

1. General

1.1 Section Includes

- 1.1.1 This section includes the materials references and the installation procedures for water supply piping, curb stops and boxes, and location/connection to existing piping.

1.2 Related Sections

- 1.2.1 Section 01 33 00 – Submittal Procedures.
- 1.2.2 Section 31 23 33 – Excavating, Trenching and Backfilling.
- 1.2.3 Section 03 20 00 – Concrete Reinforcing.
- 1.2.4 Section 03 30 00 – Cast-in-Place Concrete.
- 1.2.5 Section 01 78 00 – Close Out Submittals.

1.3 References

- 1.3.1 Guidelines for the Design, Construction and Operation of Water and Sewerage Systems, Department of Environment and Conservation, Water Resources Management Division, Government of Newfoundland and Labrador, latest revision.
- 1.3.2 American National Standards Institute/American Water Works Association (ANSI/AWWA):

1.4 Submittals

- 1.4.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- 1.4.2 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- 1.4.3 Inform the Departmental Representative of proposed source of bedding materials and provide access for the Departmental Representative's sampling and testing prior to commencing work.
- 1.4.4 Submit manufacturer's test data and certification that pipe materials meet requirements of this section prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- 1.4.5 Pipe certification to be on pipe.

1.5 Closeout Submittals

- 1.5.1 Provide data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, maintenance and operating instructions in accordance with Section 01 78 00 - Closeout Submittals.

- Data shall include, but not be limited to, top of pipe elevation, horizontal location of fittings and type, valves, valve boxes, valve chambers and bedrock profile.

1.6 Waste Management and Disposal

- 1.6.1 Separate waste materials for reuse and recycling.
- 1.6.2 Place materials defined as hazardous or toxic in designated containers.
- 1.6.3 Handle and dispose of hazardous materials in accordance with applicable regulations.
- 1.6.4 Ensure emptied containers are sealed and stored safely.
- 1.6.5 Do not dispose of unused disinfection material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.

1.7 Extra Materials

- 1.7.1 Provide Departmental Representative with following tools:

- Two (2) - service post wrenches for curb stops.
- Two (2) - tee-handle operating keys for valves.

2. Products

2.1 Pipe and Fittings

- 2.1.1 Cross-Linked Polyethylene (PEX) pipe.
 - Certified to CSA B 137.5 "Cross-linked Polyethylene Tubing for Pressure Applications", ASTM F877 and AWWA C904 Cross-linked Polyethylene Pressure Pipe for Water Service.
 - Polyethylene fittings to CSA B137.1-M89 or AWWA C906-90.

2.2 Service Connections

- 2.2.1 Install curb stop complete with box on services 50 mm or less in diameter. Set box plumb over stop and adjust top flush with final grade elevation. Leave curb stop valves fully closed.
- 2.2.2 Place temporary location marker at ends of plugged or capped unconnected water lines. Each marker to consist of a 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade. Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

2.3 Pipe Bedding Material

- 2.3.1 Granular pipe bedding shall be Type 2.

2.3.2 Granular bedding in accordance with Section 31 23 33 – Excavating, Trenching and Backfilling and following requirements:

- Crushed or screened stone, gravel or sand.
- Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.2.

2.4 Backfill Material

2.4.1 Backfill material to Section 31 23 33 – Excavating, Trenching and Backfilling.

2.5 Pipe Disinfection

2.5.1 Sodium hypochlorite, Calcium hypochlorite or Liquid chlorine to ANSI/AWWA B300 and ANSI/AWWA B301 to disinfect water mains.

2.5.2 Undertake disinfection of water mains in accordance with ANSI/AWWA C651.

2.5.3 Swab all water mains before disinfection.

3. Execution

3.1 Preparation

3.1.1 Clean pipes, fittings, valves and appurtenances of accumulated debris and water before installation.

- Inspect materials for defects to approval of the Departmental Representative.
- Remove defective materials from site as directed by the Departmental Representative.

3.2 Trenching

3.2.1 Do trenching work in accordance with Section 31 23 33 - Excavating Trenching and Backfilling.

3.2.2 Trench depth to provide cover over pipe of not less than 1.8 m from finished grade or as indicated.

3.2.3 Trench alignment and depth require the Departmental Representative's approval prior to placing bedding material and pipe.

3.3 Granular Bedding

3.3.1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm below bottom of pipe unless otherwise indicated on the contract drawings.

3.3.2 Do not place material in frozen condition.

3.3.3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.

3.3.4 Shape transverse depressions in bedding as required to suit joints.

3.3.5 Compact each layer full width of bed to at least 95 % of corrected maximum dry density, ASTM D698 – 78 Method D.

3.3.6 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.

3.4 Pipe Installation

3.4.1 Lay pipes to ANSI/AWWA C600, ANSI/AWWA M-11 and manufacturer's standard instructions and specifications. Do not use blocks except as specified.

3.4.2 Join pipes in accordance with ANSI/AWWA C600, ANSI/AWWA M-11 and manufacturer's recommendations.

3.4.3 Bevel or taper ends of PVC pipe to match fittings.

3.4.4 Handle pipe by methods approved by the Departmental Representative and as recommended by pipe manufacturer.

3.4.5 Lay pipes on prepared bed, true to line and grade:

- Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- Take up and replace defective pipe.
- Correct pipe which is not in true alignment or grade or pipe which shows differential settlement after installation greater than 10 mm in 3 m.

3.4.6 Face socket ends of pipe in direction of laying. For mains on grade of 2 % or greater, face socket ends up-grade.

3.4.7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.

3.4.8 Keep jointing materials and installed pipe free of dirt and water and other foreign materials:

- Whenever work is stopped, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

3.4.9 Position and join pipes with equipment and methods approved by the Departmental Representative.

3.4.10 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.

- 3.4.11 Align pipes before jointing.
- 3.4.12 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.
- 3.4.13 Avoid displacing gasket or contaminating with dirt or other foreign material:
- Remove disturbed or contaminated gaskets.
 - Clean, lubricate and replace before jointing is attempted again.
- 3.4.14 Complete each joint before laying next length of pipe.
- 3.4.15 Minimize deflection after joint has been made.
- 3.4.16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
- 3.4.17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Departmental Representative.
- 3.4.18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- 3.4.19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- 3.4.20 Do not lay pipe on frozen bedding.
- 3.4.21 Upon completion of pipe laying and after the Departmental Representative has inspected the work in place, surround and cover pipes between joints with approval granular material placed to dimensions indicated on the contract drawings or as directed by the Departmental Representative.
- 3.4.22 Hand place granular material in uniform layers not exceeding 150 mm thickness to minimum 300 mm over top of pipe. Dumping of material directly on top of pipe is not permitted.
- 3.4.23 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of the pipe.
- 3.4.24 Compact each layer to at least 95 % maximum density. ASTM D698-78, Method D.
- 3.4.25 Surround and cover joints and fittings with granular material placed and compacted as specified herein. Backfill remainder of trench in accordance with Section 31 23 33 – Excavating, Trenching and Backfilling.

3.5 Service Connections

- 3.5.1 Install service connections before carrying out hydrostatic or leakage test of water main.
- 3.5.2 Water service lines shall be installed to the right of sewer service lines when viewed from the position of the water main and facing the service.
- 3.5.3 Install curb stop with corporation box on services 50 mm or less in diameter. Equip larger services with a gate valve and cast iron box. Set box plumb over stop and adjust top flush with final grade elevation. Leave curb stop valves fully closed.
- 3.5.4 Place temporary location marker at ends of capped unconnected water lines. Each marker to consist of a 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above ground. Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.6 Thrust Blocks and Restrained Joints

- 3.6.1 For thrust blocks: do concrete Work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- 3.6.2 Place concrete thrust blocks between valves, tees, plugs, caps, bends, changes in pipe diameter, reducers, hydrants and fittings and undisturbed ground as indicated or as directed by the Departmental Representative.
- 3.6.3 Keep joints and couplings free of concrete.
- 3.6.4 Do not backfill over concrete within 24 hours after placing.
- 3.6.5 Install joint restraints with or without thrust blocks where indicated on the contract drawings and specifications or where required by the Departmental Representative. Joint restraints shall be of the same pressure rating as the pipe to be joined and restrained. Installation of joint restraints shall be in accordance with the manufacturer's instructions for the types of pipes to be joined and restrained. All components of joint restraint shall be corrosion resistant or suitably protected from corrosion and be approved by the Departmental Representative.

3.7 Pressure Test

- 3.7.1 After the pipe has been installed and backfilled and following the installation of service pipes and fittings, all newly installed pipe, or valved section thereof, shall be subjected to a hydrostatic pressure of 150 % of normal operating pressure based on the elevation at the lowest point in the main and corrected to elevation at test gauge location or a minimum of 1000 kPa, whichever is greater, for a period of 1 hour. Where hydrants are in the test section, the test shall be made against the closed hydrant valve.

- 3.7.2 Each valved section of pipe shall be slowly filled with water and the test pressure shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Departmental Representative. The pump, pipe connection and all necessary apparatus shall be furnished by the Contractor.
- 3.7.3 Before applying the test pressure, all air shall be expelled from the pipe. If permanent air vents are not located at all high points the Contractor shall install corporation stops at such points so that the air in the system can be expelled. After the air has been expelled, the corporation stops shall be closed and the required test pressure applied.
- 3.7.4 The pressure test shall be of a duration of at least one hour and the pressure shall not vary by more than ± 35 kPa.
- 3.7.5 Pressure testing of polyethylene pipe to be carried out as per the manufacturer's recommendations.
- 3.7.6 All faulty or leaking connections shall be corrected at the Contractor's expense.
- 3.7.7 Notify the Departmental Representative at least 24 hours in advance of proposed tests.
- 3.7.8 Perform tests in the presence of the Departmental Representative.

3.8 Leakage Test

- 3.8.1 A leakage test shall be conducted concurrently with the pressure test. The Contractor shall supply all equipment necessary for the conducting of this test.
- 3.8.2 "Leakage" shall be defined as the quantity of water that must be supplied into the newly installed pipe or any valved section thereof, to maintain pressure within ± 35 kPa of the test pressure after the air in the pipeline has been expelled.
- 3.8.3 No pipe installation will be accepted if the leakage is greater than the allowable leakage for joints plus the allowable leakage for closed metal seated valves.
- 3.8.4 Allowable leakage for joints is calculated as follows:

$$L = N D (P)^{0.5} / 128$$

Where; L = the allowable leakage in l/h.

N = the number of joints in the length of pipeline tested.

D = the nominal diameter of the pipe in meters.

P = the average test pressure during the leakage test in kilopascals.

- 3.8.5 Allowable leakage for closed metal seated valves shall be 0.00121 l/h/mm of nominal valve size.

- 3.8.6 If any test of pipe discloses leakage greater than the allowable, the Contractor shall, at his own expense, locate and repair the defective joints until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.
- 3.8.7 Notify the Departmental Representative at least 24 hours in advance of proposed tests.
- 3.8.8 Perform tests in the presence of the Departmental Representative.

3.9 Flushing and Disinfecting

- 3.9.1 Flushing and disinfecting operations shall be witnessed by the Departmental Representative. Notify the Departmental Representative at least four (4) days in advance of proposed date when disinfecting operations will commence.
- 3.9.2 Disinfection of water mains shall be done in accordance with AWWA C651-92.
- 3.9.3 Prior to being chlorinated the mains shall be filled to eliminate air pockets and shall be flushed to remove particles. Flush with a sufficient flow to produce a velocity of 1.5 m/s, unless the Departmental Representative determines that conditions do not permit the required flow to be discharged, or until foreign materials have been removed and flushed water is clear.
- 3.9.4 Flushing shall be as follows:

Pipe Size (mm)	Flow (l/s) Minimum
150 and below	38
200	75
250	115
300	150
350	200
400	250

- 3.9.5 Water from an existing distribution system, or other approved source of supply, shall be made to flow at a constant measured rate into the newly installed system
- 3.9.6 At a point not more than 3 meters downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate, such that the water will have not less than 25 mg/l free chlorine throughout the system undergoing disinfection. To assure that this concentration is provided, measure the chlorine concentration at regular intervals.
- 3.9.7 During the application of chlorine, valves shall be positioned so that the strong chlorine solution in the main being treated, will not flow into water mains in active service. Chlorine application shall not cease until the entire main is filled with heavily chlorinated water. The chlorinated water shall remain in the water main for at least 24

hours, during which time all valves and hydrants in the section shall be operated in order to disinfect the appurtenances. At the end of the 24 hour period, the treated water in all portions of the water main shall have a residual of not less than 10 mg/l free chlorine.

3.9.8 After the final flushing and before the water main is placed into service, water samples shall be collected from the line and tested for bacteriological quality and shall show the absence of coliform organisms, disinfection shall be repeated until satisfactory samples have been obtained.

3.9.9 The Contractor shall get approval of the governing agency or agencies before heavily chlorinated water can be discharged into storm, sanitary or other receiving systems. If the heavily chlorinated water cannot be accepted by nearby storm, sanitary or other receiving system, the water shall be discharged into tanks and disposed of at an approved site. The cost associated with disposing of heavily chlorinated water shall be borne by the Contractor.

3.10 Swabbing

3.10.1 Appropriately sized and designed water main swabs shall be inserted into the water main at as many locations as need be to ensure every section of water main is swept by a swab when the water is first charged into the system. After main lines have been swabbed, hydrant leads will be thoroughly flushed, but not swabbed. Flushing shall be accomplished by opening and closing valves and hydrants several times using water, under expected line pressure, with flow velocities adequate to flush foreign material out of valves and hydrants.

3.11 Surface Restoration

3.11.1 After installing and backfilling over water mains, restore surface to its original condition as directed by the Departmental Representative.

4. Measurement and Basis for Payment

4.1 Measurement for Payment

4.1.1 Trenching and backfilling will be measured as per Standard Specification 31 23 33 – Excavating, Trenching and Backfilling, Measurement for Payment.

4.1.2 Water supply piping will be measured in meters of each size of pipe installed after the work has been completed. Measurement will be horizontally in meters over the center line of the pipe when the grade of the pipe is less than 10% and in meters along the slope length of the pipe when the grade of the pipe is 10% or greater.

4.1.3 All fittings and appurtenances will be considered incidental to installation of pipe and is included in the measurement for pipe.

4.1.4 Granular bedding material will be measured in cubic meters as per Standard Specification 31 23 33 – Excavating, Trenching and Backfilling. No deduction for

pipe volume up to and including nominal diameter of 300 mm will be made. Calculation of pipe volume deduction will be made based on the nominal diameter for pipes in excess of 300 mm nominal diameter.

- 4.1.5 Locating and tie-in to existing water main to be considered incidental to installation of pipe and is included in the measurement for pipe.

4.2 Basis for Payment

- 4.2.1 All costs associated with work specified in this section shall be deemed to be included in the appropriate unit and lump sum prices quoted in the Schedule of Quantities and Prices.

- 4.2.2 Payment shall be made to the maximum of 90% of water mains, hydrants, valves, fittings and appurtenances until the system, or sections of the system if payment approved by the Departmental Representative, has passed all hydrostatic leakage tests. The 10% retained shall be called the water testing allowances.