowout-proof stem.
2. When this valve is installed into a gas service it must comply with the applicable requirements: also refer to Section 15100.
3. Operator to be manual or electric as specified by contract drawings. The manual operator to be lever lock handle complete with throttle plate every 10 degrees and electrical actuator to be top mounted Bray Electric Actuator Model 700651-113A0536.
4. 100 mm ball valves to be 60 degree V-port angle and 200 mm ball valves to be 90 degree V-port angle.

ACCEPTABLE PRODUCTS			
Flow-Tek RF-15	Kitz Type 600 UTKM	Neles Jamesbury 3000M	Watts
American Valve	Crane 9501		

END OF SECTION

VALVE AND GATE ACTUATORS

1. GENERAL

1.1 Work Included

.1 Supply, delivery, and supervision of installation, and testing of process electric actuators.

1.2 Submissions

.1 Shop Drawings: submit Shop Drawings for all actuators in accordance with Section 01300 and Section 11005. In addition to the information requirements of Section 11005, include the following:

.1 Calculations indicating the operating torque of the valve or gate for which the actuator is to be supplied.

.2 The torque rating of the actuator.

.2 Operating and Maintenance Data: Provide for incorporation in O&M Manual as specified in Section 01735.

1.3 Delivery and Storage

.1 Deliver actuators to Site using unloading methods which do not damage casings or coatings.

.2 Clearly tag actuators indicating size, type, model number, coatings, and mating parts.

.3 Store on-site for incorporation in the Work using methods recommended by the manufacturer to prevent damage, undue stresses, or weathering.

1.4 Process Valve and Actuator Detailed Specification Sheets and Schedules

.1 Process Valves are identified in the Drawings by an alpha-numeric code.

.2 Create a valve schedule listing the critical valves required for process operation. The schedule lists the valves and actuators by type, and the function and location of the valve in the process. Ensure all valves and actuators are in compliance with the Section 11100. Do not commence Work on any piping runs until review of valve and actuator selection has been received from the Contract Administrator.

2. PRODUCTS

2.1 General

.1 Provide new, unused actuators for the Work.

.2 Use materials for actuators that are free from defects or flaws.

.3 Tag actuators to indicate operating characteristics and inlet and outlet ports for electric or pneumatic services.

.4 Standard of acceptance for all electric actuators shall be top mounted Bray Electrical Actuator.

.5 Provide actuators with mechanical position indicators.

2.2 Drawings

.1 Review and verify piping and instrumentation drawings (P&IDs), ensuring that they indicate all valves and automatic actuators that are critical to proper process operation. Where valves or actuators are not indicated, inform Contract Administrator.

2.3 Manual Actuators

.1 Provide valves with manual actuators unless indicated otherwise in other Specification Sections or shown on the process and instrumentation drawings.

.2 For manual actuators located more than 1830 mm above the floor, provide chain operators.

2.4 Electric Actuators, Open/Close, Quarter Turn, Less than 1,000 N-m Torque

.1 Use electric operators that are suitable for mounting on quarter turn valves intended for on/off service.

.2 For actuators rated at less than or equal to 100 Nm, incorporate a 120V/1 phase/60 Hz motor. For actuators rated at greater than 500 Nm and less than or equal to 1,000 Nm, use a 208 V/3 phase/60 Hz motor. In each case, use motors that are high torque, reversible.

.3 Use motors that are rated for continuous duty, as defined in the appropriate NEMA standard.

.4 Incorporate thermal overload devices in motor windings to protect the motor against overheating.

.5 Unless noted otherwise, design the actuators to fail to the last position when the control function or power fails.

.6 Fit each actuator with a hand wheel that will enable manual override control of the valve. Incorporate a method of ensuring that when the manual override is engaged, motor driven operation is precluded.

.7 Make each actuator capable of operating in any horizontal or vertical orientation.

.8 Provide external mechanical indication of valve position.

.9 House internal components in a NEMA 4X enclosure, waterproof and moisture resistant and corrosion-resistant, and permanently lubricated. Use stainless steel connectors for all exposed connections.

.10 For actuator drive train, use steel or aluminum gears arranged with worm gears or compound gear assembly. Design gears in accordance with AGMA standards for heavy duty, intermittent service. Ensure that geared drive train can withstand locked rotor conditions. Incorporate bearings designed with an ABFMA B10 life in excess of 40,000 hours.

.11 Use gears and bearings that are non-lubricated or permanently lubricated.

.12 In each actuator, incorporate two SPDT travel limit switches, 10A, 120V AC, CSA listed. The travel limit switches shall each be adjustable.

.13 In each actuator, incorporate two SPDT torque limit switches, 10A, 120V AC. Make the torque limit switches factory pre-set and field adjustable.

.14 Provide mechanical limit stops, adjustable, to ensure over-turning of the valve door does not occur.

.15 Protect exterior mounted actuators against high temperature and condensation.

.16 Design the actuator so that the opening and closing speed is field adjustable.

.17 Provide a terminal board for field wiring. Include contacts to indicate the open/closed status of the valve, overheating alarm, and overtorque alarms.

2.5 Electric Actuators, Open/Close, Quarter Turn, Greater or Equal to 1,000 kN-m Torque

.1 Use electric operators that are suitable for mounting on quarter turn valves intended for open/close service.

.2 Incorporate a 600V/3 phase/60 Hz motor. Use motors that are high torque, reversible. Select motor that is capable of at least 10 starts per hour. Size motor to open valve within 60 seconds maximum.

.3 Use motors that are rated for continuous duty, as defined in IEC Standard 34-1.

.4 Incorporate thermal overload devices in motor windings to protect the motor against overheating.

.5 Unless noted otherwise, design the actuators to fail to the last position when the control function or power fails.

.6 Fit each actuator with a hand wheel that will enable manual override control of the valve. Incorporate a method of ensuring that when the manual override is engaged, motor driven operation is precluded.

.7 Provide external mechanical indication of valve position.

.8 House internal components in a NEMA 4X enclosure, waterproof and moisture resistant and corrosion-resistant, and permanently lubricated. Use stainless steel connectors for all exposed connections.

.9 For actuator drive train, use stainless steel or machine steel gears and shafts. Design gears in accordance with AGMA standards for heavy duty, intermittent service. Ensure that geared drive train can withstand locked rotor conditions. Incorporate bearings designed with an ABFMA B10 life in excess of 40,000 hours.

.10 Use oil lubricated gearbox. Seal using o-rings or gaskets. Provide a minimum of two filling points.

.11 In each actuator, incorporate two SPDT travel limit switches, 10A, 120V AC, CSA listed. The travel limit switches shall each be adjustable.

.12 In each actuator, incorporate two SPDT torque limit switches, 10A, 120V AC. Make the torque limit switches factory pre-set and field adjustable.

.13 Provide mechanical limit stops, adjustable, to ensure over-turning of the valve door does not occur.

.14 Protect exterior mounted actuators against high temperature and condensation.

.15 Design the actuator so that the opening and closing speed is field adjustable.

.16 Provide a terminal board for field wiring. Include contacts to indicate the open/closed status of the valve, overheating alarm, and overtorque alarms.

2.6 Electric Actuators, Open/Close, Multi-Turn

.1 Use electric operators that are suitable for mounting on non-rising stem valves or gates that are intended for open/close service.

.2 Incorporate a 600V/3 phase/60 Hz motor. Use motors that are high torque, reversible. Select motor that is capable of at least 10 starts per hour. Size motor to provide a minimum of 30 rpm or sufficiently high to open or close gate within 10 minutes, whichever requires greater motor size.

.3 Use motors that are rated for continuous duty, as defined in IEC Standard 34-1.

.4 Incorporate thermal overload devices in motor windings to protect the motor against overheating.

.5 Unless noted otherwise, design the actuators to fail to the last position when the control function or power fails.

.6 Fit each actuator with a hand wheel that will enable manual override control of the valve or gate. Incorporate a method of ensuring that when the manual override is engaged, motor driven operation is precluded.

.7 Provide external mechanical indication of valve or gate position.

.8 House internal components in a NEMA 4X enclosure, waterproof and moisture resistant and corrosion-resistant, and permanently lubricated. Use stainless steel connectors for all exposed connections.

.9 For actuator drive train, use stainless steel or machine steel gears and shafts. Design gears in accordance with AGMA standards for heavy duty, intermittent service. Provide method that allows higher shock loads to valves or gates at the beginning of operation so that they unseat. Ensure that geared drive train can withstand locked rotor conditions. Incorporate bearings designed with an ABFMA B10 life in excess of 40,000 hours.

.10 Use oil lubricated gearbox. Seal using o-rings or gaskets. Provide a minimum of two filling points.

.11 Design so that motor can be disconnected without draining the lubricant from the actuator gear case.

.12 In each actuator, incorporate two SPDT travel limit switches, 10A, 120V AC, CSA listed. The travel limit switches shall each be adjustable.

.13 In each actuator, incorporate two SPDT torque limit switches, 10A, 120V AC. Make the torque limit switches factory pre-set and field adjustable.

.14 Provide mechanical limit stops, adjustable, to ensure over-turning of the valve door does not occur.

.15 Protect exterior mounted actuators against high temperature and condensation.

.16 Design the actuator so that the opening and closing speed is field adjustable.

.17 Provide a terminal board for field wiring. Include contacts to indicate the open/closed status of the valve, overheating alarm, and overtorque alarms.

2.7 Electric Actuators, Modulating

.1 Select actuators for modulating duty that are generally as described in Clause 2.6, but that modulate in response to a 4-20 mA control signal. For modulating actuators, incorporate a servo drive system suitable for continuous modulation.

.2 Incorporate an 115V/1 phase/60 Hz motor. Use motors that are high torque, reversible.

.3 For modulating service, select motors that are capable of 1200 starts per hour.

.4 Fit actuators for modulating duty with a position retransmit module (4-20 mA) for remote indication.

2.8 Current-to-Pneumatic (I/P) Converters

.1 Provide I/P converters where required.

.2 Supply all required hardware for mounting the I/P converter on the controlled device.

.3 I/P converter to be of EEMAC 4, minimum.

.4 I/P converter to operate with instrument quality control air at an operating pressure range of 20 to 200 kPa.

2.9 Valve Positioners

.1 When specified on the Instrument Specification Sheets supply compatible positioners pre-mounted to each actuator. Do not mount the positioner upside down.

.2 Each positioner to service the entire operating range of the actuator. The equipment position shall be fed back to the positioner through a mechanical linkage.

.3 Positioner to operate with instrument quality, oil-free control air.

.4 Provide three independent, interchangeable cams for each positioner - linear function, square function, and square root function.

.5 Mount a pressure gauge on the positioner to measure air output.

2.10 Position Switches and Indicators

.1 When specified on the Instrument Specification Sheets, supply actuator assemblies pre-mounted with external position monitors which include two (2) cam actuated "GO" Form C rated proximity switches, a 5-pole male receptacle, a polycarbonate dome beacon and an EEMAC 4 (minimum) enclosure.

.2 Cams to be fastened to a splined shaft and adjustable without set screws.

.3 Provide a visual indicator with beacon type display showing red when the controlled device is in the closed position, and green in the open position.

.4 Supply all required hardware for mounting of position monitor in accordance with the specified valve/actuator orientation.

.5 Diaphragm actuated valves to have external position monitor actuated through linkages.

.6 Enclosures to be suitable for environment to which they are exposed.

2.11 Finishes

.1 Actuators shall be shop finished in accordance with Section 11901.

3. EXECUTION

3.1 Preparation

.1 Prior to the installation of the actuators, field measure and check all equipment locations, pipe alignments, and structural installations. Ensure that the valve location and orientation provides suitable access to manual actuators and that sufficient space and accessibility is available for maintenance and to allow unobstructed view of operation and position of pneumatic and electric actuators.

.2 Where conflicts are identified, inform the Contract Administrator and initiate the necessary piping modifications.

3.2 Installation Training

.1 Inform the installer of all procedures and requirements necessary for the successful installation of the equipment. Attest to the installer's understanding by completing Form 101, included in Section 01650.

3.3 Installation

.1 Ensure the equipment is installed as required to provide satisfactory service.

.2 Cooperate with the installer to fulfill the requirements for a successful installation, as documented by Form 102, included in Section 01650.

3.4 Testing

.1 Ensure the equipment, including all component parts, operates as intended. Testing includes field verification of operating speed and torque outputs at rated operating conditions.

.2 Cooperate with the installer to fulfill the requirements for successful testing of the equipment as documented by Form 103, included in Section 01650.

3.5 Commissioning

.1 Attend during commissioning of the process system which includes the equipment specified in this Section and to ensure the equipment functions as intended in the process system.

END OF SECTION

ACTUATED PROCESS VALVES AND GATES SCHEDULE

Modulating V-ported Ball Valves

G517-FCV
G519-FCV

END OF SECTION

COARSE BUBBLE AERATION DEVICES

1. GENERAL

1.1 Work Included

.1 This Section specifies the supply, installation, testing and commissioning of all components of the coarse bubble aeration devices within the scope of this Contract.

.2 These aeration devices will be installed in aerated grit removal tanks and shall be subjected to loads and conditions produced by lateral hydraulic flows containing solids, debris, grit and fibrous accumulations within these tanks during normal operation.

.3 The complete coarse bubble aeration device system covered in this Section shall be defined as extending from the top flange of the drop pipe sections through all submerged piping, wall brackets, cradle supports, diffusers as specified within this Section and the Contract Drawings.

.4 The Supplier shall design, fabricate and deliver components and mechanisms and all other associated equipment, appurtenances, and controls required to install coarse bubble aeration systems for existing grit removal and pre-aeration tanks at the North End Water Pollution Control Centre Centrate (NEWPCC).

.5 The Supplier shall provide Site Services for the components and all other associated equipment and appurtenances related to the installation of the coarse bubble aeration systems in the grit tanks as listed below:

.1 Witnessing of equipment installation

.2 Operation and maintenance training

.6 Work not included in this Section:

.1 The following items are specified under other Sections of these Specifications:

.1 The air supply pipes outside the grit removal and pre-aeration tanks are specified in Process Piping – Section 11050 and Detailed Piping Specification Section 11055.

1.2 Definitions

.1 Normal cubic metres per minute (Nm^3/min): the volumetric flow rate in cubic metres per minute at 20°C, 36% relative humidity and 101.3 kPa absolute pressure.

.2 Absolute pressure, kilopascals: kPaA.

.3 Gauge pressure, kilopascals: kPa.

1.3 Submissions

.1 Equipment Submittals

.1 All Drawing submittals shall include electronic copies in AutoCAD 2000 format.

.2 Shop Drawings: Submit in accordance with Section 01300 and Section 11005. In addition to the requirements of Section 11005, include the following:

.1 A copy of this Section with check to indicate conformance or acceptance of each clause. Non-conformance shall be indicated by a cross "X".

.2 Provide calculations and/or computer simulations illustrating how the coarse bubble aeration system will satisfy the aeration requirements in the grit removal and pre-aeration tanks in which it is placed. As a minimum provide:

.1 Maximum capacity and design operating airflow for each diffuser, in nm^3/min.

.2 Maximum capacity and design operating airflow for each manifold, in nm^3/min.

.3 Number of diffusers on each manifold, based on airflow requirements and diffuser capabilities.

.3 Provide the Certified Diffuser Headloss Curve for the applied coarse bubble diffusers.

.4 Manufacturer's data including the weight of each dropleg and diffuser assembly.

.5 General arrangement drawings showing the complete dropleg and diffuser assembly for each of the required arrangements.

.6 Dimensioned drawings showing dropleg, pressure test (PT) test plug, lifting lugs/lifting eyes, manifold, diffusers, orifices, connectors, supports and anchors.

.7 Start-up, testing and adjustment procedures.

.3 Operation and Maintenance Data: Provide data for incorporation in the O&M Manual as specified in Section 01300. Include complete description of operation together with general arrangement and detailed drawings, parts catalogues with complete list of repair and replacement parts with section drawings illustrating the connections and identifying numbers.

.4 Detailed Aeration System Design: Based on the basic design parameters contained in this section and the verified performance characteristics of the mixing devices proposed, undertake detailed design of the aeration system and submit the calculations, drawings and any other explanatory information. Ensure the design calculations are signed and sealed by a Professional Engineer registered in Canada or USA.

1.4 Coordination

.1 Coordinate with other Divisions to ensure there are no conflicts in Work.

1.5 Shipment, Protection and Storage

.1 Ship equipment pre-assembled to the degree, which is practicable. Inform installer of any site assembly requirements.

.2 Provide storage instructions indicating specific requirements to ensure there is not uneven wear, distortion, weathering of components or any other deterioration of the components.

.3 Identify all other special storage requirements.

2. PRODUCTS

2.1 Function

.1 The coarse bubble aeration devices provide desired rolling patterns in grit removal sections to facilitate grit settlement in grit removal sections and adequate rolling speeds to prevent solids deposition in pre-aeration sections.

.2 These aeration devices, including manifold and diffusers, are to be installed in grit removal and pre-aeration tanks. It is the design intent of these devices to be capable of withstanding the forces and conditions subject to occurring within these structures.

.3 Provide end products of one manufacturer to achieve standardization for operation, maintenance, spare parts and manufacturer's service.

.4 Diffusers shall be coarse bubble, elastomer tapered nozzle style.

.5 Provide minimum 10 air diffusers for each manifold.

2.2 Manufacturers' Qualifications

.1 Manufacturer shall provide no less than five years experience in the design, construction and operation of the coarse bubble diffused aeration equipment described herein.

.2 The Contract Administrator may require evidence, in the form of operating records, from these plants to verify the ability of the equipment to perform as required.

.3 The Contract Administrator reserves the right to request certified tests results of a diffuser tested to the conditions specified within this section.

2.3 Design Standards

.1 M-15 manifold assembly manufactured by Tideflex Technologies Inc..

2.4 Acceptable Manufacturers

.1 Acceptable manufacturers are:

.1 Tideflex Technologies Inc., M-15 manifold assembly or approved equal in accordance with B6.

2.5 Capacities and Performance

.1 Design capacity

.1 Grit removal sections:

.1 Air delivery capacity: 40 Nm^3/hr/m of tank length

.2 The diffuser unit airflow rate shall not exceed 25.5 m^3/hr (15 cfm) per diffuser under any condition with the system.

.3 Provide 10 diffusers for each horizontal manifold within grit removal sections and 15 diffusers for each horizontal manifold within pre-aeration sections.

.4 Maintain equal space between diffusers on the horizontal manifolds to promote even air distribution throughout entire tank

.5 The design diffuser unit airflow rate shall not exceed 80 percent of the diffuser' maximum capacity.

.6 Design rolling patterns: produce a rolling velocity of 0.60 to 0.75 m/s at level of 150 mm below water level near the tank entrance with designed air supply rate with grit removal sections.

.7 The manifold assembly to be M-15 model manifold assembly manufactured by Tideflex Technologies Inc. or approved equivalent.

.2 Pre-aeration sections:

.1 Air delivery capacity: 40 to 50 m^3/hr/m of tank length during normal operation.

.2 The manifold assembly to be M-15 model manifold assembly manufactured by Tideflex Technologies Inc. or approved equivalent.

.3 Add additional diffusers to the M-15 model manifold assembly as specified by the Contract Drawings.

.2 Air bower discharge temperature: 70 to 125°C.

2.6 Materials

.1 Fabricate Diffuser of EPDM .

.2 Fabricate Orifice of Stainless steel, type 304.

.3 Fabricate manifolds of Stainless steel pipe, type 304.

.4 Fabricate dropleg of Stainless steel pipe, type 304, Schedule 40.

.5 Fabricate supports and anchors of Stainless steel, type 304.

.6 Fabricate PT test plug and adapter of Stainless steel, type 304.

.7 Fabricate PT test plug core of Neoprene.

.8 All stainless steel components must be pickled and passivated in accordance with Sections 15050 and 05500.

2.7 Diffusers

.1 Provide non-clog, coarse bubble, elastomeric tapered nozzle type diffusers.

.2 Diffusers shall be clamped to a bushing or pipe nipple using a heavy duty clamp to ensure the diffuser will not separate from the connection during operation.

.3 The diffuser shall have backflow prevention capability and non-detachable from the diffuser assembly.

.4 The maximum center to center diffuser spacing shall be 24 inches.

2.8 Diffuser Connection

.1 The elastomer diffusers shall be clamped to a bushing or pipe nipple using a heavy duty clamp.

.2 The diffuser and connection shall be capable of withstanding an impact load of 45 kg (or 100 pounds) against the discharge tapered end of the diffuser, deflect to a minimum allowance of 45 degrees and recover to the normal operating position

.3 The diffusers shall be connected to the bottom of the manifold.

2.9 Horizontal Manifold

.1 Construct manifold of Type 304 stainless steel pipe.

.2 Size manifold so that headlosses are less than 10 percent of diffuser orifice losses, and in no case are the velocities greater than:

.1 Less than 150 mm diameter 12 m/s

.2 150 mm to 250 mm diameter 15 m/s

.3 Greater than 260 mm diameter 20 m/s.

.3 Provides adequate structural strength to resist buoyant forces. Use a minimum safety factor of 3.0 to determine wall thickness and support spacing.

.4 Reinforce the center tee with angle members welded to the vertical and horizontal sections as necessary to resist bending forces.

.5 Design manifold so that diffusers are held at the same elevation throughout the tank.

.6 Provide manifolds with expansion joints or flexible couplings, with appropriate stainless steel restraining rods, as necessary, to withstand expansion and contraction.

.7 Pipe Clean-Outs

.1 Pipe clean-outs shall be provided at the end of the end of each horizontal manifolds.

.2 The clean-out shall be fabricated with a SS 304 cover plate, full diameter elastomer gasket and a centered threaded stud welded into the interior of the horizontal pipe and connected with a nyloc type nut and spacer. The cap shall be capable of preventing any air discharge under a minimum operating pressure of 25 psi.

2.10 Drop Pipes

.1 Provide drop pipes to limits identified on the Drawings.

.2 Vertical drop pipes shall be minimum schedule 10, SS 304.

.3 Provide stainless steel lifting lugs/lifting eyes at appropriate locations to allow removal and re-installation of the drop pipes, manifold and diffuser assembly.

.4 Provide a 12 mm diameter PT test plug at the top of each drop pipe. Ensure the test plug is capable of receiving a probe 3 mm nominal outside diameter and rated for zero leakage at a pressure of 200 kPa.

.5 Design the drop pipe with expansion joints and/or flexible couplings as necessary to withstand thermal expansion and contraction caused by temperatures from -40°C to 150°C.

.6 Provide a flanged reinforced elastomer expansion joint followed by the cam-lock or Victaulic Rigid Coupling at the top of each drop pipe section.

.7 Support the drop pipe so that no forces are imparted to the aeration header.

.8 Stainless steel bolts, nuts and neoprene gasket shall be provided for field connection of each vertical pipe.

2.11 Vertical Piping Supports Brackets

.1 All components of the bracket assembly shall be SS 304.

.2 The bracket shall be equipped with a quick connect cam-lock type closure for locking the drop pipe section of the manifold into the bracket assembly or Victaulic Rigid Coupling Style 489 SS304 for connection to grooved ends . The interior ring of the cam-lock shall be equipped with a neoprene lining for seating against the drop pipe section.

.3 Stabilize the drop pipe against movement with horizontal and/or vertical supports.

.4 Design and provide a sufficient number of supports and anchors to fully support the drop pipe, manifold, and diffuser assembly and to eliminate vibration and the possibility of fatigue failure.

.5 Ensure supports have sufficient bearing surface to prevent the supported pipe from crimping due to slight movements in the pipe.

.6 Provide supports with a method of adjusting for angular and vertical alignment. Make support infinitely adjustable within its limits by raising and lowering nuts on threaded support rods.

.7 Double nut all connections to prevent creep.

2.12 Horizontal Manifold Support Brackets

.1 All components of the bracket assembly shall be SS 304.

.2 Assembly components shall consist of one cradle bracket to be wall anchored, extend off the wall as specified on the dimensional drawings, have a cradle portion equal to ½ the perimeter distance of the manifold and extend outward in both directions at 45 degrees for a minimum distance of 1.5 times the manifold diameter.

.3 .The assembly shall be anchored to the wall using SS 304 wall anchors at the same load capacity as the vertical wall bracket assembly.

2.13 Protective Coatings

.1 After welding, pickle and passivate all stainless steel surfaces to remove carbon deposits, grease and oil and to aid the regeneration of a uniform corrosion resistant chromium oxide film. Pickle by means of a full immersion passivation bath. Refer to Section 05500.

2.14 Spare Parts

.1 Provide as a minimum, the following spare parts:

.1 Two percent of the number of installed diffusers, including air balancing orifices.

.2 Two percent of each size and type of dropleg support.

.3 Two percent of each size and type of manifold support.

.2 Provide a list of all spare parts which may be required within five years of placing the system in operation, complete with prices in accordance with required submittals.

3. EXECUTION

3.1 Manufacturer's Representative

.1 Arrange for a technically qualified Manufacturer's Representative to attend the installation work, certify correct installation, train operating and maintenance staff and undertake the testing of the system for sufficient periods, to ensure the equipment is installed, operated, and maintained in accordance with the manufacturer's recommended procedures.

3.2 Installation

.1 Instruct the Contractor in the methods and precautions to be followed in the installation of the equipment. Certify the Contractor's understanding by completing **Form 101**, included in Section 01650.

.2 Cooperate with the Contractor to fulfill the requirements for a successful installation as documented by **Form 102**, included in Section 01650.

.3 Install diffusers after air supply piping has been thoroughly cleaned and purged.

.4 Install coarse bubble aeration devices taking all necessary precautions to ensure proper alignment and to prevent entry of any foreign matter into the piping.

.5 Inspect pipe assemblies for dimensional accuracy. Ensure tolerances conform to spooling fabrication tolerance sheet and that tool dies, jigs, and fittings used throughout the manufacturing process are periodically inspected to ensure that dimensional tolerances are observed. Visually inspect all fittings and assemblies to ensure good quality welding.

3.3 Testing

.1 Test the coarse bubble aeration system in accordance with Section 01650.

.2 Cooperate with the Contractor to fulfill the requirements for successful testing of the equipment as documented by **Form 103**, included in Section 01650.

.3 Undertake the following tests:

.1 Test each support with a lever placed on a fulcrum. Apply the static load to the opposite end of the lever, producing a vertical extracting force on the support anchor equal to the maximum buoyant force to which the anchors will be subjected, times the buoyancy safety factor (3.0).

.2 Check for air leaks by fully submerging all piping and accessories in clean water, turning the air on and eliminating any leaks at both minimum and maximum airflows. No leaks are permitted.

.3 Check for proper elevation of diffusers with an engineer's level or laser or by filling the tanks with clean water to the top of the diffusers. Ensure diffusers are at the same elevation plus or minus 5 mm.

.4 Mixing Performance Tests:

.1 Test at least one tank.

.2 Ensure that each diffuser, including all components parts, operates as intended.

.3 Conduct testing to confirm satisfactory stirring. Conduct these tests using raw wastewater of similar quality as that processed under normal operating conditions. Fill the channel with the raw wastewater, start and continue mixing with design air supply rate for 30 minutes. At that time, withdraw samples from at least five points at various location along the tank.

.4 Sample locations should be confirmed with Contractor Administrator.

.5 Analyze each sample to determine the suspended grit content. The test will be deemed successful if the 200 micron size grit capture rate equals or exceeds 95 percent.

.5 Prepare a test report summarizing the findings of the performance tests. Include appendices containing all data, description of test procedures, summary of results analysis, discussion of any anomalies, and a summary indicating compliance or non-compliance with performance requirements.

.6 In the event that the system does not satisfy the performance requirements, provide and install additional equipment or make all necessary modifications. After making these changes, repeat the mixing performance tests.

.7 Cooperate with the contractor to fulfill the requirements for successful testing of the equipment as documented by **Form 103**, included in Section 01650.

END OF SECTION

FIELD-APPLIED MAINTENANCE AND CORROSION PROTECTION COATINGS

1. GENERAL

1.1 Work Included

.1 Provide, apply, and maintain the specified field applied protective and maintenance coating systems. Coatings are required on all process and mechanical equipment, vessels, and pipes unless specifically deleted.

.2 Refer to Drawings and schedules for the type, location, and extent of coatings required and include for all field coating necessary to complete all the Work shown, specified, or scheduled.

1.2 Reference Standards

.1 Reference to the SSPC Good Painting Practice and the National Association of Corrosion Engineers specifications refers to the latest edition of these specifications.

.2 Apply all coating in accordance with manufacturers' recommendations, and to SSPC Standard. Specifications contained therein take precedence over manufacturers' recommendations.

.3 Strictly observe all safety rules and regulations of the City, applicable governing bodies, and insurance underwriters in the storage, handling, use, and application of coating system material, solvents, and cleaning agents.

.4 Employ qualified and competent personnel to perform the Work in a neat and workmanlike manner, conforming to all City and Government Safety Standards and Regulations.

1.3 Shipment, Protection, and Storage

.1 Deliver all materials to the Site in sealed containers properly labeled as to the manufacturer's name, type, and colour of contents, date of manufacture, batch number, storage requirements, and shelf-life.

.2 Provide adequately ventilated storage for all materials and ensure compliance with fire prevention regulations.

1.4 Restrictions

.1 Regardless of whatever else is specified in this Section, no paint containing a chromate based additive can be used.

2. PRODUCTS

2.1 Manufacturers

.1 All constituents of each coating system are to be provided by the same manufacturer.

2.2 Coating Application

.1 Use application methods in accordance with the coating manufacturer's recommendation for the particular coating being applied, and the requirements of SSPC Good Painting Practice.

.2 Provide traps or separators to remove oil and water from the air, so that the air from the spray gun impinging onto the steel substrata shows no condensed water or oil.

.3 Hand brush all welded and hard-to-spray areas prior to the first spray coat application, with coating mixed to manufacturer's recommended procedures.

.4 Coat by brush, roller, sheepskin dauber, or other suitable method, all areas inaccessible to the spray gun.

.5 Do not apply coatings to a surface at a temperature that will cause blistering, separation or otherwise be detrimental to the life of the coating.

.6 Only thinners specified by the manufacturer are acceptable.

.7 Materials that exceed manufacturer's published shelf life are not acceptable.

.8 Immediately brush out all runs, sags, blisters, etc, or remove and repair the area prior to the next application.

.9 Apply the coating using a 3-coat, 2-colour system.

.10 Apply coating by conventional or airless spray as power coating manufacturer's data sheet.

.11 Follow manufacturer's application procedures as closely as possible as to recommended pressures, atomization, etc.

.12 Provide final dry film coating thickness in accordance with the coating manufacturer's specification.

.13 Apply the coating 100 percent holiday free.

2.3 Drying and Curing

.1 Accommodate all drying and re-coat times in accordance with the manufacturer's specifications.

.2 Cure in accordance with the manufacturer's recommended specifications. Force curing specifications are available from manufacturer if required.

.3 Supply indirect fired heaters and ducting as required to maintain drying and curing temperatures during coating operations.

2.4 Quality Control and Acceptance

.1 Apply, cure, and handle coatings using procedures which produce a final product that complies to the manufacturer's published literature and performance testing conducted by the City.

.2 Ensure the finished coating is free of obvious defects such as runs, sags, blisters or pinholes, air entrapment, fish-eyes, and foreign matter.

.3 Provide film thickness, as determined by a calibrated Mikrotest gauge or equivalent in accordance with B6, in accordance with SSPC Good Painting Practice.

.4 Apply all immersion coating 100 percent holiday free.

.5 Conduct wet sponge holiday testing in accordance with proposed NACE Standard, "Holiday Detection of Internal Tubular Coatings" (less than 0.254 mm (10 mil) thickness).

.6 A "holiday" is an area of applied coating with electrical resistance less than 80,000 ohms as identified by a detection instrument connected to a clean sponge wetted with a solution of one teaspoon of detergent per 3.78 L of tap water.

.7 No immersion coating will be accepted or released from coating applicators until fully cured. Cure test will be performed using the M.E.K. rub test in conjunction with a time and temperature relationship for the coatings being used.

.8 Repair or replace at the Contractor's expense any coating not meeting the requirements of this Specification.

2.5 Surface Treatment

.1 Remove all organic substances such as oil, grease, paraffin, etc. in accordance with SSPC-1, "Solvent Cleaning", prior to commencement of sandblast cleaning operations.

.2 Provide proper traps or separators to remove all oil and water from the air supply. The air from the blast nozzle is to be free of condensed water or oil that will impinge onto steel substrata. In high humidity areas, the use of air dryers may be required.

.3 Do not blast surfaces when surface temperatures are less than 10°C, when substrata is less than 3°C above the dew point, when the relative humidity is greater than 80 percent, or when there is a possibility that the blasted surface will be subject to wetting prior to the primer coat being applied.

.4 Blow down all surfaces with clean, dry air; brush and vacuum free of dust before the surface is primed.

.5 Do not blast more surface than can be prime coated before visible or detrimental re-rusting occurs.

.6 Use siliceous sand, free of dirt, clay or other foreign material, graded 16/30 or 20/40 mesh to give an anchor pattern 0.038 mm to .076 mm (1.5 to 3.0 mil).

2.6 Schedule of Surface Treatments

.1 The schedule of Surface Treatments defines the components of the protective coating systems.

Reference	Description	Surface Treatment
A	Solvent Cleaning	as SSPC – SP1
B	Hand Tool Cleaning	as SSPC – SP2
C	Power Tool Cleaning	as SSPC – SP3
D	Brush Blast	as SSPC – SP7
E	Near White Metal Blast	as SSPC-SP10
F	White Metal Blast	as SSPC – SP5 (NACE #1)
G	Abrasion	The surface shall be lightly abraded using steel wool or abrasive cloth to provide a key for the next coat, to remove runs or excessive brushmarks
H	Vinyl Wash Primer	DFT 13 micron To be overcoated within 24 hr
I	Water-borne Acrylic Primer	Nominal DFT 40 micron
J	Inorganic Zinc Primer	Zinc in ethyl silicate vehicle Minimum DFT 40 micron
K	Industrial Enamel (to 100°C)	To CGSB 1-GP-61M Alkyd Enamel Minimum DFT 40 micron
L	High Build Epoxy	Black Polyamine cured Minimum DFT 200 micron
M	Bituminous Paint	To AWWA C230 MIL-P-151470
N	Silicone Alkyd (100°C to 150°C)	Minimum 60% Solids by Wt Nominal DFT 25 micron
O	Silicone Enamel (150°C to 400°C)	To CGSB 1-GP-143M Nominal DFT 40 micron
P	Fast Drying Aluminum Sealer	To CGSB 1-GP-69M Nominal DFT 25 micron
Q	Canvas Insulation Sealer	Acrylic or PVA Latex
R	Epoxy Gloss Enamel	To CGSB 1-GP-146 Nominal DFT 50 micron
SSPC: Steel Structures Painting Council Pittsburgh PA 15213 Surface Preparation Specifications 1985		

2.7 Schedule of Protective Systems

.1 The schedule of protective systems defines the combination of surface treatments required in each system and the sections of the plant to which it is to be applied. The systems have been grouped into there categories as follows:

.2 Category A: Immersed Service - equipment or material fully, partially, or intermittently immersed in sewage during routine plant operation.

.3 Category B: Exposed Service - equipment or material exposed to the normal range of atmospheric conditions and conditions common to sewage treatment facilities (high humidity, H_2S, etc.)

.4 Category C: Indoor Service - equipment or material inside buildings or other ventilated spaces.

2.8 Category A

.1 Category A: all category A systems will be tested by the Contract Administrator using a wet sponge holiday detector set at 67.5 volts. Touch up will be required at points where the detector is grounded.

Reference	Surface Treatments	Typical Applications
A1	A, D, I, L	Equipment or piping delivered with inorganic zinc primer, e.g., clarifier mechanisms, mixers, etc.
A2	A, F, J, L ,L	Equipment or piping delivered uncoated or with coatings not compatible with high build epoxy, e.g., ductile iron, cast iron or steel pipe and pipe sleeves inside treatment units. External surfaces at valves, ferrous weir plates, weirs, penstocks, fabricated pipe supports, brackets, etc.
A3	A, G, M	Aluminum surfaces in contact with concrete, e.g. stop log guides, access cover frames.
A4	A, E	Ferrous metal surface cast concrete, e.g., penstocks, sluice gates
A5	A	Stainless steels, plastics, and fiberglass products.
A6	A, E, J, M, M	Ferrous metal immersed in abrasive environment, listed below: - grit tanks

2.9 Category B

.1 Schedule

Reference	Surface Treatments	Typical Applications
B1	A, B, R, R	Equipment or piping delivered with inorganic zinc primer, e.g. clarifier motor, gearbox and motor, valve headstocks, piping above ground and outside treatment units, hydrants, etc.
B2	A, B, J, R ,R	Equipment or piping delivered not supplied with an inorganic zinc prime coat or with a prime coat not compatible with an inorganic zinc overcoat
B3	A, G, R, R	Equipment delivered with factory applied paint which is to be painted for identification only
B4	A	Stainless steel or aluminum products, e.g. insulation recovering.

2.10 Category C

.1 Schedule

Reference	Surface Treatments	Typical Applications
C1	A, B, K, K	Equipment or piping delivered c/w factory finished coatings. Coated for system identification and maintenance. Surface temperature during operation not exceeding 100°C, e.g., pumps, air handling units, valves, etc.
C2	A, G, K, K	Equipment or accessories fully primed. Surface temperatures not exceeding 100°C, e.g. pumps, steel piping
C3	A, C, I, N, N	Equipment or accessories as C1 or C2 but with operating surface temperatures between 100°C and 150°C, e.g. air compressors, blowers
C4	E, J, O	Equipment or accessories as C1 or C2 but with operating surface temperatures between 150°C and 400°C, e.g. boiler fittings
C5	B, P, K, K	Piping or valves with bituminous or tar coatings. Surface temperatures not exceeding 100°C, e.g., cast iron and ductile iron pipe, valves
C6	A, K, K	PVC pipe, fittings or accessories, coated for identification only
C7	A, H, K, K	Aluminum insulation recovering coated for identification only
C8	A, Q, G, N, N	Canvas insulation recovering.
NOTES: (1) Surface preparation "G" abrasion, has not been fully scheduled but is to be carried out between all coatings (2) No bare ferrous metal surfaces are permitted. Pipe hangar rods etc. unless zinc or cadmium plated are to be at least prime coated. Cut ends of plated surfaces (Uni-Strut, etc.) are to be spot primed		

2.11 Colour Coding

.1 Refer to Section 11910 for pipe and equipment identification colour coding.

2.12 Acceptable Products

.1 Amercoat Ltd.

.2 Carboline

.3 General Paints Ltd.

.4 ICI Paints Ltd.

.5 Plasite

.6 Rust Oleum

.7 Valspar

3. EXECUTION

3.1 Quality Assurance

.1 Apply and cure all paints and coatings strictly in accordance with the manufacturer's directions.

.2 Pay particular attention to ensure the compatibility of each surface treatment with the preceding and subsequent surface treatment and coatings. Be responsible for the compatibility of all surface treatments and coatings.

3.2 Environmental Conditions

.1 Apply no coating when the ambient or surface temperature is below 10°C or less than 3°C above the dew point.

.2 Provide a minimum of 300 lux illumination on surface to be treated.

.3 Do not apply coatings where dust is being generated.

3.3 Protection

.1 Provide sufficient drop cloths, shields, and protective equipment to prevent spray or droppings from fouling surfaces not being painted. Make good any damage resulting from inadequate or unsuitable protection.

.2 Maintain all coated surfaces until completion of the Work. Make good within seven days any damage to coatings.

.3 Place cotton waste, cloths, and material which may constitute a fire hazard in closed metal containers and remove from the Site at suitable intervals.

.4 Adequately mask, or remove and replace after painting, all grease nipples, bright metal surfaces, identification plates and other items not to be painted. Do not use solvent that may remove permanent lacquer finishes.

3.4 Condition of Surfaces

.1 Prior to starting Work, thoroughly examine all surfaces to be treated or coated. Report, in writing, to the Contract Administrator any condition or defect that may affect the integrity or quality of the finished coating. Do not start Work on any section until all such defects in that section have been corrected.

.2 On all factory primed or coated equipment, touch up defects prior to the application of subsequent coatings.

.3 Be responsible for the condition of surfaces and for correcting defects and deficiencies in the surface.

3.5 Inspection

.1 The Contract Administrator has the right to request tests, to witness the performance of tests, or to perform tests.

.2 Such inspection does not relieve any responsibility for guarantee of the coating application from the applicator.

3.6 Clean-Up

.1 After acceptance of coating, remove all masking, grease, etc, from all equipment which was not intended to be coated.

.2 Remove all unused material, containers, etc, from the Site upon completion of Work.

END OF SECTION

FACTORY-APPLIED MAINTENANCE AND CORROSION PROTECTION COATINGS

1. GENERAL

1.1 Work Included

.1 Supply and application of all factory applied prime coats or factory applied finish coats.

1.2 Submissions

.1 With the equipment Shop Drawings, submit details of the coating systems to be applied.

1.3 Quality Assurance

.1 This Specification is intended to be a minimum reference standard. The Contractor may submit for review alternative coating systems for specific items of equipment which provide equal or better corrosion protection and maintenance service than those specified herein and in accordance with B6.

2. PRODUCTS

2.1 Surface Preparation

.1 Immersion Service: after degreasing, dry blast all ferrous components to a white metal finish in accordance with SSPC-SP5 to a degree of cleanliness in accordance with NACE #1 and obtain a 50 micron blast profile.

.2 Non-immersion Service: after degreasing, dry blast all ferrous components to a near white finish in accordance with SSPC-SP10 to a degree of cleanness in accordance with NACE #3 and obtain a 50 micron blast profile.

2.2 Prime Coating

.1 Prime coat all ferrous surfaces before the blasted surfaces deteriorate.

.2 Coat ferrous surfaces with inorganic zinc primer, containing a minimum of 50 percent solids by volume, applied to a minimum dry film thickness of 75 microns.

2.3 Finish Coats

.1 Apply finish coats in conformance with Section 11900 for service, coating types and application rates.

2.4 Assembly

.1 For items which are to be bolted together before shipment, clean surfaces and coat before the parts are assembled.

.2 Continuous weld all welded connections, sealing the mating surface completely. On completion of the welding and fettling, treat all weld seams with phosphoric acid solution. Rinse and thoroughly dry before the prime is applied.

.3 Where dissimilar metals are mated insulate the mating surfaces from one another to provide protection against corrosion. Insulate bolts, nuts, washers and rivets in a similar manner.

.4 Use 304 stainless steel or better for all nuts, bolts, washers and similar fittings for immersion service. For non-immersion service, use 304 stainless or zinc or cadmium plated nuts, bolts, washers, and similar fittings. Clean and coat the inner face of non-threaded bolt holes as required for other surfaces.

3. EXECUTION

3.1 Inspection

.1 Notify the Contract Administrator two weeks before commencing the protective coating to permit the inspection by the Contract Administrator of the surface preparation and protective coating application.

3.2 Protection

.1 Protect all coated equipment adequately against damage, dust, moisture and scratching during shipment, off-loading, and storage on-Site. If, in the opinion of the Contract Administrator, the coating is damaged during shipment to the extent that touch up would not be satisfactory, return and re-coat the equipment at the Contractor's cost.

.2 Make good damage to coatings occurring at any time prior to the application of any further coatings.

3.3 Application Conditions

.1 Apply all factory applied coatings under controlled conditions, in a dust-free atmosphere at a temperature of between 10°C and 20°C, and a relative humidity should not exceed 80 percent.

END OF SECTION

IDENTIFICATION

1. GENERAL

1.1 Work Included

.1 Identification of equipment, motors, vessels, valves, ferrous, non-ferrous, and insulated piping.

2. PRODUCTS

2.1 Equipment Manufacturer's Nameplates

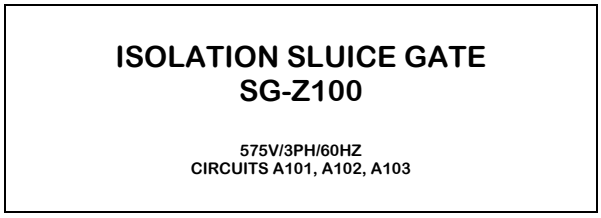
.1 Provide metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.

.2 Provide Underwriters' Laboratories or CSA registration plates, as required by respective agency.

.3 Manufacturer's nameplates to indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase, and power of motors.

2.2 Equipment - Project Identification Nameplates

.1 Supply and install white lamicoid identification plates, with black lettering, for all equipment installed under this Contract. Provide identification plates that are engraved with the unit name and equipment number in 12 mm high lettering and electrical characteristics, if applicable, in 6 mm high lettering, as shown in the following example:



.2 Submit list of plates for review prior to engraving.

2.3 Valves

.1 Provide all valves with a white lamicoid tag, with 12 mm black engraved names and numbers.

.2 Number valves as directed by the Contract Administrator or as shown on the Drawings.

.3 Attach tags to valves using fasteners. Adhesive mounts are not acceptable.

2.4 Piping

.1 For all piping installed under this Contract, use pipe markers designating the pipe service and the direction of flow.

.2 Use pre-printed pipe markers. For pre-printed pipe markers, use self-adhesive, plastic coated cloth labels. In addition to its adhesive, secure each label with a full tape band at each end of the label.

.3 Make direction arrows 150 mm long by 50 mm wide for piping with an outer diameter 75 mm or larger, including insulation. Use 100 mm long by 20 mm wide arrows for smaller diameter piping. Provide double headed arrows where appropriate.

.4 Use block capital letters for names, 50 mm high for piping with an outer diameter 75 mm or larger, including insulation. Use 20 mm high letters for smaller diameters. Identify the pipe commodity using the full names detailed on the Drawings.

.5 Use stainless steel tags for pipes and tubing with an outer diameter 20 mm and smaller.

2.5 Colour Coding

.1 Use a colour coded identification system on the following items:

.1 All piping and valves: paint or band the piping with the colours agreed prior to the Work, paint the valves in the colour of the system, other than valves on fire protection systems. Paint the valves on fire protection systems red.

.2 All pumps: paint pumps in the colour identifying the material being pumped

.3 All motors: paint all motors grey

.2 Identification shall consist of the following:

.1 Coating or banding of pipes and coating of valves to the colour of the medium being conveyed.

.2 Coat non-submerged process equipment to match the colour requirement of the material being processed.

.3 Finish valve handles and similar appurtenances in black.

IDENTIFICATION

.3 Select identification colours in accordance with the colour scheme as outlined in the following table:

Item	Colour	Colour Code
Potable Water	Sky Blue	SW 3021
Well Water Supply	Violet	SW 3022
Well Water Return	Violet	SW 3022
Flushing Water	Blue	SW 3023
Hot Water Supply	Green	SW 3024
Hot Water Return	Aqua Green	SW 3025
Glycol Supply	Medium Fuschia	SW 3026
Glycol Return	Light Fuschia	SW 3027
Rain Water Leaders	Grey	SW 3028
Primary Effluent	Mint Yellow	SW 3030
Primary Sludge	Charcoal Grey	SW 3031
Return Activated Sludge	Orange	SW 3032
Waste Activated Sludge	Yellow	SW 3033
Sludge Mixing System	Pumpkin	SW 3034
Scum/Degreasing	Blue-Grey	SW 3035
Process Drain	White	SW 3036
Mix Age Polymer Tanks	Med. Orange	SW 3040
Polymer Feed Tanks	Teal Blue	SW 3041
Dry Polymer Storage	Light Green	SW 3042
Liquid Polymer Storage	Medium Green	SW 3043
Sludge Feed/Transfer	Dark Yellow	SW 3044
Sludge Cake Line	Medium Yellow	SW 3045
Thin Sludge	Light Yellow	SW 3046
Centrate	Very Light Yellow	SW 3047
Sludge Cake Storage	Medium Yellow	SW 3045
Treated Centrate	Blue Grey	SW 3035
Sludge (Trucked)	Rich Tan	SW 3048
Sludge Cake Hopper	White	SW 3049
Sludge Cake Pump Drive	Dark Green	SW 3050
Ferric Chloride	Bright Yellow	SW 3063
Instrument Air	Forest Green	SW 3060
Process Air	Terrace Green	SW 3061
Oxygen	Purple	SW 3062
Chlorine	Bright Yellow	SW 3063
Natural Gas	Safety Yellow	SW 3064
Digester Gas	Red	SW 3065
Methanol	Bright Yellow	SW 3063
Soda Ash	Med. Orange	SW 3040
Duct Work	Warm Grey	SW 3070
Steel Pipe Supports	Ansi Light Grey	SW 3071
Bollards	Red	SW 3065
Exterior Pedestals/Panels	Lemon Yellow	SW 3071
Handrails (Painted)	Aluminum	B 59S2
Motors	Red	SW 3065
Motor Bases	Carmine Red	SW 3072
Valves/Pumps	Match conduit	
Valve Hand/Chainwheels	Red	SW 3065
Boilers	Heat Resistant Aluminum	B 59S3
Concrete/Blockwork	Platinum Grey	SW 4012

Note: SW = Sherwin Williams

3. EXECUTION

3.1 Equipment Manufacturer's Nameplates

.1 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

3.2 Equipment Project Identification Nameplates

.1 Attach plates to the equipment with rivets, sheet metal screws, or nuts and bolts (adhesive will not be accepted).

.2 Fasten plates in conspicuous locations. Where plates cannot be mounted on hot or cold surfaces, provide standoffs.

3.3 Valves

.1 Attach tags to all valves with sheet metal screws or nuts and bolts. Ensure tags are easily accessible from operator location and do not conflict with valve operation.

3.4 Piping

.1 On completion of protective coatings or finish painting, neatly stencil direction flow arrows and the commodity abbreviation on the pipe. Alternatively, attach pre-printed labels.

.2 Stencil or attach pipe markers in readily visible locations. Identify piping at the following locations:

.1 At each valve

.2 On both sides of wall penetrations

.3 At floor and roof penetrations

.4 On each leg of branches

.5 Every 15 m along continuous runs

END OF SECTION