

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 31 23 33.01 - Excavation, Trenching and Backfilling.
- .3 Section 33 41 00 - Storm Utility Drainage Piping.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM A123/A123M-13 Standard Specification for zinc (hot-dip galvanized) coatings or iron and steel products.
 - .2 ASTM A48/A48M-03(2012), Standard Specification for Gray Iron Castings.
 - .3 ASTM C478M-15, Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric).
 - .4 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A3000-13 including updates, Cementitious Materials Compendium. Includes:
 - .1 CSA-A3001-13, Cementitious Materials for Use in Concrete.
 - .2 CSA-A3002-13, Masonry and Mortar Cement.
 - .2 CAN/CSA-A23.1-09/A23.2-09(R2014), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .3 CAN/CSA-G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit manufacturer and shop drawings.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 35 43 – Environmental Procedures.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Cast-in-place concrete: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Precast manhole units: to ASTM C 478M, circular top sections, flat slab top type with opening offset for vertical ladder installation, as indicated on drawings.
- .3 Pre-cast catch basin sections: to ASTM C 478M, circular.
- .4 Joints: to be made watertight using rubber rings and butyl resin cord.
- .5 Pipe penetrations: to be made watertight by using cast-in-wall rubber gasket.
- .6 Mortar masonry cement: to CAN/CSA-A3002.
- .7 Adjusting rings: to ASTM C 478M.
- .8 Frames, gratings, and covers to dimensions as indicated and the 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 A 48/A 48M-03, strength class 30B.
 - .3 Castings: coated with two applications of asphalt varnish sand blasted or cleaned and ground to eliminate surface imperfections.
 - .4 Manhole frames and covers: heavy duty municipal type for road service. Cover cast without perforations and complete with two 25 mm square lifting holes.
 - .5 Catch basin frames and covers round, municipal type heavy-duty perforated grates.
 - .6 Access openings to all manholes and catch basin manholes shall be minimum 760 mm clear.
- .9 Granular bedding and backfill to Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .10 Concrete mixes and materials: in accordance with Section 03 30 00 – Cast-in-Place Concrete.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and datasheets.

3.2 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling and as indicated.
- .2 Obtain approval of Departmental Representative before installing manholes or catch basins.
- .3 Bedding and backfill to type and extent indicated on drawings.

3.3 CONCRETE WORK

- .1 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete reinforcement in accordance with Section 03 20 00 – Concrete Reinforcement.
- .3 Position metal inserts in accordance with dimensions and details as indicated.
- .4 Construct units in accordance with drawings, plumb and true to alignment and grade.

3.4 INSTALLATION

- .1 Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.
 - .2 Dewater excavation to approval of Departmental Representative and remove soft and foreign material before placing concrete base.
 - .3 Set precast concrete base on 150 mm minimum of Type 1 Gravel compacted to 100% of the maximum dry density to ASTM D 698, in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
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- .4 Precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make each successive joint watertight with Departmental Representative approved rubber ring gaskets.
 - .2 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
 - .3 In addition to "O" ring gaskets, joints in the pre-cast sections shall be sealed with 25 mm butyl resin cord. The cord shall be placed on the upper inside ledge of the joint prior to the placement of the subsequent section.
- .5 For sewers:
 - .1 Place stub outlets and bulkheads at elevations and in positions indicated.
 - .2 Bench to provide a smooth U-shaped channel. Side height of channel to be 0.75 times diameter of sewer. Slope adjacent floor at 1 in 20. Curve channels smoothly. Slope invert to establish sewer grade.
- .6 Compact Type 1 Gravel around structure to 95% maximum dry density to ASTM D 698, in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .7 Place frame and cover on top section to elevation as indicated. If adjustment required use concrete ring.
- .8 Installing units in existing systems:
 - .1 Where new unit is installed in existing run of pipe, ensure full support of existing pipe during installation, carefully remove that portion of existing pipe to dimensions required and install new unit as specified.
 - .2 Make joints watertight between new unit and existing pipe.
 - .3 Where deemed expedient to maintain service around existing pipes and when systems constructed under this project are ready for operation, complete installation with appropriate break-outs, removals, redirection of flows, blocking unused pipes or other necessary work.
- .9 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
- .10 Install safety platforms in manholes having depth of 5 m or greater, as indicated. Departmental Representative.

3.5 ADJUSTING TOPS OF EXISTING UNITS

- .1 Remove existing gratings, frames and I beams and store for re-use at locations designated by Departmental Representative.

- .2 Section units:
 - .1 Raise or lower straight walled sectional units by adding or removing precast sections as required.
 - .2 Raise or lower tapered units by removing cone section, adding, removing, or substituting riser sections to obtain required elevation, then replace cone section.
 - .1 When amount of raise is less than 600 mm use standard maintenance hole brick, modulo or grade rings.

3.6 TESTING

- .1 Test sanitary sewer manholes and structures.
- .2 Provide labour, equipment and materials required to perform testing.
- .3 Backfill prior to testing.
- .4 Notify Departmental Representative 24 hours in advance of proposed test. Do test in presence of Departmental Representative.
- .5 Perform water test as follows:
 - .1 If water used for flushing or testing is obtained from a potable water supply, the potable water supply is to be continuously separated from the service being flushed or tested by an air gap or a level of protection equal to or greater than that provided by a double check valve backflow prevention device.
 - .2 Plug all inlet and outlet pipes with watertight plugs.
 - .3 Fill with water to top of precast sections.
 - .4 Allow time for initial absorption.
 - .5 Measure and record volume of water required to maintain level for one hour.
 - .6 Leakage not to exceed 5.0 litres per hour per 1000mm diameter per 1000mm of height above groundwater.
 - .7 Locate and repair defects if test fails. Retest using same methodology.
 - .8 Repair leaks regardless of test results.
- .6 Conduct vacuum testing as follows:
 - .1 Plug all inlet and outlet pipes. Restrain plugs.
 - .2 Place and seal vacuum tester head to the precast section.
 - .3 Draw vacuum of 250mm Hg on the manhole and measure the time for the vacuum to drop to 225mm Hg.
 - .4 Time to be not less than 45, 50, 65, and 80 seconds for manhole diameters of 1050mm, 1200mm, 1500mm, and 1800mm respectively.
 - .5 For manholes deeper than 6 meters, increase test times by 2 seconds per 300mm of additional manhole depth.

- .6 Locate and repair defects if test fails. Retest using same methodology.
- .7 Repair leaks regardless of test results.

3.7 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials excess materials, rubbish tools and equipment.

END

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 This section specifies requirements for constructing water mains and services. Work includes supply, installation and testing of pipe, fittings and service connections, and disinfection.

1.2 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.3 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B300-10, Standard for Hypochlorites.
 - .2 ANSI/AWWA B301-10, Standard for Liquid Chlorine.
 - .3 ANSI/AWWA B303-10, Standard for Sodium Chlorite.
 - .4 ANSI/AWWA C110/A21.10-12, American National Standard for Ductile-Iron and Gray Iron Fittings for Water.
 - .5 ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.
 - .6 ANSI/AWWA C502-14, Standard for Dry-Barrel Fire Hydrants.
 - .7 AWWA C512-07, Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
 - .8 ANSI/AWWA C651-05, Standard for Disinfecting Water Mains.
 - .9 ANSI/AWWA C800-12, Standard for Underground Service Line Valves and Fittings.
 - .10 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 A 123/A 123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A 307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .3 ASTM B88M-13, Standard Specification for Seamless Copper Water Tube Metric.
 - .4 ASTM B418-12, Standard Specification for Cast and Wrought Galvanic Zinc Anodes.
 - .5 ASTM C117-13, Standard Test Methods for Material Finer Than 0.075

- mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .6 ASTM C136-14, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .7 ASTM C478M-15a, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.
 - .8 ASTM D698-12e2, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
 - .3 American Water Works Association (AWWA)/Manual of Practice
 - .1 AWWA M17-2006, Installation, Field Testing, and Maintenance of Fire Hydrants.
 - .4 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.
 - .5 CSA International
 - .1 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
 - .2 CAN/CSA-B137 Series-13, 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-B137.1-13, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - .2 CAN/CSA-B137.3-13, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
 - .3 CSA G30.18-09, Carbon and Steel Bars for Concrete Reinforcement.
 - .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S520-07, Standard for Fire Hydrants.
 - .2 CAN/ULC-S543-09, Standard for Internal-Lug, Quick Connect Couplings for Fire Hose.
 - .3 CAN/ULC-S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .7 Nova Scotia Transportation and Infrastructure Renewal (NSTIR)
 - .1 Standard Specification for Highway Construction and Maintenance (latest edition).
 - .8 National Fire Protection Association (NFPA)
 - .1 NFPA 291-16, Recommended Practice for Fire Flow Testing and Marking of Hydrants.
 - .9 Halifax Regional Water Commission, Design and Construction specifications
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(HRWC) 1, Water, Wastewater and Storm Water Systems 2017.

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 stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
- .4 Samples:
 - .1 Inform DCC Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.
 - .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 and vacuum release valves, hydrant details.
 - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.
- .3 Operation and Maintenance Data: submit operation and maintenance data for pipe, valves, valve boxes, valve chambers and hydrants for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements: deliver materials to site in original
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factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and 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 existing services.
- .2 Submit schedule of expected interruptions for approval and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative building occupants superintendent minimum of 5 days in advance of interruption in service.
- .4 Do not interrupt water service for more than 3 hours and confine this period between 10:00 and 16:00 hours local time unless otherwise authorized.
- .5 Notify Fire Department of planned or accidental interruption of water supply to hydrants.
- .6 Provide and post "Out of Service" sign on hydrant not in use.
- .7 Advise Police Department of anticipated interference with movement of traffic.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Tools: provide tools as follows:
 - .1 Service post wrenches for curb stops.
 - .2 Hydrant wrenches.
 - .3 Tee-handle operating keys for valves.
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PART 2 - PRODUCTS

2.1 PIPE, JOINTS AND FITTINGS

- .1 Ductile iron pipe: to ANSI/AWWA C151/A21.51, special class 52, cement mortar lined to ANSI/AWWA C104/A21.4.
- .2 Joints and fittings for ductile iron pipe.
 - .1 Joints:
 - .1 Push-on joints: to ANSI/AWWA: C111/A 21.11.
 - .2 Rubber gaskets for mechanical pipe joints: to ANSI/AWWA C111/A21.11.
 - .3 Rubber gaskets for flange pipe joints 1.6 mm thick: to ANSI/AWWA C111/A21.11.
 - .4 Bolts, nuts, hex head with washers: to ASTM A 307, heavy series.
 - .5 Ensure electrical conductivity across joints.
 - .2 Fittings:
 - .1 Mechanical joint cast iron and ductile iron fittings NPS 3 and larger: to ANSI/AWWA C110/A21.10.
 - .2 Flanged cast iron fittings NPS 3 and larger: to ANSI/AWWA C110/A21.10.

2.2 PROTECTION

- .1 Provide means of protection for iron fittings in corrosive soils in accordance with local practices and authorities having jurisdiction to ANSI/AWWA C105/A21.5 utilizing both:
 - .1 Anode: Z-24-48 conforming to ASTM B418, Type II.
 - .2 Polyethylene Encasement to be performed on all buried ductile iron pipe, valves, fittings and other appurtenances. Encasement to be made using 200 micron polyethylene sleeve manufactured and installed in accordance with ANSI/AWWA C105/A21.5 Latest Edition.

2.3 VALVES AND VALVE BOXES

- .1 Valves to open counter clockwise.
 - .2 Gate valves: to ANSI/AWWA C500, standard iron body, brass bronze mounted wedge double disc valves with non-rising stems, suitable for 1 MPa with mechanical flanged push-on grooved type coupling joints.
 - .3 Butterfly valves: to AWWA C504 greater than 300 mm, short body, Class 150B, minimum pressure rating 1035 kPa and as follows:
 - .1 Body: cast-iron with mechanical joint ends.
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- .2 Mechanism: cast-iron, cast steel, alloy cast-iron or ductile-iron disc, type 304 stainless steel shafts to ASTM A276/A276M, rubber seated for positive shut-off at minimum one (1) MPa differential pressure, either direction.
- .3 Operating nut: 50 mm square.
- .4 Cast iron valve boxes: bituminous coated screw type three piece sliding type adjustable over minimum of 450 mm complete with valve operating extension rod, 30 mm minimum diameter, 25 x 25 mm cross section, of such length that when set on valve operating nut top of rod will not be more than 150 mm below cover.
 - .1 Base to be large round type with minimum diameter of 300 mm.
 - .2 Top of box to be marked "WATER"/"EAU".
- .4 Air and vacuum release valves:
 - .1 75 mm diameter and larger to AWWA C512:
 - .1 Heavy duty type of cast-iron body with bronze trim and combination of small orifice and large orifice units. Small orifice size 2 mm. Valves suitable working pressure of 2068 kPa and have flanged ends to ASME B16.1. Acceptable products:
 - .1 G.A. Industries Ltd., Fig 960-C.
 - .2 APCO, Model 147C.
 - .3 Crispin, Model AL30.
 - .4 ARI Bermad D-060-C HF
 - .2 Independent floating stainless steel buoy balls located in both orifices.
 - .3 Orifices are to be capable of expelling air at a high rate during filling and at a low rate during operation and will admit air while draining the pipeline. Provide replaceable seats..
 - .4 Valves are to have no moving parts except for stainless steel balls which remain in the throat area discharging air without blowing shut or collapsing the balls.
 - .5 Valves are not leak in the closed position when pipe is filled.
 - .6 Tee: Flanged to AWWA C110/A21.10 and ASME B16.1, Class 125.

2.4 PRESSURE REDUCING VALVES

- .1 For use on transmission and distribution mains:
 - .1 On PRV's 100 mm and larger, include a pilot control system equipped with a second pilot with a single, manually adjusted set point with isolating ball valves. The backup pilot is to be piped to sense the downstream pressure beyond any flow restrictions that may be part of the control system and be furnished with indicator rod as an integral part of the valve to show position of piston.

- .2 Valve Sizes 65 mm to 200 mm, diaphragm type globe valve:
 - .1 General: hydraulically operated globe valve with inner valve assembly both top and bottom guided by means of replaceable bearing bushings. Main valve complete with a direct acting, spring loaded, diaphragm actuated pressure reducing pilot valve.
 - .2 Body: ductile iron to ASTM A536-84, with heat fused internal and external epoxy coating to NSF 61 or FDA standards and 150 lb. flanges complete with stem position indicator.
 - .3 Seat: stainless steel stationary seat, with abrasion and erosion resistant mechanically held, polyurethane disc. Valve actuation via a flat diaphragm and consist of nylon fabric, bonded with synthetic rubber. Lip seals or packing may not be used to seal actuator.
 - .4 Pilot valve: easily adjustable and equipped with a stainless steel seat and urethane disc. Pilot circuit to include a strainer, and three shut-off cocks.
 - .5 Acceptable products:
 - .1 Singer 106-PR.
 - .2 Cla-val 90-01.
 - .6 Diaphragm valve to be supplied with digital limit switch connected to the RTU if it is the larger valve in the standard chamber configuration.
- .3 Valve Sizes greater than 200 mm, Piston type valve:
 - .1 Body: cast iron, globe design with flanged covers from which all inside parts are accessible without its removal from the line. Flanges in accordance with ASME B16.1, Class 125.
 - .2 Seat: single seat design with seat base equal to size of valve. Piston and seat component metal parts to be bronze to ASTM B62. Piston to be guided and cushioned to ensure positive closure and be furnished with indicator rod as an integral part of the valve to show position of piston.
 - .3 Packing: leather to ensure tight closure and prevent metal to metal wearing of surfaces of piston.
 - .4 Pilot valve and component parts: bronze of single seated balance design type, globe body pattern. Hydraulic pilot valves are to be diaphragm operated and spring loaded permitting convenient adjustment over the specified range.
 - .5 Acceptable product:
 - .1 Ross Model – 40WR-PR-SL/W Stainless Steel trim with digital limit switch connected to RTU.

2.5 VALVE CHAMBERS

- .1 Precast concrete sections to ASTM C 478M, and in accordance with Section 33 05 16 – Manhole and Catchbasin Structures.

2.6 SERVICE CONNECTIONS

- .1 Copper tubing: to ASTM B 88M type K, annealed.

- .2 Polyvinyl chloride pressure pipe: to CAN/CSA-B137.3, type 1120 series 160 1.1 MPa.
- .3 Copper tubing joints: compression type suitable for 1 MPa working pressure.
- .4 Brass inverted key-type curb stops: red brass to ASTM B 62, compression type with without drains.
 - .1 Curb stops to have adjustable bituminous coated cast iron service box with stem to suit depth of bury.
 - .2 Top of cast iron box marked "WATER"/"EAU".
- .5 Service connections for PVC pipe:
 - .1 Service connections less than 100 mm: corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.
 - .2 Service connections 100 mm and over: use tee fitting or tapping valve and sleeve.
- .6 Bronze type service clamps: for PVC pipe service connections.
 - .1 Service clamps to be of strap-type, with confined "O" ring seal cemented in place.
 - .2 Clamps to be tapped with threads to ANSI/AWWA C800.
- .7 Tee connections: for services above NPS 100. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

2.7 HYDRANTS

- .1 Dry barrel type: to AWWA C502, ANSI/NSF 61 and as follows:
 - .1 Depth of bury: as indicated.
 - .2 Barrel: two-piece with safety break-away flange and breakway stem rod coupling.
 - .3 Main valve: compression type, 134 mm minimum diameter.
 - .4 Inlet connection: mechanical joint, 150 mm diameter.
 - .5 Nozzles: two (2) hose and one (1) pumper, with threads as follows: two 2 1/2 inch hose nozzels nominal size 3 7/32 inch with 5 threads/inch, and one pumper nozzle nominal size 4 15/16 inch with 5 threads/inch.
 - .6 Direction of opening: counter-clockwise.
 - .7 Operating nut: 32mm square.
 - .8 Acceptable products:
 - .1 Clow Brigadier "M67"
 - .2 Canada Value "Century"

- .3 Mueller "Super Centurion 250"
- .2 Hydrant paint: exterior enamel to CAN/CGSB-1.88-92. Colour to match local standard.

2.8 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to: Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Type 1 Gravel, in accordance with Division 3, Section 2.4.0 of NSTIR's Standard Specifications for Highway Construction and Maintenance.

2.9 BACKFILL MATERIAL

- .1 As indicated, select backfill material in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.10 PIPE DISINFECTION

- .1 Liquid chlorine to ANSI/AWWA B303 to disinfect water mains.
- .2 Disinfect water mains in accordance with ANSI/AWWA C651.

2.11 THRUST RESTRAINT

- .1 Thrust Blocks and Anchors: 20 MPa concrete and 15 M, grade 400 reinforcing steel where indicated.
- .2 Mechanical thrust restraints: to AWWA C111 and C153 for mechanical and push-on joints with multiple wedge or gripper ring restraining mechanism, minimum working pressure rating 240 kPa and minimum safety factor of 2:1.
 - .1 Acceptable products:
 - .1 Ebba Iron Megalug.
 - .2 Star StarGrip.
 - .3 Mueller Aquagrip.
 - .4 Clow Tyler Union TUF Grip.

2.12 PIPE TRENCH INSULATION

- .1 50 mm Extruded polystyrene, to CAN/ULC-S701, Type 4, minimum 100 psi compression strength.
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2.13 TRACER WIRE

- .1 #10 Gauge AWG single or seven strand, insulated copper tracer wire to be provided along entire length of watermain and brought to surface at hydrants and valves as determined by Departmental Representative. Contractor to provide conductivity test to Departmental Representative's satisfaction.

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 and after receipt of written approval to proceed from Departmental Representative.

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 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 to the minimum from finished grade as indicated.
- .3 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.

- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to 100% maximum density to ASTM D 698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling with compacted bedding material.

3.5 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 Bevel or taper ends of PVC pipe to match fittings.
 - .4 Handle pipe by methods approved by Departmental Representative recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
 - .5 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.
 - .6 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
 - .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
 - .8 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.
 - .9 Position and join pipes with equipment and methods approved by Departmental Representative.
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- .10 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.
 - .11 Align pipes before jointing.
 - .12 Install gaskets to manufacturer's recommendations. Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .13 Avoid displacing gasket or contaminating with dirt or other foreign material.
 - .1 Remove disturbed or contaminated gaskets.
 - .2 Clean, lubricate and replace before jointing is attempted again.
 - .14 Complete each joint before laying next length of pipe.
 - .15 Minimize deflection after joint has been made.
 - .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
 - .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
 - .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
 - .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
 - .20 Do not lay pipe on frozen bedding.
 - .21 Do hydrostatic and leakage test and have results approved by Departmental Representative before surrounding and covering joints and fittings with granular material.
 - .22 Backfill remainder of trench.
 - .23 Where a minimum pipe cover of 1.6 m cannot be achieved, water pipe shall be insulated as indicated.
-

3.6 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 concrete located between valve and solid ground. Bedding same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1 m. Valves not to be supported by pipe.
- .3 Install underground post-type as indicated.

3.7 SERVICE CONNECTIONS

- .1 Do not install service connections until satisfactory completion of hydrostatic and leakage tests of water main.
- .2 Construct service connections at right angles to water main unless otherwise directed. Locate curb stops as indicated.
- .3 Tappings on PVC-C900 pipe may be threaded without service clamps, and shall conform to the following:

| Pipe Diameter (mm) | Maximum Tap Without Clamp (mm) | Maximum Tap With Clamp (mm) |
|-----------------------|--------------------------------------|-----------------------------------|
| 100 | 20 | 25 |
| 150 | 20 | 40 |
| 200 | 25 | 50 |
| 250 | 25 | 50 |
| 300 | 40 | 75 |

- .4 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .5 Employ only competent workmen equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .6 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .7 Install multiple corporation stops, 30 degrees apart around circumference of pipe and minimum of 300 mm apart along pipe.

- .8 Tap main at 2:00 o'clock or 10:00 o'clock position only; not closer to joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m minimum, whichever is greater.
- .9 Leave corporation stop valves fully open.
- .10 In order to relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.
- .11 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .12 Install curb stop with corporation box on services NPS 2 or less in diameter.
 - .1 Equip larger services with gate valve and cast iron box.
 - .2 Set box plumb over stop and adjust top flush with final grade elevation.
 - .3 Leave curb stop valves fully closed.

3.8 HYDRANTS

- .1 Install hydrants at locations and in orientation as indicated.
- .2 Install hydrants in accordance with AWWA M17.
- .3 Install gate valve and cast iron valve box on hydrant service leads as indicated.
- .4 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and with body flange set at elevation of 50 mm above final grade.
- .5 Place concrete thrust blocks as indicated and specified ensuring that drain holes are unobstructed.
- .6 To provide proper draining for each hydrant, excavate pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to level 150 mm above drain holes.
- .7 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.9 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.

- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by Departmental Representative.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 For restrained joints: only use restrained joints approved by Departmental Representative.
 - .1 Install mechanical restraints at all joints along hydrant lead between watermain and hydrant.
- .6 Where thrust blocks cannot be laid on undisturbed ground due to excessive excavation or fill conditions, mechanical thrust restraints will be used.

3.10 CATHODIC PROTECTION

- .1 Install sacrificial zinc anodes on all directly buried metallic fittings including bends, tees, crosses, valves, and hydrants and each copper service pipe.

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 or 2 days if high early strength concrete is used.
 - .5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by Departmental Representative.
 - .6 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated as directed by Departmental Representative.
 - .7 Leave hydrants, valves, joints and fittings exposed.
-

- .8 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .11 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .12 Fill asbestos cement pipe and concrete pipe at least 24 hours before testing to allow water absorption by pipe material.
- .13 Thoroughly examine exposed parts and correct for leakage as necessary.
- .14 Apply test pressure of 1035 kPa or pressure equal to 1.5 times working pressure, whichever is greater, measured at lowest point in test section. Conduct the test over a full two (2) hour period, maintaining a constant test pressure. No leakage is permitted by the test process.
- .15 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .16 Remove joints, fittings and appurtenances with visible leaks and replace with new sound material and make watertight.
- .17 Hydrostatic test until defects have been corrected.
- .18 No leakage is permitted by the test process.

3.12 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.
 - .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .3 Place layers uniformly and simultaneously on each side of pipe.
 - .4 Do not place material in frozen condition.
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- .5 Compact each layer from pipe invert to mid height of pipe to at least 100% maximum density to ASTM D 698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 98% maximum density to ASTM D 698.

3.13 BACKFILL

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact backfill to at least 100% maximum density to ASTM D 698.
 - .1 In other areas, compact to at least 98% maximum density to ASTM D 698.

3.14 HYDRANT FLOW TESTS

- .1 Conduct flow tests on every hydrant to determine fire flows prior to painting hydrant caps and ports.
- .2 Conduct hydrant flow testing in accordance with requirements of NFPA 291.

3.15 PAINTING OF HYDRANTS

- .1 After installation, paint hydrants in accordance with Departmental requirements.
- .2 After hydrant flow tests, paint caps and ports as per NFPA 291.

3.16 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by Departmental Representative.
 - .1 Notify Departmental Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
 - .2 Conduct only after system has been successfully pressure tested.
 - .2 Prior to flushing, two (2) swabs to be launched and propelled through watermain.
 - .3 Flush and disinfect water mains to AWWA C651 and as herein specified.
 - .4 Use the continuous feed method of completely filling the main with potable water, removing air pockets, then flushing the completed main to remove
-

particulates, and refilling the main with potable water that has been chlorinated to 25 mg/L. After a 24 hour holding period in the main, there must be a free chlorine residual of not less than 10 mg/L.

- .5 Before the main is chlorinated, fill with potable water to eliminate air pockets and flush to remove particulates. The flushing velocity in the main must not be less than 0.91 m/sec. Flush water mains with potable water through available outlets until particulates have been removed. The size and number of taps should conform to Table 3 of AWWA C651 as provided here.

| Pipe Diameter | Flow Required to Produce 0.91 m/s (approx.) Velocity in Main | | Size of Tap | | | Number 65mm Hydrant Outlets |
|---------------|--------------------------------------------------------------------|-------|------------------------|------|------|--------------------------------------|
| | | | 25mm | 38mm | 50mm | |
| mm | gpm | l/s | Number of Taps on Pipe | | | |
| 100 | 120 | 7.4 | 1 | - | - | 1 |
| 150 | 260 | 16.7 | - | 1 | - | 1 |
| 200 | 470 | 29.7 | - | 2 | - | 1 |
| 250 | 730 | 46.3 | - | 3 | 2 | 1 |
| 300 | 1060 | 66.7 | - | - | 2 | 2 |
| 400 | 1880 | 118.6 | - | - | 5 | 2 |

- .6 Slowly open and close valves and hydrants to ensure thorough flushing.
- .7 If satisfactory results cannot be achieved by flushing, swab pipe by approved methods and reflush.
- .8 Disinfect water mains upon completion of flushing using chlorine solution distributed throughout entire system.
- .9 Inject 1% chlorine solution through a corporation stop in the top of newly laid pipe, at point close to where main is being filled and at rate proportional to filling rate. Prepare stock chlorine with concentration of 1% free chlorine by volume as follows:

| Product | Amount Of Compound | Quantity Of Water |
|---------------------------|-----------------------|----------------------|
| 100% Chlorine | 1.0 kg | 100 litres |
| Liquid bleach 5.25% Cl | 1.0 litres | 3.5 litres |
| Liquid bleach 10.5% Cl | 1.0 litres | 8.0 litres |

- .10 Do not use calcium hypochlorite and chlorinated lime when water temperature is less than 5°C.
- .11 The following table indicates the quantity of 1% chlorine stock solution required to produce an initial 25 mg/L concentration in 100m of pipe by diameter.

| Pipe Diameter (mm) | 100% Chlorine grams | 1% Chlorine Stock Solution (litres) |
|-----------------------|------------------------|-------------------------------------------|
| | | |
| 100 | 19.6 | 2.0 |
| 150 | 44.2 | 4.4 |
| 200 | 78.5 | 7.9 |
| 250 | 122.7 | 12.3 |
| 300 | 176.7 | 17.7 |
| 350 | 240.5 | 24.1 |
| 400 | 314.2 | 31.4 |
| 450 | 397.6 | 39.8 |
| 500 | 490.9 | 49.1 |
| 600 | 706.9 | 70.7 |
| 750 | 1104.5 | 10.4 |

- .12 Operate valves, hydrants and appurtenances while the main contains chlorine solution.
- .13 Take water samples at all hydrants and termination points, in suitable sequence, to test chlorine residual. When tests indicate minimum chlorine residual of 25 mg/L, leave system charged with disinfectant solution for 24 hours. At the end of this 24 hour period, the treated water in all portions of the main shall have a residual of not less than 10 mg/L. If the residual has fallen below 10 mg/L, the system shall be re-chlorinated.
- .14 Disposing of chlorinated water:
 - .1 In areas directly connected to a wastewater treatment facility, discharge chlorinated waste into the wastewater treatment facility. Provide prior notice and receive permission from the wastewater treatment facility operator to discharge.
 - .2 In all other wastewater sewersheds:
 - .1 Dechlorinate the chlorinated water using calcium thosulphate (CaS2O3) as outlined in AWWA C655. Once the chlorinated is neutralized, it can be discharged to a wastewater or stormwater system or the environment.
 - .2 When disposing to the environment, the disposal of the dechlorinated solution must be at least 100m from the nearest watercourse.
- .15 Bacteriological samples are to be obtained from a test sampling tap or a water service connection if available. Take samples from every 370m of new water main, plus one (1) set from the end of the line and from every branch (see AWWA C651, Section 5.1). If service connections are not available, a hydrant lead may be tapped to provide the required sampling location.

- .16 Collect samples in accordance with Appendix A of Nova Scotia Environment's "Guidelines for Monitoring Public Drinking Water Supplies". Have analysis done by an independent lab in accordance with the guidelines.
- .17 Should any of the test results be positive, repeat disinfection, flushing, sampling and analysis.
- .18 After testing and submission of the written results for the passing of the bacteriological tests, remove the corporation stops and install plugs. Check visually for leakage after plugs are installed with water main under normal operating pressure.

3.17 SURFACE RESTORATION

- .1 After installing and backfilling over water mains, restore surface to original condition as directed by Departmental Representative.

3.18 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal 01 47 15 - Sustainable Requirements: Construction.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END

PART 1 – GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Section 31 05 16 – Aggregate Materials
- .3 Section 33 05 13 – Manholes, Catch Basin and Utility Structures

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
- .2 ASTM International
 - .1 ASTM C 117-04, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbf/ft² (600 kN-m/m²)).
 - .4 ASTM D 2680-01(2009), Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
 - .5 ASTM D 3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - .6 ASTM D 3350-10, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .3 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.
- .4 CSA International
 - .1 CSA A3000-08, Cementitious Materials Compendium.
 - .2 CSA B1800-11, Thermoplastic Non-pressure Pipe Compendium.
 - .1 CSA B182.1-11, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
 - .3 CSA B182.6-11, Profile Polyethylene (PE) Sewer Pipe and Fittings for Leak-Proof Sewer Applications.
 - .4 CSA B182.11-11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Scheduling:
 - .1 Schedule Work to minimize interruptions to existing services and maintain existing sewage flows during construction.
 - .2 Submit schedule of expected interruptions for approval and adhere to approved schedule.
 - .3 Notify Departmental Representative and building manager superintendent 24 hours minimum in advance of any interruption in service.

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 pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Nova Scotia, Canada.
 - .2 Indicate on drawings proposed method for installing carrier pipe for undercrossings.
- .4 Samples:
 - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
 - .2 Submit for testing at least 2 weeks prior to beginning Work, samples of materials proposed for use as follows:
 - .1 Bedding and surround.
- .5 Certificates:
 - .1 Certification to be marked on pipe.
- .6 Test and Evaluation Reports:
 - .1 Submit manufacturer's test data and certification 2 weeks minimum before beginning Work.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
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- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect pipes from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 – PRODUCTS

2.1 PLASTIC PIPE

- .1 Type PSM Poly Vinyl Chloride (PVC): to CSA-B 182.2, DR 28 for pipe sizes 150 mm and smaller; DR 35 for pipe sizes greater than 150 mm.
- .2 Lock-in gasket and integrated bell system.

2.2 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: to CSA B182.2.
- .2 Plastic pipe: to CSA B182.1, with push-on joints.

2.3 CEMENT MORTAR

- .1 Portland cement: to CSA A3000, normal type 10.
- .2 Mix mortar 1 part by volume of cement to two parts of clean, sharp sand mixed dry.
 - .1 Add only sufficient water after mixing to give optimum consistency for placement.
 - .2 Do not use additives.

2.4 PIPE BEDDING AND SURROUND MATERIALS

- .1 Granular material to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Type 1 Gravel, in accordance with Division 3, Section 2.4.0 of NSTIR's Standard Specification for Highway Construction and Maintenance.

2.5 BACKFILL MATERIAL

- .1 As indicated on drawings.
- .2 Select Backfill Material in accordance with section 31 23 33 .01 – Excavating, Trenching and Backfilling

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 sewer pipe 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 and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction sediment and erosion control drawings sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
 - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
 - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
 - .2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.
 - .3 Clean and dry pipes and fittings before installation.
 - .4 Obtain Departmental Representative approval of pipes and fittings prior to installation.
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3.3 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer or sewer connection.
- .3 Trench alignment and depth require approval of Departmental Representative prior to placing bedding material and pipe.

3.4 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth of mm to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding 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 maximum density to ASTM D 698.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.

3.5 INSTALLATION

- .1 Lay and join pipes to: ASTM C 12.
 - .2 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
 - .3 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
 - .4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
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- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
 - .6 Joint deflection permitted within limits recommended by pipe manufacturer.
 - .7 Water to flow through pipe during construction, only as permitted by Departmental Representative.
 - .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
 - .9 Install plastic pipe and fittings in accordance with CSA B182.11.
 - .10 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's written recommendations as indicated.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
 - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
 - .11 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
 - .12 Plug lifting holes with pre-fabricated plugs approved by Departmental Representative, set in shrinkage compensating grout.
 - .13 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
 - .14 Make watertight connections to manholes.
 - .1 Use shrinkage compensating grout when suitable gaskets are not available.
 - .15 Use prefabricated saddles or field connections approved by Departmental Representative, for connecting pipes to existing sewer pipes.
 - .1 Joints to be structurally sound and watertight.
-

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.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 1 m of pipe.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density maximum density to ASTM D 698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% corrected maximum dry density maximum density to ASTM D 698.
- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

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 Under paving and walks, compact backfill to at least 95% corrected maximum dry density maximum density to ASTM D 698.
 - .1 In other areas, compact to at least 95% corrected maximum dry density maximum density to ASTM D 698.
- .4 Place unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.8 SERVICE CONNECTIONS

- .1 Install pipe to CSA B182.11 and manufacturer's instructions and specifications.
 - .2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless directed otherwise by Departmental Representative.
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- .3 Plug service lateral with water tight cap or plug as approved by Departmental Representative.
- .4 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

3.9 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 Test each section of sewer. A section is the length of pipe between successive manholes or termination points, including service connections to the street line or termination point.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Do infiltration and exfiltration test to ASTM C 828.
- .6 Do infiltration and exfiltration testing as specified herein and as directed by Departmental Representative.
 - .1 Perform tests in presence of Departmental Representative.
 - .2 Notify Departmental Representative 24 hours minimum in advance of proposed tests.
- .7 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .8 Exfiltration test:
 - .1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
 - .2 Immediately prior to test period add water to pipeline until there is head of 3 m over interior crown of pipe measured at highest point of test section or water in manhole is 3 m above static ground water level, whichever is greater.
 - .3 Duration of exfiltration test: 1 hour.
 - .4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.

- .9 Infiltration test:
 - .1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.
 - .2 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
 - .3 Install watertight plug at upstream end of pipeline test section.
 - .4 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time.
 - .5 Prevent damage to pipe and bedding material due to flotation and erosion.
 - .6 Place 90 degrees V-notch weir, or other measuring device approved by Departmental Representative in invert of sewer at each manhole.
 - .7 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.

 - .10 Allowable leakage: determined by the following formula:
 - .1 $L = F \times D \times S / 100$, where:
 - .1 L = allowable leakage in litres per hour
 - .2 D = Diameter in mm
 - .3 S = Length of section, in metres
 - .4 F = leakage factor, (litres per hour per mm of diameter per 100 metres of sewer):
 - .2 EXFILTRATION TEST:
 - .1 Porous Pipe F = 0.12 litre
 - .2 Non-Porous Pipe F = 0.02 litre
 - .3 INFILTRATION TEST:
 - .1 Porous Pipe F = 0.10 litre
 - .2 Non-Porous Pipe F = 0.02 litre

 - .11 Low Pressure Air Testing:
 - .1 Locate and repair defects if test fails. Retest. Have repair method reviewed by Departmental Representative prior to retesting.
 - .2 Repair visible leaks regardless of test results.
 - .3 CAUTION: FOR SAFETY OF PERSONNEL AND PUBLIC, OBSERVE PROPER PRECAUTIONS DURING AIR TESTING. USE TEST EQUIPMENT DESIGNED TO OPERATE ABOVE GROUND. DO NOT PERMIT PERSONNEL IN TRENCH DURING TESTING. DO NOT AIR TEST PIPE WITH DIAMETER GREATER THAN 600mm.
 - .4 Provide air testing equipment meeting the following requirements:
 - .1 Air Blower: 14 litres/sec, maximum pressure 70 kPa continuous.
 - .2 Pressure Relief Valve: Sized to relieve full blower capacity at maximum blower pressure. Range 20 - 70 kPa, adjustable.
 - .3 Pressure Gauges: Range 0 to 70 kPa with accuracy +/- 0.25 kPa.
 - .5 Provide plugs at each end of section, with one plug equipped for air inlet connection.
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- .6 Fill test section slowly until a constant pressure of 28 kPa is reached. If ground water is above section being tested, Departmental Representative may recommend increase in air pressure.
- .7 Allow minimum 2 minutes for air temperature to stabilize, adding only amount of air required to maintain pressure.
- .8 After 2 minute period, shut off air supply.
- .9 Decrease pressure to 24 kPa. Measure time required for pressure to reach 17kPa. Minimum time allowed for pressure drop is as follows:

| Pipe Diameter (mm) | Minimum Time Min:Sec |
|-----------------------|-------------------------|
| 100 | 1:53 |
| 150 | 2:50 |
| 200 | 3:47 |
| 250 | 4:43 |
| 300 | 5:40 |
| 375 | 7:05 |
| 450 | 8:30 |
| 525 | 9:55 |
| 600 | 11:20 |

- .12 Repair and retest sewer line as required, until test results are within limits specified.
- .13 Repair visible leaks regardless of test results.

3.10 DEFLECTION TESTING

- .1 Measure deflection by pulling a deflection gauge Testing 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 Within 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. If 7 1/2% deflection test fails, locate defect and repair. Retest using same methodology.
 - .4 Thirty days prior to completion of warranty period, pull a deflection gauge measuring 7 1/2% deflection through the installed section of pipeline. If 7 1/2% deflection test fails, locate defect and repair. Retest using same methodology.
 - .5 Provide deflection test report with CCTV inspection specified.
-

3.11 INSPECTION

- .1 Inspect installed sewers by television camera, photographic camera or by other visual method.
- .2 Provide television camera inspection.

3.12 CLOSED CIRCUIT TELEVISION INSPECTION

- .1 Conduct closed circuit television inspection procedures to meet National Association of Sewer Inspection Services Companies (NASSCO) Performance Specification Guidelines.
- .2 Equipment:
 - .1 Provide equipment meeting following requirements:
 - .1 Self-contained, self-leveling monitoring unit and pan-tilt 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.
- .3 Inspection:
 - .1 Perform inspection of pipe from manhole to manhole by passing TV camera through sewer in direction of flow.
 - .2 Classify results in accordance with National Association of Sewer Service Companies (NASSCO) Performance Specification Guidelines.
- .4 Records:
 - .1 Maintain inspection record in log form, during television inspection.
 - .2 Log to include location of each fault and service lateral distance measured from centreline of reference manhole and position referenced to axis of pipe.
 - .3 Photograph fault from the television screen. 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 Provide minimum of two (2) photographs for each sewer main section televised, detailing typical joint, and typical building service lateral.
 - .6 All photos and videos to be in colour.
 - .7 Identify deflection gauge size in report.

- .5 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 street name, section from manhole to manhole, page number or numbers where information for section is contained.
 - .2 Organize inspection records in sequence from upstream manhole to downstream manhole.
 - .3 Report on each sewer main section to contain:
 - .1 Heading:
 - .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 corresponding manhole numbers, magnetic north, horizontal distance, pipe and material between manholes, and direction of flow.
 - .3 Inspection findings for each sewer main section to include:
 - .1 Location of all faults.
 - .2 Photographs of all faults.
 - .3 Location of all service laterals.
 - .4 One photograph each of typical joint and typical when service laterals faults are not found.
 - .4 Place 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 Accuracy:
 - .1 Maximum permissible error in accuracy to be within following limits of fault location:
 - .1 Up to 375mm pipe: – 75mm per 100 m of length.
 - .2 450mm - 600mm pipe: – 150mm per 100 m of length.
 - .3 750mm - 900mm pipe: – 225mm per 100 m of length.
 - .7 Video Record:
 - .1 Supply a complete record of all inspections in digital format.
 - .2 Index all files, listing sections of inspections.
-

- .3 Submit thumb drive or CD/DVD with written reports to Department Representative.
- .8 Repeat Inspection:
 - .1 Prior to repairs, have methods reviewed by the Departmental Representative. Repair faults detected during television inspection. Repeat television inspection at no additional cost to the Contract.

3.13 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D 698-12e2, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12.400 ft-lbf/ft³ (600 KN-m/m³)).
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B1800-15, Thermo-Plastic Non-Pressure Pipe Compendium - B1800 Series.
 - .2 CSA B182.2-11, PVC Sewer Pipe and Fitting (PSM Type).
 - .3 CSA B182.11-06, Recommended Practice for the Installation of Thermoplastic Drain, Storm and Sewer Pipe and Fittings.
- .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .4 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)

1.3 SUBMITTALS

- .1 Submit Manufacturer's information data sheets and instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Certification to be marked on pipe.

1.5 SCHEDULING

- .1 Schedule Work to minimize interruptions to existing services and to maintain existing flow during construction.
 - .2 Submit schedule of expected interruptions to Departmental Representative for approval and adhere to approved schedule.
-

PART 2 - PRODUCTS

2.1 PLASTIC PIPE

- .1 Type PSM Poly Vinyl Chloride (PVC): to CSA-B 182.2, DR 28 for pipe sizes 150mm and smaller; DR 35 for pipe sizes greater than 150mm.
- .2 Locked-in gasket and integrated bell system.

2.2 CONCRETE PIPE

- .1 Reinforced bell and spigot, circular, concrete pipe and fittings: to CAN/CSA A257, 300mm diameter and larger, strength classification 65-D, designed for flexible rubber gasket joints to CSA A257.
- .2 Lifting holes:
 - .1 Pipe 900 mm and less diameter: no lift holes.
 - .2 Pipe greater than 900 mm diameter: lift holes not to exceed two in piece of pipe.
 - .3 Provide pre-fabricated plugs to effectively seal lift holes after installation of pipe.

2.3 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Type 1 Gravel, in accordance with Division 3, Section 2.4.0 of NSTIR's Standard Specification for Highway Construction and Maintenance.

2.4 BACKFILL MATERIAL

- .1 As indicated, Selected Backfill Material in accordance to Section 31 23 33.01 - Excavating Trenching and Backfilling.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.
-

3.2 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Do not allow contents of sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe. Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95 % maximum dry density to ASTM D698.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

3.4 PIPE INSTALLATION

- .1 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.
 - .2 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon ends.
 - .3 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points in accordance with manufacturer's recommendations.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
 - .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
-

- .6 Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.
- .10 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .11 Make watertight connections to manholes and catch basins.
- .12 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.
 - .1 Joint to be structurally sound and watertight.
- .13 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

3.5 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.
 - .1 Leave joints and fittings exposed until field testing is completed.
 - .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .4 Place layers uniformly and simultaneously on each side of pipe.
 - .5 Compact each layer from pipe invert to mid height of pipe to at least 95 % of maximum dry density to ASTM D698.
 - .6 Compact each layer from mid height of pipe to underside of backfill to at least 95 % of maximum dry density - to ASTM D698.
-

- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.7 BACKFILL

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround, in uniform layers not exceeding 300 mm compacted thickness up to grades as indicated.
- .3 Compact backfill to 95 % of maximum dry density to ASTM D698. Within 300 mm of sub-base and base gravels of sidewalks and pavement areas, compact each layer to at least 98% maximum dry density to ASTM D 698.

3.8 FIELD TESTING

- .1 Notify Departmental Representative at least 24 hours in advance of all proposed tests. Perform tests in presence of Departmental Representative.
- .2 Flush sewers and related appurtenances to remove foreign materials.
- .3 Provide labour, equipment and materials required to perform testing.

3.9 DEFLECTION TESTING

- .1 Measure deflection by pulling a deflection gauge Testing 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 Within 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. If 7 1/2% deflection test fails, locate defect and repair. Retest using same methodology.
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 - .5 Provide deflection test report with CCTV inspection specified.
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- .1 Inspect installed sewers by television camera, photographic camera or by other visual method.
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 - .2 Equipment:
 - .1 Provide equipment meeting following requirements:
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 - .3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
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 - .3 Photograph fault from the television screen. All photographs to be clear and precise with distinct definition of fault.
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 - .1 Street name.
 - .2 Manhole numbers applicable to section.
 - .3 Reference drawing number, if applicable.
 - .4 Weather on the day of inspection.
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 - .2 Photographs of all faults.
 - .3 Location of all service laterals.
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 - .4 Place 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.
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- .7 Video Record:
 - .1 Supply a complete record of all inspections in digital format.
 - .2 Index all files, listing sections of inspections.
 - .3 Submit thumb drive or CD/DVD with written reports to Engineer.
- .8 Repeat Inspection:
 - .1 Prior to repairs, have methods reviewed by the Engineer. Repair faults detected during television inspection. Repeat television inspection at no additional cost to the Contract.

END

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.
 - .2 Manufacturer's Instructions: for installation and special handling criteria, installation sequence and cleaning procedures.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
 - .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
 - .3 Packaging Waste Management: remove for reuse and return packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
-

PART 2 - PRODUCTS

2.1 RIGID PVC CONDUITS

- .1 Rigid PVC conduits to CSA C22.2 No. 211.2.
- .2 Rigid PVC couplings, reducers, plugs, caps, adaptors, and supports to make a complete installation.
- .3 Expansion joints as recommended by manufacturer and as required.

2.2 CABLE PULLING EQUIPMENT

- .1 6 mm stranded nylon pull rope tensile strength 5 kN.

2.4 WARNING TAPE

- .1 Standard 4-mil polyethylene 76 mm wide tape, yellow with black letters, imprinted with "CAUTION BURIED ELECTRIC CABLE BELOW".

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install duct pipe in accordance with manufacturer's instructions and at elevations as indicated.
 - .2 Clean inside of ducts before laying.
 - .3 Install plastic duct spacers and ensure full, even support every 1.5 m and smooth transition throughout duct length.
 - .4 Slope ducts with 1 to 400 minimum slope.
 - .5 Install plugs and cap both ends of ducts to prevent entrance of foreign materials during and after construction.
-

- .6 Pull through each duct steel wooden 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 material.
 - .1 Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 Install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Place continuous strip of warning tape 1/2 way between installation and grade level before backfilling trenches.
- .9 Install markers as required.
- .10 Notify the Departmental Representative for field review upon completion of direct buried ducts and obtain acceptance prior to backfill.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

END
