

Part 1 General

1.1 MEASUREMENT AND PAYMENT

.1 METHOD OF MEASUREMENT

- .1 Measurement of "Irrigation Pipe – PVC 300 mm SDR 21 IPS" as indicated on the plans and drawings and described in the Specifications shall be in linear metres supplied.
- .2 Measurement of "Irrigation Pipe – HDPE 300 mm DR17" as indicated on the plans and drawings and described in the Specifications shall be in linear metres supplied.
- .3 Measurement of "Irrigation Pipe – HDPE 400 mm DR17" as indicated on the plans and drawings and described in the Specifications shall be in linear metres supplied.
- .4 No measurement shall be made for "Fittings – PVC, HDPE" as indicated on the plans and drawings and described in the Specifications. Fittings shall include all PVC and HDPE elbows, tees, flange adaptors and will be considered a Lump Sum.
- .5 Measurement of "Gate Valves" as indicated on the plans and drawings and described in the Specifications shall be in units supplied including valve boxes and marker posts.
- .6 Measurement of "Air Control Valves" as indicated on the plans and drawings and described in the Specifications shall be in units supplied including saddles and marker posts.
- .7 Measurement of "Hydrants" as indicated on the plans and drawings and described in the Specifications shall be in units supplied.
- .8 Measurement of "Irrigation Pipe Installation" as indicated on the plans and drawings and described in the Specifications shall be in linear metres of pipeline installed. Irrigation pipe installation shall include all hauling and placement of pipeline (Owner and Contractor supplied), excavation, backfilling, stockpiling of topsoil, re-placement of topsoil, granular bedding, pipe installation, electrical cable installation, installation of all fittings, gate valves, air control valves, thrust blocks, hydrants, thrust blocks, electrical receptacles, and marker posts.
- .9 Measurement of "Road Crossings" as indicated on the plans and drawings and described in the Specifications shall be measured as units of road crossings installed. Road crossings will include road and utility crossings at the road locations, installation of encasement pipe, irrigation pipe, pipe strapping, backfilling, and marker posts.
- .10 Measurement of "Utility Crossings" as indicated on the plans and drawings and described in the Specifications shall be measured as units of utility crossings installed. Utility crossings will include installation of irrigation pipe across existing utilities to the standard of the jurisdiction having authority (eg., Manitoba Hydro, City of Brandon, MTS).

- .2 BASIS OF PAYMENT – Payment for "Irrigation Pipe – PVC 300 mm SDR 21 IPS" , "Irrigation Pipe – HDPE 300 mm DR17", "Irrigation Pipe – HDPE 400 mm DR17",

"Fittings – PVC, HDPE", "Gate Valves", "Air Control Valves", "Hydrants", "Irrigation Pipe Installation", "Road Crossings", "Utility Crossings" shall be at the Contract Unit Price for each item measured as specified herein which shall be payment in full for those operations described in the Specifications and for those operations incidental to the Work for which no price or prices or provisions for payment are included in the Contract.

1.2 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 Owner will supply material as follows:
 - .1 1098 m, 300 mm diameter, 160 psi PVC IPS, SDR 26
 - .2 2340 m, 300 mm diameter, 125 psi PVC IPS, SDR 32.5
 - .3 2218 m, 250 mm diameter, 100 psi PVC IPS, SDR 41

1.3 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.
 - .2 ANSI/AWWA C800-05, Standard for Underground Service Line Valves and Fittings.
 - .3 ANSI/AWWA C900-07, Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.
- .2 ASTM International
 - .1 ASTM A123/A123M-09, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A307-10, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .3 ASTM C117-04, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .4 ASTM C136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .5 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - .6 ASTM D2657-07, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
 - .7 ASTM F714-10, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 41-GP-25M-77, Pipe, Polyethylene, for the Transport of Liquids.
- .4 CSA International
 - .1 CAN/CSA-B137 Series-09, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).

- .1 CAN/CSA-B137.1-09, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
- .2 CAN/CSA-B137.3-09, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
- .2 CSA G30.18-09, Carbon and Steel Bars for Concrete Reinforcement.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Pipe certification to be on pipe.
- .3 Shop Drawings:
 - .1 Submit drawings for pipe and fittings, as requested.
- .4 Samples:
 - .1 Inform Departmental Representative of proposed source of bedding materials.
 - .2 Submit manufacturer's test data and certification that pipe materials meet requirements of this section 4 weeks minimum prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air control valves, hydrant details.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, and hydrants.
- .3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, and hydrants for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect water distribution piping from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

1.7 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to general site operations.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Tools: provide tools as follows:
 - .1 2 tee-handle operating keys for valves.

Part 2 Products

2.1 PIPE, JOINTS AND FITTINGS

- .1 Polyvinyl chloride pressure pipe: The pipe shall be manufactured of Type 1 Grade 1 polyvinyl chloride 1120 in accordance with either of the two following alternatives:
 - .1 The pipe shall conform to the current ASTM Standard D1784, Standard for Rigid Polyvinyl Chloride Compound and D2241, Standard for Polyvinyl Chloride Plastic Pipe, and shall have CSA Certification to the current CSA Standard B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications. Each length of PVC pipe shall be clearly stamped with the CSA Certification Trademark Logo.
 - .2 The pipe shall conform to the current AWWA Standard C900, Standard for Polyvinyl Chloride Pressure Pipe.

Each length of pipe shall have an integral bell end with a rubber gasket as supplied by the pipe manufacturer. Pipe lengths shall not exceed six metres.
- .2 PVC Pipe: SDR 21, SDR 32.5, SDR 41, gasket bell end, 300 mm IPS O.D. (ASTM D2241), actual O.D. 323.85 mm.
- .3 PVC appurtenances shall be used only in conjunction with PVC pipe. The appurtenances shall be manufactured in accordance with the same specifications as the PVC series or class pipe, and shall be of the same, or better, series or class as the pipe with which the fittings are used. PVC appurtenances shall be injection moulded for watermain, pipelines or forcemains 300 mm diameter or less.
- .4 Polyethylene pressure pipe:
 - .1 High Density Polyethylene Pipe shall be manufactured from pressure rated black polyethylene compound material that meets or exceeds ASTM D3350 cell classification 345464C with PE 3608 or PE 4710 Polyethylene resin. Pipe shall have a hydrostatic design basis (HDB) of 1600 psi at 73°F and hydrostatic strength (HDS) of 800 psi at 73°F. Pipe larger than 200 mm nominal inside diameter shall conform to the ASTM F714 Specifications for Polyethylene Plastic Pipe based on outside diameter. The pipe shall be made from virgin compound (with the exception that it may contain clean rework compound generated in the manufacturer's own plant from resin compound of the same class and type from the same raw material supplier) having 100,000 hours of stress resistance at a minimum pressure of 11MPa for PE 3608 and PE 4710 resin. The

minimum wall thickness of the pipe shall be not less than the value of "t" as determined by the formula:

$$t = \frac{(P)(OD)}{(2S + P)}$$

where t = wall thickness (in mm)

P = pressure rating (in kPa)

OD = outside diameter (in mm)

S = design stress (kPa)

- .2 The Contractor shall at the request of the Departmental Representative provide the manufacturer's stress values used for determining minimum wall thickness. The pressure rating of the pipe shall be such that it may be operated at double the rated working pressure continuously for at least two hours at 23°C. It must withstand shock pressure equivalent to four times its rated working pressure for a 60 second duration. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign inclusions, bubbles, resin chunks or other imperfections. The pipe shall be uniform in colour, opacity, density and physical properties. The eccentricity of the pipe shall not exceed 5% of the nominal pipe diameter.
- .3 The pipe shall be permanently and legibly marked as per the applicable standard in such a way as not to lower the quality of the pipe.
- .4 High Density Polyethylene pipe identification shall be placed on each length of pipe and shall include pipe size, manufacturer's trademark or name, date of manufacture, series or DR rating, Canadian Standards Association, NSF International Certification or Water Quality Association (WQA) complete with certification trademark logo and the CSA;ASTM specification to which the pipe is certified. Certification of polyethylene pipe using NSF shall be to both NSF 61 and NSF 14 requirements. Certifiers must be accredited by the Standards Council of Canada (SCC) and by the American National Standards Institute (ANSI).
- .5 Pipeline flange connection materials shall consist of a polyethylene stub end, an epoxy coated ductile iron or all stainless steel back-up ring drilled in accordance with the current AWWA Standard C110, Standard for Gray-Iron and Ductile Iron Fittings, a reinforced rubber gasket and all stainless steel nuts, bolts and washers. Pipe lengths for 150 mm and larger shall not exceed 12 m (40 ft.).
- .5 PE appurtenances shall be used only in conjunction with PE pipe. The appurtenances shall be manufactured in accordance with the same specifications as the PE pipe, and shall be of the same equivalent series rating as the pipe with which the appurtenances are used. PE appurtenances shall be injection moulded for watermain, pipelines, or forcemains 300 mm diameter or less. Fabricated appurtenances must be FRP reinforced
- .6 High Density Polyethylene Electrofusion Appurtenances shall be manufactured in compliance with ASTM F-1055 standard for electrofusion type polyethylene fittings for controlled outside diameter polyethylene pipe and tubing. Fittings shall be tested in compliance with ASTM D-2513 and ASTM F-1055. Resin shall be PE 3608 or PE 4710 virgin material that complies with ASTM D-1248 and ASTM D-3350. The fittings shall comply with NSF Standard 61 Plastic Pipe Institute (PPI) rating. Electrofusion fittings shall be rated for a maximum operating pressure of 165 psi. Fittings shall be manufactured with an integral identification resistor that automatically sets the fusion time on the Electrofusion Processor.

- .7 All buried steel components shall be coated with an epoxy paint. Protective coatings damaged during handling and installation of items covered by this section, shall be repaired by the Contractor at no additional cost to the Owner, by recoating with matching material to adequate thickness or coating the pipe with an approved protective tape and primer.

2.2 VALVES AND VALVE BOXES

- .1 Gate valves shall conform to the current AWWA C509 Standard for Resilient Seated Gate Valves and shall be suitable for 1,000 kPa service. The valves shall have an epoxy coated cast iron body with Buna-N encapsulated rubber disc trim. Gate valve stem seals shall be O-Ring type. The valve shall be complete with a counter-clockwise opening non-rising spindle. The joints shall be of the same type as the pipe to which the valve is joined. Each gate valve shall be complete with a valve box, including an extension spindle with a 50 mm square operating nut, stone disc, and metal valve box cover and gate valve marker post. The box and extension spindle shall be adjustable to suit the depth of bury specified for the pipe, plus or minus 0.3 metres.

2.3 CONCRETE (THRUST BLOCKS)

- .1 The Contractor shall be responsible for the supply and placement of concrete of suitable workability. Concrete shall be in accordance with CSA Standard CAN3-A23.1-04 in all respects. Specified strength shall be 30 MPa.
- .2 Concrete shall be manufactured using Type HS sulphate resistant cement of a recognized standard brand complying with CSA A3001.
- .3 Air content shall be between 4 and 6 percent.
- .4 Maximum slump shall be 80 mm.
- .5 Maximum aggregate size shall be 28 mm.
- .6 All sampling and testing of aggregates and concrete shall be carried out in accordance with the applicable sections of CSA Standard CAN3-A23.1-04 and CAN3-A23.2-04.
- .7 All reinforcing steel shall be deformed bars of Grade 300 billet steel conforming to the applicable provisions of CSA:G30.18-M92.

2.4 SUPPORT BLOCKS

- .1 Precast concrete blocks used to support gate valves shall be manufactured using sulphate resistant cement Type 50. Dimensions minimum 100 mm x 300 mm x 300 mm to support valve and rest on trench base.

2.5 ENCASMENT PIPE

- .1 Encasement pipe used in Highway or Provincial Road Crossings shall conform to the plans or as specified in Appendix B (Manitoba Water Services Board Standard Construction Specification). Encasement pipe used in highway crossings shall be at least 100 mm in diameter larger than PVC carrier pipe and 50 mm in diameter larger than polyethylene carrier pipe. Encasement pipe for Highway or Provincial Road Crossings shall be PVC SDR 26 or High Density Polyethylene DR 17.

2.6 HYDRANTS

- .1 Hydrants: 200 mm x 150 mm x 1500 mm galvanized steel IPS J-pipe with female ringlock top.

2.7 PIPE BEDDING

- .1 Bedding sand shall be dry, unfrozen, fine granular material all of which passes through a 9.5 mm sieve, and not more than 8% of which passes through a 75 um sieve

2.8 BACKFILL MATERIAL

- .1 As indicated.

2.9 PIPE SUPPORTS, BANDING, AND MARKER POSTS FOR CROSSINGS AND AIR VENTS

- .1 The treated spruce or cedar wood straps shall be 38 mm x 89 with corners trimmed if necessary to fit the encasement pipe.
- .2 Banding shall be of sufficient strength to ensure wood straps remain intact during insertion of pipe. The Contractor shall supply sufficient banding to allow a minimum of three bands for each pipe wholly or partially installed in the HDPE casing pipe.
- .3 Marker posts shall be minimum 150 x 150 x 2440 mm pressure treated spruce or cedar painted with two coats of red exterior oil-based paint. Marker posts shall be installed at all road crossings, air valve riser locations, and hydrant/outlet locations.

2.10 AIR CONTROL VALVES

- .1 Nelson ACV 200 (or approved equivalent).

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation.
 - .1 Inspect materials for defects to approval of Departmental Representative.
 - .2 Remove defective materials from site as directed by Departmental Representative.

3.3 PIPELINE LOCATION

- .1 The pipeline shall be located as shown on the drawings or as modified by the Departmental Representative. Prior to construction, the Departmental Representative will establish and stake the location of the pipeline in the field. The stakes shall be sufficiently offset from the pipeline centreline to allow construction to proceed without disturbing the stake line. The Contractor will be responsible for accurately placing the pipeline relative to the stake line, and for preserving proper alignment.

3.4 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Ensure trench depth allows coverage over pipe of 900 mm minimum from finished grade.
- .3 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material and pipe.
- .4 Pipe grades shall be smooth vertical transitions to pipeline high points at the locations of the Air Control Valves.

3.5 HANDLING

- .1 The Contractor shall use every precaution to prevent damage to the pipe. No metal tools or heavy objects shall be unnecessarily permitted to come in contact with the pipe. Any damage to the pipe from any cause during loading, hauling or installation and before final acceptance by the Departmental Representative shall be repaired as directed by the Departmental Representative, by and at the expense of the Contractor. Material that cannot be repaired shall be removed and replaced at the Contractor's expense.
- .2 Pipe shall be loaded and unloaded using boom tractors or other equipment approved by the Departmental Representative. The Contractor shall not roll or drop the pipe from any conveyance used for hauling.
- .3 Extreme care shall be exercised during cold weather when wet surfaces on the pipe coating may freeze together and be damaged by subsequent movement. Caution shall also be exercised in handling of pipe during cold weather as PVC pipe is susceptible to impact damage.
- .4 When stringing beside the trench, pipe shall be fully supported in such a way as to prevent damage to the exterior surface of the pipe

3.6 PIPE INSTALLATION

- .1 Lay pipes to manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as specified.
- .2 Join pipes in accordance with manufacturer's recommendations.
- .3 Handle pipe by methods recommended by pipe manufacturer and approved by Departmental Representative. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade.

- .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .2 Take up and replace defective pipe.
- .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.
- .5 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
 - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Position and join pipes with equipment and methods approved by Departmental Representative.
- .9 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .10 Align pipes before jointing.
- .11 Complete each joint before laying next length of pipe.
- .12 Minimize deflection after joint has been made.
- .13 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- .14 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
- .15 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .16 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .17 Do not lay pipe on frozen bedding.
- .18 Do hydrostatic and leakage test and have results approved by Departmental Representative before surrounding and covering joints and fittings with granular material.
- .19 Backfill remainder of trench.
- .20 Bell or coupling holes shall be provided at each joint to permit the joint to be made properly. The ends of each pipe and fitting shall be cleaned and wiped before each joint is made. Joints shall be made in accordance with the recommendations of the manufacturer and the instructions of the Departmental Representative.
- .21 Before any joints are made, the Contractor shall obtain the approval of the Departmental Representative for the method to be used and, if required, shall demonstrate to the Departmental Representative, in a suitable location, his ability to carry out the method proposed. Use of a backhoe or large hydraulic equipment to aid in pipe insertion is subject to approval of the Departmental Representative. Pipeline construction shall begin at the upstream end of the pipeline and progress downstream in a continuous manner.

- .22 Turned wood plugs of the proper size shall be provided and used by the Contractor to prevent the ingress of water, dirt, or debris into the pipe while work is in progress or while the work is closed down.

3.7 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations as indicated.
- .2 Support valves located in valve boxes or valve chambers by means of bedding same as adjacent pipe and with concrete support block. Valves not to be supported by pipe.

3.8 UNDERCROSSING

- .1 See Appendix B.

3.9 HYDRANTS

- .1 Install hydrants at locations as indicated.
- .2 Install 200 mm gate valve and cast iron valve box on hydrant service leads as indicated.
- .3 Set hydrants plumb.
- .4 Place concrete thrust blocks as indicated.

3.10 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 Place concrete thrust blocks between tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated.
- .2 Keep joints and couplings free of concrete.
- .3 Do not backfill over concrete within 24 hours after placing.
- .4 Prior to placement of the thrust block, all fittings shall be wrapped in a plastic membrane with a minimum thickness of 3 mm as approved by the Departmental Representative.
- .5 Blocking shall be placed between solid undisturbed ground and the fitting to be anchored. The area of bearing on the undisturbed ground in each instance shall be as shown on the drawings. The blocking shall be so placed that the fitting joints will be accessible for repair.

3.11 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Departmental Representative at least 24 hours in advance of proposed tests.
 - .1 Perform tests in presence of Departmental Representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete.
- .5 Test pipeline in sections not exceeding 500 m in length, unless otherwise authorized by Departmental Representative.

- .6 Leave hydrants, valves, joints and fittings exposed.
- .7 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .8 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .9 Expel air from main by slowly filling main with potable water.
- .10 Thoroughly examine exposed parts and correct for leakage as necessary.
- .11 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .12 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .13 Repeat hydrostatic test until defects have been corrected.
- .14 Repeat test until leakage is within specified allowance for full length of water main.
- .15 Pipelines shall be tested for pressure and leakage. The test pressure for both types of tests shall be the pressure rating of the pipes (i.e. 80 psi for Series 80 pipe). The tests shall not commence until a minimum of 24 hours has passed since the pipe was filled with water.
- .16 PRESSURE TEST: The duration of each test shall be no less than two (2) hours. At the end of the first hour, the pressure shall be boosted to its initial value. At the end of the second hour, the pressure shall be checked. The drop in pressure shall not exceed 2%. If the pressure drop is in excess of this, the Contractor shall find the leak, correct it, and repeat the test until the line can show a pressure drop of less than 2% in one hour. As an alternative to the above, a pressure drop of no more than 15% over a 12 hour period shall be acceptable.
- .17 LEAKAGE TEST: The duration of each test shall be no less than two (2) hours. The leakage shall not exceed the following limits:

LENGTH OF PIPE SECTION IN METERS	LEAKAGE –ml PER HOUR/km OF PIPELINE PER mm OF NOM. ID
3.0	162
3.9	125
6.0	81

If the rate of leakage exceeds the allowable limit, the Contractor shall find the leak, correct it, and repeat the test until the leakage falls within the limit.

3.12 CLEANING

- .1 After completion of installation, all scale, dirt, welding electrodes, slag, rags and other foreign material shall be removed from the lines.
- .2 Cleaning may be accomplished by flushing with water. Where foreign material cannot be removed by these or other convenient means satisfactory to the Departmental Representative, the Contractor shall, where necessary, dismantle and reassemble the piping to effect removal of foreign material.
- .3 All practical precautions shall be taken to prevent the introduction of foreign material into the previously installed pipeline.

3.13 MARKER POSTS

- .1 Marker posts shall be installed as indicated on the plans at the following locations:
 - .1 Gate valve installations
 - .2 Air release installations
 - .3 Utility pipeline crossings
 - .4 Provincial Road and PTH crossings

3.14 AIR CONTROL VALVE RISERS

- .1 The riser tees shall be installed on the pipeline as shown on the drawings. Marker posts shall be installed next to all air valve risers.

END OF SECTION

Part 1 General

1.1 MEASUREMENT AND PAYMENT

- .1 METHOD OF MEASUREMENT – Measurement for "Utility Vaults" will be based on units of utility vaults supplied and installed as indicated on the plans and drawings and described in the Specifications. Sub-base material, compaction, connections, bollards, installation shall be considered incidental to "Utility Vaults".
- .2 BASIS OF PAYMENT – Payment for "Utility Vaults" shall be based on the Contract Unit Price for " Utility Vaults " measured as specified herein which shall be payment in full for those operations described on the plans and drawings and in the Specifications for those operations incidental to the Work for which no price or prices or provisions for payment are included in the Contract.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C117-[04], Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C136-[06], Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D698-[07e1], Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³)).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-[88], Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-[M88], Sieves, Testing, Woven Wire, Metric.
- .3 CSA International
 - .1 CSA A23.1/A23.2-[09], Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA A23.4-[09], Precast Concrete-Materials and Construction.
 - .3 CSA B66-[10], Design, Material and Manufacturing Requirements for Prefabricated Septic Tanks and Sewage Holding Tanks.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for utility vault and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings to indicate:
 - .1 Design calculations for items designed by manufacturer.

- .2 Tables and bending diagrams of reinforcing steel.
- .3 Camber.
- .4 Formwork.
- .5 Finishing schedules.
- .6 Methods of handling and erection.
- .7 Storage facilities.
- .8 Openings, sleeves, inserts and related reinforcement.

1.4 QUALITY ASSURANCE

- .1 Manufacturers of precast concrete elements are to be certified by CSA as meeting requirements of CSA A23.4.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

Part 2 Products

2.1 DESIGN REQUIREMENTS

- .1 Dimensions of utility to be 3000 mm (length) x 1500 mm (width) x 1200 mm (depth).
- .2 Utility vault to have concrete base and sidewalls.
- .3 Utility vault lid to be lockable reinforced fibreglass to dimensions of 3000 mm x 1500 mm. Fibreglass lid (or approved equivalent) to withstand loads of 450 kg (min.).

2.2 CONCRETE MIXES AND MATERIALS

- .1 Concrete mixes and materials: to CSA B66 CSA A23.1/A23.2.
- .2 ASTM C1433 precast reinforced concrete box sections for culverts, storm drains and sewers.
- .3 High sulfate resistant cement to ASTM C1433.
- .4 Sidewall thickness: 254 mm.
- .5 Base thickness: 254 mm.

2.3 MANUFACTURE

- .1 Manufacture units in accordance to CSA A23.4.

2.4 FINISHES

- .1 Finish tanks to CSA A23.4, commercial grade.

2.5 TANK BEDDING AND SURROUND MATERIAL

- .1 Granular material of the following requirements:
 - .1 Crushed or screened stone, gravel or sand according to Section 32 11 16.01 Granular Sub-base.

2.6 PROTECTIVE BOLLARDS

- .1 100 mm diameter galvanized steel fitted with high visibility reflective tape.
- .2 Location to be field selected by the Departmental Representative.
- .3 Minimum depth of burial to 1.5 m.
- .4 Minimum above ground stick-up of 1.2 m.

2.7 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for utility vault installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

2.8 INSTALLATION

- .1 Place bedding and surround material in unfrozen condition.
- .2 Do excavation in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Place tank bedding material in accordance with details as indicated.
 - .1 Compact to 95% maximum dry density to ASTM D698.
- .4 Do backfilling in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.9 PROTECTION

- .1 Place six (6) 100 mm diameter galvanized steel bollards in a perimeter around utility vaults. Location of bollards to be determined in the field.
- .2 Bollard installation to 1.5 m below ground (min.) and 1.2 m above ground (min.).
- .3 Bollards to be completed with high visibility reflective tape.

END OF SECTION