

This specification outlines the requirements for the construction of storm water and sanitary sewage force mains and associated appurtenances.

## PART 1 REFERENCES

This specification refers to the following standards, specifications, or publications:

American Water Works Association (AWWA)

C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
C110/A21.10	Ductile-Iron and Gray-Iron Fittings
<u>C111/A21.11</u>	<u>Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings</u>
C150/A21.50	Thickness Design of Ductile-Iron Pipe
C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
C207	Steel Pipe Flanges for Water Service, Sizes 4in Through 144in (100mm Through 3,600mm)
C600	Installation of Ductile-Iron Mains and Their Appurtenances
C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4in Through 12in. (100mm Through 300mm), for Water Transmission and Distribution
C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14in Through 48in (350mm Through 1,200mm), for Water Transmission and Distribution
C907	Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4in Through 12in (100mm Through 300mm), for Water, Wastewater, and Reclaimed water Services

ASTM International

D698	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> ))
D2310	Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber Reinforced Thermosetting-Resin) Pipe
D2992	Standard Practice for Obtaining Hydrplastic or Pressure Design Basis for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings
D2996	Standard Specification for Filament-Wound "Fiberglass"

(Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

CSA Group

B70 Cast Iron Soil Pipe, Fittings, and Means of Joining

B137 Thermoplastic Pressure Piping Compendium

I.T.T. Grinnell

Figure 167 size Insulation Protection Shield

Figure 181 size Roller Hanger

## PART 2 GENERAL

### 2.1 SCHEDULING:

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions and adhere to schedule approved by the Owner.
- .3 Notify the Owner a minimum of 24 hours in advance of interruption in service.

### 2.2 SUBMITTALS

- .1 Submit in accordance with Section 01340 – Shop Drawings, Samples and Submissions.
- .2 Product Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for pipes and backfill and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
  - .1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Newfoundland and Labrador, Canada.
  - .2 Submit shop drawings showing proposed method of installation for sewage force main in undercrossing.
- .4 Samples:

.1 Submit four (4) weeks minimum before beginning Work, with proposed source of bedding materials and provide access for sampling.

.5 Certification to be marked on pipe.

.6 Test and Evaluation Reports: submit manufacturer's test data and certification at least two (2) weeks prior to beginning Work.

## 2.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01600 – Material and Equipment and with manufacturer's written instructions.

.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.

## PART 3 PRODUCTS

### 3.1 MATERIALS

.1 Ductile iron pipe:

.1 in accordance with AWWA C151/A21.51 and by design in accordance with AWWA C150/A21.50 for 350 mm diameter and larger.

.2 Pressure Class 350 (for 2400 kPa) for 100 mm to 300 mm diameter, (unless otherwise specified in the MERX Schedule of Quantities and Prices) and by design in accordance with AWWA C150/A21.50 for 350 mm diameter and larger (unless otherwise specified in the MERX Schedule of Quantities and Prices);

.3 Cement mortar lined in accordance with AWWA C104/A21.4.

.4 Joints: in accordance with AWWA C111/A21.11

.1 Mechanical, rubber gaskets with plain tip, high strength heat treated cast-iron or alloy steel tie head bolts with hex nuts.

.2 Push-on joint with continuous rubber moulded ring gasket.

.5 Rubber gaskets to AWWA C111/A21.11, lead tipped for mechanical joints.

.6 Fittings in accordance with CSA B70, AWWA C110/A21.10 and cement mortar lined in accordance with AWWA C104/A21.4.

- .2 Polyvinyl chloride (PVC) pressure pipe:
- .1 In accordance with AWWA C900 for pipe size 100 mm to 300 mm and AWWA C905 for pipe size 350 mm to 900 mm.
  - .2 DR 18, ~~(and pressure class 150), (unless otherwise specified in the MERX Schedule of Quantities and Prices.)~~
  - ~~.4.3~~ ~~1 MPa~~ Gasket bell end, cast iron outside diameter.
  - .4 Pipe joints: bell and spigot with rubber gaskets solvent welded joints or mechanical joints to AWWA C111/A21.11, with transition gaskets to pipe manufacturers specifications.
  - .5 Rubber gaskets: to AWWA C111/A21.11. Gaskets for mechanical joints to be duck-tipped transition gaskets for PVC.
  - .6 Cast iron fittings in accordance with AWWA C110/ A21.10 and for pipe diameters larger than NPS 4 cement mortar lined in accordance with AWWA C104/ A21.4.
  - .7 PVC fitting in accordance with CSA B137 or AWWA C907.
  - ~~.2~~ ~~In accordance with CSA B137, PVC series 160, 1.1 MPa elastomeric gasket coupling.~~
- .3 Composite epoxy impregnated fibreglass PVC pipe
- .1 ~~i~~In accordance with ASTM D2996, class H, ~~U~~unplasticized PVC core over wrapped with bonded fibreglass reinforced epoxy resin.
  - ~~.3.2~~ Pressure class 300, ~~(2.400 kMPa)~~ with cast iron outside diameter and integral bell gasketed joints in accordance with ASTM D2992. Material in accordance with ASTM D2310 classification RTRP-11HZ-5001-PVC-13223.
  - ~~.4.3~~ Cast iron fittings in accordance with AWWA C110/ A21.10 and for pipe diameters larger than NPS 4 cement mortar lined in accordance with AWWA C104/ A21.4.
  - ~~.5.4~~ PVC fitting in accordance with CSA B137 or AWWA C907.
- .4 Polyethylene pressure pipe:
- ~~.3.1~~ ~~I~~n accordance with CSA B137, ~~(unless otherwise specified in the MERX Schedule of Quantities and Prices).~~
  - ~~.4.2~~ Polyethylene to polyethylene joints: to be thermal butt fusion welded in accordance with AWWA C207 or flanged with steel backing flanges.
  - ~~.2.3~~ Polyethylene fittings in accordance with CSA B137 for pipe sizes NPS 4 and less.
  - ~~.4.5~~ Pipe insulation to be rigid polyethylene foam factory applied, core density 32 to 48 kg/m<sup>3</sup>, closed cell content 90 % minimum, water absorption p.024 gm/cm<sup>3</sup> per surface immersed 45 hours, 2.44 metre head of water, thermal conductivity 0.019 to 0.028 W/m.° C compressive strength 210 to

281 kg/m<sup>2</sup>, tensile strength 527.3 kg/m<sup>2</sup>, shear 2109 kg/m<sup>2</sup>, maximum service temperature 121 °C.

- .5.6 Pipe metal jacket to be 0.889 mm galvanized steel formed from a continuous strip that is shaped and jointed in a spiral pattern using a pressure grooved, single lock, waterproof seam.
- .6.7 Adjustable steel yoke pipe roll shall be as manufactured by I.T.T. Grinnell Figure 181 size "Roller Hanger" to match outside diameter of insulated pipe systems.
- .7.8 Insulation protection shield shall be as manufactured by I.T.T. Grinnell Figure 167 size "Insulation Protection Shield" to match outside diameter of insulated pipe system.

### 3.2 PIPE BEDDING MATERIALS

- .1 Granular bedding and backfill materials in accordance with Section 02223 – Excavating, Trenching and Backfilling.
- .2 Concrete for cradles, encasement, supports, thrust blocks in accordance with Section 03300 – Cast-in-Place Concrete, strength 25 MPa.

### 3.3 BACKFILL MATERIAL

- .1 As indicated.
- .2 Type 3, in accordance with Section 02223 - Excavating, Trenching and Backfilling.

## PART 4 EXECUTION

### 4.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for pipe installation in accordance with manufacturer's written instructions.
- .1 Visually inspect substrate in presence of the Owner.
- .2 Inform the Owner 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 the Owner.

### 4.14.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, Contract Documents, and site-specific erosion and sedimentation control plan, whichever is more stringent.
  - .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
  - .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- 4.2 Clean pipes and fittings of debris and water before installation. Carefully inspect materials for defects before installing. Remove defective materials from site.
- 4.3 Establish location and extent of known service lines and complete any Work with or around existing underground services as per Section 1005 – General Instructions.

#### 4.24.3 TRENCHING ~~AND BACKFILL~~

- .1 Do trenching ~~Word and backfill~~ in accordance with Section 02223 – Excavating, Trenching, and Backfilling.
- .2 Trench alignment and depth require approval from the Owner prior to placing bedding material or pipe.
- ~~.3.1 Do not backfill trenches between joints until pipe slope and alignment have been checked and accepted. Do not backfill at joints and valves until pressure and leakage test results are within limits specified. Provide a minimum 1.8 m cover unless otherwise specified.~~

#### 4.34.4 GRANULAR BEDDING

- .1 Fill excavation below design elevation of bottom of specified bedding with compacted material as indicated.
- .2 Place granular bedding in unfrozen condition.
- .3 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .4 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
- .5 Shape transverse depressions as required to suit joints.

- ~~4.6~~ Place bedding material to details indicated and compact each layer full width of bed to minimum of 95 % of ~~c~~Corrected ~~M~~maximum ~~d~~Dry ~~D~~ensity, where the maximum dry density is determined in accordance with ASTM D698 and corrected as specified in Section 02501 – Corrected Maximum Dry Density.

#### 4.44.5 CONCRETE BEDDING AND ENCASEMENT

- .1 Pipe may be positioned on concrete blocks to facilitate placing of concrete. When necessary, rigidly anchor or weight pipe to prevent flotation when concrete is placed.
- .2 Do not backfill over concrete within 24 hrs after placing concrete.

#### 4.54.6 INSTALLATION

- ~~.1~~ Do not lay pipe on frozen bedding.
- ~~4.2~~ Lay and join pipes in accordance with AWWA C600 for ductile iron pipe and manufacturer's recommendations. Torque wrench to be used for mechanical joint assembly. ~~Avoid damage to machined ends of pipes in handling and moving pipe.~~
- ~~.3~~ Lay and join pipe other than ductile iron pipe in accordance with manufacturer's recommendations.
- ~~.4~~ Avoid damage to machined ends of pipes in handling and moving pipe.
- ~~.5~~ Maintain grade and alignment of pipes.
- ~~2.6~~ Align pipes carefully before jointing.
- ~~.7~~ Do not exceed maximum joint deflection recommended by pipe manufacturer unless directed in writing by the Owner. Use special bends where necessary to avoid joint deflection.
- ~~.8~~ Support pipe firmly over entire length, except for clearance necessary at couplings.
- ~~3.1~~ Do not use blocks to support pipe.
- ~~.9~~ Keep pipe and pipe joints free from foreign material.
- ~~4.10~~ Avoid bumping gasket and knocking it out of position, or contaminating with dirt or other foreign material. Remove disturbed ~~g~~Gaskets ~~so~~ disturbed to be removed, cleaned, lubricated and replaced before jointing is attempted. Use gasket lubricant as recommended by manufacturer.
- ~~5.11~~ Support pipes by means of hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.



- ~~6.12~~ Apply sufficient pressure in making joint to ensure that joint is complete to manufacturer's recommendations.
- ~~7.13~~ Apply restraint to force main to ensure that joints when completed are held in place, by tamping fill material under and alongside pipe, or otherwise as approved by the Owner.
- ~~8.14~~ Block pipe as directed when any stoppage of work occurs to prevent creep during down time.
- ~~9~~ ~~Do not lay pipe on frozen bedding. Insulated above ground high density polyethylene pipe to be installed in accordance with manufacturers recommendations.~~
- ~~10~~ ~~Upon completion of pipe laying and after the Owner has inspected work in place, surround and cover pipes between joints with approved granular material placed to dimensions indicated or directed.~~
- ~~11~~ ~~Leave joints and fittings exposed for hydrostatic testing. If it is necessary to backfill sections of the force main prior to testing, take full responsibility and bear all costs for any additional excavation and backfill to expose pipe, fittings or joints that may be necessary.~~
- ~~12~~ ~~Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping material directly on top of pipe is not permitted.~~
- ~~13~~ ~~Compact each layer to at least 95 % maximum density in accordance with ASTM D698, Method D.~~
- ~~14.15~~ When HDPE pipe is used, butt fusion to be carried out by a qualified technician.

#### 4.64.7 THRUST BLOCKS

- ~~1~~ ~~Restrain bends, tees and fittings using concrete thrust blocks as indicated.~~
- ~~1.2~~ ~~Place concrete thrust blocks between bends, tees and fittings and undisturbed ground. Keep pipe couplings free of concrete.~~
- ~~2.3~~ Bearing area of thrust blocks to be as indicated or specified by the Owner.
- ~~3.4~~ Do not backfill over concrete within 24 hrs.

#### 4.8 PIPE SURROUND

- ~~1~~ ~~Place surround material in unfrozen condition.~~
- ~~2~~ ~~Upon completion of pipe laying and after the Owner has inspected work in place, surround and cover pipes as indicated. Leave joints and fittings exposed until field testing is completed.~~



- .3 Leave joints and fittings exposed for hydrostatic testing. If it is necessary to backfill sections of the force main prior to testing, take full responsibility and bear all costs for any additional excavation and backfill to expose pipe, fittings or joints that may be necessary.
- .4 Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping material directly on top of pipe is not permitted.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum dry density in accordance with ASTM D698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 90 % corrected maximum dry density, where the maximum dry density is determined in accordance with ASTM D698 and corrected as specified in Section 02501 – Corrected Maximum Dry Density.
- .7 When field test results are acceptable to the Owner, place surround material at pipe joints.

#### 4.9 BACKFILL

- .1 Do not backfill trenches between joints until pipe slope and alignment have been checked and accepted.
- .2 Do not backfill at joints and valves until pressure and leakage test results are within limits specified.
- .3 Place backfill material in unfrozen condition.
- .4 Provide a minimum 1.8 m cover unless otherwise specified.
- .5 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.

#### 4.74.10 FIELD TESTING OF FORCE MAIN

- .1 Testing of force main to be carried out in presence of the Owner's Representative.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests. Testing of force main to be carried out under supervision of the Owner.
- .3 Test force main in sections not exceeding 300 m in length, unless otherwise authorized by the Owner.
- .2.4 Before testing, bed and cover pipe between joints to prevent movement of force main when test pressure is applied.

- ~~3.5~~ Strut and brace caps, bends and tees, to prevent movement when test pressure is applied.
- ~~6~~ Expel air from force main, by slowly filling main with water.
- ~~1~~ High points to be drilled and tapped and suitable cocks installed to vent air and to be shut when pressure is applied.
- ~~4.2~~ Remove cocks after satisfactory completion of test and seal holes with tight fitting plugs.
- ~~5.7~~ Apply a hydrostatic test pressure of 150 % of the normal working pressure based on the elevation of the lowest point in the main and corrected to elevation at the test gauge location or a minimum of 1000 kPa, whichever is greater, for a period of one hour.
- ~~6.8~~ Apply pressure for 1 hour for pressure test and 2 hours for leakage test.
- ~~9~~ Examine exposed pipe, joints and fittings while system is under pressure.
- ~~7.10~~ Remove defective joints, pipe and fittings and replace with new sound material. Make leaking joints watertight.
- ~~8.1~~ ~~Test force main in sections not exceeding 300 m in length, unless otherwise authorized by the Owner.~~
- ~~11~~ Define leakage as amount of water supplied from water storage tank or meter in order to maintain test pressure for 2 hours.
- ~~9.12~~ The allowable leakage is 0.03 L/mm pipe diameter per 300 metres, per hour for a working pressure of 1000 kPa. For other working pressures test in accordance with AWWA C600.
- ~~13~~ Locate and repair defects if leakage is greater than amount specified.
- ~~14~~ Repeat test until leakage is within specified allowance for full length of force main.
- ~~15~~ Complete backfill.
- ~~16~~ Repeat test after completing backfill. Locate and repair defects and backfill. Repeat tests, repairs and backfills as needed until leakage is less than amount specified.

#### ~~4.8.11~~ SWABBING

- ~~1~~ Appropriately sized and designed sewer swabs shall be inserted into the main at as many locations as need be to insure every section of sewer main is swept by a swab when the system is first charged into the system.

**PART 5 PAYMENT**

**5.1 MEASUREMENT FOR PAYMENT**

- .1** Sewage force main will be measured through fittings and chambers after the work is completed.
- .1 Measurement will be horizontally in metres over the centre line of the pipe when the grade of the pipe is less than 10 % and in metres along the slope length of the pipe when the grade of the pipe is 10 % or greater, for each size pipe and depth class supplied and installed.
- .2 Combination air release valve and vacuum valve and chamber to be measured in units for each installed, including all labour and materials including the connection to the force main.
- .3 Fittings will be measured in units of each size installed.
- .4 Force main connection to maintenance holes, including grouting flange and bends, will be measured by the unit.
- .5 Swabbing of force main will be measured in metres of pipe swabbed for each size of pipe cleaned.
- .6 Breaking into and connecting to existing maintenance holes to be measured by the each.

**5.2 BASIS OF PAYMENT**

- .1 All costs associated with the work outlined in this specification shall be deemed to be included in the appropriate unit and lump sum prices quoted as outlined in the Measurement for Payment subsection of this section and as included in the MERX Schedule of Quantities and Prices.
- .2 Payment will be made to the maximum of 90 % of the value of force mains, fittings and appurtenances until the system (or sections of the system, if payment approved by the Owner) has passed all hydrostatic and leakage tests. The 10 % retained shall be called the force main testing allowance.
- .3 Trenching and backfilling will be measured in accordance with Section 02223 - Excavating, Trenching, and Backfilling.
- .4 Granular bedding material will be measured in cubic metres of material incorporated into work in accordance with Section 02223 - Excavating, Trenching, and Backfilling.

- .5 Concrete for bedding, encasement of pipes, supports and thrust blocks will be measured in accordance with Section 03300 – Cast-in-Place Concrete.

Not For Construction