

PART 1 - GENERAL

- 1.1 RELATED WORK .1 Excavating, trenching,
and backfilling: Section 31 23 10
- .2 Manholes, catchbasins
and structures: Section 33 39 00
- 1.2 REFERENCES .1 CAN/CSA-B1800-15, Thermoplastic Nonpressure Piping
Compendium.
- 1.3 SHOP DRAWINGS .1 Submit shop drawings in accordance with Section
01 33 00.
- .2 Submit shop drawings for all pipe, fittings, valves,
and all other items necessary for a complete
installation. Include details showing dimensions and
tolerance of pipe and joint proposed.
- 1.4 MATERIAL
CERTIFICATIONS .1 Submit manufacturer's test data and certification
that products and materials meet requirements of this
Section.
- .2 Ensure certification is marked on pipe.
- 1.5 DELIVERY,
STORAGE AND
HANDLING .1 Handle and store pipe, valves, fittings, in such a
manner as to avoid shock and damage and as per
manufacturer's recommendations. Do not use chains or
cables passed through pipe bore.
- .2 Store gaskets in cool location, out of direct
sunlight, and away from petroleum products.
- 1.6 SCHEDULING OF
WORK .1 Schedule Work to minimize interruptions to existing
services and maintain existing flows during
construction.
- .2 Submit schedule of expected interruptions for
approval and adhere to approved schedule.
- .3 Notify Departmental Representative 24 hours minimum
in advance of any interruption in service.
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PART 2 - PRODUCTS

2.1 SEWER PIPE .1 PVC pipe and fittings: type PSM polyvinyl chloride, to CAN/CSA-B1800-15, DR35, complete with bell and spigot joints with locked in rubber gaskets.

2.2 PIPE BEDDING MATERIAL .1 Clear Stone: as specified in Section 31 23 10.

PART 3 - EXECUTION

3.1 PREPARATION .1 Clean pipes and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.

.2 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

.3 Provide proper implements, tools and facilities approved by the Departmental Representative, for the safe and convenient prosecution of the Work.

.4 Take every precaution to prevent foreign material from entering the pipe.

3.2 TRENCHING AND BACKFILLING .1 Provide trenching, excavating and backfilling to Section 31 23 10.

3.3 PIPE BEDDING .1 Place bedding depth indicated.

.2 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior, including spading under the pipe haunches. Do not use blocks when bedding pipe.

.3 Shape transverse depressions in bedding as required to make joints.

.4 Carry bedding material horizontally across actual trench width. Mounding bedding material will not be permitted.

- 3.3 PIPE BEDDING (Cont'd)
- .5 After pipe installation place remainder of bedding in layers over pipe to dimensions indicated.
 - .6 Compact each layer of bedding to 95% Standard Proctor Density.
- 3.4 PIPE LAYING
- .1 Carefully lower pipe into the trench. Do not drop or dump materials into the trench.
 - .2 Lay and join pipes, fittings and valves as specified herein and according to manufacturer's published instructions.
 - .3 Lay pipe and fittings on prepared bed, true to line and grade indicated, within following tolerances:
 - .1 Horizontal Alignment: 50 mm.
 - .2 Vertical Alignment: the lesser of 12 mm or one half the rise per pipe length.
 - .4 Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.
 - .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary water-tight bulkheads when pipe laying is not in progress.
 - .6 Do not lay pipe when the trench bottom is frozen, underwater or when trench conditions or weather are unsuitable.
- 3.5 PIPE JOINTING
- .1 Install gaskets in accordance with manufacturer's published instructions. During cold weather store gaskets in heated area to assure flexibility.
 - .2 Align pipe carefully before joining. Do not use excessive force to join pipe sections.
 - .3 Support pipes as required to assure concentricity until joint is properly completed.
 - .4 Keep pipe joints free from mud, silt, gravel or other foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
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- 3.5 PIPE JOINTING (Cont'd) .6 Where deflection at joints is permitted, deflect only after joint is completed. Do not exceed maximum joint deflection recommended by manufacturer.
- .7 Cut pipe as required for fittings or closure pieces, square to centreline, and as recommended by manufacturer.
- .8 Make watertight connections to manholes and structures.
- .9 At structures provide flexible joint not more than 300 mm from outside face of structure, or as otherwise indicated.
- 3.6 PIPE BACKFILL .1 As specified in Section 31 23 10.
- 3.7 PIPE CLEANING .1 Prior to testing, clean gravity sewer to remove foreign materials.
- 3.8 TESTING SANITARY GRAVITY SEWER .1 Tests for PVC sanitary sewers:
- .1 All PVC sanitary sewers including services shall be tested for watertightness by an air test after backfilling.
- .2 The test shall be conducted between two consecutive manholes.
- .3 The test section shall be plugged at each end with one of the plugs equipped for the air inlet. All services, stubs and fittings into the sewer test section shall be properly capped or plugged and braced to prevent leakage.
- .4 The air control equipment shall consist of valves and pressure gauges used to control the air entry rate and to monitor the air pressure. The air control equipment shall include a shut-off valve, pressure regulating valve, pressure reduction valve and a monitoring pressure gauge having minimum divisions of 69 KPa and accuracy of .28 KPa.
- .5 Air shall be supplied to the test section slowly, filling the pipe until a constant pressure of 24 KPa is maintained. The air pressure must be regulated to prevent the pressure inside the pipe from exceeding 34 KPa.
- .6 When constant pressure of 24 KPa is reached, throttle the air supply to maintain the internal pressure above 21 KPa for a minimum of 5 minutes to permit the temperature of the entering air to equalize with the pipe wall temperature. Check for
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- 3.8 TESTING SANITARY GRAVITY SEWER (Cont'd)
- .1 (Cont'd)
 - .6 (Cont'd) leakage with a soap solution. If leakage is evident, release the pressure in the line, tighten leaky caps and plugs and repressurize as before.
 - .7 After a stabilization period, adjust the air pressure to 24 KPa and shut off the air supply. Observe the gauge until the air pressure reaches 20.5 KPa, then commence timing with a stop watch until the pressure drops to 17 KPa. The time required for this pressure loss of 3.5 KPa is outlined in the Unibell Handbook of PVC Pipe, October 1986 - Table 68, P313.
 - .2 Elevation and location:
 - .1 Provide Departmental Representative with a high powered battery operated lamp for visual examination of all sewers. The lamp will be shone through the sewer from manhole to manhole. At least half diameter of the end of the pipe at the light source at one manhole shall be visible from the other manholes when viewed from either direction. Also, the viewing is to observe any standing water.
- 3.9 DEFLECTION TESTING - PVC PIPE
- .1 Measure deflection by pulling a deflection gauge through each pipe from manhole to manhole after backfilling.
 - .2 Provide deflection gauges to measure a 5% and 7-1/2% deflection. Gauges to be a "Go-No-Go" device.
 - .3 Thirty days after installation, pull a deflection gauge measuring 5% deflection through the installed section of pipeline. If this test fails proceed with 7-1/2% deflection test.
 - .4 Thirty days prior to completion of Warranty Period Maintenance, pull a deflection gauge measuring 7-1/2% deflection through the installed section of pipeline.
 - .5 If 7-1/2% deflection test fails, locate defect and repair. Retest to satisfaction of Departmental Representative.
- 3.10 CLOSED CIRCUIT TELEVISION INSPECTIONS
- .1 Contractor shall arrange and pay for television camera inspection of installed sanitary pipeline, 200 mm and larger.
 - .2 Scheduling:
 - .1 The video inspection shall be first performed when the sanitary sewer has been cleaned and all
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- 3.10 CLOSED .2 Scheduling:(Cont'd)
CIRCUIT TELEVISION .1 (Cont'd)
INSPECTIONS manhole adjustments and street reinstatement have
(Cont'd) been completed.
- .3 Equipment:
.1 Provide equipment meeting following requirements:
.1 Self-contained monitoring unit and camera with remotely controlled lighting system capable of varying the illumination.
.2 Picture quality shall produce continuous 600-line resolution picture, showing entire periphery of pipe.
.3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
- .4 Definition of fault:
.1 Any pipe joint which displays a gap or spread, offset, gasket, or signs of infiltration.
.2 Any section of pipeline which is crushed, broken or displays cracks.
.3 Any variance in grade of pipeline.
.4 Any gravel, roots, or foreign material which may impede flow.
.5 Any deformation in shape of pipe.
- .5 Inspection:
.1 Perform inspection of pipe by passing TV camera through pipeline in direction of flow.
- .6 Records:
.1 Maintain inspection record in log form, during television inspection.
.2 Log to include location of each fault.
.3 Photograph fault from the television screen using a digital camera or provide hard copy stills directly from system if possible. All photographs to be clear and precise with distinct definition of fault.
.4 Include detailed technical description with photographs as supporting data for each fault.
.5 All photos and videos to be in colour.
- .7 Reports:
.1 Provide a composite report of TV inspection. Enclose report in binder on letter size paper. Include following pages and information.
.1 Title page identifying project, camera operator and dates of inspection.
.2 Index page identifying pipeline, page number or numbers where information for section is contained.
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- 3.10 CLOSED .7 Reports:(Cont'd)
CIRCUIT TELEVISION .2 Report on each pipeline to contain:
INSPECTIONS .1 Heading:
(Cont'd) .1 Street name.
.2 Manhole numbers applicable to
section.
.3 Reference drawing number, if
applicable.
.4 Weather on the day of inspection.
.5 Statement of soil condition in area
of inspection, i.e., dry, damp, wet,
frozen.
.6 Date of inspection.
.2 Key Plan showing magnetic north,
horizontal distance, pipe and material and
direction of flow.
.3 Inspection findings for each pipeline to
include:
.1 Location of all faults.
.2 One photograph each of typical joint and
flanged connection.
.4 Mount photographs on left-hand page and place
corresponding description on right- hand page. Number
all photographs in order. Number beside photograph to
correspond with description number.
.5 Enclose all pages of report in transparent
sheet protector.
.6 Provide copy of video tape to Departmental
Representative.
- 3.11 TESTS TO BE .1 Should testing or inspection disclose
REPEATED non-conformance, locate and repair defective pipe or
joint to the approval of the Departmental
Representative.
.2 Re-test to determine success or otherwise of
remedial measures applied to pipework. These re-tests
are to be repeated at no extra cost to Contract until
results show that remedial measures have been
successful.
.3 In the event the Departmental Representative
suspects the sanitary gravity sewer no longer
complies with requirement of the test, the
Departmental Representative may order additional
testing. Should the length of pipeline prove
defective, the Contractor shall repair or make good
the defect at no extra cost to Contract.
.4 Cost of additional testing to be at no extra cost to
Contract if test proves a defect. However, if this
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- 3.11 TESTS TO BE REPEATED
(Cont'd) .4 (Cont'd)
testing shows pipe to be satisfactory, cost of second test will be borne by Departmental Representative.
- 3.12 CLEANUP .1 Upon completion of testing of each section remove all ancillary equipment and plug holes. Do not backfill around test plugs until inspected by Departmental Representative.

PART 1 - GENERAL

- 1.1 Work Included .1 This section specifies requirements for constructing suction lift pumping stations. Work generally includes supply and installation of pumping equipment, pump controller, valves, metal fabrications and related pipe work.
- 1.2 Related Sections.1 Section 03 30 00 - Cast-In-Place Concrete
- .2 Manholes, Catch Basins and Structures:
Section 33 39 00
- 1.2 Reference Standards .1 ANSI/ASME B-16.1-2010, Class 125, Cast Iron Pipe Flanges and Flanged Fittings.
- .2 ANSI/AWWA C104/A21.4-2013, Cement Mortar Lining for Ductile-Iron Pipe and Fittings.
- .3 ANSI/AWWA C110/A21.10-2012, Ductile-Iron and Gray Iron Fittings for Water.
- .4 ANSI/AWWA C151/A21.51-2009, Ductile-Iron Pipe, Centrifugally Cast, for Water.
- .5 CAN/CSA C22.2 No. 100-2004(R2009), Motors and Generators.
- .6 CSA C22.1-2015, Canadian Electrical Code.
- .7 CSA Bulletin S2619-1998, Information and Documentation
- .8 IEEE-112-2004, Standard Test Procedures for Polyphase Induction Motors and Generators.
- .9 National Fire Protection Association.
- .10 NEMA MG-1-2011, Motors and Generators.
- 1.3 Shop Drawings .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate details of piping, valves, supports, pumps, metal fabrications, access hatches, electrical connections and appurtenances.
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- 1.3 Shop Drawings (Cont'd) .3 Indicate nominal efficiency in accordance with NEMA MGI-1, 12.53 (A) and (B), based on IEEE-112, Method B. Motors shall be high efficiency in accordance with these standards.
- 1.4 Operating and Maintenance Data .1 Provide operating and maintenance data in accordance with Section 01 78 00 and as follows:
.1 System description.
.2 Design parameters, system hydraulics, design calculations, and system curves.
.3 Performance curves for the pumps, layout, and wiring diagrams.
.4 Related civil, mechanical, and electrical drawings.
.5 Manufacturer's operation instructions.
.6 Name, address, and telephone number of equipment suppliers.
.7 Information on guarantees and warranties.
- 1.5 Handling and Storage .1 Handle and store pumps, pipe, valves, and fittings in such a manner as to avoid shock and damage. Do not use chains or cables passed through pipe or equipment. Do not damage coatings or linings.
- 1.6 Maintenance Material .1 Provide manufacturer's recommended spare parts list.
.2 Parts to be available for use on site within 24 hours notice.
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PART 2 - PRODUCTS

- 2.1 General .1 Pump characteristics:
- .1 Cavendish Sewage Pump Station: Pump: T3A-3-4
Speed: 1850 rpm
Motor: 11.2kW (15 HP), 208V, 3 PH, 60 HZ
Duty Point 22.3 l/s (354 usgpm) at 19.8 m
(65.1 ft)
Discharge: 150 mm Centre Type
Suction: 75 mm
 - .2 Brackley Sewage Pump Station:
Pump: T3A-B-4
Motor: 7.46 KW (10 HP), 208V, 3 PH, 60 HZ
Speed: 1650 rpm
Duty Point: 17.7 l/s (280 usgpm) at 16.6 m
(54.4 ft)
Discharge 75 mm
Suction: 75 mm
 - .3 Pumps, motors and frame configurations as per project drawings.
- 2.2 Pumps .1 Complete factory-built, tested and assembled base mounted duplex pump station for above ground installation. The pumps shall be horizontal, self-priming, solids handling sewage pump sets complete as follows:
- .1 Pumps and baseplate, configuration as shown on the drawings.
 - .2 V-belt drives and belt guard, complete with minimum of two (2) V belts per drive.
 - .3 TEFC high efficiency electric motor as specified.
 - .4 Air release valve and gastight vent pipe vented to the wet-well.
 - .5 PVC Volute drain, ball valve and clear hose connector.
 - .6 112mm diameter combination suction vacuum and discharge pressure gauge set with ballcock connectors, diaphragm and mounting panel.
 - .7 Discharge pipe and fittings comprised of check valves, elbows, nipples and 3-way plug valve to allow isolation of any pump from service.
 - .8 Volute with high temperature sensor.
 - .9 Complete system to be factory tested at design condition before shipping. Show design operation point on performance test curve and insert into operation and maintenance manual.

- 2.2 Pumps
(Cont'd)
- .2 Casing and volute in contact with sewage to be cast iron, Class 30 or higher grade.
 - .3 Impeller ductile iron, dynamically balanced, non-clog, two-vaned, semi-open with integral pump-out vanes on the back shroud. Threaded on to pump shaft and secured by lock screw.
 - .1 Impeller to be capable of handling solids, fibrous material, heavy sludge and other matter found in normal sewage applications.
 - .4 Rotating assembly, including bearings, shaft mechanical seal and impeller must be removable as a unit without removing pump volute or piping.
 - .5 Mechanical seals shall have tungsten titanium carbide rotating and stationary faces lubricated by a separate oil-filled reservoir. Furnish oil level gauge for use on site.
 - .6 Inspection coverplate to be removable and support a replaceable wear plate. Wear plate to impeller clearance to be externally adjustable.
 - .1 Contain the bearing housing in the bearing cavity, complete with oil level sight gauge, fill/vent plug, double lip seals, shaft and bearings. Protect the bearing housing from seal failure.
 - .7 Bearings to be anti-friction ball type of proper size and design to withstand all radial and thrust loads expected during normal operation. Bearings to be oil lubricated from a dedicated reservoir.
 - .8 Power:
 - .1 Power to pumps transmitted by V-belt drive assemblies with a minimum of two (2) V belts. Provide the sheave/belt combination at the speed ratio needed to achieve the specified pump operating conditions.
 - .2 Enclose pump drives on all sides by a guard constructed of fabricated steel or combination of materials, including expanded, perforated, or solid sheet metal. No opening to a rotating member shall exceed 13mm.
 - .9 Electric motors:
 - .1 The motors shall be furnished by the pump manufacturer for complete compatibility.
 - .2 Motor shall be horizontal mounted, TEFC squirrel cage type induction motor, NEMA design B, CSA approved, with minimum Class F motor winding insulation and designed for a 40°C ambient.
 - .3 Motor shall be appropriately matched to the speed and torque requirements of the proposed pump and shall be capable of continuous duty. The

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- 2.2 Pumps
(Cont'd)
- .9 Electric motors:(Cont'd)
- .3 (Cont'd)
horsepower rating and start characteristics shall be matched to the pump.
- .4 The horsepower stated above shall not overload the motor service factor rating at any point along the impeller curve above the static head. Motor to be capable of sustaining the minimum number of starts per hour as specified under NEMA.
- .5 Motors shall comply with the latest edition of NEMA standard MG-1 and CSA C22.2 No. 100.
- .6 Motor nameplate and shop drawings shall indicate nominal efficiency in accordance with NEMA MGI-12.53 (A) and (B), based on IEEE-112, Method B. Motors shall be high efficiency in accordance with these standards.
- .7 Motor shall have a minimum 1.15 service factor and shall be operable at the service factor load continuously without exceeding the insulation rated temperature rise at 40°C ambient.
- .8 Motor bearings shall be of the grease lubricated type and shall be constructed and mounted to exclude dirt and moisture and to prevent lubricant from reaching the motor internals. Anti-friction bearings shall have a minimum L-10 rating life of 100,000 hours under AFBMA standards.
- .9 Motors shall have rugged cast iron frames with mounting supports, end brackets, bearing housings, fan covers and conduit junction box and connected to the pump at the factory. Lifting eyes and drain holes fitted with pipe plugs shall be supplied.
- .10 Parts and service to be available within 24 hours notice. Critical and common parts to be in stock at all times.
- .11 Supply and service of the pumping system shall be from a supplier that is within 4 hours of the site driving at the posted speed limit.
- .12 Acceptable Product: Gorman-Rupp T3A-B-4.
- 2.3 Wetwell
Ventilation
- .1 Hot-dipped galvanized vent pipe as per the drawings using stainless steel flange bolts.
- 2.4 Piping,
Fittings and Valves
- .1 Ductile iron pipe: AWWA C151, Special Class 54, cement mortar-lined to AWWA C104 and coated outside with standard coating.
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- 2.4 Piping, Fittings and Valves (Cont'd)
- .1 (Cont'd)
 - .1 Joints:
 - .1 Mechanical, high strength heat-treated cast iron or alloy steel T-head bolts with hex nuts.
 - .2 Grooved-type coupling joint with malleable iron couplings and gaskets.
 - .3 Flanged-end joint, cast iron to ANSI B16.1, with cloth-inserted rubber gasket.
 - .2 Fittings: to AWWA C110, cement mortar-lined to AWWA C104, complete with an internal seal coat.
 - .3 Coatings: all pipe and fittings to be coated with manufacturer's standard coating.
 - .4 Isolation valves and check valves located in discharge lines to be supplied by pumping equipment manufacturers.
 - .5 Suction and discharge lines for each pump: ductile iron Special Class 54, or as specified in the project documents. Install check valves and valves as specified in each pump discharge line. Each valve to have a throughway size not less than the pump discharge pipe size to ensure full, free-flow operation.
 - .6 Test suction lines for air leaks and confirm suitability to maintain a continuous vacuum for up to 30mm Hg.
- 2.5 Pumping Station Accessories
- .1 Pre-cast concrete sections and cover. As specified in Section 33 39 00 and as indicated on the Drawings with opening to suit access cover and pipe work.
- 2.6 Access Frame and Cover
- .1 Fabricated aluminum access frame using an extrusion of 6351 aluminum. Cover to be fabricated using a plate of 5086 aluminum designed to withstand shear and deflect not more than 1/79 of the maximum span for minimum specified loads of 7.2 kPa uniform load or 1100 kg point load. The cover is to rest on a rubber gasket to be hinged along one side with a heavy duty aluminum hinge.
 - .2 Top of the access frame to be flush, the handle recessed. Install padlock within the recess to lock the cover in the closed position.
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- 2.6 Access Frame and Cover
(Cont'd)
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- .3 Provide cover stay to allow the cover to be locked in the open position.
- .4 Each access frame to be capable of supporting the full weight of any of the station equipment and maintenance personnel.
- .5 Design access frames for embedding into the concrete top of a sewer station, extrusion to be shaped such as to provide good anchoring to the concrete. All surfaces in contact with the concrete to be bitumastic coated.
- .6 Frames to be capable of being installed side-by-side by bolting them together using standardized bolting kits.
- .7 Provide aluminum rail nuts within the extrusions, permitting a level regulator hanger and a chain hook to be attached without any modifications required to the frame.
- .8 Clearly display a bilingual confined space warning label on the underside of the cover.
- .9 Provide a safety grate for fall through protection. When installed in pairs, safety grates should open outward unless specified otherwise in the project documents.
- 2.7 Labels
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- .1 Suitable nameplates to be permanently affixed onto the pumps, motor, control enclosure components, and other operating components to indicate the purpose of the component or operating routine and parameters applying to the component. The suction lift pump motors and control equipment are to be CSA approved and the CSA logo must appear on the nameplates of these components.
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PART 3 - EXECUTION

- 3.1 Installation
- .1 Verify all layouts, dimensions, elevations and other pertinent data prior to proceeding with the Work.
 - .2 Back prime all metal surfaces being mounted directly against concrete surfaces with bitumastic paint with the exception of surfaces that will be grouted in.
 - .3 Examine all components to be incorporated into the Work for cracks, pits, blow holes, finishes, and any other defects. Do not incorporate any defective materials into the Work. Remove any defective materials from the site immediately and replace defective materials with new materials. Inspect all materials and remove all dirt and other debris.
 - .4 Install all components in strict accordance with each manufacturer's instructions, recommendations and the approved shop drawings for the various materials to be incorporated in the Work.
 - .5 Install pumps, pipe, fittings, valves, accessories and appurtenances using skilled workers experienced in the tasks required.
 - .6 Handle all components carefully taking care not to damage the surface finish on these components. Make good any damage or supply new components as appropriate.
 - .7 Install isolation bushings between stainless steel anchors and other dissimilar materials.
 - .8 Equipment bases: concrete to suit pumping equipment and pipe work provided by pumping equipment manufacturer.
 - .9 Arrange for start-up, testing and commissioning by the equipment manufacturers' representatives in presence of the Departmental representatives after the installation has been completed and is ready for start-up and commissioning.
 - .10 All electrical installations to be completed to meet or exceed all applicable codes.
 - .11 Anchor bolts: the correct and full number, size and length of anchor bolt or other connecting bolts shall be used, as required by the equipment manufacturer or as shown on the Drawings. Anchor bolts shall be stainless steel epoxy type.
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3.2 Pipe
Installation

- .1 Carefully examine pipes and appurtenances for cracks or other defects, and clean of all dirt and debris before installation.
- .2 Temporarily support all pipe during assembly and install fittings in a manner such that the pipe is not stained during the joining procedure.
- .3 Flanged joints: prior to assembling the joints, thoroughly clean all flanges with a wire brush worked in a direction parallel to the serrations. Use gasket lubricant to ease gasket installation. During assembly, tighten diametrically opposing pairs of bolts simultaneously. Gaskets to be standard full-face type, best quality rubber sheeting 3mm thick cloth inserted.
- .4 Connecting pipe work: supply and install all small connecting pipe work, fittings and valves, whether shown on the Drawings or not but required for the proper functioning and servicing of the equipment. Do all such Work in accordance with the manufacturer's instructions at no additional cost to the Contract. Where pipe is to be connected to equipment, the placement of the piping will be done in a manner such that neither pipe nor equipment is strained during the joining procedure.
- .5 Confirm all pipe penetrations to wet well are grouted and sealed appropriately to provide a physical separation from pump building.

3.3 Valves and
Appurtenances

- .1 Install all valves and appurtenances where shown on the Drawings. Check and adjust to ensure smooth operation. Confirm that the valves are installed in the proper orientation with respect to flow direction.
- .2 Install and connect all the equipment and make all necessary arrangements for a representative of the company supplying the equipment to check the complete installation before start-up or commissioning of the Works.

3.4 Supervision

- .1 Provide skilled supervision during the installation of equipment. Allow in tendered price for the services of a skilled representative of the manufacturer's of each item of equipment to be present during the installation and testing and to be

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- 3.4 Supervision (Cont'd)
- .1 (Cont'd)
present on as many further occasions as are required to put each item of equipment in working order.
 - .2 Allow in tendered price for the services of skilled representatives of the equipment suppliers to adequately acquaint the permanent plant operators with the proper operation and maintenance of all equipment specified.
- 3.5 Lubrication
- .1 Lubricate all equipment in accordance with the equipment manufacturer's recommendations.
- 3.6 Responsibility of Temporary Trial Usage
- .1 Obtain written permission from the Departmental Representative to use and test permanent equipment and systems prior to acceptance by the Departmental Representative.
 - .2 The guarantee period will not be affected by temporary trial use of the equipment.
 - .3 Clean and renew equipment and systems used prior to acceptance. Restore to original or new working condition.
 - .4 Protect equipment and system openings from dirt, dust, and other foreign materials during temporary usage.
- 3.7 Inspection Testing and Start-up
- .1 Provide the services of qualified servicemen mechanics or other trained personnel of the equipment suppliers or manufacturers to check the complete installation and be present for start-up of the equipment. Submit a written report signed by the equipment manufacturer's representative to the Departmental Representative stating the following:
 - .1 A satisfactory installation of equipment has been performed and/or outlining any modifications that have been made as a result of the commissioning or testing of the equipment.
 - .2 Equipment is now ready for permanent operation.
 - .3 Operation, lubrication and maintenance instructions for the equipment have been presented to the Departmental Representative.
 - .4 Equipment has been properly lubricated with the correct lubricants.
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3.7 Inspection
Testing and
Start-up
(Cont'd)

- .2 Advise the Departmental Representative in writing at least one (1) week in advance of the proposed date for testing and start-up. Provide all necessary tools, materials and equipment for carrying out tests. Conduct all tests in the presence of the Departmental Representative.
- .3 Defective material or equipment shall be replaced with new material or equipment. Bear all cost including re-testing and making good.
- .4 Test interior pipework: water inside pipework to be gradually increased until it reaches a minimum of 690 kPa and maintain test pressure for one hour. No leakage will be allowed.
- .5 The re-prime of a completely empty suction line to full pumping to take a maximum of five (5) minutes operating at the selected speed and impeller diameter with the re-prime lift of the installation condition. The re-prime test condition is from normal "on" pump level.
- .6 The re-prime lift is to be published, dated and certified by the pump manufacturer upon request.
- .7 Test pump flow in accordance with specified pump curves stated for pump characteristics. Test pump flow by drawdown test or flow meter.

PART 1 - GENERAL

- 1.1 RELATED REQUIREMENTS
- .1 Excavating, Trenching and Backfilling: Section 31 30 00
 - .2 Sewage Lift Station: Section 32 32 13
 - .3 Sanitary Sewer: Section 33 31 00
 - .4 Reinstatement: Section 32 98 00
- 1.2 ACTION AND INFORMATIONAL SUBMITTALS
- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Provide Departmental Representative at least 4 weeks prior to beginning Work, with proposed source of bedding materials and provide access for sampling.
 - .3 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Certification to be marked on pipe.

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Polyvinyl chloride (PVC) pipe: to AWWA C900
 - .1 SDR: 18.
 - .2 Pressure Class: Class 235.
 - .3 Gasket bell end.
 - .4 Pipe joints: bell and spigot with rubber gaskets solvent welded joints or mechanical joints to ANSI/AWWA C111/A21.11, with transition gaskets to pipe manufacturers specifications.
 - .5 Rubber gaskets: to ANSI/AWWA C111/A21.11.
 - .6 MJ fittings to AWWA C153 cement mortar lined to AWWA clay and coated outside with standard coating.
 - .7 PVC fittings: to AWWA C907 and certified to CSA Standard B137.3.

2.2 PIPE BEDDING AND SURROUND MATERIALS .1 Sand material to Section 31 23 10.

2.3 MARKER TAPE .1 Underground warning tape: minimum 75 mm wide, metal detector warning tape, clearly marked "Caution - Buried Forcemain Line" colour red.

PART 3 - EXECUTION

3.1 PREPARATION .1 Pipes and fittings to be clean and dry.
.2 Prior to installation, obtain Departmental Representative's approval of pipes and fittings.

3.2 TRENCHING .1 Do trenching Work, in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

3.3 SAND BEDDING .1 Place sand bedding in unfrozen condition.
.2 Place sand bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm.
.3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
.4 Shape transverse depressions as required to suit joints.
.5 Compact each layer full width of bed to at least 95% corrected maximum dry density.
.6 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material.

3.4 INSTALLATION .1 Avoid damage to machined ends of pipes in handling and moving pipe.
.2 Maintain grade and alignment of pipes.
.3 Align pipes carefully before jointing.

- 3.4 INSTALLATION (Cont'd)
- .4 Do not exceed maximum joint deflection recommended by pipe manufacturer.
 - .5 Support pipe firmly over entire length, except for clearance necessary at couplings. Do not use blocks to support pipe.
 - .6 Keep pipe and pipe joints free from foreign material.
 - .7 Avoid bumping gasket and knocking it out of position, or contaminating with dirt or other foreign material. Remove disturbed gaskets clean, lubricate and replace before jointing is attempted.
 - .8 Support pipes using hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .9 Apply sufficient pressure in making joint to ensure that joint is complete to manufacturer's recommendations.
 - .10 Apply restraint to pipe to ensure that joints when completed are held in place, by tamping fill material under and alongside pipe, or otherwise as approved by Departmental Representative.
 - .11 When stoppage of Work occurs, block pipe as directed by Departmental Representative to prevent creep during downtime.
- 3.5 THRUST BLOCKS
- .1 Restrain bends, tees and fittings by concrete thrust blocks as indicated.
 - .2 Keep pipe couplings free of concrete.
 - .3 Bearing area of thrust blocks to be as indicated.
- 3.6 PIPE SURROUND
- .1 Place surround material in unfrozen condition.
 - .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated. Leave joints and fittings exposed until field testing is completed.
 - .3 Hand place surround material in uniform layers simultaneously on each side of pipe not exceeding 150 mm compacted thickness as indicated.
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- 3.6 PIPE SURROUND (Cont'd)
- .4 Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density.
 - .5 Compact each layer from mid height of pipe to underside of backfill to at least 95% corrected maximum dry density.
- 3.7 BACKFILL
- .1 Place backfill material in unfrozen condition.
 - .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- 3.8 LEAKAGE TESTING
- .1 Provide labour, equipment and materials required to perform hydrostatic test.
 - .2 The operation of any existing valve not part of the new construction, shall be by CW&SU staff. 24 hours notice is required by the CW&SU for all filling, flushing or chlorination operations for new construction.
 - .3 All services, hydrants, mains and other appurtenances shall be included in the system test.
 - .4 Perform tests in presence of the Departmental Representative or his representative.
 - .5 All valves must be pressure tested, including hydrant valves.
 - .6 Where hydrant extensions are required, install extensions prior to testing.
 - .7 Open all valves in test section.
 - .8 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air-vacuum release valves are installed.
- 3.9 PIPEWORK
- .1 Test pipework after backfilling.
 - .2 Ensure all air release valves on section being tested are installed and operational before testing. Fill watermain, for testing. Pipeline to remain filled for not less than 24 hours prior to pressure test. Ensure all air is purged before starting pressure and leakage tests.
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3.9 PIPEWORK
(Cont'd)

- .3 Gradually increase water pressure inside pipe until it reaches 1035 kPa at the lowest location under test. Maintain pressure test for two hours.
- .4 Measured leakage of water as measured by a water meter approved by the Departmental Representative.

$$Q_m = (LDP^{0.5}) \div 795,000$$

Where: Q_m = allowable leakage, in litres/hr.
L = length of pipeline in metres
D = diameter of pipe in millimetres
P = average test pressure in kilopascals

- .5 The allowable leakage shall not be exceeded between adjacent valves.
- .6 Replace, at no cost to Contract, all pipes, valves, fittings and couplings which are defective. Perform test at no cost to Contract until pipeline is approved by Departmental Representative.

PART 1 - GENERAL

- 1.1 RELATED WORK
- .1 Excavating, Trenching and Backfilling:
Section 31 23 10
 - .2 Suction Lift Pump Station: Section 33 32 13
 - .2 Exterior Waterproofing: Section 33 39 00
- 1.2 REFERENCES
- .1 ASTM C478M-15, Specification for Precast Reinforced Concrete Manhole Sections.
 - .2 ASTM C858-2010, Standard Specification for Underground Precast Concrete Utility Structures.
 - .3 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for use in Building construction.
 - .4 CAN/CSA-A23.1-04/A23.2-09, Concrete Materials and Methods for Concrete Construction.
 - .5 CAN/CSA-A3000-2008, Cementitious Materials.
 - .6 CAN/CSA S6-14, Canadian Highway Bridge Design.
 - .7 CAN/CSA A257-09 Standards for Concrete Pipe and Manhole Sections.
- 1.3 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Submit manufacturer's test data and certification that materials meet requirements of this section. Include manufacturer's drawings, information, size of components, dimensions and details where pertinent.
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PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Precast manhole and catch basin sections: to ASTM C478M-15, circular. Manhole top sections shall be eccentric cone type where identified on Drawings. Precast concrete bases to be approved by Departmental Representative.
 - .2 Joints: to be made watertight using rubber O-rings.
 - .3 Mortar:
 - .1 Cement: to CAN/CSA-A3000.
 - .4 Adjusting rings: precast concrete, to ASTM C478.
 - .5 Frames and covers: to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray iron castings: to ASTM A48.
 - .3 Bearing surfaces to be ground to eliminate surface imperfections.
 - .4 Manhole frames and covers: heavy duty municipal type for road service and as indicated on the drawings.
 - .1 Acceptable product: IMP Group Ltd. Type R10.
 - .6 Sand bedding material: as specified in Section 31 23 10.
 - .7 Precast Lift Station Slab:
 - .1 Design to CAN/CSA A257-09 and with CAN/CSA S6-14 Canadian Highway Bridge Design Code, minimum standard CL-625.
 - .1 Pedestrian load - 5.0 KPa.
 - .2 Concrete unit weight - 24.0 KN/m³.

PART 3 - EXECUTION

- 3.1 EXCAVATION AND BACKFILLING
- .1 Provide excavating and backfilling in accordance with Section 31 23 10.
 - .2 Obtain approval of Departmental Representative before installing, manholes or catch basins.
- 3.2 CONCRETE WORK
- .1 Do concrete work in accordance with Section 03 30 00.
 - .2 Position metal inserts in accordance with dimensions and details as indicated.
- 3.3 INSTALLATION
- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
 - .2 Complete manholes and catch basins as pipe laying progresses.
 - .3 Dewater excavation as directed by Departmental Representative and remove soft and foreign material before placing concrete base.
 - .4 Set precast concrete base on 150 mm minimum of granular bedding compacted in accordance with Section 31 23 10.
 - .5 Set riser sections on precast base and make joint watertight with O-ring gaskets. Grout joints inside and out with non-shrink grout.
 - .6 Plug lifting holes with non-shrink grout.
 - .7 Place stub outlets at elevations and in position indicated. Provide type of gasket connection as indicated.
 - .8 Install manhole benching where shown on the Drawings using concrete suitable for exposure classification C-2 as specified in CSA-A23.1.
 - .9 Install frames and covers on applicable top sections to elevation shown on Drawings or as directed.
 - .10 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

- 3.3 INSTALLATION (Cont'd)
- .11 Apply waterproofing for sanitary manholes as indicasted in Section 07 11 00.
 - .12 Install frost barrier to depth shown on Drawings and band minimum three locations to manhole wall.
- 3.4 SYSTEM CLEANLINESS
- .1 Upon manhole adjustment, removal of catchment device and all works associated with restoration around the manhole, the contractor shall provide all testing equipment, labour, incidentals, traffic control, etc., required to undertake an inspection of the system to verify its cleanliness. This inspection must be done in the presence of the Departmental Representative.
- 3.5 TESTING
- .1 No test shall be carried out on a manhole structure until it has developed sufficient strength to withstand stresses produced by such test.
 - .2 All incoming and outgoing sewers and service lines shall be plugged, the plugs restrained and the vacuum tester head placed on the manhole frame and sealed. A vacuum of 250 mm Hg shall then be drawn on the manhole and the time measured for the vacuum to drop to 225 mm Hg. This time shall not be less than 40 seconds for manhole diameters up to 1200 mm. For manholes deeper than 6 m, the test times shall be increased by 2 seconds per 300 mm of additional manhole depth.
 - .3 Should any leakage take place, take necessary measures approved by the Departmental Representative to make them completely watertight.

PART 1 - GENERAL

1.1 RELATED SECTIONS .1 Installation of Cables in Trenches and Ducts:
Section 26 05 44

1.2 REFERENCES .1 Canadian Standards Association (CSA)
.1 CSA C22.2 No. 211.2-06, Rigid PVC
(Unplasticized) Conduit.

PART 2 - PRODUCTS

2.1 PVC DUCTS AND FITTINGS .1 Rigid PVC duct: to CSA C22.2 No. 211.2, with moulded fittings, for direct burial.
.2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors of same product material as duct, to make complete installation.
.3 Rigid PVC 90° and 45° bends.
.4 Rigid PVC 5° angle couplings.
.5 Expansion joints where conduits exit ground.

2.2 SOLVENT WELD COMPOUND .1 Solvent cement for PVC duct joints.

2.3 CABLE PULLING EQUIPMENT .1 6 mm stranded polypropylene pull rope, tensile strength 5 kN, continuous throughout each duct run with 3 m spare rope at each end.

PART 3 - EXECUTION

- 3.1 INSTALLATION
- .1 Install duct in accordance with manufacturer's instructions.
 - .2 Clean inside of ducts before laying.
 - .3 Open trench completely before conduits are laid and ensure that no obstructions will necessitate change in grade of conduits.
 - .4 Ensure full, even support every 1.5 m throughout duct length.
 - .5 Install conduits at elevations and slope ducts with 1 to 400 minimum slope.
 - .6 During construction, cap ends of ducts to prevent entrance of foreign materials.
 - .7 Pull through each duct mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.
 - .8 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.