

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing precast concrete manholes, catch basins and headwalls. Work includes supply and installation of concrete bases, precast sections, metal castings and testing.

1.2 REFERENCES

- .1 ASTM A48/A48M-03 (R2008), Specification for Gray Iron Castings.
- .2 ASTM C478M-08, Specification for Precast Reinforced Concrete Manhole Sections.
- .3 ASTM C 76 Reinforced concrete, cement, aggregate, mixture, and concrete test.
- .4 ASTM D698-07a¹, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .5 CAN/CSA-A23.1-04/A23.2-04(R2009), Concrete Materials and Methods for Concrete Construction.
- .6 CSA A179-04(R2009), Mortar and Grout for Unit Masonry.
- .7 CAN/CSA A3000-08, Cementitious Materials Compendium.

1.3 MATERIAL CERTIFICATION

- .1 At least four (4) weeks prior to commencing work, submit manufacturer's test data and certification that materials meet requirements of this section. Include manufacturer's drawings, information and shop drawings where pertinent in accordance with Section 01 33 00 - Submittal Procedures.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings for all manholes, catch basins and for the headwall in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit manufacturer's test data and certification that materials meet requirements of this section. Include manufacturer's drawings, information, size of components, dimensions and details where pertinent.

1.5 HANDLING AND STORAGE

- .1 Handle and store pipe and fittings in such manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore.

- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Precast manhole and catch basin sections: to ASTM C478M, circular. Top sections flat slab top type with opening offset for vertical ladder installation. Precast concrete bases to be approved by Departmental Representative.
- .2 Precast concrete headwall machine-made units meeting requirements of ASTM C 76 regarding reinforced concrete, cement, aggregate, mixture, and concrete test. Minimum 28-day compressive strength shall be 30 MPa. Mark date of manufacture and name or trademark of manufacturer clearly on the inside of inlet, headwall or wingwall.
- .3 Joints:
 - .1 To be made watertight using rubber O-ring in wall or bituminous gaskets.
 - .2 Interlocking synthetic rubber links shaped to continuously fill the outer space between pipe and wall opening.
- .4 Mortar:
 - .1 Aggregate: to CSA A179.
 - .2 Cement: to CAN/CSA-A3000.
- .5 Adjusting rings: precast concrete to ASTM C478M.
- .6 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray iron castings: to ASTM A48.
 - .3 Bearing surfaces to be ground to eliminate surface imperfections.
 - .4 Manhole frames and covers: heavy duty municipal type for road service and as indicated on the Drawings. Cover cast without perforations and complete with two (2) 25mm square lifting holes for sanitary sewer applications.
 - .5 Catch basin frames and covers: minimum 400 lb. per set.
- .7 Granular bedding material: as specified in Section 31 23 10.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

.1 Excavate and backfill in accordance with Section 31 23 10.

.2 Obtain approval of Departmental Representative before installing, manholes, catch basins, or headwalls.

3.2 INSTALLATION

.1 Carefully inspect products for defects and remove defective products from site.

.2 Construct units in accordance with details indicated, plumb and true to alignment and grade.

.3 Complete units as pipe laying progresses.

.4 Dewater excavation as directed by Departmental Representative and remove soft and foreign material before placing concrete base.

.5 Set precast concrete base on 150mmm minimum of granular bedding compacted to 98% maximum dry density to ASTM D698.

.6 Set first ring section on precast base and make joint watertight with O-ring gaskets. Grout joints inside and out with non-shrink grout.

.7 Install gaskets as per manufacturer's instructions.

.8 Plug lifting holes with non-shrink grout.

.9 Place stub outlets at elevations and in position indicated. Provide type of gasket connection as indicated.

.10 Install benching where shown on the Drawings using concrete suitable for exposure classification C-2 as specified in CSA-A23.1.

.11 Place frame and cover or grating on top section to elevation as indicated. If adjustment required, use concrete ring. Secure frame in place with cement grout.

.12 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.

3.3 TESTING

.1 Test sanitary sewer manholes and structures by performing either water testing or vacuum testing.

.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 Water testing: perform test as follows:
 - .1 Plug all inlet and outlet pipes with watertight plugs.
 - .2 Fill with water to top of precast sections.
 - .3 Allow time for initial absorption.
 - .4 Measure and record volume of water required to maintain level for one hour.
 - .5 Leakage not to exceed 0.3% per hour per volume unit.
 - .6 Locate and repair defects if test fails. Retest.
 - .7 Repair visible leaks regardless of test results.
- .6 Vacuum testing: perform test as follows:
 - .1 Plug all inlet and outlet pipes. Restrain plugs.
 - .2 Place and seal vacuum tester head on the manhole frame.
 - .3 Draw vacuum of 10 inches 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 1.0m, 1.25m, 1.5m and 1.8m, respectively.
 - .5 For manholes deeper than 6.1m, increase test times by two (2) seconds per 300mm of additional manhole depth.
 - .6 Locate and repair defects if test fails. Retest.
 - .7 Repair visible leaks regardless of test results.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This Section specifies requirements for construction of domestic and sprinkler watermain connections. Work includes supply, installation and testing of pipe, valves, fittings and related appurtenances.

1.2 REFERENCES

- .1 ANSI/AWWA B300-10 Hypochlorites
- .2 ANSI/AWWA C104/A21.3-08, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water.
- .3 ANSI/AWWA C110/A21.10-12, Ductile- Iron and Gray-Iron Fittings for Water American Water Works Association.
- .4 ANSI/AWWA C153-11, American National Standard for Ductile-Iron Compact Fittings for Water Service.
- .5 ANSI/AWWA C500-09, Standard for Metal-Seated Gate Valves for Water Supply Service.
- .6 ANSI/AWWA C900-07, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. to 12 In. (100mm - 300mm) for Water Transmission and Distribution.
- .7 ANSI/AWWA C905-2010, Polyvinyl- Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 48 In.
- .8 ASME B16.1-2010 Cast Iron Pipe Flanges and Flanged Fittings
- .9 ASTM B62-09, Standard Specification for Compositon Bronze or Ounce Metal Castings.
- .10 ASTM F876-10e1, Standard Specification for Polethylene Crosslinked (PEX) Tubing.
- .11 ASTM F1282-10, Standard Specification for Polyethylene/Aluminum/Polethylene (PE-AL-PE) Composite Pressure Pipe.
- .12 AWWA C651-05 Disinfecting Water Mains
- .13 AWWA B301-10, Liquid Chlorine.
- .14 CAN/CSA B137 Series-09, Thermoplastic Pressure Piping Compendium.
- .15 Health Canada:
 - .1 Guidelines for Canadian Drinking Water Quality.

1.3 SHOP DRAWINGS

- .1 Provide shop drawings in accordance with Section 01 33 00 for all pipe, fittings, valves, thrust restraint and all other items necessary for a complete installation. Include details showing dimensions and tolerances of pipe and joint proposed.

1.4 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section and the latest Guidelines for Canadian Drinking Water Quality as published by Health Canada.

1.5 HANDLING AND STORAGE

- .1 Handle and store pipe, valves and fittings, in such manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore. Do not damage coatings or linings.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.
- .3 Store valves to prevent retention of water and damage by freezing.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Watermain to be PVC DR-18, diameter as shown on the drawings. Class 150 for pipes, 150mm to 300mm and Class 235 for pipes 350mm to 900mm.
- .2 Water service lateral shall be "Q-Line" tubing or MUNICIPEX tubing.

2.2 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

- .1 Pipe and Joints: to CAN/CSA B137.3-M, AWWA C900 or AWWA C905 cast-iron outside diameter, gasketed bell-end joint.
- .2 Fittings:
 - .1 Gray or ductile iron: to AWWA C110 and C153 cement mortar lined, minimum pressure rating 1035 kPa for cast, 1720 kPa for ductile iron.
- .3 Lateral: to meet CSA B137.5 and ASTM F1282 or ASTM F876.

2.3 GATE VALVE

- .1 Standard buried type: to AWWA C500 or AWWA C590 up to and including 300mm, minimum working pressure rating 1380 kPa and as follows:
 - .1 Body: cast-iron with mechanical joint ends.

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- .2 Mechanism: bronze mounted, solid or resilient wedge, epoxy coated, stainless steel bonnet, stainless steel packing gland nuts and bolts, non-rising spindle, and O-ring seals.
- .3 Direction to close: clockwise.
- .4 Operating nut: 50mm square.

- .2 Epoxy coat all gate valves with minimum 150 microns coating.

2.4 VALVE BOXES

- .1 Valve Boxes: to AWWA C500 and as follows:
 - .1 Cast-iron, slide type, adjustable for depth of pipe below finished grade.
 - .2 Covers marked "Water", "Sprinkler" or "Service" as applicable.
 - .3 Lugged to prevent turning and rolling of cover, and cover notched to suit.
 - .4 Have clear opening of 135mm.
 - .5 Bonnet on the bottom section which is capable of enclosing the packing gland section of the gate valve.

2.5 SERVICE SADDLE

- .1 Service saddles for PVC pipe shall be cast iron or cast-bronze body with stainless steel straps and components. Service saddles must be used for service connections on PVC pipe. Saddles will require two wide straps.

2.6 COUPLINGS (SOLID SLEEVE TO AWWA C110)

- .1 Mechanical joint sleeve type: to AWWA C110 for use on new PVC pipe. Provide spacer ring between pipe ends. Where gap between pipe ends is less than 3/8".

2.7 INSULATION

- .1 Rigid insulation as specified in Section 31 23 10.

2.8 THRUST RESTRAINT

- .1 Thrust block and anchors: Use 25 MPa concrete and 15 M, Grade 400 reinforcing steel where indicated.
- .2 Mechanical joint restraint device: 100mm to 600mm, ductile follower gland to AWWA C111 and C153 with multiple wedge restraining mechanism, minimum working pressure rating 350 psi and minimum safety factor of 2:1. Lugs to have twist off torque nuts.

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2.9 DISINFECTANT

- .1 Sodium hypochlorite or calcium hypochlorite: to AWWA B300.
- .2 Liquid Chlorine: to AWWA B301.

2.10 REDUCING AGENT

- .1 Hydrogen Peroxide, 35% by mass commercial grade.

2.11 BOLTS FOR BURIED SERVICE

- .1 T-head bolts and nuts: Low alloy Corten steel.

2.12 HYDRANT

- .1 Fire Protection Hydrant: to ANSI/AWWA C502, compression type, suitable for depths of bury and locations indicated with traffic safety breakaway flanges, two (2) 63.5mm hose nozzles and one (1) 150mm standard pumper nozzle.
 - .1 Hydrants will open counter-clockwise. Drain holes will be internally plugged.
- .2 Domestic Flush Hydrants: to ANSI/AWWA C502, compression type, suitable for depths of bury and locations indicated with traffic safety breakaway flanges, two (2) 63.5mm hose nozzles only.
 - .1 Hydrants will open counter-clockwise. Drain holes will be internally plugged.
- .3 Hydrants will be painted to match existing site hydrant, Department Representative to provide exact colour:
 - .1 Fire Protection Hydrants will be red.
 - .2 Domestic Flush Hydrants will be light blue.

2.13 ANODE PACKS

- .1 Zinc anodes (ZN24-48), as directed.

2.14 HOSE BIB

- .1 Hose bib shall be cast brass with backflow protection (anti-siphon), 19mm male thread nozzle, full circle handwheel, 125psi pressure rating, freezeless, and CSA approved.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Clean pipes, fittings, valves and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.
- .2 Provide proper implements, tools and facilities approved by the Departmental Representative for the safe and convenient execution

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

3.2 TRENCHING, BEDDING AND BACKFILLING

- .1 Do trenching, bedding and backfilling to Section 31 23 10 and as specified on the drawings.
- .2 Bedding in accordance with Section 31 23 10, item 2.1.6.

3.3 BURIED PIPE INSTALLATION

- .1 Lay and join pipe, fittings, and valves as specified herein and according to manufacturer's published instructions
- .2 Do not lay pipe and fitting when trench bottom is frozen, underwater or when trench conditions or weather are unsuitable.
- .3 Lay pipe and fittings on prepared bed, true to line and grade indicated, within following tolerances:
 - .1 Horizontal Alignment: 150mm.
 - .2 Vertical Alignment: 75mm.
- .4 Face bell ends in direction of laying. On grade of 5% or greater, lay pipe upgrade. For grades exceeding 16%, install appropriately designed gradient thrust restraints.
- .5 Do not exceed maximum joint deflection recommended by manufacturer.
- .6 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
- .7 Do not use excessive force to joint pipe sections.
- .8 Install gaskets in accordance with manufacturer published instructions. Use only lubricant approved for potable water as supplied by manufacturer. During cold weather, store gaskets in heated area to assure that gaskets remain flexible.
- .9 Align pipes carefully before joining.
- .10 Support pipes as required to assure concentricity until joint is properly completed.
- .11 Keep pipe joints free of mud, silt, gravel or other foreign materials.
- .12 Avoid displacing gasket or contaminating with dirt, petroleum products or other foreign material. Remove, clean, re-install and lubricate gaskets so disturbed.
- .13 Complete each joint before laying next length of pipe.

- .14 Where deflection at joints is permitted, deflect only after spigot is fully inserted in bell.
- .15 At structures, provide a flexible joint not more than 300mm from outside face of structure.
- .16 Cut pipe as required for fittings or closure pieces, square to centreline, and as recommended by manufacturer. Do not damage pipe lining or coating and leave smooth bevelled edge.
- .17 For corrosion protection, install polyethylene tube or sheet on all ductile- iron fittings, as per manufacturer's instructions and to AWWA C105. Install zinc anodes.
 - .1 All services, curb stops, and main stops= 11kg.
 - .2 All fire hydrants= 11kg.
 - .3 All valves>200mm= 11kg.
 - .4 All else= 5.5kg.
- .18 Give sufficient notice so that appropriate installation inspection and approval of watermain pipe tapping can be undertaken by the authorities having jurisdiction.

3.4 THRUST RESTRAINTS

- .1 Where concrete thrust blocks are required provide formed thrust blocks to undisturbed ground on all tees, bends, plugs and caps. Keep joints and couplings free of concrete and construct, so as to avoid conflict with manholes in dual pipe trenches.
- .2 Backfill over thrust blocks when concrete has sufficient strength and can withstand earth pressure.
- .3 Provide mechanical joint restraint devices on all sections of fire protection mains.
- .4 Reaction backing for plugs and caps shall be a concrete thrust block, such that the plug or cap will be securely held in place by the blocking alone, and such that the blocking will not interfere with the connecting of a new pipe at a future time.
- .5 Place polyethylene on bends before pouring concrete thrust blocks.

3.5 HYDRANT INSTALLATION

- .1 Install hydrants at locations indicated or where directed.
- .2 Set hydrant plumb, with hose outlets parallel to roadway, pumper connection facing roadway and breakaway flange as indicated.
- .3 Install hydrant units as per manufacturer's instructions and as indicated on the Drawings.

- .4 Install 11kg zinc anode on all hydrants.

3.6 VALVES, VALVE BOXES, POST INDICATOR VALVES (PIVs)

- .1 Install valves at locations indicated. Joints and bedding as specified for pipe and fittings.
- .2 On direct buried valves, install valve boxes and PIVs plumb and centred over operating nut, and true to line and grade.
- .3 Install 11kg zinc anodes on all valves.
- .4 Place select backfill material, material, maximum size 50mm around valve box to subgrade.
- .5 Set PIV target plates in accordance with manufacturer's published instructions.

3.7 DOMESTIC SERVICE LATERALS

- .1 Lay service pipe in a smooth trench bottom with gravel bedding 250mm below the pipe and a minimum 18 inches over the pipe.
- .2 Backfill with well graded select backfill.
- .3 Install new 11kg zinc anode on copper services.
- .4 Hose bib to be installed as indicated on the drawings.
- .5 Tapping into a water main shall be done with the use of proper tools and equipment and in accordance with pipe and service saddle manufacturer's specifications. The water main shall be tapped at 67.5° from top of center line of the pipe.

3.8 HYDROSTATIC TESTING

- .1 Provide labour, equipment and materials required to perform hydrostatic test.
- .2 The operation of any valve shall be done by Park Staff. Notify the Departmental Representative 24 hours prior to all filling, flushing or chlorination operations for new construction.
- .3 All services, mains and other appurtenances shall be included in the system test.
- .4 Testing shall not be carried out until, the access road base course (first lift of gravel) has been placed and compacted.
- .5 Perform tests in presence of a professional engineer or their representative

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- .6 All valves must be pressure tested, including hydrant valves.
- .7 Open all valves in test section.
- .8 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air-vacuum release valves are installed.
- .9 The test shall be conducted at a minimum pressure of the greater of 1035 kPa or one and one-half (1.5) times the operating pressure at the lowest point of the system being tested. In any case, the test pressure shall not exceed 1035 kPa.
- .10 The test shall be conducted over a full two (2) hour period, maintaining a constant test pressure. Allowable leakage shall not exceed the amount given by the formula:

$$Q = \frac{(LD \text{ sq.root } P)}{795000}$$

Where,

Q= allowable leakage in L/hr,

L= length of pipe tested in m,

D= diameter of pipe tested in mm,

P= test pressure in kPa.

- .11 Locate and repair defects if test fails. Retest until results show remedial measures have been successful.
- .12 All water used for pipe testing including pressure testing, chlorination, flushing and dechlorination shall be the responsibility of the contractor, and shall be potable water.

3.9 FLUSHING AND DISINFECTION

- .1 Flushing and disinfection of any water system can proceed only after system has been successfully pressure tested.
- .2 Flush and disinfect water mains to AWWA C651 and as herein specified. Notify the Departmental Representative 24 hours prior to flushing and disinfection.
- .3 Flush water mains with potable water through available outlets until foreign materials have been removed and water is clear. The size and number of taps should conform to Table 3 of AWWA C651.

Pipe Diameter inches	Flow Required gpm	L/S	Size of Tap (inches)			Number of Hydrants
			1	1 1/2	2	
Number of Taps on Pipe						
4	100	6.3	1	-	-	1
6	200	12.6	-	1	-	1
8	400	25.2	-	2	1	1
10	600	37.9	-	3	2	1
12	900	56.8	-	-	3	2

- .4 Slowly open and close valves and hydrants to ensure thorough flushing.
- .5 If satisfactory results cannot be achieved by flushing, swab pipe by approved methods and re-flush.
- .6 After testing and submission of the written results for the passing of the bacteriological tests, remove corporation stops and install plugs. Check visually for leakage after plugs are installed with water main under normal operating pressure.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing gravity sanitary sewers. Work includes supply, installation, low pressure testing of pipe, fittings and service connections.

1.2 REFERENCE STANDARDS

- .1 CAN/CSA A257 Series-09, Concrete Pipe and Manhole Sections.
- .2 CAN/CSA B1800-11, Thermoplastic Nonpressure Piping Compendium.
- .3 ASTM D4254-00(2006), Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings for all pipe, fittings, valves, and all other items necessary for a complete installation. Include details showing dimensions and tolerance of pipe and joint proposed.

1.4 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Ensure certification is marked on pipe.

1.5 HANDLING AND STORAGE

- .1 Handle and store pipe and fittings in such manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.

1.6 SCHEDULING OF WORK

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

- .3 Notify Departmental Representative 24 hours minimum in advance of any interruption in service.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Sanitary pipe is to be PVC DR-35, size as indicated on Drawings.

2.2 PLASTIC PIPE AND FITTINGS

- .1 Type PSM Polyvinyl Chloride to CSA B1800.
- .2 Joints: bell and spigot with rubber gasket recommended by pipe manufacturer.
- .3 Bend: PVC DR35, same manufacturer as the pipe.

2.3 SERVICE SADDLES

- .1 PVC main: PVC strap-on saddle, in- line tee or wye, with gasket, all stainless steel strap and O-ring in branch end.

2.4 PIPE BEDDING MATERIAL

- .1 As specified in Section 31 23 10, item 2.1.6.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Clean pipes and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.
- .2 Obtain Departmental Representative's approval of pipes and fittings prior to installation.
- .3 Provide proper implements, tools and facilities approved by the Departmental Representative, for the safe and convenient execution of the work.
- .4 Take every precaution to prevent foreign material from entering the pipe.

3.2 TRENCHING, BEDDING AND BACKFILLING

- .1 Do trenching, bedding and backfilling to Section 31 23 10 and as specified on the Drawings.

3.3 PIPE INSTALLATION

- .1 Lay and join pipe and fittings as specified herein and according to manufacturer's published instructions.
- .2 Carefully lower pipe into the trench. Do not drop or dump materials into trench.
- .3 Lay pipe and fittings on prepared bed, true to line and grade indicated, within following tolerances:
 - .1 Horizontal Alignment: 50mm.
 - .2 Vertical Alignment: the lesser of 12mm or one half the rise per pipe length.
- .4 Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.
- .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.
- .6 Do not lay pipe when the trench bottom is frozen or underwater or when trench conditions or weather are unsuitable.

3.4 PIPE JOINTING

- .1 Install gaskets in accordance with manufacturer's published instructions. During cold weather store gaskets in heated area to assure flexibility.
- .2 Align pipe carefully before joining. Do not use excessive force to join pipe sections.
- .3 Support pipes as required to assure concentricity until joint is properly completed.
- .4 Keep pipe joints free from mud, silt, gravel or other foreign material.
- .5 Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
- .6 Complete each joint before laying next length of pipe.
- .7 Where deflection at joints is permitted, deflect only after joint is completed. Do not exceed maximum joint deflection recommended by manufacturer.
- .8 Cut pipe as required for fittings or closure pieces, square to centerline, and as recommended by manufacturer.

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- .9 Make watertight connections to manholes. Use non-shrink grout when suitable gaskets are not available.
- .10 At structures provide flexible joint not more than 300mm from outside face of structure, or otherwise indicated.

3.5 PIPE CLEANING

- .1 Prior to testing, clean gravity sewer to remove foreign materials.

3.6 TESTING

- .1 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.
- .2 Provide labour, equipment and materials required to perform testing.
- .3 Notify Departmental Representative at least 24 hours in advance of all proposed tests. Perform tests in presence of Departmental Representative.
- .4 Flush sewers and related appurtenances to remove foreign materials.
- .5 Before testing, ensure that all relevant open ends are blanked off with watertight plugs or caps.
- .6 Low Pressure Air Testing

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 (24 INCHES).

- .1 Provide air testing equipment meeting the following requirements:
 - .1 Air Blower: 0.5 cfs, maximum pressure 10 psi continuous.
 - .2 Pressure Relief Valve: Sized to relieve full blower capacity at maximum blower pressure. Range 3-10 psi, adjustable.
 - .3 Pressure Gauges: Range 0 to 10 psi with accuracy +/- 0.04 psi.
- .2 Provide plugs at each end of section, with one plug equipped for air inlet connection.
- .3 Fill test section slowly until a constant pressure of 4 psi is reached. If ground water is above section being tested, Departmental Representative may recommend increase in air pressure.
- .4 Allow minimum 2 minutes for air temperature to stabilize, adding only amount of air required to maintain pressure.
- .5 After 2-minute period, shut off air supply.

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- .6 Decrease pressure to 3.5 psi. Measure time required for pressure to reach 2.5 psi. Minimum time allowed for pressure drop is as follows:

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

- .7 Locate and repair defects if test fails. Retest.
.8 Repair visible leaks regardless of test results.

3.7 CLOSED CIRCUIT TELEVISION INSPECTION

- .1 Provide inspection of installed sanitary sewer by television camera; once at 30 days after substantial performance and again one (1) year after substantial performance.
- .2 Equipment:
- .1 Provide equipment meeting following requirements:
- .1 Self-contained monitoring unit and camera with remotely controlled lighting system capable of varying the illumination.
- .2 Picture quality shall produce continuous 600-line resolution picture, showing entire periphery of pipe.
- .3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
- .3 Definition of fault:
- .1 Any sewer pipe joint which displays a gap or spread, offset, gasket, or signs of infiltration.
- .2 Any service lateral which displays water infiltrating around service connection, or a steady flow through service lateral.
- .3 Any service lateral exhibiting pronounced protrusion into the sewer main.
- .4 Any section of sewer which is crushed, broken or displays cracks.
- .5 Any variance in grade of sewer main section.
- .6 Any gravel, roots, or foreign material which may impede flow.
- .7 Any deformation in shape of pipe.
- .8 Any ponding of water in pipe.
- .4 Inspection:
- .1 Perform inspection of pipe from manhole to manhole by passing TV camera through sewer in direction of flow.
- .5 Records:

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- .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 using a 35 mm camera. 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 photographs for each sewer main section televised, detailing typical joint, and typical building service lateral.
 - .6 All photos and videos to be in colour.
- .6 Reports:
- .1 Provide a composite report of CCTV 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 Mount photographs on left- hand page and place corresponding description on right-hand page. Number all photographs in order. Number beside each photograph to correspond with description number.
 - .5 Enclose all pages of report in transparent sheet protector.
- .7 Accuracy:

- .1 Maximum permissible error in accuracy to be within following limits of fault location:
 - .1 Up to 375mm pipe: ± 75 mm per 100m of length.
 - .2 450mm - 600mm pipe: ± 150 mm per 100m of length.
 - .3 750mm - 900mm pipe: ± 225 mm per 100m of length.
- .8 Records:
 - .1 Supply a complete record of all inspections on DVD.
 - .2 Index all DVDs, listing sections of inspections.
- .9 Repeat Inspection: Repair faults detected during television inspection. Repeat television inspection for those sections repaired.

3.8 CLEAN-UP

- .1 Upon completion of testing of each section remove all ancillary equipment and plug holes. Do not backfill around test plugs until inspected by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 WORK INCLUDED

- .1 This section specifies requirements for constructing gravity storm sewers and concrete culverts. Work includes supply, installation, low pressure testing of pipe, fittings and service connections.

1.2 REFERENCE STANDARDS

- .1 CAN/CSA A257 Series-09, Concrete Pipe and Manhole Sections.
- .2 CAN/CSA B1800-11, Thermoplastic Nonpressure Piping Compendium.
- .3 ASTM C76M-11, Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
- .4 ASTM D1056-07, Flexible Cellular Materials - Sponge or Expanded Rubber.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings for all pipe, fittings, valves, and all other items necessary for a complete installation. Include details showing dimensions and tolerance of pipe and joint proposed.

1.4 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Ensure certification is marked on pipe.

1.5 HANDLING AND STORAGE

- .1 Handle and store pipe and fittings in such manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.

1.6 PART 2 - PRODUCTS

2.1 Culverts

- .1 Reinforced concrete to CSA A257, minimum strength classification 100D,

diameter as indicated on the Drawings.

2.2 PIPE BEDDING MATERIAL

- .1 As specified in Section 31 23 10, item 2.1.6.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Clean pipes and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.
- .2 Obtain Departmental Representative's approval of culverts prior to installation.
- .3 Provide proper implements, tools and facilities approved by the Departmental Representative, for the safe and convenient execution of the work.
- .4 Take every precaution to prevent foreign material from entering the pipe.

3.2 TRENCHING, BEDDING AND BACKFILLING

- .1 Do trenching, bedding and backfilling to Section 31 23 10 and as specified on the Drawings.

3.3 CULVERT INSTALLATION

- .1 Lay and join pipe and fittings as specified herein and according to manufacturer's published instructions.
- .2 Carefully lower pipe into the trench. Do not drop or dump materials into trench.
- .3 Lay pipe and fittings on prepared bed, true to line and grade indicated, within following tolerances:
.1 Horizontal Alignment: 50mm.
.2 Vertical Alignment: the lesser of 12mm or one half the rise per pipe length.
- .4 Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.
- .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipe laying is not in progress.

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- .6 Do not lay pipe when the trench bottom is frozen or underwater or when trench conditions or weather are unsuitable.

3.4 CULVERT JOINTING

- .1 Install gaskets in accordance with manufacturer's published instructions. During cold weather store gaskets in heated area to assure flexibility.
- .2 Align pipe carefully before joining. Do not use excessive force to join pipe sections.
- .3 Support pipes as required to assure concentricity until joint is properly completed.
- .4 Keep pipe joints free from mud, silt, gravel or other foreign material.
- .5 Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
- .6 Complete each joint before laying next length of pipe.
- .7 Where deflection at joints is permitted, deflect only after joint is completed. Do not exceed maximum joint deflection recommended by manufacturer.
- .8 Cut pipe as required for fittings or closure pieces, square to centerline, and as recommended by manufacturer.
- .9 Make watertight connections to manholes. Use non-shrink grout when suitable gaskets are not available.
- .10 At structures provide flexible joint not more than 300mm from outside face of structure, or otherwise indicated.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 26 05 00 - Electrical General Requirements.
- .4 Section 31 23 10 - Excavating, Trenching and Backfilling.
- .5 Section 33 65 73 - Concrete Encased Duct Banks and Manholes.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No. 211.1, Rigid Types EBI and DB2/ES2 PVC Conduit.
 - .2 CSA C22.2 No. 211.3, Reinforced Thermosetting Resin Conduit RTRC and Fittings (Bi-national standard, with UL 1684).

1.3 SUBMITTALS

- .1 Submit WHMIS MSDS - Material Safety Data Sheets acceptable to Labour Canada, and Health and Welfare Canada for solvent cement. Indicate VOC content.
- .2 Submit manufacturer's data and certification at least 2 weeks prior to commencing work.
- .3 Submit manufacturer's information data sheets and instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and Handle materials in accordance with Section 01 61 00 - Common Product Requirements.

1.5 RECORD DRAWINGS

- .1 Provide record drawings, including details of pipe and cable duct materials, maintenance and operating instructions.

PART 2 - PRODUCTS

1.6 PVC DUCTS AND FITTINGS

- .1 Rigid PVC duct: to CSA C22.2 No. 211.1, type rigid PVC for direct burial with minimum wall thickness at any point of 2.8 mm. Nominal length: 3.0 m plus or minus 12 mm. Type DB2 (thinwall) PVC conduits unacceptable.
- .2 Rigid PVC split ducts as required.
- .3 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make complete installation.
- .4 Rigid PVC 90° and 45° bends as required.
- .5 Rigid PVC 5° angle couplings as required.
- .6 Expansion joints as required.
- .7 Preformed, interlocking intermediate duct spacers for duct size as indicated.
- .8 Use epoxy coated galvanized steel conduit for sections extending above finished grade.

1.7 SOLVENT WELD COMPOUND

- .1 Solvent cement for PVC duct joints.

1.8 FRE CONDUITS AND FITTINGS

- .1 FRE conduits to CSA C22.2 No. 211.3.
- .2 Conduits to be composed of glass filaments encapsulated in an epoxy matrix. Each conduit to have an integral expanded coupling with urethane gasket for sealing. No threads or adhesives to be used for assembling joints.
- .3 Conduit to be suitable for continuous operation from -40° C to +100° C without change in mechanical properties.
- .4 FRE 90° Bends, 5° Bends, couplings, adaptors caps, etc to make complete installation as indicated on drawings.

1.9 CABLE PULLING EQUIPMENT

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

1.10 MARKERS

- .1 Concrete type cable markers: as indicated, with words: "Cable", "Joint" or "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.
- .2 150 mm wide, 4 mil, polyethylene marker tape in all trenches. Use red colored tape. Install at depth as per drawings.

EXECUTION

1.11 INSTALLATION

- .1 Install duct in accordance with manufacturer's instructions.
- .2 Clean inside of ducts before laying.
- .3 Ensure full, even support every 1.5 m throughout duct length.
- .4 Slope ducts with 1 to 400 minimum slope.
- .5 During construction, cap ends of ducts to prevent entrance of foreign materials.
- .6 Pull through each duct 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 matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Install markers as required.

END OF SECTION