

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 31 23 33.01 – Excavation, Trenching and Backfilling.

**1.2 REFERENCES**

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
  - .1 ANSI/AWWA C104/A21.4-13, Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
  - .2 ANSI/AWWA C110/A21.10-12, American National Standard for Ductile Iron and Gray Iron Fittings for Water.
  - .3 ANSI/AWWA C111/A21.11-12, American National Standard for Rubber Gasket-Joints for Ductile-Iron Pressure Pipe and Fittings.
  - .4 ANSI/AWWA C151/A21.51-09, AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.
  - .5 ANSI/AWWA C901-08, AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, Inch (13 mm) through 3 Inch (76 mm), for Water Service.
- .2 ASTM International
  - .1 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .3 Manufacturer's Standardization Society of the Valve and Fittings Industry
  - .1 MSS-SP-70-11, Gray Iron Gate Valves, Flanged and Threaded Ends.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for valves, couplings and mechanical joints and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 CLOSEOUT SUBMITTALS**

- .1 Submit in accordance with Section 01 78 00 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for materials for incorporation into manual.

**1.5 DELIVERY, STORAGE AND HANDLING**

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

- .3 Storage and Handling Requirements:
  - .1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect piping materials from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 22 – Construction/Demolition Waste Management and Disposal.

## **Part 2 Products**

### **2.1 PIPE**

- .1 Service water pipe: ductile iron cement mortar lined 1 m outside of building.
  - .1 Ductile iron: ANSI/AWWA C151/A21.51.
  - .2 Cement mortar lining for ductile iron pipe: ANSI/AWWA C104/A21.4.
  - .3 Polyethylene (PE) pipe: ANSI/AWWA C901.

### **2.2 FITTINGS**

- .1 NPS 3 and larger mechanical joints: to ANSI/AWWA C110/A21.10.

### **2.3 JOINTS**

- .1 Rubber gaskets for mechanical joints: to ANSI/AWWA C111/A21.11.
- .2 Bolts, nuts, hex head with washers: to ASTM A307, heavy series.

### **2.4 VALVES AND VALVE BOXES**

- .1 Gate valves and valve boxes are to be McAvity or approved equal and must meet requirements of the latest AWWA C509, standard iron body, double disc valves with non-rising stems, resilient seat, suitable for 1 MPa with mechanical joints. These shall have a 50mm square operating nut and centering wheel. They will open counter-clockwise and will have mechanical joints to be complete with component parts.
- .2 Cast iron valve boxes: bituminous coated sliding type adjustable over a minimum of 450 mm. Base to be large round type with minimum diameter of 350mm. Covers shall be Bibby VC-825 (112mm depth) and have sustainable opening for removal by pick axe. Top of value box to be clearly marked "WATER" (form part of the ion casting).
- .3 Composite value boxes shall be:
  - .1 Mueller MVB composite valve box or approved equal complete with 305mm or 686mm ductile-iron adjustable top and guide plate as per Detail drawing. Mueller adjustable valve box top (AJBC-5D) or approved equal, will be accepted for use with existing cast iron boxes for height adjustments under certain conditions, to be determined by the Engineer or his designate, providing that the top bell section of the cast iron valve box has been properly cut off to allow for fit.

**Part 3 Execution**

**3.1 EXAMINATION**

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

**3.2 INSTALLATION**

- .1 Install in accordance with Canadian Plumbing Code local authority having jurisdiction.
- .2 Piping cut square, reamed, free of cuttings and foreign material.
- .3 Minimum depth of bury: 1.50m, as indicated.
- .4 Lay buried piping in compacted washed sand in accordance with AWWA Class "B" bedding.
- .5 Where piping enters building, provide support, and seal against ingress of moisture; to approval of authority having jurisdiction.
- .6 Assemble piping using fittings manufactured to ANSI standards and in accordance with manufacturer's instructions.
- .7 Apply 1 layer of protective coating to buried piping.

**3.3 PRESSURE TESTING**

- .1 Conform to Section 21 05 01 – Common Work Results for Mechanical.

**3.4 DISINFECTION**

- .1 Co-ordinate with Section 22 11 16 – Domestic Water Piping.

**3.5 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 31 23 33.01 – Excavation, Trenching and Backfilling.

**1.2 MEASUREMENT AND PAYMENT**

- .1 All work within this section shall be included in the Lump Sum contract.

**1.3 REFERENCES**

- .1 ASTM International
  - .1 ASTM C117-04, Standard Test Method for Material Finer Than 75 MU m (No. 200) Sieve in Mineral Aggregates by Washing.
  - .2 ASTM C136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .3 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft<sup>4</sup>-lbf/ft<sup>3</sup> (600 kN-m/m).
  - .4 ASTM D3034-08, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
  - .5 ASTM D3350-10, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
- .2 CSA International
  - .1 CSA B1800-11, Thermoplastic Non-pressure Pipe Compendium.
    - .1 CSA B182.2-11, PSM Type Polyvinylchloride PVC Sewer Pipe and Fittings.
    - .2 CSA B182.11-11, Standard Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.

**1.4 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates:
  - .1 Certification to be marked on pipe.
- .4 Test and Evaluation Reports:
  - .1 Submit manufacturer's test data and certification 2 weeks minimum before beginning Work.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 22 – Construction/Demolition Waste Management and Disposal.
- .2 Place excess or unused insulation and insulation accessory materials in designated containers.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Dispose of unused adhesive material at official hazardous material collections site.
- .5 Place materials defined as hazardous or toxic in designated containers.

## **Part 2 Products**

### **2.1 PLASTIC PIPE**

- .1 Type PSM Polyvinyl Chloride (PVC): to ASTM D3034 or CSA B182.2.
  - .1 Standard Dimensional Ratio (SDR): 35.
  - .2 Locked-in gasket and integral bell system.
  - .3 Nominal lengths: 4 m.

### **2.2 PIPE BEDDING AND SURROUND MATERIALS**

- .1 Granular material to following requirements:
  - .1 Crushed or screened stone, gravel or sand.
  - .2 Gradations to be within limits specified when tested to ASTM C136 or ASTM C117.
- .2 Table:

| Sieve Designation | % Passing Stone/Gravel | % Passing Gravel/Sand |
|-------------------|------------------------|-----------------------|
| 200 mm            | -                      | -                     |
| 75 mm             | -                      | -                     |
| 50 mm             | -                      | -                     |
| 38.1 mm           | -                      | -                     |
| 25 mm             | 100                    | -                     |
| 19 mm             | -                      | -                     |
| 12.5 mm           | 65-90                  | 100                   |
| 9.5 mm            | -                      | -                     |
| 4.75 mm           | 35-55                  | 50-100                |
| 2.00 mm           | -                      | 30-90                 |
| 0.425 mm          | 10-25                  | 10-50                 |
| 0.180 mm          | -                      | -                     |
| 0.075 mm          | 0-8                    | 0-10                  |

- .3 Concrete mixes and materials for cradles, encasement, supports: to Section 03 30 00 – Cast-in-Place Concrete.

### **2.3 BACKFILL MATERIAL**

- .1 As indicated.
- .2 Type 3, in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .3 Unshrinkable fill: to Section 31 23 33.01 – Excavating, Trenching and Backfilling.

## **Part 3 Execution**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- .1 Temporary Erosion and Sedimentation Control:
  - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
  - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
  - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Clean pipes and fittings of debris and water before installation and remove defective materials from site to approval of Departmental Representative.
- .3 Clean and dry pipes and fittings before installation.
- .4 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

### **3.3 TRENCHING**

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

### **3.4 GRANULAR BEDDING**

- .1 Place bedding in unfrozen condition.

- .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
  - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% corrected maximum dry density.

### **3.5 INSTALLATION**

- .1 Lay and join pipes to: ASTM C12.
- .2 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .3 Handle pipe using methods approved by Departmental Representative.
  - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Joint deflection permitted within limits recommended by pipe manufacturer.
- .7 Water to flow through pipe during construction, only as permitted by Departmental Representative.
- .8 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .9 Install plastic pipe and fittings in accordance with CSA B182.11.
- .10 Pipe jointing:
  - .1 Install gaskets in accordance with manufacturer's written recommendations.
  - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
  - .3 Align pipes before joining.
  - .4 Maintain pipe joints free from mud, silt, gravel and foreign material.
  - .5 Avoid displacing gasket or contaminating with dirt or foreign material. Gaskets so disturbed to be removed, cleaned and lubricated and replaced before joining is attempted.
  - .6 Complete each joint before laying next length of pipe.
  - .7 Minimize joint deflection after joint has been made to avoid joint damage.
  - .8 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
  - .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

- .11 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .12 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.
- .13 Make watertight connections to manholes.
  - .1 Use shrinkage compensating grout when suitable gaskets are not available.

### **3.6 PIPE SURROUND**

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
  - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95% corrected maximum dry density.

### **3.7 BACKFILL**

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

### **3.8 FIELD TESTING**

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Departmental Representative, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Perform infiltration and exfiltration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.
- .5 Do infiltration and exfiltration test to ASTM C828.
- .6 Carry out tests on each section of sewer between successive manholes including service connections.
- .7 Exfiltration test:
  - .1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.



- .2 Immediately prior to test period add water to pipeline until there is head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static ground water level, whichever is greater.
- .3 Duration of exfiltration test: 2 hours.
- .4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.
- .8 Infiltration test:
  - .1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.
  - .2 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
  - .3 Install watertight plug at upstream end of pipeline test section.
  - .4 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
  - .5 Prevent damage to pipe and bedding material due to flotation and erosion.
  - .6 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.
- .9 Infiltration and exfiltration: not to exceed following limits in L per hour per 100 m of pipe, including service connections.

| Nominal Pipe diameter in mm  | Asbestos-Cement or Plastic pipe | Concrete or Vitrified Clay pipe |
|--|---------------------------------|---------------------------------|
| Values shown in columns 2 and 3 are in litres per hour per 100 metres of pipe. |                                 |                                 |
| 100  | 3.88                            | 25.5                            |
| 125  | 4.62                            | 30.0                            |
| 150  | 5.51                            | 34.0                            |
| 200  | 7.45                            | 41.5                            |
| 250  | 9.39                            | 49.5                            |
| 300  | 11.33                           | 56.5                            |
| 350  | 13.27                           | 63.5                            |
| 400  | 14.91                           | 70.0                            |
| 450  | 16.84                           | 76.0                            |
| 500  | 18.78                           | 81.5                            |
| 550  | 20.72                           | 87.0                            |
| 600  | 22.80                           | 92.5                            |
| 700  | 26.53                           | 102.0                           |
| 800  | 30.11                           | 110.5                           |
| 900  | 33.69                           | 118.0                           |
| 1000   | 37.56                           | 124.5                           |
| 1100   | 41.29                           | 130.0                           |
| 1200   | 45.01                           | 135.0                           |

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

**3.9            CLEANING**

- .1      Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1          Leave Work area clean at end of each day.
- .2      Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

**1.2 MEASUREMENT AND PAYMENT**

- .1 All work within this section shall be considered incidental to the lump sum contact.

**1.3 REFERENCES**

- .1 ASTM International
  - .1 ASTM C12-16, Standard Practice for Installing Vitrified Clay Pipe Lines.
  - .2 ASTM C14M-15a, Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
  - .3 ASTM C76M-15, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
  - .4 ASTM C117-13, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
  - .5 ASTM C136-14, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
  - .6 ASTM C425-04(2013), Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
  - .7 ASTM C428-05, Standard Specification for Asbestos-Cement Nonpressure Sewer Pipe.
  - .8 ASTM C443M-11, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
  - .9 ASTM C506M-16a, Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain and Sewer Pipe.
  - .10 ASTM C507M-15, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe (Metric).
  - .11 ASTM C663-98(2013), Standard Specification for Asbestos-Cement Storm Drain Pipe.
  - .12 ASTM C700-13, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
  - .13 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> 600 kN-m/m<sup>3</sup>).
  - .14 ASTM D1056-14, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
  - .15 ASTM D1869-15, Standard Specification for Rubber Rings for Asbestos-Cement Pipe.
  - .16 ASTM D2680-2014, Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.

- .17 ASTM D3034-15e1, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .18 ASTM F405-13, Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.
- .19 ASTM F667-16, Standard Specification for Large Diameter Corrugated Polyethylene Tubing and Fittings.
- .20 ASTM F794-14, Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
- .2 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-8.1-M88, Sieves, Testing, Woven Wire, Inch Series.
  - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
  - .3 CAN/CGSB-34.9-94, Asbestos-Cement Sewer Pipe.
- .3 CSA International
  - .1 CAN/CSA-A3000-13, Cementitious Materials Compendium.
  - .2 CSA A257 Series-14, Standards for Concrete Pipe.
  - .3 CAN/CSA-B1800-15, Thermoplastic Non-pressure Pipe Compendium - B1800 Series.
  - .4 CSA G401-14, Corrugated Steel Pipe Products.
- .4 U.S. Environmental Protection Agency (EPA) / Office of Water
  - .1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

#### **1.4 SCHEDULING**

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

#### **1.5 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
  - .1 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- .4 Certification to be marked on pipe.
- .5 Test and Evaluation Reports: submit manufacturer's test data and certification at least 2 weeks prior to beginning Work.

- .6 Manufacturer's Instructions: submit to Departmental Representative 1 copy of manufacturer's installation instructions.

## **1.6 DELIVERY, STORAGE AND HANDLING**

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Products.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
  - .1 Store materials in accordance with manufacturer's recommendations.
  - .2 Store and protect pipes from damage.
  - .3 Replace defective or damaged materials with new.
- .4 Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 74 22 – Construction/Demolition Waste Management & Disposal.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Waste Reduction Workplan in accordance with Section 01 74 22 – Construction/Demolition Waste Management & Disposal.

## **Part 2 Products**

### **2.1 CONCRETE PIPE**

- .1 Non-reinforced circular concrete pipe and fittings: to CSA A257 as indicated, flexible rubber gasket joints to CSA A257.
- .2 Reinforced circular concrete pipe and fittings: to CSA A257, as indicated, flexible rubber gasket joints to CSA A257.
- .3 Reinforced concrete arch pipe: to ASTM C506M.
- .4 Reinforced concrete elliptical pipe: to ASTM C507M.
- .5 Lifting holes:
  - .1 Pipe 900 mm and less diameter: no lift holes.
  - .2 Pipe greater than 900 mm diameter: lift holes not to exceed two in piece of pipe.
  - .3 Provide pre-fabricated plugs to effectively seal lift holes after installation of pipe.

### **2.2 VITRIFIED CLAY PIPE**

- .1 Vitrified clay pipe and fittings: to ASTM C700, strength as indicated, bell and spigot unglazed bore.
- .2 Pipe joints: flexible joints type 1 to ASTM C425.

### **2.3 CORRUGATED STEEL PIPE**

- .1 Corrugated steel pipe and couplers: to CSA G401.

## **2.4 ASBESTOS CEMENT PIPE**

- .1 Asbestos-cement pipe and fittings: to CAN/CGSB-34.9.
- .2 Pipe joints: rubber gasket joints to ASTM D1869.

## **2.5 PLASTIC PIPE**

- .1 Type PSM Poly Vinyl Chloride (PVC): to CAN/CSA-B1800.
  - .1 Standard Dimensional Ratio (SDR): 35.
  - .2 Locked-in gasket and integral bell system.
  - .3 Nominal lengths: 4 m.
- .2 Large diameter, ribbed PVC sewer pipe and fittings: to CAN/CSA-B1800.
- .3 Corrugated polyethylene pipe: high density to ASTM F667, ASTM F405.
- .4 Acrylonitrile - Butadiene - Styrene (ABS): to ASTM D2680, CAN/CSA-B1800.

## **2.6 PIPE BEDDING AND SURROUND MATERIAL**

- .1 Granular material in accordance with Section 31 05 16 – Aggregate Materials and following requirements:
  - .1 Crushed or screened stone, gravel or sand.
  - .2 Gradations to be within limits specified when tested to CAN/CGSB-8.1.
- .2 Table:

| Sieve Designation (mm) | % Passing   |       |
|------------------------|-------------|-------|
| Stone/Gravel           | Gravel/Sand |       |
| 200                    | -           | 100   |
| 75                     | -           | -     |
| 50                     | -           | -     |
| 38.1                   | -           | -     |
| 25                     | 100         | -     |
| 19                     | 75-100      | -     |
| 12.5                   | -           | -     |
| 9.5                    | -           | -     |
| 4.75                   | 30-70       | 22-85 |
| 2.00                   | 20-45       | -     |
| 0.425                  | 10-25       | 5-30  |
| 0.180                  | -           | -     |
| 0.075                  | 3-8         | 0-10  |

- .3 Concrete mixes and materials for bedding, cradles, encasement, supports: in accordance with Section 03 30 00 - Cast-in-Place Concrete.

## **2.7 BACKFILL MATERIAL**

- .1 As indicated on drawings.
- .2 Type 3 in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .3 Unshrinkable fill: in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.

## **2.8 JOINT MORTAR**

- .1 Portland cement: to CAN/CSA-A3000, normal type 10.
- .2 Mortar: one part Portland cement to two parts clean sharp sand mixed with minimum amount of water to obtain optimum consistency for use intended. Do not use additives.

## **Part 3 Execution**

### **3.1 PREPARATION**

- .1 Temporary Erosion and Sedimentation Control:
  - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
  - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
  - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- .2 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

### **3.2 TRENCHING**

- .1 Do trenching Work in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .2 Protect trench from contents of sewer.
- .3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.
- .4 Water jetting of backfill under haunches of corrugated steel pipe may be permitted if recommended by manufacturer and approved by Departmental Representative.

### **3.3 CONCRETE BEDDING AND ENCASEMENT**

- .1 Do concrete Work in accordance with Section 03 30 00 – Cast-in-Place Concrete. Place concrete to details as indicated by Departmental Representative.
- .2 Position pipe on concrete blocks to facilitate placing of concrete.
  - .1 When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .3 Backfill over concrete once cured as directed by Departmental Representative.

### **3.4 GRANULAR BEDDING**

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layers 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.
  - .1 Do not use blocks when bedding pipes.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 95 % maximum density to ASTM D698.
- .6 Fill excavation below bottom of specified bedding adjacent to manholes or catch basins with compacted bedding material.

### **3.5 INSTALLATION**

- .1 Lay and join pipes to: ASTM C12.
- .2 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .3 Handle pipe using methods approved by Departmental Representative.
  - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .4 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.
  - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .5 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .6 Lay corrugated steel pipe:
  - .1 With outside circumferential laps facing upgrade and longitudinal laps or seams at side or quarter points.
  - .2 With longitudinal centre line of paved invert coinciding with flow line.
- .7 Joint deflection permitted within limits recommended by pipe manufacturer.
- .8 Water to flow through pipes during construction only as permitted by Departmental Representative.
- .9 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .10 Install plastic pipe and fittings in accordance with CAN/CSA-B1800.
- .11 Joints:
  - .1 Corrugated steel pipe:
    - .1 Install gaskets as indicated.
    - .2 Match corrugations or indentations of coupler band with pipe sections before tightening.
    - .3 Tap coupler firmly while tightening, to take up slack and ensure snug fit.
    - .4 Ensure bolts are inserted and tightened.
  - .2 Concrete, clay and asbestos cement pipe:
    - .1 Install gaskets as recommended by manufacturer.



- .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. Remove disturbed or dirty gaskets; clean, lubricate and replace 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 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .9 Mortared joints:
  - .1 Pipe interior: circular pipes 700 mm diameter and larger, and arch or elliptical pipe equivalent to 900 mm diameter or larger shall have interior gap between ends of adjacent pipes filled with mortar.
    - .1 Apply mortar minimum 7 days after backfilling has been completed to allow pipe settlement to occur.
    - .2 Finish interior surface of joints smooth.
  - .2 Pipe exterior: for bell and spigot pipe, use mortar to seal outside of joints. Press and bed mortar into place.
    - .1 Allow mortar to set minimum of 1 hour before backfilling.
- .12 When any stoppage of Work occurs, restrain pipes as directed by Departmental Representative, to prevent "creep" during down time.
- .13 Plug lifting holes with Departmental Representative approved prefabricated plugs, set in shrinkage compensating grout.
- .14 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.
- .15 Make watertight connections to manholes and catch basins.
  - .1 Use shrinkage compensating grout when suitable gaskets are not available.
- .16 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes.
  - .1 Joint to be structurally sound and watertight.
- .17 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.

### **3.6 PIPE SURROUND**

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
  - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
  - .1 Do not dump material within 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 95 % maximum density to ASTM D698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90 % maximum density to ASTM D698.
- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

### **3.7 BACKFILL**

- .1 Place backfill material in unfrozen condition.
- .2 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 95 % maximum density to ASTM D698. In other areas, compact backfill to at least 90 % maximum density to ASTM D698.
- .4 Place unshrinkable backfill in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.

### **3.8 FIELD TESTS AND INSPECTIONS**

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 Draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction directed by Departmental Representative.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Television and photographic inspections:
  - .1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means.
  - .2 Provide means of access to permit Departmental Representative to do inspections.

### **3.9 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.
- .3 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 22 – Construction/Demolition Waste Management & Disposal.
  - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

**END OF SECTION**

**Part 1 General**

**1.1 RELATED REQUIREMENTS**

- .1 Section 31 23 33.01 – Excavation, Trenching and Backfilling.

**1.2 REFERENCES**

- .1 ASTM International
  - .1 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).
- .2 CSA International
  - .1 CSA B1800-11, Thermoplastic Non-Pressure Pipe Compendium (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8, B182.11 and B182.13).
  - .1 CSA B182.2-11, PSM Type Polyvinylchloride (PVC) Sewer Pipe and Fittings.

**1.3 ACTION AND INFORMATIONAL SUBMITTALS**

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for drainage material and include product characteristics, performance criteria, physical size, finish and limitations.

**1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling in accordance with Section 01 74 22 – Construction/Demolition Waste Management and Disposal.
- .2 Place excess or unused insulation and insulation accessory materials in designated containers.
- .3 Divert unused metal materials from landfill to metal recycling facility.
- .4 Dispose of unused adhesive material at official hazardous material collections site.
- .5 Place materials defined as hazardous or toxic in designated containers.

**1.5 SITE CONDITIONS**

- .1 Examine sub-surface investigation report which is available for inspection at Construction site trailer.
- .2 Known underground utility lines and buried objects are as indicated on plans.

**Part 2 Products**

**2.1 BEDDING AND SURROUND MATERIALS**

- .1 Coarse filter aggregate: to in accordance with Section 31 05 16 – Aggregate Materials, CSA A23.1/A23.2, Group 1 20-5 mm.
- .2 Fine filter aggregate: to CSA A23.1/A23.2 and in accordance with Section 31 05 16 – Aggregate Materials.
- .3 Flexible plastic tubing and fittings: corrugated, perforated nominal inside diameter 100 mm.
- .4 Rigid plastic pipe and fittings: to CSA B182.2, size NPS4, complete with fittings.

**2.2 BACKFILL MATERIAL**

- .1 Type 2, in accordance with Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .2 Excavated or graded material existing on site may be suitable to use if approved by Departmental Representative.

**Part 3 Execution**

**3.1 EXAMINATION**

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for drainage materials installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of Departmental Representative.
  - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
  - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.
- .2 Make sure graded subbase conforms with required drainage pattern before placing bedding material.
- .3 Make sure improper slopes, unstable areas, areas requiring additional compaction or other unsatisfactory conditions are corrected to approval of Departmental Representative.
- .4 Make sure foundation wall and damp proofing/rigid insulation have been installed and approved by Departmental Representative before placing bedding material.

**3.2 BEDDING PREPARATION**

- .1 Cut trenches in sub-base and place bedding materials in uniform layers not exceeding 150 mm compacted thickness
- .2 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
- .3 Shape transverse depressions, as required, to suit joints.
- .4 Compact each layer full width of bed to at least 95% of corrected maximum dry density

- .5 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material.

### **3.3 PIPE OR TUBING INSTALLATION**

- .1 Make sure pipe interior and coupling surfaces are clean before laying.
- .2 Lay perforated pipe to slope of 1:100. For pipe face perforations and coupling slots downward.
- .3 Lay non-perforated pipe to slope of 1:50 from perforated pipe to disposal area. Make joints watertight.
- .4 Grade bedding to establish pipe slope.
- .5 Install end plugs at ends of collector drains to protect pipe ends from damage and ingress of foreign material.
- .6 Connect drainage system to building storm sewers, as indicated.

### **3.4 PIPE OR TUBING SURROUND MATERIAL**

- .1 Upon completion of pipe laying and after Departmental Representative has inspected and approved Work in place, surround and cover pipe as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness, as indicated.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Compact each layer from pipe invert to mid-height of pipe to at least 95% of corrected maximum dry density.
- .5 Place low strength unshrinkable fill where compaction cannot be achieved using mechanical methods.

### **3.5 BACKFILL MATERIAL**

- .1 Place backfill material above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .2 Use appropriate compaction equipment.
  - .1 Conduct hand tamping around confined areas of pipe.
  - .2 Do not use water or other hydraulic means to place or consolidate backfill material.

### **3.6 CLEANING**

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning.
  - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 – Cleaning.

**END OF SECTION**