

DIVISION 40

PROCESS INTEGRATION

Part 1 General

1.1 DESCRIPTION

- .1 This section specifies general clauses applicable to the supply and installation of all process mechanical systems.
- .2 The process mechanical systems include all of the systems handling process water, flushing water, hauled liquid waste, and leachate and those directly related to the process system.
- .3 The Work under this section shall include the supply, installation, testing and start-up of the Process Mechanical Material and Products to provide a complete and workable installation in accordance with the contract drawings and specifications and all applicable codes, standards and ordinances. Any work and/or other necessary materials not specifically mentioned in the specifications or shown on the drawings, but necessary to complete the installation, shall be furnished by the Contractor as if specifically mentioned herein and detailed.
- .4 All work related to fire suppression, domestic plumbing (building water and wastewater lines), and heating systems are specified in Division 21, Division 22 and Division 23.

1.2 RELATED SECTIONS

- .1 Refer to Division 26 and 25 for Electrical Work and Controls and Instruments related to Process Mechanical work.
- .2 All Sections Division 1 - are an integral part of this specification and shall be read in conjunction herewith.
- .3 The process mechanical drawings do not show structural details and any information involving accurate measurements of buildings. Refer to architectural and structural drawings as well as all other divisions of this specification.
- .4 Piping and mechanical work shall be painted in accordance with the painting specifications in Division 9.

1.3 WARRANTY

- .1 Furnish a written guarantee stating that all work executed in this contract will be free from defective workmanship and materials for a period of one (1) year from the date of Total Performance of work. The Contractor shall repair and replace any work which fails or becomes defective during the term of the guarantee/warranty, providing the operating and maintenance instructions have been complied with. The period of guarantee specified shall not, in any way, supplant any other guarantees of a longer period provided by Manufacturers or as called for in the project documents.

1.4 PERMITS, CERTIFICATES, AND FEES

- .1 The Contractor shall give all notices, obtain all permits and pay all fees so that the work specified herein may be carried out.
- .2 The Contractor shall make all necessary arrangements with Utilities Companies for services and meters as required and pay for all the costs involved.
- .3 Arrange for inspection of all work by the authorities having jurisdiction over the work including local building, plumbing and Utilities Representatives. On completion of the

work, present to the Contract Administrator the final unconditional certificate of approval of the inspecting authorities.

1.5 CODES AND STANDARDS

- .1 Comply with the requirements of the latest edition of the applicable CSA standards, the requirement of the Authorities, Federal, Provincial and Municipal Codes, the applicable standards of the Underwriters Association and all other Authorities having jurisdiction. Comply with the guidelines of Manitoba Conservation in the undertaking of the work. These codes and regulations constitute an integral part of these specifications.
- .2 Welding shall conform to the ANSI/ASME Power Piping Code and the ASME Boiler and Pressure Vessel Code.
- .3 Welders shall be qualified and licensed in Manitoba, and welder qualifications shall be in accordance with CSA-Z662.
- .4 Welding safety requirements shall be in accordance with CSA-W117.2 - Code for Safety in Welding and Cutting.
- .5 Work shall be performed in accordance with the Regulations of the Manitoba Workplace Health and Safety Act.
- .6 Installation shall be in accordance with the National Building Code and all regulations and codes of the Province, Territory or Municipality in which the work is located.
- .7 In case of conflict, the codes shall be taken as the minimum acceptable criteria where they exceed those in the contract documents. In no instance reduce the standard or scope of work, or intent established by the contract documents by applying any of the codes referred to herein. Where the contract documents indicate a standard exceeding code requirements, the contract documents shall take precedence.

1.6 APPROVED EQUALS

- .1 Approval of alternative equipment shall be in accordance with B7.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

- .1 All materials and equipment shall be delivered, handled and stored subject to the provisions contained herein and according to the manufacturer's recommendations.
- .2 Provide temporary storage facilities and heated storage where required for sensitive items such as motors.
- .3 Equipment, including pumps and motors, shall not be placed in temporary or final locations in the new structures before a date approved by the Contract Administrator. The date of delivery into the structure shall be commensurate with the construction progress and the suitability, with respect to temperature, humidity, etc. of the building.
- .4 Take precautions to maintain equipment in good condition and to avoid corrosion or other damage, which may affect the equipment's performance. Provide temporary coatings as required to prevent corrosion.
- .5 Leave factory covers in place and prevent entry of foreign materials into working parts of equipment.
- .6 Protect members and bearings with plastic covers.
- .7 Grease all shafts and sheaves to prevent corrosion.

- .8 The Contractor shall recognize the time interval required for complete construction before the structure is suitable for equipment installation. If equipment is manufactured before it is required at the site, the Contractor shall provide suitable heated dry storage space for the equipment, to the approval of the Contract Administrator. All equipment and motors shall be rotated at least weekly during the storage period, and after installation, until the equipment is placed in normal use.
- .9 All material damaged or otherwise harmfully affected during delivery, storage, handling or installation shall be replaced by the Contractor at his/her own expense.

1.8 EQUIPMENT SUPPORTS, ANCHORS, AND BASES

- .1 The Contractor shall provide all structural work required for foundation and support of units, foundation bolts, sleeves, washers, nuts, shims and templates to locate bolts.
- .2 Anchor bolts shall be set in concrete with one end of the bolt hooked as detailed; or sleeved anchor bolts as detailed may be set in concrete. Expansion type bolts drilled into concrete may not be used in lieu of anchor bolts.
- .3 Provide a minimum of 25 mm non-metallic grout between bedplates and concrete foundation, fill voids, finish and remove wedges after grout is set. Grout shall be Embeco, non metallic type or approved equal in accordance with B7.
- .4 Where grouting is required for bedplates and equipment bases on concrete foundations, the surface of the concrete foundation shall be roughened to provide a bond.
- .5 All bases shall be finished to match the floor.

1.9 MATERIALS

- .1 Provide new materials and equipment of first class quality, delivered, erected, connected and finished in every detail, and supplied with the acceptance of the Contract Administrator.
- .2 Assume responsibility of ensuring that equipment provided performs as specified.

1.10 INSTALLATION

- .1 Follow the recommended installation details and procedures for all equipment as found in the supplier's technical data, supplemented by the shop drawings, the contract drawings and the specifications and the directions of the Contract Administrator. Co-ordinate work with the work of other trades to avoid conflict.
- .2 Install mechanical work in advance of concrete pouring as necessary.
- .3 For equipment or material of the same type or classification, install only products of one manufacturer.
- .4 Install all equipment with adequate access for inspection and servicing and to provide minimum interferences. Conserve headroom and leave maximum usable space.
- .5 Employ only skilled tradesmen properly licensed by the Province or Territory, for all work requiring tradesmen with special skill.
- .6 Motors shall be aligned, shimmed and coupled to fit shafts, to the tolerances given by the manufacturer.

- .7 Set equipment in place and install piping, fittings, valves and other items. Make final adjustments in alignment and elevation before securely fastening equipment and other items in place.
- .8 Control alignment so that excess forces are not imposed on equipment when piping connections are tightened.
- .9 Do not tighten pipes until grout is set.
- .10 Tighten so that there are no excessive stresses set up in flanges.

1.11 VIBRATION ISOLATION

- .1 Provide vibration isolators for all mechanical motor driven equipment throughout the project, unless specifically noted otherwise. This shall include but not be limited to all piping connected to vibration isolated equipment.
- .2 Provide Vibration Isolators as manufactured by Vibro-Acoustics, Vibron or Air Master.
- .3 Provide all sound and vibration elimination materials by one supplier unless otherwise specified. Provide shop drawings showing isolator location, load forces, anchor positions, etc. and installation instructions.
- .4 Statically and dynamically balance rotating equipment for minimum vibration and low operating noise level.
- .5 Provide flexible connectors for pipes to all equipment supported by vibration isolators.
- .6 Provide flame proof flexible connectors between fans, heaters, equipment and ducts.
- .7 Equipment installed by the Contractor shall operate smoothly without excessive wear, adjustment and attention. Vibration shall not exceed the manufacturer's specified limits for individual products. Vibrations in pumps shall be within acceptable field vibration limits as outlined in the Standards of the Hydraulics Institute.

1.12 GUARDS

- .1 Provide vibration free guards on all exposed drives and rotating parts, to meet the requirements of the Manitoba Workplace Health and Safety Act.
- .2 Provide means to permit lubrication, use of test instruments and movement of motors to adjust belt tension.

1.13 MINOR DEVIATIONS

- .1 The Contractor shall allow for additional material such as pipe and ducts for modifications that may be required to correct minor conflicts or deviations.

1.14 PRIMARY MEASURING ELEMENTS

- .1 Install all primary elements specified in Division 25 – Integrated Automation.

1.15 SHOP DRAWINGS

- .1 Shop drawings shall be submitted in accordance with Section 01 33 00 - Submittal Procedures, and in accordance with the requirements of the various divisions.
- .2 Materials incorporated into the work prior to approval of shop drawings shall be removed and replaced at the Contract Administrator's discretion and at the Contractor's expense.

1.16 OPERATION AND MAINTENANCE MANUALS

- .1 Submit operation and maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals, and in accordance with the requirements of Division 40, all sections.

1.17 TRAINING

- .1 Refer to Section 01 79 00 – Demonstration and Training.

1.18 COMMISSIONING

- .1 Refer to Section 01 98 13 – General Commissioning Requirements.

1.19 MANUFACTURER’S REPRESENTATIVE

- .1 Refer to Section 01 79 00 – Demonstration and Training, Section 01 98 13 – General Commissioning (CX) Requirements and to other sections of Division 40 with regard to start up and check out services by the manufacturers of equipment.
- .2 Arrange and pay for field services of Manufacturer’s representatives required for instruction on specialized portions of the installation.

1.20 PAINTING

- .1 All piping, with the exception of stainless steel, shall be painted in accordance with paint specifications in Division 9.
- .2 All unpainted equipment and appurtenances shall be given shop prime paint suitable for field painting as specified in Division 9.
- .3 Do not paint over nameplates.
- .4 Equipment having a finished shop coat shall be touched up.
- .5 Hangers, supports and fabricated equipment shall be primed and painted as specified in Division 9.

1.21 IDENTIFICATION OF EQUIPMENT

- .1 Provide a manufacturer's nameplate on each piece of equipment.
- .2 Fasten nameplates securely in a conspicuous place.
- .3 Identify each piece of equipment by the tag indicated on the Process and Instrumentation Diagrams.

1.22 VALVE IDENTIFICATION

- .1 Tag all valves, automatic control and instruments with the corresponding valve number as indicated on the Process and Instrumentation Diagrams.
- .2 Tags shall be 75 mm x 35 mm x 2.5 mm thick laminated plastic with black faced and white lettering, secured to the valve stem with a key chain.

1.23 ELECTRIC STARTING SWITCH IDENTIFICATION

- .1 Identify electric starting switches, remote push button stations and equipment supplied under this division with lamacoid plates having 6 mm minimum letter size. Identification to state equipment controlled.

1.24 CLEANUP AND DISINFECTION

- .1 All piping and equipment shall be thoroughly cleaned of dirt, cuttings and other foreign substances.
- .2 Disconnect, clean and reconnect whenever necessary for purposes of locating and removing obstructions.
- .3 Flush and chlorinate all potable water systems as specified in plumbing codes and where applicable, in accordance with AWWA standards for Disinfection of Facilities.
- .4 The Contractor shall provide bacteriological testing showing that domestic pipe cleanliness meets provincial standards prior to placing potable water systems into service.

1.25 LUBRICATION

- .1 For all equipment, furnish lubricants in sufficient quantity for 12 months operation by the City.
- .2 Identify lubricants furnished by brand, grade and item of equipment for which it is intended.
- .3 Operate, drain and flush out bearings and refill with a new change of oil before completion.

1.26 DRAWINGS OF RECORD

- .1 Refer to Division 1, Section 01 78 00 - Closeout Submittals.
- .2 Drawings of Record are required for process mechanical revisions.

1.27 MOTORS

- .1 Refer to Division 26 for all motor design requirements.

1.28 CUTTING AND PATCHING

- .1 The Contractor shall locate and provide holes and sleeves for all process mechanical work in accordance with the contract drawings and specifications.

1.29 TEMPORARY USE

- .1 Refer to Section 01 14 00 – Work Restrictions regarding temporary use of process mechanical piping and/or equipment.

1.30 PATENTS

- .1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the City and the Contract Administrator harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them or any part machine, manufacture or composition of matter on the work, in violation or infringement of such letters patent or rights.

1.31 DOCUMENTATION AND SYSTEMS ACCEPTANCE

- .1 Meet requirements stated in Section 01 78 00 - Closeout Submittals.

- .2 Contractor shall obtain suitable document signed by the City or his representative, confirming:
 - .1 The City has received satisfactory instruction in operation and maintenance of all equipment and systems.
 - .2 Operation and maintenance manuals have been provided to the City.
 - .3 Specified spare parts of components, keys, removables, handles, tools and the like, have been accepted by the City.

Part 2 Products

- .1 Not Used.

Part 3 Execution

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 DESCRIPTION OF WORK

- .1 The supply and installation of all process valves applicable to the upgrades of the two hauled wastewater facilities and construction of the leachate sampling building. Excluded are domestic plumbing valves.

1.2 RELATED WORKS

- .1 General Requirements – Division 01
- .2 Section 40 05 00 – Common Work Results for Process Integration
- .3 Section 40 20 00 – Process Piping Materials and Methods

1.3 SUBMITTALS

- .1 The Contractor shall submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures and as follows:
 - .1 Assembly drawings and material list.
 - .2 Details of all parts and principal dimensions.
 - .3 Submit installation manuals before shipment of any equipment.
 - .4 Submit operation and maintenance manuals.

1.4 SUPPLIERS

- .1 All valves and operators of the same type shall be provided by one manufacturer.

Part 2 Products

2.1 BALL VALVES

- .1 Ball valves for stainless steel pipe:
 - .1 Two piece stainless steel body
 - .2 Full standard port
 - .3 Minimum 1035 kPa working pressure
 - .4 Type 316 stainless steel wetted parts to CF8M
 - .5 Blow out proof stem
 - .6 Solid stainless steel ball
 - .7 PTFE seat and packing
 - .8 Lever handle
 - .9 Ends to suit connection
 - .10 Kitz, Trueline, Jenkins, Crane, Mueller or approved equal in accordance with B7

2.2 PLUG VALVES

- .1 Sized to match pipe shown on drawings
- .2 Cast iron body to ASTM A126 Class B; welded nickel seat

- .3 Valve shall meet ANSI/AWWA C517
- .4 Permanently lubricated radial shaft bearings of 316 SS
- .5 Flanges to ANSI-B16.1, Class 125
- .6 One piece construction plug c/w EPDM coating
- .7 Adjustable packing
- .8 Thrust washers of 316 SS and Teflon
- .9 Drip tight shut off up to rated working pressure
- .10 Pressure rating to 1200 kPa (175 psi) for valves up to 300ø
- .11 Fusion bonded epoxy interior and exterior coating. Use flat washers under flange nuts to prevent damage to finish
- .12 For horizontal installation, install valve such that the seat is downstream and when open the plug is located at the top; for vertical installation ensure seat is at the top of the valve
- .13 Minimum open area of 80%
- .14 Valves on 300ø discharge from Tanks 3 & 4 shall be provided with buried worm gear actuators for use with electric actuators. These valves will have a high cycle count, opening and closing once per truck dump
- .15 Manual valve actuators shall be as follows and as indicated on the drawings:
 - .1 100 mm and smaller – hand lever
 - .2 150 mm and larger – totally enclosed, grease packed gear actuator c/w position indicator and handwheel
- .16 Val-Matic Cam-Centric Series #5800R, DeZurik Model PEC (Eccentric), Pratt Ball Centric, or approved equal in accordance with B7

2.3 MULTI-TURN ELECTRIC ACTUATORS FOR TANKS 3 & 4 DISCHARGE

- .1 Capable of operation at up to 60 starts per hour in gravity flow application and with the host valve installed in the orientation indicated on drawings
- .2 A handwheel shall be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to electrical operation automatically by starting the motor. Clockwise operation of the handwheel shall give closing movement of the valve.
- .3 Actuators and their associated plug valves shall be supplied through a single vendor
- .4 Minimum torque factor shall be based on the following:
 - .1 Fluid with solid particles
 - .2 One or more cycles per day
 - .3 Ability to fully open and close the supplied 300ø plug valve both when holding tank is empty and when it is full
- .5 The safety margin of motor power available for seating and unseating the valve shall be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal
- .6 Operating time of approximately 60 seconds

- .7 600 V, 3 phase , 60 Hz motor
- .8 Incorporating motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self contained, sealed enclosure
- .9 The reversing starter, control transformer and local controls shall be integral with the valve actuator, suitably housed to prevent breathing and condensation
- .10 Actuators shall be o-ring sealed, watertight to IP66/IP68 7m for 72hrs, NEMA 4, 6
- .11 Motor temperature shall be limited by 2 thermostats embedded in the motor end windings and integrated into its control
- .12 The actuator gearing shall be totally enclosed in an oil-filled gear case suitable for operation at any angle. The design shall permit the opening of the gearcase for inspection or disassembly without releasing the stem thrust or taking the valve out of service. Drive gearing shall be self locking to prevent the valve back-driving the actuator.
- .13 The actuator shall incorporate local controls for Open, Close and Stop and a Local/Stop/Remote mode selector switch. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation. Stop and Remote position settings shall be available for monitoring via dry contact
- .14 Four contacts shall be provided which can be selected to indicate any position of the valve. Contacts shall maintain and update position indication during handwheel operation when all external power to the actuator is isolated.
- .15 The actuator shall receive a 4-20mA position command signal and return a 4-20mA position signal
- .16 The actuator shall have a fault signal available for monitoring via dry contact output
- .17 The actuator display shall include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted
- .18 Text display shall indicate actuator status and alarms. An integral datalogger shall record and store operational data
- .19 Acceptable product: Rotork IQ3 series

2.4 BUTTERFLY VALVES AND MANUAL ACTUATORS

- .1 Valves 50 mm to 100 mm shall be wafer style body. Valves over 100 mm shall be lug style body
- .2 CRN # (Canadian Registration Number) for applicable Province (include on shop drawings)
- .3 All materials contacting the process fluid shall be "Food Grade" quality and meet ANSI safety criteria as set out in NSF 60/61
- .4 Ductile iron body with extended neck allowing for insulation
- .5 Stainless steel disc
- .6 Wafer body to have flange locating holes, factory coated for use in potable water immersion
- .7 Rated for 1035 kPa working pressure

- .8 For installation between 1035 kPa ANSI drilled flanges. Connecting pipe flanges shall have a flat mating surface for proper sealing against the valve. Flange gaskets shall not be required
- .9 Maximum seating/unseating torque based on water at 70° F, 100 psi:
 - 100φ = 59 n.m. 150φ = 114 n.m. 200φ = 195 n.m.
 - 250φ = 311 n.m. 300φ = 422 n.m. 350φ = 678 n.m.
- .10 Single piece shaft – 316 SS – consistent diameter throughout body
- .11 Valve seat – peroxide cured EPDM (sulphur cured seats are not acceptable)
- .12 For operating temperature range -35° to 135° C
- .13 Bi-directional drip-tight shutoff
- .14 Keystone Series GR, Bray Series 30/31, or approved equal in accordance with B7.
- .15 Manual butterfly valve actuators:
 - .1 For valve 150 mm and smaller – lever operated cast iron c/w 10 position plated steel notch plate and stainless steel spring
 - .2 For valves 200 mm and larger – enclosed gear actuator, cast iron housing and cover, alloy steel worm, steel shaft, Buna N seals, self-lubricated, totally enclosed, aluminum hand wheel, position indicator, and adjustable travel stops. Design for 445 N rim pull

2.5 CHECK VALVES

- .1 Check valves:
 - .1 Stainless steel body to ASTM A-351 CF8M, ANSI series stainless steel disc to ASTM A-240, Type 304
 - .2 Valve closes drip tight prior to reversal of flow condition
 - .3 1035 kPa rating
 - .4 Resilient o-ring seat of Buna N or Viton
 - .5 Stainless steel hinge, pins and spring
 - .6 Suitable for horizontal or vertical installations
 - .7 Valve options:
 - .1 External lever and weight to increase closing force of disc
 - .8 Check-Rite Model 260 c/w SA-16 lever and weight, or approved alternative.

2.6 MANUAL GEAR OPERATORS

- .1 Manual gear operators shall be sized for the operating rim pull of 80 N at maximum working pressure differential across the valve
- .2 Provide hand lever operator for valves 150 mm and smaller
- .3 Provide handwheel operators for gate valves, knife gate valves and globe valves unless operators are specified
- .4 Provide geared type actuator complete with valve position indicator for valves 200 mm and larger. Handwheel operator shall be provided unless otherwise specified

2.7 ELECTRIC ACTUATORS FOR VALVES SMALLER THAN 250 MM

- .1 Electric operators shall include motor, power gearing, torque switches, mechanical position indicator and accessories as required and specified hereunder.
- .2 Cast aluminum construction and permanently lubricated gears.
- .3 Temperature rating from -29° to 65°C
- .4 Operator shall be furnished with a handwheel for manual operation. The motor rotor shall not operate when handwheel is in use. No declutch mechanism shall be required for manual operation. Handwheel shall not require more than 180 N pull at the rim to operate.
- .5 Electric motors shall be CSA approved, suitable for humid environment, NEMA 4. Provide Class F or better insulation.
- .6 Output relays for monitoring, fault alarms, and open/closed limits.
- .7 Suitable for two-position, ESD, or modulating applications.
- .8 Able to accept analogue or digital inputs.
- .9 Operator shall develop 1.5 times the torque required to operate valve at 1035 kPa.
- .10 Acceptable manufacturer: Rotork.

2.8 COMBINATION AIR RELEASE VALVES

- .1 Size as shown on drawings with threaded NPT connection
- .2 Single conical metal body c/w baked polyester coating and external lever for maintaining max distance between the liquid and sealing mechanism while minimizing valve height, plug-disc linkage external of air valve body.
- .3 Double orifice
- .4 Vibrations of lower float must not unseat the smaller, automatic valve
- .5 Flushing ball valve
- .6 Air and gas shall be discharged and admitted at high velocity throughout the range of 80 kPa differential pressure to the rated working pressure of the valve
- .7 All inner metal parts shall be stainless steel
- .8 Pressure rating of 1000 kPa (145 psi)
- .9 Minimum working pressure of 20 kPa (3 psi)
- .10 ARI D-023 series, Bermad C65 Combination Air Valve, Vent-O-Mat RGXII or approved equal in accordance with B7

2.9 PRESSURE GAUGES

- .1 Provide 115 mm diameter, cast aluminum pressure gauges – black finish – stainless steel internals – liquid filled – dial type to CGSB 91-GP-1 – glass window, white dial, black lettering – ½ of 1% accuracy unless otherwise stated.
- .2 Full scale value of each gauge shall be such that at normal system operating pressure the dial shall be between the 11:00 and 2:00 positions on the gauge.
 - .1 Provide brass gauge cock and “RAY” Center joint piston pressure snubber for pulsating operation on all air piping.

- .2 Provide 13 mm inlet and outlet Chemline SG series Gauge Isolator. Gauge isolator to have:
 - .1 Stainless steel fasteners
 - .2 Teflon PTFE bonded Hypalon dished diaphragm
 - .3 Glycerine filled upper chamber
- .3 Use materials compatible with system requirements
- .4 Porous stone style pressure snubbers are not acceptable
- .5 Acceptable Gauge Manufacturers: Ashcroft, Terrice, Taylor, Weiss, Weksler, Winters, Marshall Town or approved equal in accordance with B7.

2.10 PRESSURE SWITCHES

- .1 Provided as per Division 26.
- .2 Provide ball valve on all pressure switches.

2.11 SPRAY NOZZLES

- .1 Unit shall have toolless installation and removal of the nozzle from the supply pipe, and allow positive alignment of spray pattern
- .2 Tip shall be one piece construction stainless steel with a 7.6 mm (0.298 inch) orifice
- .3 Providing a flat and thin fan shaped spray delivering high impact and ability to flush away debris
- .4 Spray angle of 50 degrees from the vertical at 276 kPa (40 psi) supply pressure
- .5 Minimum 1 L/s (16 USGPM) capacity at 276 kPa (40 psi) supply pressure
- .6 Minimum 1035 kPa (150 psi) rated operating pressure
- .7 BEX ZLFP50160 or approved equal in accordance with B7

Part 3 Execution

3.1 FIELD PAINTING

- .1 All exposed surfaces of valves shall be painted after installation; refer to Division 09.

3.2 DELIVERY

- .1 Provide for unloading and storage of the valves on the site of the Work.

3.3 VALVES AND OPERATORS

- .1 Install all valves and operators in strict accordance with manufacturer's shop drawings and instructions.
- .2 Install extension stems, stem supports and other accessories as required and as shown on drawings.

3.4 GAUGES AND FIXTURES

- .1 Install all gauges and fixtures in strict accordance with manufacturer's shop drawings and instructions.

3.5 TESTING

- .1 Field test all valves in presence of the Contract Administrator to demonstrate the installation is correctly completed and all valves are operating satisfactorily.

3.6 TRAINING

- .1 The Contractor shall provide training to the City's designated operators in accordance with Section 01 79 00 – Demonstration and Training. Training shall include suggested maintenance, inspection, replacement of moving parts, etc.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 This section specifies the general requirements for supply and installation of all process mechanical piping systems and is supplemented by other specific details shown or specified in the respective piping system section.

1.2 RELATED SECTIONS

- .1 All sections, Division 01
- .2 Section 09 91 00 – Painting
- .3 Division 26 – Electrical
- .4 Division 33 - Utilities
- .5 Division 40 – Process Integration

1.3 DESIGN REQUIREMENTS

- .1 The design has been completed to the degree necessary for the Contractor to tender the project. The pipe support system is not fully detailed and will require the Contractor to undertake some design for the piping system to be installed.
- .2 Piping supports are generally not shown on the process/mechanical layout drawings. Provide the design of piping supports, pipe guides, and anchors based upon the piping layout. Typical support details and structural attachments shown on the drawings indicate the level of quality that will be considered acceptable.
- .3 The Contractor is responsible for the final aspects of the pipe support system and thrust restraint design. The components of the design that will be generated will be as follows:
 - .1 Final layout, illustrated using layout and section drawings.
 - .2 Piping support system design, including details and location of all supports. The support system will ensure that the weight of the pipework and commodities, and the need for lateral and vertical support are considered fully. Additional pipe support requirements are specified below in Clause 3.10 – Installation of Supports and Hangers.
 - .3 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.
- .4 Design documentation shall be submitted to the Contract Administrator to confirm compliance with the requirements of the piping systems.

1.4 SUBMITTALS

- .1 The Contractor shall submit shop drawings and product data in accordance with Section 01 33 00 – Submittal Procedures as follows:
 - .1 Assembly drawings and material list.
 - .2 Details of all parts and principal dimensions.
 - .3 Submit installation manuals before shipment of any equipment.

- .4 Submit operation and maintenance manuals 30 days prior to start up.

1.5 QUALITY ASSURANCES

- .1 Domestic Water, Drainage and Vent Piping: Provincial and Municipal codes.

1.6 REFERENCES

- .1 ASTM D2564-88, Specification for Solvent Cements for Poly Vinyl Chloride
- .2 CAN/CSA-B137.3, Rigid Polyvinyl Chloride (PVC) for Pressure Application
- .3 CAN/CSA-B137.6, Chlorinated Polyvinyl Chloride (CPVC) Pipe, Tubing, and Fittings for Hot- and Cold- Water Distribution Systems
- .4 CAN/CSA-B181.2-M87, PVC Drain, Waste and Vent Pipe and Pipe Fittings
- .5 CAN/CSA-B182.1-M87, Plastic Drain and Sewer Pipe and Pipe Fittings
- .6 CSA B181.12-1967 – Recommended Practice for the Installation of PVC Drain, Waste and Vent Pipe and Pipe Fittings

Part 2 Products

2.1 PIPE - FOR BURIED SERVICE

- .1 Polyethylene and PVC Pipe
 - .1 All underground pipe shall be by Division 33

2.2 PIPE - FOR NON-BURIED SERVICE

- .1 Polyvinyl Chloride
 - .1 CSA-B137.3
 - .2 Class 12454B PVC compound
 - .3 Schedule 80
 - .4 Solvent weld joints
- .2 Polyvinyl Chloride (Non-pressure Service - DWV)
 - .1 PVC Schedule 40
 - .2 CSA-B181.2 and CSA-B 182.1
 - .3 Solvent weld joints
- .3 Dual Containment PVC
 - .1 CSA B1800
 - .2 Schedule 40
 - .3 Containment pipe shall prevent gases in the surrounding environment from entering the containment or carrier pipe
 - .4 Iplex Drain-Guard Double Containment using System 15 primary components, or approved equal in accordance with B7
- .4 Steel
 - .1 65 diameter and smaller
 - .1 To ASTM-A120

- .2 Galvanized, standard wall thickness
- .3 Screwed joints Class 150, unless otherwise indicated on drawings
- .2 75 diameter to 300 diameter
 - .1 To ASTM-A53 - Grade B
 - .2 Galvanized, standard wall thickness
 - .3 Seamless pipe
 - .4 Victaulic flanged joints for valve and equipment connections
 - .5 Victaulic coupled joints for pipe to pipe connections
 - .6 Welded joints are not acceptable
 - .7 Exterior primed for field painting (refer to Section 09 91 00 - Painting)
- .5 Stainless Steel for Process Piping
 - .1 ASTM-A778 or A312 Type 304 L pipe
 - .2 ASTM-A774 or A-403 Type 304 L fittings
 - .3 Minimum Wall Thickness:
 - .1 Schedule 10S
 - .4 Vacuum rating: 100 kPa
 - .5 Longitudinally welded by Tungsten Inert Gas (TIG) for all sludge treatment piping and/or Metal Inert Gas (MIG) method elsewhere
 - .6 Ends prepared for welding or to suit connections as shown on drawings
 - .7 Provide flanges where required to connect to valves and equipment and at 3 m maximum spacing on straight runs
- .6 Flexible Leachate Truck Connection Hose
 - .1 Constructed with rigid PVC helix; having a corrugated exterior and smooth bore
 - .2 Cold temperature rating of -40°C
 - .3 Designed to handle materials typically encountered in leachate sourced from landfills, with low pH, and including methane gas and hydrogen sulfide
 - .4 Bending radius less than 275 mm for 150ø hose
 - .5 150ø Cam-lock connections
 - .6 Provide banding coils around flexing sections as indicated in drawings
 - .7 Kanalite Blue or approved equal in accordance with B7

2.3 PIPE FITTINGS

- .1 PVC
 - .1 For pressure service to CSA3-B137.3
 - .2 For non-pressure service to CSA-181.2
 - .3 Schedule to match pipe
 - .4 Solvent joint fittings to match pipe
 - .5 To AWWA-C111 - rubber gasket type where required
 - .6 Flanges, reducing bushings and other fittings to be compatible with line pipe material
- .2 Polyethylene

- .1 To match pressure rating of pipe supplied
- .3 Stainless Steel
 - .1 Wall thickness to match or exceed line pipe wall
 - .2 Elbows to 450 mm shall be smooth flow and manufactured to the requirements of ANSI B16.9.
 - .3 Backing flanges to be stainless steel, ANSI-B16.5 Class 150 standard, or ANSI-B16.5 Class 300 where noted on drawings.
 - .4 Ends to be prepared to suit piping as required.
 - .5 Fitting ASTM type to match pipe ASTM type.

2.4 FLANGES

- .1 Flanges for stainless steel shall be welding neck or slip-on type as shown on the drawings.
- .2 Slip-on flanges shall be in accordance with AWWA-C207, and rated for 1035 kPa.
- .3 Use flat face flanges to connect to cast iron flanges, and raised face flanges to connect to raised face flanges.
- .4 Flange surfaces mating to resilient seated butterfly valves shall be smooth
- .5 Flange class shall be plainly marked on all flanges.

2.5 BOLTS AND NUTS

- .1 Bolts and nuts shall be to AWWA C207.
- .2 Bolts and nuts shall be stainless steel to ASTM-240, Type 304 hexagonal heads.
- .3 Size and length to match flanges and valves.

2.6 FLANGE GASKETS

- .1 For flanges, 1.6 mm cloth inserted rubber SBR, Garlock Style 22 or approved alternate for temperatures below 100°C.
- .2 Use flat ring gaskets with raised face flanges.
- .3 Use full faced gaskets with flat face flanges.

2.7 VICTAULIC COUPLINGS

- .1 Victaulic couplings shall be used for jointing standard steel pipe and where shown on drawings.
- .2 Victaulic couplings shall be in accordance with the recommendations of the Victaulic Company of Canada, Anvil International (Gruvlok) or approved alternative.
- .3 For rigid connections in wastewater piping use:
 - .1 Victaulic Zero - Flex Style 07.
 - .2 Gruvlok Figure 7401.
- .4 For flexible couplings allowing for expansion, contraction and deflection use:
 - .1 Victaulic 71, Gruvlok Figure 7001 Standard Couplings for maximum working pressures to 3450 kPa.

- .2 Victaulic 77 Gruvlok Figure 7001 Standard Couplings for maximum working pressures in accordance with manufacturer's recommendations.
- .5 Coupling gaskets - Grade E-EDPM for water from -34°C to +110°C.
- .6 Bolts and nuts - Zinc electroplated, from ASTM-A183 or stainless steel Type 304.
- .7 Coupling Materials
 - .1 Ductile Iron to ASTM-A536 for normal conditions.
 - .2 Stainless steel Type 304 for corrosive conditions.

2.8 VICTAULIC GROOVES

- .1 Standard Steel Pipe – roll or cut grooves to coupling manufacturer's standards. The use of cut grooves shall maintain a minimum pipe work pressure of 1035 kPa.
- .2 Light Wall Steel Pipe - roll grooves to coupling manufacturer's standards.
- .3 Stainless Steel Pipe - roll grooves to coupling manufacturer's standards.

2.9 VICTAULIC FITTINGS (GROOVED ENDS)

- .1 Steel to ASTM A106 Grade B - segmentally welded.

2.10 VICTAULIC FLANGES

- .1 Use hinged Victaulic Flange Style 341 or Gruvlok Flange Figure 7012 for pipe diameters 300 mm and smaller.
- .2 Use four-piece Victaulic Flange Style 341 or Gruvlok Flange Figure 7012 for pipe diameters 350 mm and larger.

2.11 FLEXIBLE PIPE ACCESSORIES

- .1 Cam-Lock Couplers
 - .1 Provide female coupler c/w hose shank for attachment to PVC hose.
 - .2 Provide threaded male adapter for connection to rigid pipe elbow.
 - .3 Material of construction shall be 316 stainless steel.
 - .4 Provide Buna "N" gaskets.
 - .5 Fittings to be rated for a minimum operating pressure of 150 psi.

2.12 FLEXIBLE PROCESS PIPE SECTIONS

- .1 Double arched butyl rubber expansion joint with multiple plies of polyester or nylon cord and full faced flanges with retaining rings drilled to 150# ANSI standards
- .2 50mm minimum axial compression.
- .3 Acceptable product: Flexicraft Ultraspool Double, or approved equal in accordance with B7.

2.13 SLEEVE TYPE COUPLINGS

- .1 Use only as indicated on the drawings.
- .2 Use steel couplings, standard shop coated, with Dresserloy or approved alternative nuts and bolts, and plain grade 27 gaskets.

- .3 Couplings to be Dresser Style 38 or approved alternative, standard length, standard weight.
- .4 Transition couplings to be Dresser Style 162 or approved alternative.
- .5 For underground service use couplers with followers and middle rings fully coated with Dresser Al-Clad or approved alternative and installed with harness, nuts, bolts and rings packed with protective Denso Plast and coated with Denso tape.
- .6 Joint harness details shall be in accordance with AWWA Steel Pipe Manual M11.
- .7 Design of joint harness shall be based on an operating pressure of 1035 kPa unless otherwise noted.
- .8 Harness nuts and bolts to be hot dipped galvanized.

2.14 WELDING OUTLETS

- .1 Fabricate to the requirements of ANSI-B16.9, ANSI-B16.11 and ANSI-B31.1.
- .2 Welded outlets include weldolets, sockolets and thredolets.

2.15 PIPE SLEEVES

- .1 Process pipes passing through walls below grade shall be stainless steel with a diameter equal to the process pipe. The annular space around these sleeves shall be sealed using a modular seal, or as indicated on the drawings.
- .2 End connections shall be as indicated on the drawings.
- .3 Special sleeves shall be as shown on the drawings.

2.16 MODULAR SEALS

- .1 Provide modular mechanical type seals between pipes and sleeves where passing through perimeter walls below grade and where shown on drawings. These to consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve when linking bolts are tightened in sequence. Acceptable product: "Link-seal" by Thunderline or approved equal in accordance with B7.
 - .1 For penetrations through Hauled Wastewater Buildings 1 & 2, Tanks 1, 2, 3, or 4, use Model OS-316
 - .2 For other penetrations, use Model S-316

2.17 SUPPORTS AND HANGERS - GENERAL

- .1 Hangers and supports shall conform to ANSI Code for Pressure Piping B31.1.
- .2 Materials, design and manufacture for Pipe Hangers and Support shall be in accordance with ANSI/MSS SP-58.
- .3 Hot dip galvanize all supports, hangers, guides, sway braces, restraints, dampeners, bolts, washers and nuts after fabrication and before installation.
- .4 Hangers and supports shall be sized to suit the pipe sizes as shown on drawings and as recommended by the manufacturer.

2.18 PIPE SUPPORTS

- .1 Wall supports - use Grinnell Fig. 194, Fig. 195, Fig. 199 or Caddy welded steel brackets hot dipped galvanized, or as shown on the drawings.

- .2 Floor Supports - use supports as detailed on drawings.
- .3 Pipe saddle supports - use Grinnell Fig. 265 or Caddy 724 adjustable pipe saddle support complete with riser pipe and floor flange.
- .4 Strap supports - use Grinnell Fig. 212 or Caddy 450 for PVC pipe. Use stainless steel u-bolts for stainless steel piping. Provide straps for larger pipe as detailed on drawings.
- .5 Wall supports for PVC pipe up to 50 mm diameter shall be Grinnell tube strap or approved alternate.

2.19 PIPE HANGERS

- .1 For non-insulated steel pipe of 150 mm and smaller use Grinnell Figure CT97C coated adjustable pipe ring complete with hanger rod and expansion case or insert for mounting on concrete surface.
- .2 For non-insulated steel pipes to 600 mm use Grinnell Fig. 260 or Caddy 401 adjustable clevis galvanized.
- .3 For concrete inserts use Grinnell Fig. 152, Fig. 117 and Fig. 285 to suit service conditions and pipe size.
- .4 For ceiling flanges, use Grinnell Fig. 153.
- .5 Hanger rods shall be machine threaded both ends and shall be hot dipped galvanized after fabrication.
- .6 Spring hangers shall be Grinnell Fig. 80-V or 81-H constant support spring hangers.
 - .1 Any part of a hanger or other pipe support in direct contact with stainless steel shall be nylon coated with NCA-1477 nylon thermoplastic 0.5 mm thick or shall be of 304 stainless steel. Provide felt paper between pipe and concrete pipe supports to prevent bonding.

Part 3 Execution

3.1 NUTS AND BOLTS

- .1 Install nuts and bolts so that bolts have a minimum of two exposed threads projecting after tightening; with a maximum of 8 threads projecting.
- .2 Apply Denso paste to exposed threads, flanges and coupling bolts.

3.2 INSTALLATION OF PIPE AND FITTINGS

- .1 Prior to commencing piping work, examine route for conflicts and notify the Contract Administrator of any conflicts. Obtain approval of the Contract Administrator for any relocations.
- .2 Install to piping lines and elevations shown on the drawings.
- .3 Install all piping parallel to building walls.
- .4 Determine exact location of each pipe in the field with respect to adjacent and interconnecting piping and equipment.
- .5 Install all piping systems in accordance with the ANSI code for pressure piping, B31.1.

- .6 Provide victaulic flanged or coupled joints intermittently in all steel piping systems to facilitate removal of every section of the piping systems by two men and without cutting any pipe or joint.
- .7 Provide unions intermittently in all screwed piping systems to facilitate removal of valves and every section of the piping system without cutting any pipe or joint.
- .8 Provide temporary bracing and supports to adequately support pipes and fittings during installation.
- .9 Where the required piping is not shown on drawings or is shown diagrammatically, the pipes shall be installed in such a way as to conserve head room and interfere as little as possible with the spaces through which they pass.
- .10 Maintain grade on all draining pipes. Horizontal water piping shall be run with a grade of 2% to drain.
- .11 Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting. Top of the fitting shall be flat for water-containing pipe.
- .12 Where piping is to connect to equipment, dimensions shown on the drawings are based on catalogue information of first named supplier.
- .13 Modify work to suit final dimensions shown on shop drawings for equipment.
- .14 Ascertain the correct equipment dimensions before ordering piping closure lengths and fittings. Review of drawings by the Contract Administrator will not relieve the Contractor of his/her obligation in this respect.

3.3 PIPING INSTALLATION UNDERGROUND

- .1 All underground piping shall be installed by Divisions 31 and 33.

3.4 JOINTING PIPES - GENERAL

- .1 Clean pipes inside and outside before assembly. Remove welding slag.
- .2 Ream pipes and tubes.
- .3 Make screwed joints using approved compound or teflon tape applied to male threads. Use thread tape on P.V.C. pipe.
- .4 Connect pipes to equipment as shown or specified, without springing the pipes.
- .5 Provide complete isolation of dissimilar metals. Do not connect copper to any ferrous metal.
- .6 Use standard fittings for direction changes.
- .7 Follow the recommendations of the manufacturer for jointing pipes and installing couplings and fittings.

3.5 WELDED STAINLESS STEEL PIPING

- .1 Welds shall be made by a certified welder, skilled in welding stainless steel pipes. The Contractor must submit the following information to the Contract Administrator: Quality control manual, registration certificates and welding ticket for all welders, welding protocols and proposed methods.
- .2 Prepare pipe ends by grinding and bevelling; then clean using stainless steel brushes and acetone.

- .3 Select filler rods and electrodes to conform with the pipe composition and submit lists for review.
- .4 Make tack welds employing gas tungsten arc methods and remove while making the root pass.
- .5 Use gas tungsten arc welding for materials to 3 mm thick; and for root pass for heavier thicknesses, use Gas Metal Arc Welding or Shielded Metal Arc Welding.
- .6 Use argon only as arc shielding gas and purge gas.
- .7 All welds shall have full penetration without shrinkage or porosity. Welds shall be smooth and shall not have undue protrusions on the pipe interior.
- .8 Inspections and Tests
 - .1 Provide a visual examination of all welds, including entire circumference of weld externally and whenever possible internally.
 - .2 Re-inspect and re-test any repaired or re-worked welds.
- .9 All welds shall be pickled and passivated.

3.6 RUBBER GASKET JOINTS

- .1 Make rubber gasket and mechanically coupled victaulic joints in carbon steel pipe, PVC pipe or other pipes in accordance with the manufacturer's instructions. Use appropriate tools to pull joints, to field cut joints and to prepare pipes for joining. After assembly check the gasket position.

3.7 FLANGED JOINTS

- .1 Fit flanged joints so that gaskets are bearing uniformly and joints are even. Apply an anti-seize compound to bolt threads and tighten bolts evenly.

3.8 VICTAULIC JOINTS

- .1 Grooves shall be rigid style, made in accordance with the coupling manufacturer's recommendations.

3.9 EXPANSION PIECES

- .1 Install piping to permit free movement of piping caused by thermal expansion and contraction except where it is anchored.
- .2 Install Victaulic couplings on flexible radius grooved cast iron pipe wherever pipe crosses structural expansion joints and install flexible Victaulic couplings wherever steel pipe crosses structural expansion joints.
- .3 Provide for expansion and contraction by installing suitable expansion pieces as is necessary or where indicated.
- .4 Provide expansion pieces having ratings equivalent to the test pressures specified for the particular piping system and wetted surfaces of material similar to that of the piping system.
- .5 Design expansion pieces for the lengths of straight runs shown and the temperature differentials specified.

- .6 Provide anchors and guides where necessary to direct expansion into expansion pieces.

3.10 INSTALLATION OF SUPPORTS AND HANGERS

- .1 Support all piping after alignment and before tightening joints.
- .2 Do not move pipe after tightening joints.
- .3 Provide all hangers, supports, anchor bolts, washers and nuts to support pipes at the lines and elevations indicated and/or as detailed on the drawings.
- .4 Provide inserts in concrete, concrete piers and anchor bolts as required. Provide reinforcing bars in concrete for inserts carrying pipe over 100 mm in diameter.
- .5 Bolt base flanges to the floors or to concrete.
- .6 Provide all necessary sway braces, dampeners, flexible hoses and restraints to eliminate all movements of piping due to vibration. Install additional braces and anchors as necessary to eliminate vibrations.
- .7 Provide hangers, supports, anchors, guides, dampeners, flexible hoses, restraints and sway braces that will cope with the loads and thrust forces from all directions so that all pipe joints will function and thrust is not transferred to the equipment to which the pipe is connected.
- .8 Maximum hanger spacing and minimum rod size shall be in accordance with the following:

<u>Pipe Size</u>	<u>Rod Size</u>	<u>Maximum Spacing Steel</u>	<u>Maximum Spacing P.V.C.</u>
up to 25 mm	10 mm	1200 mm	1200 mm
25 - 50 mm	10 mm	1800 mm	1800 mm
65 - 90 mm	12 mm	2400 mm	2100 mm
100 - 125 mm	16 mm	2400 mm	2100 mm
150 mm	20 mm	3600 mm	2400 mm
200 - 300 mm	22 mm	5500 mm	2400 mm
350 and up	25 mm	6500 mm	2800 mm

- .9 A pipe hanger, support or brace shall be provided at each fitting which changes the direction of flow or splits flow, and at each proposed valve.
- .10 Install sufficient hangers and supports to provide an adequate safety factor as outlined in ANS1-B31.1.
- .11 Drilling into concrete, and using expansion type inserts will be permitted only on approval of the Contract Administrator.

3.11 PIPES THROUGH FLOORS AND WALLS

- .1 Provide stainless steel pipe sleeves where pipes pass through floors and walls. (PVC, tin or blocked out sleeves are only acceptable where indicated on the drawings).
- .2 Install sleeves as detailed on the drawings.
- .3 For cast-in-place sleeves, provide continuously welded rings on pipes passing through walls below grade or where walls are watertight. The thrust/seepage rings shall be as detailed on the drawings.
- .4 Remove coating from pipes to be cast in concrete to permit a good bond.

- .5 Where electrical insulation from concrete rebar is required, use modular seals with pipe sleeves where shown on drawings.
- .6 Where thrust restraint is required design according to AWWA Manual M11 or as detailed.
- .7 For stainless steel pipe passing through concrete use stainless steel sleeves. Coat surfaces of stainless steel in contact with concrete, with bitumastic.
- .8 There shall be no direct contact between structural steel and stainless steel.
- .9 Seal space between sleeves and pipes with non-hardening mastic -Duraseal-A or approved alternative.

3.12 CLEANING

- .1 Clean all pipes, fittings and miscellaneous items after installation.
- .2 Remove all materials from pipes, whatever their origin, by flushing with water, blowing with air and dismantling and manually cleaning.
- .3 Prevent entrance of foreign materials from pipes to equipment or pumps.

3.13 SHOP FINISHES

- .1 Shop priming of the equipment shall be as specified in Section 09 91 00 - Painting.

3.14 FIELD PAINTING

- .1 Field painting shall be in accordance with Section 09 91 00 - Painting.

3.15 PRESSURE AND LEAKAGE TESTING

- .1 Hydraulic tests shall be carried out for a period of 8 hours and pressure maintained with no appreciable pressure drop. Where leakage occurs, repairs shall be made and the entire system shall be retested.
 - .1 Process liquid piping shall be tested at 1.5X working pressure or 1035 kPa (150 psi), whichever is greater and within the pipe's rated capacity, measured at the low point in the system or as specified otherwise.
- .2 Lines which will be normally open-ended on completion of the work shall be initially plugged for testing purposes.
- .3 Air shall not be used as a test medium for systems not using air.
- .4 Leaks in screwed fittings shall be corrected by remaking joints; leaks in PVC joints shall be cut out and re-glued. Caulking will not be permitted.
- .5 Leaks in valves shall be rectified by replacement of the valve.
- .6 A test form is to be filled out, witnessed, kept on site for the Contract Administrator to verify at any time during construction and then they are to be included in the final submission of the contractor O&M manuals.

END OF SECTION

Part 1 General

1.1 SUMMARY

- .1 Test the airtightness of all four (4) Hauled Wastewater Building Holding Tanks and submit a report summarizing findings.

1.2 SCHEDULE

- .1 Begin smoke testing for a holding tank only after all wall penetrations for that tank have been completed and work required to seal existing openings has finished.
- .2 The smoke test must be successfully completed prior to a holding tank and corresponding hauled wastewater receiving lane being put into service.
- .3 Provide a minimum 7 days' advance notice to the Contract Administrator that smoke testing is scheduled to occur.

1.3 SUBMITTALS

- .1 Provide smoke production product information and Material Safety Data Sheets.
- .2 The following deliverables shall be submitted at the completion of each test:
 - .1 Electronic version (.pdf) of the smoke test field reports
 - .1 Include general description of test setup including equipment used and methodology, test result, remedial action taken (as necessary), holding tank ID, duration and time of test, and date of test in the reports.
 - .2 Each report shall be signed by the Contractor and the Contract Administrator's personnel on site to witness the test.
 - .2 Smoke test digital photographs in JPEG format
 - .3 Smoke test digital video in minimum 720x480 resolution
- .3 Provide four (4) copies of each report for insertion into Operating and Maintenance Manuals.

Part 2 Products

2.1 BLOWERS

- .1 The Contractor shall provide a portable blower designed for smoke testing capable of discharging air and smoke into the holding tank supply vent without excessive loss of smoke through the supply vent connection.

2.2 SMOKE PRODUCTION

- .1 The smoke generated shall be white to gray smoke, leaving no residue, and shall be non-toxic and non-explosive. The smoke compound shall not contain zinc chloride or other toxic compounds.

2.3 MISCELLANEOUS

- .1 Contractor shall provide all other equipment, tools, and incidentals required to perform smoke testing as required by these specifications including, but not limited to, duct connecting adapters, cameras, confined space entry equipment, and traffic control equipment.

Part 3 Execution

3.1 TESTING PROCEDURE

- .1 Provide sufficient observers and cameras to monitor the following potential sources of air leaks simultaneously:
 - .1 Inside the adjacent holding tank
 - .2 In the equipment room located immediately above the holding tank
 - .3 In the stairwell
- .2 Connect blower discharge to above grade supply air vent opening.
- .3 Temporarily turn off existing fan EF-2 in the sludge dewatering building if the operation of that fan will tend to draw smoke out of the holding tank being tested.
- .4 Begin blowing smoke through the holding tank supply air vent into the holding tank, recording video in each monitored location throughout the test.
- .5 The smoke test will be considered successfully completed if after 5 minutes of continuous introduction of smoke into the holding tank there are no signs of smoke anywhere outside the holding tank being tested.
- .6 If evidence of air escaping from the holding tank is discovered, the Contractor shall repair the leak and retest the holding tank for another 5 minute smoke test. Repeat as necessary.
- .7 The smoke test in any holding tank shall not be started if there is smoke present in any neighbouring area.

END OF SECTION