

The Executed Agreement including General Conditions and Supplementary Conditions, Division 01, applicable drawings and amendments are part of and are to be read in conjunction with this Section.

## **1 GENERAL**

### **1.01 SECTION INCLUDES**

- .1 Materials and installation for water mains, hydrants, valves, valve boxes, and valve chambers, including service connections.

### **1.02 RELATED SECTIONS**

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 77 00 - Contract Closeout Procedures and Submittals
- .3 Section 31 23 33 - Excavating, Trenching and Backfilling
- .4 Section 03 20 00 - Concrete Reinforcement
- .5 Section 03 30 00 - Cast-in-Place Concrete

### **1.03 REFERENCES**

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA B300-10 (with AWWA B3004-11), Hypochlorites.
  - .2 ANSI/AWWA B301-10, Liquid Chlorine.
  - .3 ANSI/AWWA B303-05, Sodium Chlorite.
  - .4 ANSI/AWWA C104/A21.4-08, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
  - .5 ANSI/AWWA C105/A21.5-10, Polyethylene Encasement for Ductile-Iron Pipe Systems.
  - .6 ANSI/AWWA C111/A21.11-12, Rubber-Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings.
  - .7 ANSI/AWWA C110/A21.10-12, Ductile-Iron and Gray Iron Fittings, 3 inch through 48 inch (75 mm through 1200 mm), for Water.
  - .8 ANSI/AWWA C150/A21.50-2008, Thickness Design of Ductile-Iron Pipe.
  - .9 ANSI/AWWA C151/A21.51-09, Ductile-Iron Pipe,

- Centrifugally Cast, for Water.
- .10 ANSI/AWWA C153/A21.53-11, Ductile-Iron Compact Fittings for Water Service.
  - .11 ANSI/AWWA C200-12, Steel Water Pipe - 6 in (150 mm) and Larger.
  - .12 ANSI/AWWA C203-08, Coal Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
  - .13 ANSI/AWWA C205-12, Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 Inch (100 mm) and Larger - Shop Applied.
  - .14 ANSI/AWWA C206-11, Field Welding of Steel Water Pipe.
  - .15 ANSI/AWWA C207-07, Steel Pipe Flanges for Waterworks Service, 4 Inch through 144 Inch (100 mm through 3,600 mm).
  - .16 ANSI/AWWA C208-12, Dimensions for Fabricated Steel Water Pipe Fittings.
  - .17 ANSI/AWWA C300-11, Reinforced Concrete Pressure Pipe, Steel-Cylinder Type.
  - .18 ANSI/AWWA C301-07, Prestressed Concrete Pressure Pipe, Steel-Cylinder Type.
  - .19 ANSI/AWWA C303-08, Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type.
  - .20 ANSI/AWWA C500-09, Metal-Seated Gate Valves for Water Supply Service.
  - .21 ANSI/AWWA C504-10, Rubber-Seated Butterfly Valves.
  - .22 ANSI/AWWA C600-10, Installation of Ductile-Iron Water Mains, and Their Appurtenances.
  - .23 ANSI/AWWA C602-11, Cement-Mortar Lining of Water Pipelines - 4 In. (100 mm) and Larger.
  - .24 ANSI/AWWA C603-05 Installation of Asbestos Cement Pressure Pipe.
  - .25 ANSI/AWWA C651-05, Disinfecting Water Mains.
  - .26 ANSI/AWWA C800-05, Underground Service Line Valves and Fittings (Also Included: Collected Standards for Service Line Materials).
  - .27 ANSI/AWWA C900-07, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch

through 12 Inch (100 mm - 300 mm), for Water Distribution.

- .2 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM A 53/A 53M-12, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.
  - .2 ASTM A 307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
  - .3 ASTM B 88-05(2011), Standard Specification for Seamless Copper Water Tube Metric.
  - .4 ASTM C 117-13, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
  - .5 ASTM C 136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .6 ASTM C 478M-13, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.
  - .7 ASTM D 698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m<sup>3</sup>)).
  - .8 ASTM D 2310-06(2012), Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
  - .9 ASTM D 2657-07, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
  - .10 ASTM D 2992-12, Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fitting.
  - .11 ASTM D 2996-01(2007)e1, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting Resin) Pipe.
  - .12 ASTM F 714-12a, Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
  - .13 ASTM C 618-12a, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for

- Use as a Mineral Admixture in Concrete.
- .3 American Water Works Association (AWWA)/Manual of Practice
    - .1 ANSI/AWWA M9-08, Concrete Pressure Pipe.
    - .2 ANSI/AWWA M11-04, Steel Pipe - A Guide for Design and Installation.
    - .3 AWWA M17-06, Installation, Field Testing, and Maintenance of Fire Hydrants.
  - .4 Canadian General Standards Board (CGSB)
    - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
    - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
    - .3 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
    - .4 CGSB 41-GP-25M-12, Pipe, Polyethylene, for the Transport of Liquids.
  - .5 Canadian Standards Association (CSA International)
    - .1 CAN/CSA-A257 Series-09, Standards for Concrete Pipe.
    - .2 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A2005).
      - .1 CAN/CSA A3002, Masonry and Mortar Cement.
    - .3 CSA B137 Series-09, Thermoplastic Pressure Piping Compendium. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
      - .1 CSA B137.1, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
      - .2 CSA B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
      - .3 CAN/CSA-G30.18-09, Carbon Steel Bars for Concrete Reinforcement, includes update No. 1 (2012).
      - .4 CAN/CSA-G164-M92(R2002) Hot Dip Galvanizing of Irregularly Shaped Articles.
  - .6 Department of Justice Canada (Jus)
    - .1 Canadian Environmental Protection Act, 1999 (CEPA).

- .7 Transport Canada (TC)
  - .1 Transportation of Dangerous Goods Act, 1992 (TDGA).
- .8 The Master Painters Institute (MPI)
  - .1 Architectural Painting Specification Manual.
- .9 Underwriters' Laboratories of Canada (ULC)
  - .1 CAN/ULC-S520-07, Hydrants.
  - .2 CAN4-S543-09, Internal-Lug, Quick Connect Couplings for Fire Hose.
- .10 Design and Construction Specifications, Municipal of East Hants.

#### **1.04 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.
- .3 Pipe certification to be on pipe.

#### **1.05 CLOSEOUT SUBMITTALS**

- .1 Provide record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, location of air and vacuum release valves, hydrant details, maintenance and operating instructions in accordance with Section 01 77 00 - Contract Closeout Procedures and Submittals.
  - .1 Include top of pipe, horizontal location of fittings and type, valves, valve boxes, valve chambers and hydrants.

#### **1.06 WASTE MANAGEMENT AND DISPOSAL**

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal, paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with the Waste Management Plan.
- .3 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic, waste in accordance with the Waste Management Plan.

- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, and Regional and Municipal regulations.
- .6 Ensure emptied containers are sealed and stored safely.
- .7 Divert unused metal and wiring materials from landfill to metal recycling facility to the satisfaction of Departmental Representative.
- .8 Divert unused concrete materials from landfill to local facility to the satisfaction of Departmental Representative.
- .9 Dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials.
- .10 Divert unused aggregate materials from landfill to facility to the satisfaction of Departmental Representative.
- .11 Dispose of unused disinfection material at official hazardous material collections site to the satisfaction of Departmental Representative.
- .12 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other locations where they will pose health or environmental hazard.
- .13 Fold up metal banding, flatten and place in designated area for recycling.

#### **1.07 SCHEDULING OF WORK**

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions to Departmental Representative for consent and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative minimum of 48 h in advance of interruption in service.
- .4 Do not interrupt water service for more than 3 h and confine this period between 10:00 and 16:00 h local time unless otherwise authorized.

- .5 Notify HRM fire department of any planned or accidental interruption of water supply to hydrants.
- .6 Provide "Out of Service" sign on hydrant not in use.
- .7 Advise local police department of anticipated interference with movement of traffic.

## **2 PRODUCTS**

### **2.01 PIPE, JOINT, AND FITTINGS**

- .1 Ductile Iron Pipe: to AWWA C151, cement mortar lined.
- .2 Fittings: to AWWA C110 or C153, cement mortar lined, minimum pressure rating 1035 kPa for cast, 1720 for ductile.
- .3 Cement Mortar Lining: to AWWA C104. Provide internal seal coat unless otherwise required by Project Documents.
- .4 Joints: gasketed mechanical or push-on to AWWA C111; flanged where indicated, to AWWA C110 with Class 125 flanged ends to ANSI/ASME B16.1.

### **2.02 VALVES AND VALVE BOXES**

- .1 Valves to open in same direction as local standard.
- .2 Gate valves: to ANSI/AWWA C500-02, standard iron body, bronze mounted wedge valves with non-rising stems, suitable for 1.0 MPa with mechanical joints.
- .3 Valve Box: composite or cast iron; three piece sliding type adjustable over minimum of 450 mm complete with valve operating extension rod, 30 mm minimum diameter, 25 x 25 mm cross section, of such length that when set on valve operating nut top of rod will not be more than 150 mm below cover.
  - .1 Base to be large round type with minimum diameter of 300 mm.
  - .2 Top of box to be marked "SERVICE" & "SPRINKLER".

### **2.03 HYDRANTS**

- .1 Hydrants: dry barrel type, to AWWA C502, designed for working pressure of 1035 kPa with two 65 mm threaded hose outlets, one 100 mm threaded pumper connection, 150 mm riser barrel, 134 mm minimum diameter main valve and 150 mm mechanical joint inlet connection.

Hydrants to open in direction indicated in Halifax Water Specifications with an operating nut 32 mm square, threads to local connect to CAN4-S543. Provide metal caps. Depth of bury 1.8 m minimum to top of pipe. Provide two hose and one pumper nozzles. Hose nozzles to be two 2.5 inch nozzles, nominal size 3 7/32 inch with 5 threads/inch. Pumper nozzle to be nominal size 4 29/32 inch with 6 threads/inch. Nozzles to be Storz type.

- .2 Hydrant paint: exterior enamel to CAN/CGSB-1.88-92. Colour: to match existing hydrants on site.

#### **2.04 PIPE BEDDING AND SURROUND MATERIAL**

- .1 As indicated and in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

#### **2.05 BACKFILL MATERIAL**

- .1 As indicated and in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

#### **2.06 PIPE DISINFECTION**

- .1 Liquid chlorine to ANSI/AWWA B303-05 to disinfect water mains or as required by local practices for procedure.
- .2 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

#### **2.07 ANODE PACKS**

- .1 Zinc Anodes (ZN 24-48) complete with Clamps.

#### **2.08 THRUST RESTRAINTS**

- .1 Thrust blocks and Anchors: 20 MPa concrete and 15 M, grade 400 reinforcing steel where indicated on drawings and in Standard Specifications for Municipal Services (Latest Edition).

#### **2.09 SERVICE PIPE AND FITTINGS**

- .1 Copper tubing: to ASTM B88, type k annealed, minimum pressure rating 1035 kPa.
- .2 Joints: Compressure type, minimum pressure rating 1035 kPa.
- .3 Corporation stop: brass to ASTM B62 and NSF 61-G, compression type, inlet threads to AWWA C800.



- .4 Curb Stop and drain: brass to ASTM B62, and NSF 61-G, compression type joints and O-ring seal.
- .5 Service clamp: bronze body, confined O-ring seal cemented in place and straps suitable for connecting main. Outlet tapped and threaded to AWWA C800.
- .6 Service Box: adjustable type, cast iron bottom section, cast iron Lid with recessed pentagon nut and internal stem to suit depth of bury. Service box to have appropriate foot piece.

### **3 EXECUTION**

#### **3.01 PREPARATION**

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

#### **3.02 TRENCHING**

- .1 Do trenching work in accordance with Section 31 23 33 - Excavating Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe of a minimum of 1.6 m and a maximum depth of 2.0 m below finished grade or as indicated, where minimum cover is not possible, insulate pipe.
- .3 Trench alignment and depth to be to the satisfaction of Departmental Representative prior to placing bedding material and pipe.

#### **3.03 GRANULAR BEDDING**

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Do not use blocks when bedding pipe.
- .5 Shape transverse depressions in bedding as required to

suit joints.

- .6 Compact each layer full width of bed to at least 100% Corrected Maximum Dry Density to ASTM D 698.
- .7 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33 - Excavating Trenching and Backfilling with compacted bedding material.

### **3.04 INSTALLATION**

- .1 Lay pipes to ANSI/AWWA C600-10 and manufacturer's standard instructions and specifications. Do not use blocks except as specified.
- .2 Join pipes in accordance with ANSI/AWWA C600-10 and manufacturer's recommendations.
- .3 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
  - .2 Take up and replace defective pipe.
  - .3 Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3m.
- .5 Face socket ends of pipe in direction of laying. For mains on grade of 2% or greater, face socket ends up-grade.
- .6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .7 Keep jointing materials and installed pipe free of dirt and water and other foreign materials.
  - .1 Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Position and join pipes with equipment and methods to the satisfaction of Departmental Representative.
- .9 Cut pipes in approved manner as recommended by pipe manufacturer, without damaging pipe or its coating and

- to leave smooth end at right angles to axis of pipe.
- .10 Align pipes before jointing.
  - .11 Install gaskets to manufacturer's recommendations.  
Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
  - .12 Avoid displacing gasket or contaminating with dirt or other foreign material.
    - .1 Remove disturbed or contaminated gaskets.
    - .2 Clean, lubricate and replace before jointing is attempted again.
  - .13 Complete each joint before laying next length of pipe.
  - .14 Minimize deflection after joint has been made.
  - .15 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
  - .16 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or to the satisfaction of Departmental Representative.
  - .17 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
  - .18 Do not lay pipe on frozen bedding.
  - .19 Do hydrostatic and leakage test and have results to the satisfaction of Departmental Representative in accordance with Nova Scotia Standard Specifications for Municipal Services Halifax Water Standards.
  - .20 Backfill remainder of trench.
  - .21 Place watermain pipe so that mid-point of a full length of pipe is over any other pipe crossing at all times.
  - .22 Where pipes cross with less than 150 mm clear vertical between them, place a 300 x 300 mm pad of 50 mm extruded polystyrene insulation between them.
  - .23 Install zinc anodes on all bends, tees, valves, hydrant bases and copper service connections.

### **3.05 VALVE INSTALLATION**

- .1 Install valves to manufacturer's recommendations at locations as indicated.

- .2 Support valves located in valve boxes or valve chambers by means of bedding same as adjacent pipe. Maximum length of pipe on each end of valve shall be 1 m. Valves not to be supported by pipe.
- .3 Install zinc anodes on all valves.

### **3.06 HYDRANTS**

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

### **3.07 THRUST BLOCKS AND RESTRAINED JOINTS**

- .1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or to the satisfaction of Departmental Representative.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 Only use restrained joints to the satisfaction of Departmental Representative.

### **3.08 HYDROSTATIC AND LEAKGE TESTING**

- .1 Do tests in accordance with Standard Specifications for Municipal Services, Latest Edition. Test Pressure shall be minimum 200 PSI.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Departmental Representative at least 24 hours in advance of proposed tests. Perform tests in presence of Departmental Representative.
- .4 Where section of system is provided with concrete thrust blocks, conduct tests at least 5 days after placing concrete or 2 days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365 m in length, unless otherwise authorized by Departmental Representative.
- .6 Open valves.
- .7 Expel air from main by slowly filling main with potable water.
  - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
  - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .8 Thoroughly examine exposed parts and correct for leakage as necessary.
- .9 Apply hydrostatic test pressure at 200psi for period of 2 hours. No pressure drop is permitted.
- .10 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .11 Repeat hydrostatic test until defects have been corrected.
- .12 Locate and repair defects if leakage is detected.
- .13 Repeat test until leakage is no longer detected.

### **3.09 PIPE SURROUND**

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying and after Departmental Representative is satisfied with Work in place,

- surround and cover pipes as indicated.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
    - .1 Do not dump material within 0.5 m of pipe.
  - .4 Place layers uniformly and simultaneously on each side of pipe.
  - .5 Compact each layer from pipe invert to mid height of pipe to at least 100% Corrected Maximum Dry Density to ASTM D 698.
  - .6 Compact each layer from mid height of pipe to underside of backfill to at least 100% Corrected Maximum Dry Density to ASTM D 698.

### **3.10 BACKFILL**

- .1 Place backfill in unfrozen condition.
- .2 Place backfill material, above pipe surround, in lifts compatible with compaction equipment (not to exceed 300 mm), up to grades as indicated.
- .3 Compact backfill in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

### **3.11 PAINTING OF HYDRANTS**

- .1 After installation, paint hydrants as approved by authority having jurisdiction.
- .2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

### **3.12 FLUSHING AND DISINFECTING**

- .1 Flushing and disinfecting operations: witnessed by Departmental Representative.
  - .1 Notify Departmental Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.

.3 Flushing flows as follows:

Pipe Size NPS	Flow (L/s) Minimum
6 and below	18
8	75
10	115
12	150

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .6 When flushing has been completed to Departmental Representatives satisfaction, introduce strong solution of chlorine as to the satisfaction of Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .7 Rate of chlorine application to be proportional to rate of water entering pipe.
- .8 Chlorine application to be close to point of filling water main and to occur at same time.
- .9 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .10 Flush line to remove chlorine solution after 24 hours.
- .11 Measure chlorine residuals at extreme end of pipe-line being tested, use purpose specific testing ports for sampling, not fire hydrants.
- .12 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
  - .1 Take samples daily for minimum of two days and test at a Certified Health Lab.
  - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.

- .13 Take water samples at purpose specific and service connections, in suitable sequence, to test for chlorine residual.
- .14 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
  - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

### **3.13 SURFACE RESTORATION**

- .1 After installing and backfilling over water mains, restore surface to original condition to the satisfaction of Departmental Representative.

END OF SECTION



The Executed Agreement including General Conditions and Supplementary Conditions, Division 01, applicable drawings and amendments are part of and are to be read in conjunction with this Section.

## **1 GENERAL**

### **1.01 SECTION INCLUDES**

- .1 Materials and installation for gravity sewers.

### **1.02 RELATED SECTIONS**

- .1 Section 31 23 33 - Excavating Trenching and Backfilling
- .2 Section 32 31 13 - Reinstatement
- .3 Section 03 30 00 - Cast-in-Place Concrete

### **1.03 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ASTM C 117-13, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D 698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft<sup>4</sup>-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>)).
  - .4 ASTM D 3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
  - .3 Canadian Standards Association (CSA International).
    - .1 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

- .2 CSA B1800-11, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
- .1 CSA B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.
- .2 CSA B182.2, PVC Sewer Pipe and Fittings (PSM Type).
- .3 CSA B182.11, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

#### **1.04 DEFINITIONS**

- .1 Pipe section is defined as length of pipe between successive manholes and/or between manhole and any other structure which is part of sewer system.

#### **1.05 SUBMITTALS**

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform the Departmental Representative at least 2 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- .3 Ensure certification is marked on pipe.

#### **1.06 SCHEDULING**

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

### **2 PRODUCTS**

#### **2.01 PLASTIC PIPE**

- .1 Type PSM Polyvinyl Chloride (PVC): to CSA-B182.2-11.
  - .1 Standard Dimensional Ratio (SDR): 28 for pipe

equal to or less than 150mm in diameter, 35 for a pipe greater than 150mm diameter.

- .2 Locked-in gasket and integral bell system.
- .3 Nominal lengths: 6 m.

## **2.02 SERVICE CONNECTIONS**

- .1 Type PSM Poly (Vinyl) Chloride: to CSA-B182.2-11.
- .2 Plastic pipe: to CSA B182.1-95, with push-on joints.

## **2.03 CEMENT MORTAR**

- .1 Portland cement: to CSA A8/A5/A362-93.
- .2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry.
  - .1 Add only sufficient water after mixing to give optimum consistency for placement.
  - .2 Do not use additives.

## **2.04 PIPE BEDDING AND SURROUND MATERIAL**

- .1 As indicated and in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.
- .2 Concrete mixes and materials for cradles, encasement, supports to Section 03 30 00 - Cast-in-Place Concrete.

## **2.05 BACKFILL MATERIAL**

- .1 As indicated and in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

# **3 EXECUTION**

## **3.01 PREPARATION**

- .1 Clean and dry pipes and fittings before installation.
- .2 Pipes and fittings to be to the satisfaction of the Departmental Representative prior to installation.

## **3.02 TRENCHING**

- .1 Do trenching work in accordance with Section 31 23 33 - Excavating Trenching and Backfilling.
- .2 Do not allow contents of any sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth to be to the satisfaction of Departmental Representative prior to placing bedding material and pipe.

### **3.03 GRANULAR BEDDING**

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layer, not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
- .4 Do not use blocks when bedding pipe.
- .5 Shape transverse depressions in bedding as required to suit joints.
- .6 Compact each layer full width of bed to at least 100% Corrected Maximum Dry Density to ASTM D 698.
- .7 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted Type 2 gravel to 100% Corrected Maximum Dry Density to ASTM D 698.

### **3.04 INSTALLATION**

- .1 Lay and join pipes in accordance with manufacturer's recommendations and to satisfaction of the Departmental Representative.
- .2 Handle pipe using methods to the satisfaction of the Departmental Representative.
  - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer and only deflect pipe joints with the approval of the Departmental Representative.
- .6 Do not allow water to flow through pipe during construction, except as may be permitted by the Departmental Representative.
- .7 Whenever Work is suspended, install removable

- watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
  - .9 Pipe jointing:
    - .1 Install gaskets in accordance with manufacturer's recommendations.
    - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
    - .3 Align pipes before joining.
    - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
    - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
    - .6 Complete each joint before laying next length of pipe.
    - .7 Minimize joint deflection after joint has been made to avoid joint damage.
    - .8 At rigid structures, install pipe joints not more than 0.45 m from side of structure.
    - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
  - .10 When stoppage of Work occurs, block pipes to the satisfaction of the Departmental Representative to prevent creep during down time.
  - .11 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
  - .12 Make watertight connections to manholes
    - .1 As indicated;
    - .2 Pipe to manhole connecting gaskets to manufacturers specifications and recommendations;
    - .3 Use shrinkage compensating grout when suitable

gaskets are not available.

### **3.05 PIPE SURROUND**

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after the Departmental Representative is satisfied with pipe joints, surround and cover pipes and backfill to grade.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .4 Do not dump material within 0.5 m of pipe.
- .5 Place layers uniformly and simultaneously on each side of pipe.
- .6 Compact each layer from pipe invert to depth as indicated at least 100% Corrected Maximum Dry Density to ASTM D 698.
- .7 Compact each layer from mid height of pipe to underside of backfill to at least 100% Corrected Maximum Dry Density to ASTM D 698.

### **3.06 BACKFILL**

- .1 Place backfill in unfrozen condition.
- .2 Place backfill material, above pipe surround, in lifts compatible with compaction equipment (not to exceed 300 mm), up to grades as indicated.
- .3 Compact backfill in accordance with Section 31 23 33 - Excavating, Trenching and Backfilling.

### **3.07 FIELD TESTING**

- .1 If water used for flushing or testing is obtained from a potable water supply, the potable water supply is to be continuously separated from the service being flushed or tested by an air gap or a level or protection equal to or greater than that provided by a double check valve backflow prevention device.
- .2 Test each section of sewer. A section is the length of pipe between successive manholes or termination points, including service connections to the street

- line or termination point.
- .3 Provide labour, equipment and materials required to perform testing.
  - .4 Notify the Departmental Representative at least 24 hours in advance of all proposed tests. Perform tests in presence of the Departmental Representative.
  - .5 Flush sewers and related appurtenances to remove foreign materials.
  - .6 Exfiltration test:
    - .1 Fill section with water to displace air from main and service connections. Fill section. No increase in infiltration rate will be allowed if head exceeds 750 mm.
    - .2 Install watertight plug at upstream end of section.
    - .3 Discontinue dewatering minimum of 3 days before taking test measurements.
    - .4 Place 90-degree 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.
  - .7 Allowable leakage: determined by the following formula:

$$L = F \times D \times S / 100$$

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 mm of diameter per 100 metres of sewer):

Exfiltration Test: Porous Pipe F = 0.12 litre

Non-Porous Pipe F = 0.02 litre

Infiltration Test: Porous Pipe F = 0.10 litre

Non-Porous Pipe F = 0.02 litre

- .8 Low Pressure Air Testing Caution: for safety of personnel and public, observe proper precautions during air testing. Use test equipment designed to

- operate aboveground. Do not permit personnel in trench during testing. Do not air test pipe with diameter greater than 600 mm .
- .9 Provide air testing equipment meeting the following requirements:
    - .1 Air testing equipment meeting the following requirements.
    - .2 Air Blower: 14 litres/sec, maximum pressure 70 kPa continuous.
    - .3 Pressure Relief Valve: Sized to relieve full blower capacity at maximum blower pressure. Range 20 - 70 kPa, adjustable.
    - .4 Pressure Gauges: Range 0 to 70 kPa with accuracy +/- 0.25 kPa.
  - .10 Provide plugs at each end of section, with one plug equipped for air inlet connection.
  - .11 Fill test section slowly until a constant pressure of 28 kPa is reached. If ground water is above section being tested, the Departmental Representative may recommend increase in air pressure.
  - .12 Allow minimum 2 minutes for air temperature to stabilize, adding only amount of air required to maintain pressure.
  - .13 After 2 minute period, shut off air supply.
  - .14 Decrease pressure to 24 kPa. Measure time required for pressure to reach 17 kPa. Minimum time allowed for pressure drop is as follows: Pipe Diameter (mm)  
Minimum Time Min:Sec 100 1:53 150 2:50 200 3:47 250 4:43 300 5:40 375 7:05 450 8:30 525 9:55 600 11:20.
  - .15 Locate and repair defects if test fails. Retest.
  - .16 Repair visible leaks regardless of test results.

### 3.08 DEFLECTION TESTING

- .1 Conduct closed circuit television inspection procedures to meet North American Association of Pipeline Inspectors (NAAPI) and the WRC Standard.
- .2 Equipment:
  - .1 Provide equipment meeting following requirements:
    - .1 Self-contained monitoring unit and pan-tilt



- camera with remotely controlled lighting system capable of varying the illumination.
- .2 Picture quality shall produce continuous 600-line resolution picture, showing entire periphery of pipe.
- .3 A meter device with readings above ground or marking on cable to clearly identify exact location of camera.
- .3 Inspection:
  - .1 Perform inspection of pipe from manhole to manhole by passing TV camera through sewer in direction of flow.
  - .2 Classify results in accordance with North American Pipeline Inspectors (NAAPI) and WRC Standard.
- .4 Records:
  - .1 Maintain inspection record in log form, during television inspection.
  - .2 Log to include location of each fault and fitting distance measured from centreline of reference manhole and position referenced to axis of pipe.
  - .3 Photograph fault from the television screen. All photographs to be clear and precise with distinct definition of fault.
  - .4 Include detailed technical description with photographs as supporting data for each fault.
  - .5 All photos and videos to be in colour.
- .5 Reports:
  - .1 Provide a composite report of TV inspection. Enclose report in binder on letter size paper. Include following pages and information:
    - .1 Title page identifying project, camera operator and dates of inspection.
    - .2 Index page identifying street name, section from manhole to manhole, page number or numbers where information for section is contained.
  - .2 Organize inspection records in sequence from upstream manhole to downstream manhole.
  - .3 Report on each sewer main section to contain:

- .1 Heading:
  - .1 Street name.
  - .2 Manhole numbers applicable to section.
  - .3 Reference drawing number, if applicable.
  - .4 Weather on the day of inspection.
  - .5 Statement of soil condition in area of inspection, i.e., dry, damp, wet, frozen.
  - .6 Date of inspection.
- .2 Key Plan, showing corresponding manhole numbers, magnetic north, horizontal distance, pipe and material between manholes, and direction of flow .
- .3 Inspection findings for each sewer main section to include:
  - .4 Location of all faults.
  - .5 Photographs of all faults.
  - .6 Location of all service laterals.
- .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 Accuracy:
  - .1 Maximum permissible error in accuracy to be within following limits of fault location:
    - .1 Up to 375 mm pipe:  $\pm 75$  mm per 100 m of length
    - .2 450 mm - 600 mm pipe:  $\pm 150$  mm per 100 m of length.
    - .3 750 mm - 900 mm pipe:  $\pm 225$  mm per 100 m of length.
- .7 Video Tapes:
  - .1 Supply a complete record of all inspections on digital format.
  - .2 Index all tapes, listing sections of inspections.
  - .3 Submit DVD/CD's with written reports to the

Departmental Representative.

.8 Repeat Inspection:

.1 Repair faults detected during television inspection. Repeat television inspection at no cost to Departmental Representative.

END OF SECTION

**Part 1 General****1.1 REFERENCES**

- .1 Canadian Standards Association (CSA International):
  - .1 CSA C22.2 No. 211.1-06, Rigid Types EBI and DB2/ES2 PVC Conduit.

**1.2 SUBMITTALS**

- .1 Provide submittals in accordance with Section 01 00 01 - Project Specific General Requirements.
- .2 Product Data:
  - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Submit two (2) copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 00 01 - Project Specific General Requirements.
- .3 Quality assurance submittals: submit following in accordance with Section 01 00 01 - Project Specific General Requirements.

**1.3 DELIVERY, STORAGE AND HANDLING**

- .1 Packing, shipping, handling and unloading:
  - .1 Deliver, store and handle materials in accordance with Section 01 00 01 - Project Specific General Requirements with manufacturer's written instructions.
- .2 Waste Management and Disposal:
  - .1 Separate waste materials for reuse and recycling in accordance with Section 01 00 01 - Project Specific General Requirements.

**Part 2 Products****2.1 SUSTAINABLE REQUIREMENTS**

- .1 Materials and products in accordance with Section 01 00 01 - Project Specific General Requirements.

**2.2 PVC DUCTS AND FITTINGS**

- .1 Rigid PVC duct: to CSA C22.2 No. 211.1, with moulded fittings, for direct burial expanded flange ends:

- .1 Nominal length: 3.0m plus or minus 12mm.
- .2 Nominal wall thickness: 6mm
- .2 Rigid PVC split ducts.
- .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 degrees and 45 degrees bends.
- .5 Rigid PVC 5 degrees angle couplings.
- .6 Expansion joints every 40m and as required.

### **2.3 SOLVENT WELD COMPOUND**

- .1 Solvent cement for PVC duct joints.

### **2.4 CABLE PULLING EQUIPMENT**

- .1 1/4" stranded nylon pull rope tensile strength 5 kN.

### **2.5 MARKERS**

- .1 Cable markers: as indicated, with words: "Cable", "Joint" or "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

## **Part 3 Execution**

### **3.1 MANUFACTURER'S INSTRUCTIONS**

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

### **3.2 INSTALLATION**

- .1 Install conduit in accordance with manufacturer's instructions.
- .2 Clean inside of ducts before lying.
- .3 Ensure full, even support every 1.5m 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 steel mandrel not less than 300mm long and of diameter 6m less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter:
  - .1 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 3m spare rope at each end.
- .8 Install markers as required.

### **3.3 CLEANING**

- .1 Proceed in accordance with Section 01 00 01 - Project Specific General Requirements.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

**END OF SECTION**