

PART 1 - GENERAL

- | | | |
|--------------------------------|-----|--|
| <u>1.1 WORK INCLUDED</u> | .1 | This section specifies requirements for construction water mains, and service connections. Work includes supply, installation and testing of pipe, fittings and related appurtenances. |
| | | |
| <u>1.2 RELATED SECTIONS</u> | .1 | Concrete: Section 03 33 00 |
| | .2 | Excavating, Trenching and Backfilling: Section 31 23 10 |
| | .3 | Reinstatement: Section 32 98 00 |
| | | |
| <u>1.3 REFERENCE STANDARDS</u> | .1 | ANSI/ASME B18.2.1-2012, Square and Hex Bolts and Screws. |
| | .2 | ANSI/AWWA B300-2010, Hypochlorites. |
| | .3 | AWWA B301-04, Liquid Chlorine. |
| | .4 | ANSI/AWWA C104/A21.3-2008, Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water. |
| | .5 | ANSI/AWWA C110/A21.10-2012, Ductile Iron and Gray-Iron Fittings for Water. |
| | .6 | ANSI/AWWA C111/A21.11-2012, Rubber-Gasket Joints for Ductile Iron Pressure Pipe and Fittings. |
| | .7 | ANSI/AWWA C151/A21.51-2009, Ductile Iron Pipe, Centrifugally Cast, for Water. |
| | .8 | ANSI/AWWA C153-2011, Ductile Iron Compact Fittings for Water Service. |
| | .9 | ANSI/AWWA C500-2009, Metal-Seated Gate Valves for Water Supply Service. |
| | .10 | ANSI/AWWA C502-05, Dry-Barrel Fire Hydrants. |
| | .11 | ANSI/AWWA C509-06, Resilient Seated Gate Valves for Water Supply Service. |
| | .12 | ANSI/AWWA C606-2011, Grooved and Shouldered Joints. |
| | .13 | AWWA C651-05, Disinfecting Water Mains. |

1.3 REFERENCE
STANDARDS
(Cont'd)

- .14 ANSI/AWWA C800-05, Underground Service Line Valves and Fittings.
- .15 ASTM A183-03(R2009), Carbon Steel Track Bolts and Nuts.
- .16 ASTM A193-2012, Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
- .17 ASTM A194-2012, Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
- .18 ASTM A276-2013, Stainless Steel Bars and Shapes.
- .19 ASTM A307-2012, Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .20 ASTM A536-84(2009), Ductile Iron Castings.
- .21 ASTM B62-2009, Composition Bronze or Ounce Metal Castings.
- .22 ASTM B88-2009, Seamless Copper Water Tube.
- .23 ASTM F1674-2011, Standard Test Method for Joint Restraint Products for Use with PVC Pipe.
- .24 AWWA C900-2007, Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. (100 mm) through 12 in. (300 mm), for Water Distribution.
- .25 AWWA C907-2012, Polyvinyl Chloride (PVC) Pressure Fitting for Water - 4 in. through 9 in. (100 mm through 200 mm).
- .26 CAN/CSA B137 Series 09, Thermoplastic Piping Compendium.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 for all pipe, fittings, valves and all other items necessary for a complete water main installation.

1.5 CERTIFICATES

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section.

1.6 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 passing 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.

1.7 SCHEDULING
OF WORK

- .1 Coordinate and organize work to minimize interruptions to existing services.
- .2 Notify Departmental Representative and building occupants a minimum of 72 hours in advance of planned interruptions in service.
- .3 Do not interrupt water service except between 9:00 a.m. and 4:00 p.m. local time, unless otherwise authorized.
- .4 Notify Departmental Representative of any accidental interruption to water service immediately.

1.8 TESTING -
GENERAL

- .1 Provide a written plan outlining the measures that will be taken for the hydrostatic testing, chlorination and disinfection of the water system extensions. This plan is to indicate the areas to be tested, the sequence of testing and the sample locations for bacteriological tests. This plan will follow all requirements set forth in clauses 3.11 and 3.12 of this Section and be provided to and approved by the Departmental Representative prior to any testing taking place.

PART 2 - PRODUCTS

- | | | |
|---|----|---|
| <u>2.1 GENERAL</u> | .1 | Diameter, material and strength class of pipe and fittings: as indicated on the Drawings. |
| | | |
| <u>2.2 DUCTILE IRON
PIPE AND FITTINGS</u> | .1 | Pipe: Special Class 52, to AWWA C151. |
| | .2 | Fittings: to AWWA C110 or C153, cement mortar lined, minimum pressure rating 1035 kPa for cast-iron, 1720 kPa for ductile-iron. |
| | .3 | Hydrant Tee: to AWWA C153 and AWWA C111 complete with ductile-iron rotatable mechanical joint gland on plain end branch. |
| | .4 | Pipe Coatings: |
| | | .1 Interior: cement mortar lining with asphaltic seal coat to AWWA C104. |
| | | .2 Exterior: manufacturer's standard coating. |
| | .5 | Joints: mechanical or push-on to AWWA C111. |
| | | |
| <u>2.3 POLYVINYL
CHLORIDE PIPE</u> | .1 | Pipe and Joints: to CAN/CSA B137.3-M, AWWA C900, cast-iron outside diameter, gasketed bell-end joint. |
| | .2 | Pressure rating: 165 psi (DR18) |
| | | |
| <u>2.4 ADJUSTABLE
VERTICAL
INDICATOR POST</u> | .1 | Telescoping stem. |
| | .2 | Standard left hand opening. |
| | .3 | Window and "OPEN" and "SHUT" target plates. |
| | .4 | Non-supervisory. |
| | .5 | Lockable using standard size corrosion-proof padlocks (supplied by others). |
| | .6 | Head and Bell: Cast Iron. |
| | .7 | Canada Underwriters Laboratory (C-UL) certified. |
| | .8 | Colour: fire engine red. |

2.4 ADJUSTABLE
VERTICAL
INDICATOR POST
(Cont'd)

- .9 Acceptable Product:
.1 Mueller A-20806 Adjustable Vertical Indicator Post.

2.5 GATE VALVES

- .1 Standard buried type: to AWWA C509 up to and including 300 mm, minimum working pressure rating 1380 kPa and as follows:
.1 Body: cast-iron with mechanical joint ends.
.2 Mechanism: solid resilient wedge, epoxy coated, S.S. bonnet, S.S. packing gland nuts and bolts, non-rising spindle, and O-ring seals.
.3 Direction to close: all clockwise.
.4 Operating nut: 50 mm square.
.5 Acceptable products:
.1 Clow McAvity F-6100 Resilient Seat Valve
.2 Mueller A2360-23 Resilient Wedge Valve
.3 AVK Series 25/00 Resilient Seat
.2 Tapping valve: to AWWA C509 up to 300 mm, minimum working pressure rating 1380 kPa and as follows:
.1 Body: cast-iron with flanged by mechanical joint ends.
.2 Mechanism: solid resilient wedge, epoxy-coated, S.S. bonnet, S.S. packing gland nuts and bolts, non-rising spindle, and O-ring seals.
.3 Direction to close: clockwise
.4 Operating nut: 50 mm square.
.5 Acceptable Products:
.1 Mueller A2360-19 Resilient Wedge
.2 Clow F-6114 Resilient Seat Valve
.6 Tapping sleeve: stainless steel, or epoxy coated (minimum epoxy coating 150 microns complete with stainless steel bolts).
.1 Acceptable products:
.1 Mueller H-304 (SS)
.2 Rockwell 622
.3 Romac FTS420
.4 Robar 6906
.5 Smith Blair 622
.6 Ford FTSC
.3 Epoxy coat all gate valves with minimum 150 microns coating.

2.6 VALVE BOXES

- .1 Valve Boxes: to AWWA C500 and as follows:
.1 Cast-iron, slide type, adjustable for depth of pipe below finished grade.

-
- 2.6 VALVE BOXES .1 Valve Boxes:(Cont'd)
(Cont'd)
- .2 Covers marked "Water", "Sprinkler", "Service" or "Hydrant", as applicable.
 - .3 Lugged to prevent turning and rolling of cover, and cover notched to suit.
 - .4 Have clear opening of 135 mm.
 - .5 Bonnet on the bottom section which is capable of enclosing the packing gland section of the gate valve.
 - .6 Acceptable products:
 - .1 IMP Model V.1
- 2.7 BOLTS FOR .1 T-head bolts and nuts: Low alloy Corten steel.
BURIED SERVICE
- 2.8 SERVICE PIPE .1 Services 50 mm and smaller:
AND FITTINGS
- .1 Copper tubing: to ASTM B88, type K annealed, minimum pressure rating 1035 kPa.
 - .2 Joints: compression type, minimum pressure rating 1035 kPa.
 - .3 Corporation stop: brass to ASTM B62, compression type, inlet threads to AWWA C800, minimum pressure rating of 1035 kPa.
 - .1 Acceptable products:
 - .1 19-25mm Mueller B25008 (Ball Valve)
 - .2 38-50mm Mueller H15008
 - .3 19-50mm Cambridge Brass 301-A3H3 to 301- 7H7 (Ball Valve)
 - .4 Curb stop and drain: brass to ASTM B62, compression type joints. Minimum pressure rating of 1035 kPa.
 - .1 Acceptable products:
 - .1 38-50mm Mueller H15219 (Oriseal)
 - .2 19-50mm Cambridge Brass 203-H3H3 to 203- H7H7 (Ball Valve)
 - .5 Insulated couplings for use with PVC watermains.
 - .1 Acceptable products:
 - .1 19-50mm Mueller
 - .2 19-50mm Cambridge Brass
 - .6 Service saddle: bronze body, confined O-ring seal cemented in place, double stainless steel strap type and straps suitable for connecting to a main. Outlet tapped and threaded to AWWA C800.
 - .1 Acceptable products:
 - .1 Rockwell
 - .2 Mueller
 - .3 Ford
 - .4 Robar

-
- 2.8 SERVICE PIPE AND FITTINGS
(Cont'd)
- .1 (Cont'd)
- .7 Service Box: adjustable type, cast iron bottom section, stainless steel operating rod and cotter pin, cast iron lid with recessed pentagon nut and internal stem to suit depth of bury. Service boxes to be magnetized to facilitate future locates. Service box to have appropriate foot piece. 38 mm to 50 mm curb stops to be fitted with full size valve boxes.
- .1 Acceptable products: Mueller
- .8 Service connections 75 mm and larger refer to pipe specification in clauses 2.2 and 2.3 of this Section.
- 2.9 COUPLINGS
- .1 Mechanical joint sleeve type: to AWWA C110; use on new ductile iron pipe. Provide spacer ring between pipe ends. Where gap between pipe ends is less than 10 mm, spacer not required.
- .2 Metal to PVC collar type: to AWWA C219-91 and ASTM A336.
- .1 Robar figure 1706 coupling.
- 2.10 THRUST RESTRAINT
- .1 Thrust blocks and anchors: Use 30 MPa concrete and 15 M, Grade 400 reinforcing steel where indicated.
- .2 Mechanical joint restraint device for ductile iron pipe: 100 mm to 300 mm, ductile follower gland to AWWA C111 and C153 with multiple wedge restraining mechanism, minimum working pressure rating 2410 kPa and minimum safety factor of 2:1. Lugs to have twist-off torque nuts.
- .1 Acceptable products:
- .1 Ebba Iron Megalug
- .2 Ford
- .3 Stargrip
- .3 Mechanical joint restraint device for PVC pipe: to conform to ASTM F1674, Standard Test Method for Joint Restraint Products for use with PVC Pipe.
- .1 Megalug
- .2 Stargrip
- .4 All buried valves and fittings including tees, bends, solid sleeves and reducers to be restrained mechanical joints complete with exterior PVC compatible corrosion protection applied to metal components.
- .5 Use mechanical joint restraint devices in combination with concrete thrust blocks. No pipe
-

<u>2.10 THRUST RESTRAINT (Cont'd)</u>	.5	(Cont'd) joints are permitted within the "minimum pipe length" as denoted in the drawings.
	.6	Thrust block design requirements are as indicated on drawings.
<u>2.11 DISINFECTANT</u>	.1	Sodium hypochlorite or calcium hypochlorite: to AWWA B300.
	.2	Liquid chlorine: to AWWA B301.
<u>2.12 REDUCING AGENT</u>	.1	Hydrogen peroxide, 35% by mass commercial grade.
<u>2.13 INSULATION</u>	.1	As specified in Section 07 20 00.
<u>2.14 MARKER STAKE</u>	.1	Timber marker stake - pressure treated, 40 mm x 90 mm painted orange. Must be installed as location marker at end of service points.
<u>2.15 GEOTEXTILE</u>	.1	Refer to Section 31 23 10.
<u>2.16 ANODE PACKS</u>	.1	Zinc anodes (ZN24-48), complete with clamps, as directed.
<u>2.17 POLYETHYLENE</u>	.1	200 micron polyethylene sheet conforming to AWWA C105.
<u>2.18 EXTERIOR CORROSION PROTECTIVE COATING</u>	.1	Anti-corrosion petrolatum paste, tape and mastic. .1 Acceptable products: .1 Winn & Coates (Denso) Ltd. .2 Trenton .3 Petro .4 Tapecoat .5 STAC

PART 3 - EXECUTION

- | | |
|---|---|
| <u>3.1 PREPARATION</u> | <ul style="list-style-type: none">.1 Carefully inspect products for defects and remove defective products from site..2 Ensure that pipe, fittings, valves and hydrants are clean before installation. |
| <u>3.2 TRENCHING,
BEDDING AND
BACKFILLING</u> | <ul style="list-style-type: none">.1 Do trenching, bedding and backfilling to Section 31 23 10 and as specified on the drawings..2 Use granular bedding material for pipe bedding and protection unless otherwise specified..3 Clear stone may be used in wet or freezing conditions only where specified or with the prior approval of the Departmental Representative..4 Blasting for rock removal shall not be permitted. |
| <u>3.3 BURIED PIPE
INSTALLATION</u> | <ul style="list-style-type: none">.1 Lay and join pipe, fittings, and valves, as specified herein and according to manufacturer's published instructions..2 Do not lay pipe and fittings when trench bottom is frozen, under water or when trench conditions or weather are unsuitable..3 Lay pipe and fittings on prepared bed, true to line and grade indicated, within the following tolerances:<ul style="list-style-type: none">.1 Horizontal Alignment: 150 mm.2 Vertical Alignment: 75 mm.4 Face bell ends in direction of laying. On grades of 5% or greater, lay pipe up grade. For grades exceeding 16%, install appropriately designed gradient thrust restraint..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 use excessive force to join pipe sections..7 Install gaskets in accordance with manufacturer's published instructions. Use only lubricant approved for potable water. During cold weather, store gaskets |

3.3 BURIED PIPE
INSTALLATION
(Cont'd)

- .7 (Cont'd)
in heated area to assure that gaskets remain flexible.
- .8 Align pipes carefully before joining.
- .9 Support pipes as required to assure concentricity until joint is properly completed.
- .10 Keep pipe joints free from mud, silt, gravel or other foreign materials.
- .11 Avoid displacing gasket or contaminating with dirt, or other foreign material. Remove, clean, re-install and lubricate gaskets so disturbed. Do not reuse a gasket that has been contaminated with petroleum products.
- .12 Complete each joint before laying next length of pipe.
- .13 Where deflection at joints is permitted by the Departmental Representative, deflect only after spigot is fully inserted in bell. Do not exceed joint deflection recommended by manufacturer.
- .14 At structures, provide flexible joint not more than 300 mm from outside face of structure unless otherwise indicated. Support pipe between structure wall and first joint with 30 MPa concrete.
- .15 Cut pipe as required for fittings or closure pieces, square to centerline, and as recommended by manufacturer. Do not damage pipe lining or coating. Leave smooth beveled edge.
- .16 Install zinc anodes on all valves, hydrant bases, and copper service connections.
- .17 Give sufficient notice so that appropriate inspection and approval of pipe installation can be undertaken by the Departmental Representative.
- .18 Minimum depth of cover to be 1.6m as shown on the drawings. Insulation is required wherever minimum depth of cover is not possible.

3.4 ADJUSTABLE
VERTICAL
INDICATOR POSTS

- .1 Install Adjustable Vertical Indicator Posts in accordance with manufacturers instructions over resilient wedge gate valves to form Post Indicator Valve (PIV) assembly.
- .2 Install PIV protective concrete culvert surround as indicated in drawings.

3.5 VALVES AND
VALVE BOXES

- .1 Install valves at locations indicated. Joints and bedding as specified for pipe and fittings.
- .2 On direct buried valves, install valve boxes plumb and centered over operating nut, and true to line and grade.
- .3 Install zinc anodes on all valves as indicated in drawings.
- .4 Place select backfill material, maximum size 50 mm around valve box to subgrade.
- .5 When valves are installed with cover in excess of 2.1 m, provide a valve stem extension to suit grades.
- .6 Within the Institution unpaved areas, install valve asphalt pad as indicated in drawings.
- .7 Valves installed on PVC watermain to have a 450mm x 450mm pre-cast concrete block placed underneath for support. Refer to PVC handbook installation guide.

3.6 THRUST
RESTRAINT

- .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, but not less than 24 hours.
- .3 Provide mechanical joint restraint devices where indicated.
- .4 Use thrust blocks on all vertical bends.
- .5 Where mechanical joint restraint is used alone, provide a single length of pipe within the "minimum pipe length" as indicated in drawings.

3.6 THRUST
RESTRAINT
(Cont'd)

- .6 Reaction backing for plugs and caps shall be concrete.
- .7 Place HD polyethylene on bend before pouring concrete thrust block.

3.7 SERVICE
LATERALS

- .1 General:
 - .1 Service size and configuration to be as approved by the Departmental Representative dependent on existing building internal plumbing arrangements.
 - .2 Connect to existing building service laterals to suit existing conditions and in accordance with standard details as indicated on drawings. Connect to existing services in accordance with the following installation instructions.
 - .3 The Departmental Representative does not warrant or guarantee the condition of existing water lines at the proposed location of any existing service connection.
 - .4 Compression couplings shall not be used within 1.5 metres of the foundation of any serviced building.
 - .5 Laterals from the curb stop to inside the premise shall be installed as a single piece of pipe with no couplings unless the length is greater than 20 m, in which case one compression fitting is permitted per 20 m or part thereof.
 - .6 Maintain minimum of 1.6 metre ground cover on service connections. Maximum depth of bury shall not exceed 2m.
 - .7 Install water service 300 mm horizontally and vertically (above) from gravity sewer service in common trench.
 - .8 Lay service pipe in a smooth trench bottom with granular bedding 150 mm below the pipe and a minimum 450 mm over the pipe.
 - .9 Backfill with well graded Selected Backfill.
 - .10 The Departmental Representative reserves the right to limit the number and location of bends on service connections.
 - .11 Install new zinc anode on service in accordance with drawings.
 - .12 Locate curb stops as indicated on drawings as applicable. Locate curb stops 300 mm from pavement line unless there is a sidewalk over the lateral. Where sidewalks are intended to cross over the lateral locate the curb stop 1 m beyond the sidewalk.
 - .13 Do not install curb stop within 1.5 metres of a building.
 - .14 Install service box over curb stop, set plumb with the top of service box flush with finished grade. Where grade has not been finalized or

3.7 SERVICE
LATERALS
(Cont'd)

- .1 General:(Cont'd)
 - .14 (Cont'd)
established, leave the top of service box 150 mm above top of curb or edge of asphalt. Place select backfill material, maximum size 50 mm, around the service box to subgrade.
 - .15 Leave corporation stop fully open. Operate curb stop to ensure flow, then close curb stop and leave closed.
 - .16 Pressure test and chlorinate all service laterals 100 mm and larger.
 - .17 If the Departmental Representative is required outside regular working hours during the installation of service connections, pay incurred costs of salaries and expenses for overtime hours required.
 - .18 Provide plan and profile record drawings for all service laterals.
 - .19 Do not backfill services until approved by Departmental Representative.
- .2 Direct Tapping alternative for up to 75 mm Services:
 - .1 Do not tap closer than 1.0 m to adjacent service or pipe joint. Tap water main and install corporation stops at a position between 75 and 90 from vertical using type of connection and tapping method appropriate for type, size and pressure of water main. Tape a 150 mm wide continuous band around polyethylene encasement when used, centered on the area to be tapped.
 - .2 Provide a minimum of 1.0 m working space along the main and 150 mm clear space around the main for tapping.
 - .3 Tapping must be scheduled with Departmental Representative a minimum of 24 hours in advance.
- .3 Tapping Sleeves alternative for 100 mm and larger Services:
 - .1 All services 100 mm and larger must be done using a Tapping Sleeve and Tapping Valve.
 - .2 Edge of tapping sleeve must be a minimum of 1.0 m from flange, fitting or bell of pipe to be tapped.
 - .3 If two tapping sleeves are installed together, a minimum of 1.0 m separation is required.
 - .4 Test tapping valves and sleeves before tapping of main. Test tapping valves from both directions. Departmental Representative shall witness all tests prior to tap.
 - .5 Do not use a tapping sleeve of the same nominal size as the existing water main. The tapping sleeve must be at least one size smaller than the diameter of the tapped water main.

3.7 SERVICE
LATERALS
(Cont'd)

- .4 Sprinkler Service:
- .1 Install sprinkler service connections in accordance with drawings. Departmental Representative to approve location of service saddle on sprinkler line.
 - .2 The Departmental Representative reserves the right to limit the number and location of bends on services.
 - .3 Pressure test and chlorinate all sprinkler lines from the water main to the backflow prevention device, testable valve, or location specified by Departmental Representative at each building. Testing shall be carried out in accordance with this Section. PWGSC/CSC is responsible for carrying out any other testing requirements necessary to demonstrate that the sprinkler lines meet applicable fire code requirements.
 - .4 Carry out construction inspection and preparation of Record Drawings for all sprinkler services in accordance with Section 01 78 00.

3.8 CONNECTIONS TO
EXISTING MAINS

- .1 Connect new mains to existing mains as indicated.
- .2 Do not make a connection to an existing main within 1.0 m of a fitting, pipe joint or another service. Use mechanical joint sleeves to effect connection.
- .3 The Departmental Representative and PWGSC do not guarantee leak tight operation of existing valves.
- .4 No work will be performed on existing mains until all items required to complete the connection are on site and the outside diameter and type of pipe have been confirmed.
- .5 PWGSC will operate existing valves in their exiting systems.
- .6 When a connection is made to an exiting main an inspection of the joints for leakage must be made by the Departmental Representative while the main is under operating pressure, prior to backfilling.
- .7 Backfill on Departmental Representative's approval only.

3.9 EXTERIOR
CORROSION
PROTECTIVE COATING

- .1 Apply where noted on the drawings and as directed by the Departmental Representative where alternative corrosion protection measures (polywrap, epoxy coating, cathodic protection) are not employed.
- .2 Utilize primer, mastic and tape in accordance with manufacturer's instructions.

3.10 HYDROSTATIC
TESTING

- .1 Provide labour, equipment and materials required to perform hydrostatic test.
- .2 The operation of any existing valve not part of the new construction shall be by PWGSC. 24 hours notice is required for all filling, flushing or chlorination operations for new construction.
- .3 All services, hydrants, mains and other appurtenances shall be included in the system test.
- .4 Do not carry out testing until:
 - .1 the street base course (first lift of gravel) has been placed and compacted for paved areas,
 - .2 the gravel surface has been reinstated in gravelled areas,
 - .3 the subgrade surface has been reinstated in other areas.
- .5 Perform tests in presence of the Departmental Representative. Provide Departmental Representative with at least 24 hours notice prior to conducting any tests. Provide a 6 mm NPT connection at an appropriate location for the Departmental Representative's pressure gauge.
- .6 Pressure test all valves, including hydrant valves.
- .7 Where hydrant extensions are required, install extensions prior to testing.
- .8 Open all valves in test section.
- .9 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air-vacuum release valves are installed.
- .10 Conduct the test at a minimum pressure of the greater of 1035 kPa or one and one-half (1.5) times the operating pressure at the highest point of the system being tested. In any case, the test pressure must not exceed 1205 kPa. do pressure testing in sections where necessary to meet testing requirements.

3.10 HYDROSTATIC
TESTING
(Cont'd)

- .11 Conduct the test over a full two (2) hour period, maintaining a constant test pressure. No leakage is permitted during the test period.
- .12 Locate and repair defects if test fails. Retest until results show remedial measures have been successful.
- .13 Water used for pipe testing including pressure testing, chlorination, flushing and de-chlorination will be the responsibility of the contractor, and will be chlorinated potable water. A water source will be made available by PWGSC, conditions permitting.
- .14 Following acceptance of field tests, the Departmental Representative may order a second test. Cost of retesting will be paid by PWGSC providing the test is satisfactory.

3.11 FLUSHING AND
DISINFECTION

- .1 Chlorination of any water system can proceed only after system has been successfully pressure tested, with the test witnessed by the Departmental Representative.
- .2 Flush and disinfect water mains to AWWA C651 and as herein specified. Notify the Departmental Representative 24 hours in advance of 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		Flow Required to Produce 2.5 ft/s (approx.) Velocity in Main		Size of Tap, In.(mm)			Number of 2½" (64mm) Hydrant Outlets
				1(25)	1½(38)	2(51)	
In.	(mm)	Gpm	(L/s)	Number of Taps on Pipe			
4	(100)	100	(6.3)	1	-	-	1
6	(150)	200	(12.6)	-	1	-	1
8	(200)	400	(25.2)	-	2	1	1
10	(250)	600	(37.9)	-	3	2	1

- .4 Slowly open and close valves and hydrants to ensure thorough flushing.

3.11 FLUSHING AND
DISINFECTION
(Cont'd)

- .5 If satisfactory results cannot be achieved by flushing, swab pipe by approved methods and re-flush.
- .6 Disinfect water main upon completion of flushing using chlorine solution distributed throughout entire system.
- .7 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 proportioned to filling rate. Prepare stock chlorine with concentration of 1% free chlorine by volume as follows:

<u>Product</u>	<u>Amount Of Compound</u>	<u>Quantity of Water (litre)</u>
high test calcium hypochlorite (67-70%Cl)	1.0 kg	60
liquid laundry bleach (5.25% Cl)	1.0 litre	3.5
(10.5% Cl)	1.0 litre	7.0

- .8 Calcium hypochlorite is not to be used when water temperature is less than 5°C.
- .9 The following table indicates the quantity of 1% chlorine stock solution required per 100 metre length of pipe.

<u>Pipe Diameter (mm)</u>	<u>1% Stock Chlorine Solution (litres)</u>
100	4.9
150	10.9
200	19.4
250	30.4

- .10 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .11 Take water samples at all hydrants and termination points, in suitable sequence, to test chlorine residual. When tests indicate minimum chlorine residual of 50mg/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 must have a residual of not less

3.11 FLUSHING AND
DISINFECTION
(Cont'd)

- .11 (Cont'd)
than 25 mg/L. If the residual has fallen below 25mg/L
the system shall be rechlorinated.
- .12 Flush disinfectant solution from line after 24
hours. Under no circumstances shall disinfectant
solution remain in the line longer than 48 hours. Add
1.0% hydrogen peroxide reducing agent to the
disinfectant solution at point of discharge or within
a retention facility such that the solution is
disposed to the environment with a total chlorine
residual no greater than 0.0 mg/L in accordance with
the requirements of the Nova Scotia Environment and
Labour. Check chlorine residuals before disposal and
at regular intervals during disposal to ensure
compliance. This de-chlorination requirement can only
be excluded with the written consent of Nova Scotia
Environment.
- .13 Dispose of de-chlorinated disinfectant solution.
Where disposing to the environment, disposal of the
de-chlorinated solution must be at least 100 meters
from the nearest watercourse.
- .14 Where disinfectant solution is de-chlorinated at
point of discharge, inject stock reducing agent at a
rate proportioned to discharge rate. Monitor
injection and discharge rates continuously to ensure
proper proportioning.
- .15 Prepare stock reducing agent with concentration of
1% Hydrogen Peroxide (H_2O_2) by volume, as follows:

<u>Liquid Reducing Agent</u>	<u>Amount of Agent (litres)</u>	<u>Quantity of Water (litres)</u>
----------------------------------	---	---

Hydrogen Peroxide (35% (H_2O_2) by mass)	1.0	34.0
---	-----	------

Hydrogen Peroxide required to reduce total chlorine
residual of disinfectant solution contained per 100
metre length of pipe, from 50 mg/L to 0.0 mg/L.

<u>Pipe Diameter (mm)</u>	<u>1% Hydrogen Peroxide Stock Solution (litres)</u>
---------------------------	---

100	4.5
150	10.2
200	18.1
250	28.2

3.11 FLUSHING AND
DISINFECTION
(Cont'd)

- .17 Where total chlorine residual of disinfectant solution exceeds 50 mg/L, quantity of stock reducing agent for de-chlorination can be increased in direct proportion to the quantity indicated in the above table.
- .18 After disinfectant solution is flushed from water main, assist Departmental Representative in obtaining two water samples on each of two (2) consecutive days (at least 24 hours apart) for bacteriological tests. Hydrants shall not be used as sampling points. Repeat disinfection procedure if bacteriological tests fail.
- .19 Obtain bacteriological sampling from all service laterals connected into the new water main, at no less than 366 m (1,200 ft.) intervals along transmission routes and from every branch connection. (Refer to AWWA C651, Section 5.1). A hydrant lead, if approved by the Departmental Representative, may be tapped to provide the required sampling location in areas where there are no service laterals.
- .20 Collect samples in accordance with Appendix A of the Nova Scotia Environment and Labour Guidelines for Monitoring Public Drinking Water Supplies. Do analysis by an independent lab in accordance with Section 410 of the Guidelines.
- .21 Should any of the test results be positive, repeat disinfection, flushing, sampling and analysis.
- .22 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.

PART 1 - GENERAL

- | | | |
|---|----|--|
| <u>1.1 RELATED WORK</u> | .1 | Excavating, Trenching and Backfilling: Section 31 23 10 |
| | .2 | Manholes, Catchbasins and Structures: Section 33 39 00 |
| | | |
| <u>1.2 REFERENCES</u> | .1 | CAN/CSA-B1800-2011, Thermoplastic Nonpressure Piping Compendium. |
| | | |
| <u>1.3 SHOP DRAWINGS</u> | .1 | Submit shop drawings in accordance with Section 01 33 00. |
| | .2 | Submit shop drawings for all pipe, fittings, valves, and all other items necessary for a complete installation. Include details showing dimensions and tolerance of pipe and joint proposed. |
| | | |
| <u>1.4 MATERIAL CERTIFICATIONS</u> | .1 | Submit manufacturer's test data and certification that products and materials meet requirements of this Section. |
| | .2 | Confirm certification is marked on pipe. |
| | | |
| <u>1.5 DELIVERY, STORAGE AND HANDLING</u> | .1 | Handle and store pipe, valves, fittings, in such a manner as to avoid shock and damage and as per manufacturer's recommendations. Do not use chains or cables passed through pipe bore. |
| | .2 | Store gaskets in cool location, out of direct sunlight, and away from petroleum products. |
| | | |
| <u>1.6 SCHEDULING OF WORK</u> | .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

- | | | |
|----------------------------------|----|---|
| <u>2.1 SEWER PIPE</u> | .1 | PVC pipe and fittings: type PSM polyvinyl chloride, to CAN/CSA-B1800, DR35, complete with bell and spigot joints with locked in rubber gaskets. |
| | .2 | Sewer laterals of 150mm diameter or less to be type PSM polyvinyl chloride, to CAN/CSA-B1800, DR28 (white), complete with bell and spigot joints with locked in rubber gaskets from the main to the building. |
| <u>2.2 PIPE BEDDING MATERIAL</u> | .1 | Granular bedding material: as specified in Section 31 23 10. |
| <u>2.3 GROUT</u> | .1 | Shrinkage compensating to Section 03 30 00. |
| <u>2.4 COUPLINGS</u> | .1 | Collar-type: steel with minimum pressure rating 1035 Kpa, appropriate to the type and size of pipe being joined, epoxy coated with type 316 stainless steel bolts and nuts. |
| <u>2.5 PROTECTIVE COATINGS</u> | .1 | Anti-corrosion petrolatum mastic, paste and tape.
.1 Acceptable manufacturers: Winn & Coales (Denso) Ltd., Trenton, Petro. |

PART 3 - EXECUTION

- | | | |
|------------------------|----|---|
| <u>3.1 PREPARATION</u> | .1 | Clean pipes and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site. |
| | .2 | Obtain Departmental Representative's approval of pipes and fittings prior to installation. |
| | .3 | Provide proper implements, tools and facilities approved by the Departmental Representative, for the safe and convenient prosecution of the Work. |

-
- | | | |
|--|----|--|
| <u>3.1 PREPARATION
(Cont'd)</u> | .4 | Take every precaution to prevent foreign material from entering the pipe. |
|
 | | |
| <u>3.2 TRENCHING
AND BACKFILLING</u> | .1 | Provide trenching, excavating and backfilling to Section 31 23 10. |
|
 | | |
| <u>3.3 GRANULAR
BEDDING</u> | .1 | Provide granular bedding to Section 31 23 10. |
|
 | | |
| <u>3.4 PIPE LAYING</u> | .1 | Carefully lower pipe into the trench. Do not drop or dump materials into the trench. |
| | .2 | Lay and join pipes, fittings and valves as specified herein and according to manufacturer's published instructions. |
| | .3 | Lay pipe and fittings on prepared bed, true to line and grade indicated, within following tolerances:
.1 Horizontal Alignment: 50 mm.
.2 Vertical Alignment: the lesser of 12 mm or one half the rise per pipe length. |
| | .4 | Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade. |
| | .5 | Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary water-tight bulkheads when pipe laying is not in progress. |
| | .6 | Do not lay pipe when the trench bottom is frozen, underwater or when trench conditions or weather are unsuitable. |
|
 | | |
| <u>3.5 PIPE JOINTING</u> | .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. |
-

-
- | | | |
|---|----|---|
| <u>3.5 PIPE JOINTING
(Cont'd)</u> | .5 | Avoid displacing gasket or contaminating with dirt, petroleum products, or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed. |
| | .6 | Where deflection at joints is permitted, deflect only after joint is completed. Do not exceed maximum joint deflection recommended by manufacturer. |
| | .7 | Cut pipe as required for fittings or closure pieces, square to centreline, and as recommended by manufacturer. |
| | .8 | Make watertight connections to manholes and structures. |
| | .9 | At structures provide flexible joint not more than 300 mm from outside face of structure, or as otherwise indicated. |
|
 | | |
| <u>3.6 PROTECTIVE
COATING FOR
FITTINGS AND VALVES</u> | .1 | Coat collar type couplings and bolts and other areas indicated on drawings with protective coating, in accordance with manufacturer's instructions. |
| | .2 | Transport and store coating materials between 5°C and 30°C. |
| | .3 | Ensure surface to be coated is free of loose coating, soil or other foreign matter. |
| | .4 | Apply priming paste to areas after surface preparation is completed. |
| | .5 | Apply mastic to irregular surfaces to ensure smooth surfaces and no air pockets. |
|
 | | |
| <u>3.7 PIPE BACKFILL</u> | .1 | As specified in Section 31 23 10. |
|
 | | |
| <u>3.8 PIPE CLEANING</u> | .1 | Prior to testing, clean gravity sewer to remove foreign materials. |
|
 | | |
| <u>3.9 WATER-TIGHT
TESTING</u> | .1 | Test all sanitary gravity sewers for watertightness. Do tests in the presence of the Departmental Representative. |
-

3.9 WATER-TIGHT
TESTING
(Cont'd)

- .2 Obtain water used for flushing or testing from a potable water supply that is continuously separated from the service being flushed or tested by an air gap of a level of protection equal to or greater than that provided by a double check valve backflow prevention device. Ensure that no back-splash or particulate matter transfer possibility exists between the sanitary sewer and the water supply.
- .3 Provide all labour, equipment and materials required to perform hydrostatic and leakage tests.
- .4 Before testing confirm all relevant open ends are blanked off with watertight plugs or caps.
- .5 Discharge test water through newly laid pipeline if a suitable outfall exists, or otherwise in accordance with the Contract and applicable environmental regulations.
- .6 Exfiltration test:
 - .1 Fill section with water to displace air from main and service connections. Fill and maintain nominal head on concrete pipe 24 hours before testing to allow absorption of water by pipe material.
 - .2 Add water to establish test head of 3 m over either crown of pipe, measured at highest point of section, or level of static ground water, whichever is greater. Do not exceed net internal head of 8.13 m.
 - .3 Maintain test head for 1 hour.
 - .4 Measure and record volume of water required to maintain head during test period.
- .7 Infiltration test:
 - .1 Conduct infiltration test instead of exfiltration test where level of static ground water is 760 mm or more above crown of pipe measured at highest point of section. No increase in infiltration rate will be allowed if head exceeds 760 mm.
 - .2 Install watertight plug at upstream end of section.
 - .3 Discontinue dewatering minimum of three (3) days before taking test measurements.
 - .4 Place 90° V-notch weir, in invert of main at downstream end of section. Add water until flow is observed through notch.
 - .5 Measure and record total volume of flow for one hour.
- .8 Allowable leakage: determined by the following formula:

$$L = F \times D \times \underline{S}$$

3.9 WATER-TIGHT .8 Allowable leakage:(Cont'd)
TESTING
(Cont'd)

100

where:

L = allowable leakage in litres per hour
D = Diameter in mm
S = Length of section, in metres
F = leakage factor, (litres per hour per
per mm of diameter per 100 metres of
per mm of diameter per 100 metres of
sewer)
= 0.02 (Non-Porous Pipe)
= 0.12 (Porous Pipe - Exfiltration
Test)
= 0.10 (Porous Pipe - Infiltration
Test)

- 3.10 DEFLECTION .1 Measure deflection by pulling a deflection gauge
TESTING - PVC PIPE through each pipe from manhole to manhole after
backfilling.
- .2 Provide deflection gauges to measure a 5% and 7-1/2%
deflection. Gauges to be a "Go-No-Go" device.
- .3 Thirty days after installation, pull a deflection
gauge measuring 5% deflection through the installed
section of pipeline. If this test fails proceed with
7-1/2% deflection test.
- .4 Thirty days prior to completion of Warranty Period
Maintenance, pull a deflection gauge measuring 7-1/2%
deflection through the installed section of pipeline.
- .5 If 7-1/2% deflection test fails, locate defect and
repair. Retest to satisfaction of Departmental
Representative.

- 3.11 CLOSED .1 Arrange and pay for television camera inspection of
CIRCUIT TELEVISION installed pipeline.
INSPECTIONS
- .2 Scheduling:
.1 First perform the video inspection when the
sanitary sewer has been cleaned and all manhole
adjustments and street reinstatement have been
completed.

3.11 CLOSED
CIRCUIT TELEVISION
INSPECTIONS
(Cont'd)

- .2 Scheduling:(Cont'd)
 - .2 Video inspect the entire system a second time eleven months after substantial completion.
- .3 Equipment:
 - .1 Provide equipment meeting following requirements:
 - .1 Self-contained monitoring unit and camera with remotely controlled lighting system capable of varying the illumination.
 - .2 Picture quality shall produce continuous 600-line resolution picture, showing entire periphery of pipe.
 - .3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
- .4 Definition of fault:
 - .1 Any pipe joint which displays a gap or spread, offset, gasket, or signs of infiltration.
 - .2 Any section of pipeline which is crushed, broken or displays cracks.
 - .3 Any variance in grade of pipeline.
 - .4 Any gravel, roots, or foreign material which may impede flow.
 - .5 Any deformation in shape of pipe.
- .5 Inspection:
 - .1 Perform inspection of pipe by passing TV camera through pipeline in direction of flow.
- .6 Records:
 - .1 Maintain inspection record in log form, during television inspection.
 - .2 Log to include location of each fault.
 - .3 Photograph fault from the television screen using a digital camera or provide hard copy stills directly from system if possible. All photographs to be clear and precise with distinct definition of fault.
 - .4 Include detailed technical description with photographs as supporting data for each fault.
 - .5 All photos and videos to be in colour.
- .7 Reports:
 - .1 Provide a composite report of TV inspection. Enclose report in binder on letter size paper. Include following pages and information.
 - .1 Title page identifying project, camera operator and dates of inspection.
 - .2 Index page identifying pipeline, page number or numbers where information for section is contained.

3.11 CLOSED
CIRCUIT TELEVISION
INSPECTIONS
(Cont'd)

- .7 Reports:(Cont'd)
 - .2 Report on each pipeline 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 magnetic north, horizontal distance, pipe and material and direction of flow.
 - .3 Inspection findings for each pipeline to include:
 - .1 Location of all faults.
 - .2 One (1) photograph each of typical joint and flanged connection.
 - .4 Mount photographs on left-hand page and place corresponding description on right- hand page. Number all photographs in order. Number beside photograph to correspond with description number.
 - .5 Enclose all pages of report in transparent sheet protector.
 - .6 Provide a copy of video tape to Departmental Representative.

3.12 TESTS TO BE
REPEATED

- .1 Should testing or inspection disclose non-conformance, locate and repair defective pipe or joint to the approval of the Departmental Representative.
- .2 Re-test to determine success or otherwise of remedial measures applied to pipework. Repeat these re-tests at no extra cost to Contract until results show that remedial measures have been successful.
- .3 In the event the Departmental Representative suspects the sanitary gravity sewer no longer complies with requirement of the test, the Departmental Representative may order additional testing. Should the length of pipeline prove defective, the Contractor shall repair or make good the defect at no extra cost to Contract.
- .4 Cost of additional testing to be at no extra cost to Contract if test proves a defect. However, if this testing shows pipe to be satisfactory, cost of second test will be borne by Departmental Representative.

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

PART 1 - GENERAL

- 1.1 RELATED WORK
- .1 Cast-in-Place Concrete: Section 03 30 00
 - .2 Exterior Waterproofing: Section 07 11 00
 - .3 Excavating, Trenching and Backfilling: Section 31 23 10
- 1.2 REFERENCES
- .1 ASTM A48/A48M-2003(R2012), Specification for Gray Iron Castings.
 - .2 ASTM A123-2011, Standard Specification for Zinc-Dipped (Hot-Dipped Galvanized) coatings on Iron and Steel Products.
 - .3 ASTM C478M-2013, Specification for Precast Reinforced Concrete Manhole Sections.
 - .4 ASTM C858-2010, Standard Specification for Underground Precast Concrete Utility Structures.
 - .5 CAN/CGSB 51.34-M86, Vapour Barrier, Polyethylene Sheet for use in Building construction.
 - .6 CAN/CSA-A23.1-04/A23.2-09, Concrete Materials and Methods for Concrete Construction.
 - .7 CAN/CSA-A257 Series - 2009, Standards for Concrete Pipe.
 - .8 CAN/CSA-A3000-2008, Cementitious Materials.
 - .9 CAN/ULC S701-2011, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .10 CSA G40.20/G40.21-04 (R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels.
- 1.3 SHOP DRAWINGS
- .1 Submit shop drawings in accordance with Section 01 33 00.
 - .2 Submit manufacturer's test data and certification that materials meet requirements of this section. Include manufacturer's drawings, information, size of components, dimensions and details where pertinent.
-

PART 2 - PRODUCTS

- 2.1 MATERIALS
- .1 Precast manhole and catch basin sections: to ASTM C478M, circular. Manhole top sections flat slab top type with opening offset for vertical ladder installation. Precast concrete bases to be approved by Departmental Representative.
 - .2 Joints: to be made watertight using rubber O-rings.
 - .3 Mortar:
 - .1 Cement: to CAN/CSA-A3000.
 - .4 Adjusting rings: precast concrete, to ASTM C478.
 - .5 Frames and covers: to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray iron castings: to ASTM A48, strength class 30B.
 - .3 Castings: coated with two (2) applications of asphalt varnish, sand blasted or cleaned and ground to eliminate surface imperfections.
 - .4 Bearing surfaces to be ground to eliminate surface imperfections.
 - .5 Manhole frames and covers: heavy duty municipal type for road service and as indicated on the drawings. Cover cast with perforations for storm sewer application. Cover cast without perforations and complete with two (2) 25mm square lifting holes or bar handles for sanitary sewer and other applications. Manhole frames and covers to be complete with four (4) lock down bolts as indicated on the drawings.
 - .1 Sanitary sewer, vented, secured cover.
 - .2 Storm sewer, open, secured cover, as applicable.
 - .3 Acceptable product (secured type): McCoy Foundry, Mueller Canada, or approved equivalent.
 - .6 Granular bedding material: as specified in Section 31 23 10.
 - .7 Concrete: for adjustment, cast-in-place bases and benching, as specified in Section 03 30 00.
 - .8 Waterproofing (sanitary manholes only):
 - .1 Refer to Section 07 11 00.
-

- 2.1 MATERIALS .9 Frost barrier (sanitary manholes only):
(Cont'd) .1 Rigid insulation: to Section 07 20 00.

PART 3 - EXECUTION

- 3.1 EXCAVATION AND .1 Provide excavating and backfilling in accordance
BACKFILLING with Section 31 23 10.

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

- 3.2 CONCRETE WORK .1 Do concrete work in accordance with Section 03 30
00.

- .2 Position metal inserts in accordance with dimensions
and details as indicated.

- 3.3 INSTALLATION .1 Construct units in accordance with details
indicated, plumb and true to alignment and grade.
- .2 Complete manholes and catch basins as pipe laying
progresses.
- .3 Dewater excavation as directed by Departmental
Representative and remove soft and foreign material
before placing concrete base.
- .4 Set precast concrete base on 150 mm minimum of
granular bedding compacted in accordance with
Section 31 23 10.
- .5 Set riser sections on precast base and make joint
watertight with O-ring gaskets. Grout joints inside
and out with non-shrink grout.
- .6 Plug lifting holes with non-shrink grout.
- .7 Place stub outlets at elevations and in position
indicated. Provide type of gasket connection as
indicated.
- .8 Install manhole benching where shown on the Drawings
using concrete suitable for exposure classification
C-2 as specified in CSA-A23.1.
- .9 Install frames and covers on applicable top sections
to elevation shown on Drawings or as directed. Use
cast-in-place concrete (min. 150 mm thickness) or
-

- 3.3 INSTALLATION (Cont'd)
- .9 (Cont'd)
cast-in-place concrete with 15 M reinforcing bar in centre (for adjustments between 75 mm and 150 mm) or "Rapid-Set" or "Set-45" epoxy mortar (between 20 mm and 75 mm). Cast-in-place concrete shall not exceed the outside edge of the capping ring.
- .10 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
- .11 Apply waterproofing for sanitary manholes as indicated and in accordance with Section 07 11 00.
- 3.4 SYSTEM CLEANLINESS
- .1 Upon manhole adjustment, removal of catchment device and all works associated with restoration around the manhole, the contractor shall provide all testing equipment, labour, incidentals, traffic control, etc., required to undertake an inspection of the system to verify its cleanliness. This inspection must be done in the presence of the Departmental Representative.
- 3.5 LEAKAGE TEST
- .1 Install watertight plugs or seals on inlets and outlets of each unit and fill with water. Allow 24 hours for absorption of water into concrete and top up before testing. Leakage not to exceed 0.3% per hour of volume of unit.
- .2 If permissible leakage is exceeded, correct defects. Repeat until acceptable to Departmental Representative.

PART 1 - GENERAL

- 1.1 RELATED WORK
- .1 Trenching, Backfilling and Backfilling: Section 31 23 10
 - .2 Manholes, Catchbasins and Structures: Section 33 39 00
- 1.2 REFERENCES
- .1 ASTM C1433-10, Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers.
 - .2 CSA B1800-06, Thermoplastic Nonpressure Piping Compendium.
 - .3 CAN/CSA A257 Series-09, Concrete Pipe and Manhole Sections.

PART 2 - PRODUCTS

- 2.1 GENERAL
- .1 Use PVC pipe for storm sewers up to and including 300 mm nominal diameter.
 - .2 Use concrete pipe for all storm sewers greater than 300 mm nominal diameter.
- 2.2 PVC PIPE
- .1 Pipe and Fittings: Type PSM Polyvinyl Chloride to CSA B1800, DR35.
 - .2 Catch Basin Leads: Type PSM Polyvinyl Chloride to CSA B1800, DR35.
 - .3 Joints: bell and spigot with locked-in rubber gasket.
- 2.3 CONCRETE PIPE
- .1 Reinforced concrete pipe to CAN/CSA-A257, diameter as indicated, minimum strength classification as follows:
 - .1 Up to 750mm nominal diameter: 65D
 - .2 Greater than 750mm nominal diameter: 100D
-

2.4 PIPE BEDDING MATERIAL .1 Granular bedding material: as specified in Section 31 23 10.

PART 3 - EXECUTION

3.1 PREPARATION .1 Clean pipes and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects. Remove defective materials from site.
.2 Provide proper implements, tools and facilities approved by the Departmental Representative for the safe and convenient prosecution of the work. Take every precaution to prevent foreign material from entering pipe.

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

3.3 GRANULAR BEDDING .1 Provide granular bedding to Section 31 23 10.

3.4 PIPE LAYING .1 Carefully lower pipe into the trench. Do not drop or dump materials into the trench.
.2 Firmly and accurately set pipe to line and elevation on bedding material to the depth shown on the Drawings.
.3 Check profiles at the commencement of work. Confirm grades and depths. Any variation shall be made only at the order of the Departmental Representative. Set line of pipe and set elevation by a method approved by the Departmental Representative.
.4 Start laying of the pipe at the lowest pipe and lay upgrade unless approved otherwise by the Departmental Representative.
.5 Do not lay pipe when the trench bottom is frozen or underwater or when trench conditions or weather are unsuitable.
.6 Temporarily support all pipe during assembly and install fittings in a manner to ensure pipe is not

3.4 PIPE LAYING
(Cont'd)

- .6 (Cont'd)
strained during jointing procedure. Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .7 Whenever it is necessary to cut pipe to fit into pipeline, do this work and provide materials at no extra cost to the Contract. No extra compensation will be considered for cutting of pipe or for placing cut pipe in the pipeline.

3.5 PIPE
JOINTING

- .1 Align pipes carefully before jointing.
- .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gaskets and maintain concentricity until gaskets are properly positioned.
- .3 Maintain pipe joints clean and free from foreign materials.
- .4 Complete each joint before laying next length of pipe.
- .5 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations. Minimize deflection after joint has been made to avoid damage.
- .6 Connections to manholes, catch basins and structures to be watertight and structurally sound, all as specified in Section 33 39 00.

3.6 PIPE
CLEANING

- .1 Leave internal parts of storm sewer in clean condition.
- .2 Remove debris by scraping, dragging, brushing, picking or flushing as required.

3.7 DEFLECTION
TESTING - PLASTIC
PIPE

- .1 Measure deflection by pulling deflection gauge through each pipe from manhole to manhole after backfilling.
- .2 Provide deflection gauges to measure a 5% and 7-1/2% deflection. Gauges to be a "Go-No-Go" device.
- .3 Thirty (30) days after installation, pull a deflection gauge measuring 5% deflection through the

-
- 3.7 DEFLECTION TESTING - PLASTIC PIPE
(Cont'd)
- .3 (Cont'd)
installed section of pipeline. If this test fails proceed with 7-1/2% deflection test.
- .4 Thirty (30) days prior to completion of warranty period, pull a deflection gauge measuring 7-1/2% deflection through the installed section of pipeline.
- .5 If a 7-1/2% deflection test fails, locate defect and repair. Retest to satisfaction of Departmental Representative.
- 3.8 CLOSED CIRCUIT TELEVISION INSPECTION
- .1 Arrange and pay for television camera inspection of installed pipeline.
- .2 Scheduling:
.1 The video inspection will be first performed when the storm sewer has been cleaned and all manhole adjustments and street reinstatement have been completed.
.2 The entire system will also be video inspected a second time eleven months after substantial completion.
- .3 Equipment:
.1 Provide equipment meeting following requirements:
.1 Self-contained monitoring unit and camera with remotely controlled lighting system capable of varying the illumination.
.2 Picture quality shall produce continuous 600-line resolution picture, showing entire periphery of pipe.
.3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
- .4 Definition of fault:
.1 Any 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.
-

3.8 CLOSED CIRCUIT .5
TELEVISION
INSPECTION
(Cont'd)

Inspection:

.1 Perform inspection of pipe from manhole to manhole by passing TV camera through sewer in direction of flow.

.6 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 using a digital camera or provide hard copy stills directly from TV system if possible. All photographs to be clear and precise with distinct definition of fault.

.4 Include detailed technical description with photographs as supporting data for each fault.

.5 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.

.7 Reports:

.1 Provide a composite report of TV inspection. Enclose report in binder on letter size paper. Include following pages and information.

.1 Title page identifying project, camera operator and dates of inspection.

.2 Index page identifying 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.

- 3.8 CLOSED CIRCUIT .7 Reports:(Cont'd)
TELEVISION .3 (Cont'd)
INSPECTION .3 Inspection findings for each sewer main
(Cont'd) 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 photograph to correspond with description
number.
.5 Enclose all pages of report in transparent
sheet protector.
- .8 Accuracy:
.1 Maximum permissible error in accuracy to be
within following limits of fault location:
.1 Up to 375mm pipe: $\pm 75\text{mm}$ per 100m of
length.
.2 450mm - 600mm pipe: $\pm 150\text{mm}$ per 100 m of
length.
.3 750mm and greater pipe: $\pm 225\text{mm}$ per 100m
of length.
- .9 Video Tapes:
.1 Supply a complete record of all inspections on
VHS format video tape.
.2 Index all tapes, listing sections of
inspections.
.3 Submit video tapes with written reports to
Departmental Representative.
- .10 Repeat Inspection:
.1 Repair faults detected during television
inspection. Repeat television inspection at no cost
to the Departmental Representative.