

This specification outlines the requirements for constructing water mains, service connections and appurtenances in open cut. This Section outlines the requirements for constructing water mains including pipes, joints and fittings, pipe protection, valves, valve boxes and chambers, service connections, fire hydrants, etc. and their installation. Includes flushing and disinfecting.

PART 1 REFERENCES

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

American Association of State Highway and Transportation Offices (AASHTO)

M105 Standard Specification for Gray Iron Castings

ASME International

B16.1 Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

ASTM International

A307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

B62 Standard Specification for Composition Bronze or Ounce Metal Castings

B68/B68M Standard Specification for Seamless Copper Tube, Bright Annealed

C478/C478M Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³), Method D)

D2310 Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

D2992 Standard Practice for Obtaining Hydrostatic 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

F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing

F877	Standard Specification for Crosslinked Polyethylene (PEX) Hot- And Cold-Water Distribution Systems
F1282	Standard Specification for Polyethylene / Aluminum / Polyethylene (PE-AL-PE) Composite Pressure Pipe
F2023	Standard Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Tubing and Systems to Hot Chlorinated Water
<u>ASTM F2164</u>	<u>Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure</u>

American Water Works Association (AWWA)

B300	Hypochlorites
B301	Liquid Chroline
C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
<u>C105/A21.5</u>	<u>Polyethylene Encasement for Ductile-Iron Pipe Systems</u>
C110/A21.10	Ductile-Iron and Gray-Iron Fittings
C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
C150/A21.50	Thickness Design of Ductile-Iron Pipe
C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast
C153/A21.53	Ductile-Iron Compact Fittings
C207	Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
C219	Bolted, Sleeve-Type Couplings for Plain-End Pipe
<u>C301</u>	<u>Prestressed Concrete Pressure Pipe, Steel-Cylinder Type</u>
C303	Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
C500	Metal-Seated Gate Valves for Water Supply Service
C502	Dry-Barrel Fire Hydrants
C504	Rubber-Seated Butterfly valves, 3in. (75mm) Through 72in. (1,800mm)
C509	Resilient-Seated Gate Valves for Water Supply Service
C600	Installation of Ductile-Iron Mains and Their Appurtenances

C651	Disinfecting Water Mains
C800	Underground Service Line Valves and Fittings
C900	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 <u>in</u> Through <u>6012</u> <u>in</u> . (100 mm Through <u>1,500</u> <u>300</u> mm), <u>for Water Transmission and Distribution</u>
C901	Polyethylene (PE) Pressure Pipe and Tubing, <u>3/4</u> <u>1/2</u> <u>in</u> . (<u>193</u> mm) Through 3in. (76mm), For Water Services
C904	Cross-linked Polyethylene (PEX) Pressure <u>Tubing Pipe</u> , <u>1/2</u> <u>-</u> <u>in</u> . (<u>123</u> mm) through <u>3</u> <u>-</u> <u>in</u> . (76 mm), for Water Service
C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14in Through 48in (350mm Through 1,200mm), for Water Transmission and Distribution
C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 <u>in</u> . (<u>100mm</u>) Through <u>636</u> <u>in</u> . (<u>100 mm Through 1,6050 mm</u>), For Water <u>works</u> Distribution and Transmission
C907	Injection-Molded Polyvinyl Chloride (PVC) Pressure Fittings, 4 <u>in</u> . <u>1</u> Through <u>12</u> <u>in</u> . (100 mm Through 300mm), <u>for Water, Wastewater, and Reclaimed Water Service</u>
C909	Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure pipe, <u>4</u> <u>-</u> <u>in</u> . (<u>100 mm</u>) and <u>Larger</u> Through <u>24</u> <u>in</u> . (<u>100 mm</u> Through <u>600 mm</u>) <u>for Water, Wastewater, and Reclaimed Water Service</u>
M17	Manual Installation, Field Testing, and Maintenance of Fire Hydrants
CSA Group	
A3000	Cementitious Materials Compendium
B64	Backflow Preventers and Vacuum Breakers
B137	Thermoplastic Pressure Piping Compendium
G30.18	Carbon Steel Bars for Concrete Reinforcement
Canadian General Standard Board (CGSB)	
1-GP-12C	Standard Paint Colours
Underwriters Laboratories of Canada (ULC)	
CAN-S520	Standard for Fire Hydrants

NSF International

NSF/ANSI Standard 14

NSF/ANSI Standard 61

Plastic Pipe Institute (PPI)

TN-46

Guidance for Field Hydrostatic Testing of High Density
Polyethylene Pressure Pipelines: Owner's Considerations,
Planning, Procedures, And Checklists

TR-4

Listing of Hydrostatic Design Basis, Hydrostatic Design Stress, Strength Design Basis, Pressure Design Basis, Minimum Required Strength Ratings for Thermoplastic Piping Materials or Pipe

PART 2 GENERAL

2.1 SCHEDULING OF WORK

- .1 Schedule work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions for approval by the Owner and adhere to interruption schedule as approved by the Owner.
- .3 Notify building occupants a minimum of 24 hrs. in advance of any interruption in service.
- .4 Do not interrupt water service for more than 3 hrs. and confine this period between 10:00 and 16:00 hrs. local time unless otherwise authorized.
- .5 Notify fire department of any planned or accidental interruption of water supply to hydrants.
- .6 Provide and post "Out of Service" sign on hydrant not in use.
- .7 Advise local police department of anticipated interference with movement of traffic.
- .8 Schedule a meeting to discuss pressure testing, swabbing and disinfection a minimum of 24 hours before connection. The Operating Authority shall be invited to the meeting.

2.2 SUBMITTALS

- .1 Submit in accordance with Section 01340 – Shop Drawings, Samples and Submissions.
- .2 Product Data:

- .1 Submit manufacturer's instructions, product literature and data sheets for distribution piping materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Pipe certification to be on pipe.
- .3 Submit complete shop drawings and construction schedule for water mains 600 mm diameter and larger. Include method for installation of water main.
- .4 Inform Owner of proposed source of bedding materials and provide access for sampling at least four (4) weeks prior to commencing work.
- .5 Submit manufacturer's test data and certification that pipe materials meet requirements of this section at least four (4) weeks prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .6 Pipe certification to be on pipe.

2.3 CLOSEOUT SUBMITTALS

- .1 Provide data necessary to produce record drawings, including details of pipe materials, invert elevations, horizontal location of tees, bends, laterals and caps, valves, hydrants and end caps in accordance with Section 01720 – Closeout Submittals.
- .2 Submit directions for operating valves, list of equipment required to operate valves, and details of pipe material, location of air and vacuum release valves, and hydrant details.
- .3 Submit operation and maintenance instructions for pipe, valves, valve boxes, valve chambers and hydrants.

2.4 DELIVERY, STORAGE, AND HANDLING

- .1 Perform in accordance with Section 01600 – Material and Equipment.

2.5 MAINTENANCE MATERIAL SUBMITTALS TOOLS AND EQUIPMENT

- .1 Supply in accordance with 01720 – Closeout Submittals.
- .2 Provide as follows: as directed by the Owner:
 - .1 One service post wrench for curb stops.
 - .2 One tee-handle operating keys for valves.
 - .3 One wrench for operating fire hydrant operating nut.

PART 3 PRODUCTS

3.1 PIPE, JOINTS AND FITTINGS

.1 Ductile Iron Pipe: ~~shall be in accordance with~~~~designed to~~ ANSI/AWWA C150/A21.50 and manufactured ~~to~~~~in accordance with~~ ANSI/AWWA C151/A21.51. All pipe shall be cement mortar lined ~~and asphaltic seal~~ ~~coated in accordance with~~~~to~~ ANSI/AWWA C104/ A21.4. ~~All lining available by iron pipe manufacturers are approved for contact with potable water in accordance with National Sanitation Foundation (NSF) standard 61.~~ Pipe shall be supplied in minimum pressure class below, or to the pressure classes shown on the drawing:

Pressure Class	Pipe diameter (mm)
350	100–300
250	350–500
200	600
150	900 mm and larger

.1 Joints:

.1 Push-on joint with continuous rubber molded ring gasket in accordance with AWWA C111/ A21.11.

.2 ~~Mechanical, Rubber gaskets for mechanical pipe joints with plain tip, high strength heat treated cast-iron or alloy steel tie head bolts with hex nuts to ANSI/AWWA C111/A21.11.~~

.2.3 ~~Rubber gasket for flange pipe joints 1.6 mm thick: to ANSI/AWWA C111/A21.11.~~

.4 ~~Bolts, nuts, hex head washers to ASTM A307, heavy series. Head bolts and nuts with plain tip, high strength heat treated cast-iron or alloy steel tie.~~

.3.5 ~~Ensure electrical conductivity across joints.~~

.2 Fittings:

.1 Mechanical joint cast iron and ductile iron fittings NPS 3 and larger to ANSI/AWWA C110/A21.10.

.2 Flanged cast iron fittings NPS 3 and larger: to ANSI/AWWA C110/A21.10.

.3 Compact Fittings to ANSI/AWWA C153/A21.53.

.4 in accordance with AWWA C110/A21.10 or AWWA C153/A21.53 for pipe diameters larger than NPS 4. Restrained joint fittings must be rated to the same pressure rating as the pipe. Thrust blocks are not required on restrained joint fittings.

.2 Reinforced concrete pipe in accordance with ANSI/AWWA C303 class.

.1 Pipe and fittings joints

.1 Bell and spigot steel joints with confined rubber gaskets.

.2 Flanged joints to conform in accordance with AWWA C-207.

.3 Pipe joints:

.1 flanged to ANSI/AWWA C207,

.2 push-on joints with performance requirements to ANSI/AWWA C111/A21.11.

.4 Fitting joints:

.1 For sizes under NPS 30, push on joints with performance requirements to ANSI/AWWA C111/A21.11.

.2 For sizes equal to or greater than NPS 30, flanged to ANSI/AWWA C207.

.2.5 Pipe fittings: reinforced concrete to ANSI/AWWA C301 or ANSI/AWWA C303 as indicated.

.3 Polyvinyl chloride pressure pipe: ANSI/AWWA C900, pressure class 150, DR 18, 1MPa gasket bell end, cast iron outside diameter.

.1 CAN/CSA-B137.3, PVC series 160, 1.1 MPa elastomeric gasket coupling for pipes with NPS 12 or less.

.2 PVC pipe is an acceptable option for NPS 3 to 16 only.

.3 In accordance with CSA B137 unless otherwise specified in the MERX Schedule of Quantities and Prices or AWWA C900 for pipe sizes 100 mm to 300 mm, Dr 18 (pressure class 150 psi) unless otherwise specified in the MERX Schedule of Quantities and Prices or in accordance with AWWA C905 for pipe sizes 350 mm to 900 mm, DR 18 (pressure class 235 psi) unless otherwise specified in the MERX Schedule of Quantities and Prices. All pipe shall be certified in accordance with CSA B137, shall be UL listed and FM approved, and shall be 1 MPa gasket bell end, cast iron outside diameter.

.4.3 In accordance with CSA B137, rated at 235 psi, unless otherwise specified in the MERX Schedule of Quantities and Prices or in accordance with AWWA C909 for pipe sizes 100 mm to 450 mm. All pipe shall be certified to CSA B 137, shall be UL listed and FM approved, and shall be 1 MPa gasket bell end, cast iron outside diameter.

.5.4 Composite epoxy impregnated fibreglass PVC pipe in accordance with ASTM D2996, class H. Unplasticized PVC core overwrapped with bonded fibreglass reinforced epoxy resin. Pressure class 300,

2.4 MPa with cast iron outside diameter and integral bell gasketed joints in accordance with ASTM D2992. Material in accordance with ASTM D2310 classification RTP-11HZ-5001-PVC-13223.

.6.5 PVC Fittings in accordance with CSA B-137.3 or AWWA C907 for pipe sizes 100 mm to 300 mm and shall be UL listed and FM approved.

.7.6 Cast iron fittings in accordance with ANSI/AWWA C104/A21.4 for pipe larger than 300 mm.

.3.4 Polyethylene pressure pipe

.1 NPS 1/2 to NPS 6: to ASTM F 714, type PE 3408, series DR 11, unless otherwise specified.

.2 90 mm to 1600 mm: to CGSB 41-GP-25M, type PE 1404, series 250, unless otherwise specified.

.1 ~~Polyethylene pressure pipe in accordance with CSA B-137 (unless otherwise specified in the MERX Schedule of Quantities and Prices).~~

.3 ~~Polyethylene HDPE to polyethylene HDPE joints: to be in accordance with be thermal butt fusion joined, to ASTM D2657 welded in accordance with AWWA C207, AWWA C906 or flanged with backing flanges when necessary.~~

.2.4 ~~Cast iron fittings with flanged ends: to ANSI/AWWA C110/A21.10 for pipe size above NPS 4. Cement mortar lined to ANSI/AWWA C104/A21.4.~~

.3.5 ~~Polyethylene fittings in accordance with CSA B137.1 for pipe sizes NPS 4 or less.~~

.4.5 Bolted, sleeve-type couplings in accordance with AWWA C219.

3.2 PIPE PROTECTION

.1 Provide means of protection for iron pipe in corrosive soils in accordance with local practices and authorities having jurisdiction. When indicated, provide polyethylene encasement in accordance with ANSI/AWWA C105/A21.5.

3.23.3 VALVES AND VALVE BOXES

.1 Valves to open counter clockwise and to be supplied with a square-sided operating nut, 51 mm to the side, unless otherwise specified.

.2 Gate valves in accordance with AWWA C500, standard iron body, bronze mounted, wedge double disc valves with non-rising stems, suitable for 1 MPa with mechanical joints or resilient-seated in accordance with AWWA C-509.

.2.3 Butterfly valves shall conform to the requirements of AWWA C504 of types and joints as indicated.

.3.4 Resilient wedge valves greater than 400 mm in diameter shall be gear operated. All other valves 400 mm in diameter and greater shall be gear operated.

~~.4.1 Valves to open counter clockwise and to be supplied with a square sided operating nut, 51 mm to the side, unless otherwise specified.~~

.5 Underground type indicator valve where indicated. Indicator post to accurately indicate valve open or closed. Valve to be electrically supervised as indicated.

.6 Air and vacuum release valves: ~~in accordance with CSA B64~~, heavy duty combination air release valves employing direct acting kinetic principle.

.1 -Fabricate valves ~~to be constructed~~ of cast iron body and cover, with bronze trim, stainless steel floats with shock-proof synthetic seat suitable for 2 MPa working pressure.

.2 -Valves to expel air at a high rate during filling, at a low rate during operation, and to admit air while line is being drained.

.3 -Valve to be complete with a surge check unit.

.4 -Ends to be flanged ~~to ANSI/AWWA C110/A21.10 in accordance with ASME B16.1.~~

.7 Cast iron valve boxes:

.1 ~~B~~ituminous coated screw type or three piece, 125 mm diameter sliding type, as indicated.

.2 ~~A~~justable over a minimum of 450 mm.

.3 Valve to have circular guide plate that fits over operating nut and prevents lateral movement of valve box. Guide plate not to interfere with operation of valve or key.

.4 Base to be large round type with minimum inside diameter of 234 mm.

.5 Top of box to be marked "WATER".

.6.8 PVC valve boxes to be as per manufacturer's recommendations.

3.3.3.4 VALVE CHAMBERS

.1 Concrete and reinforcing steel in accordance with Section 03200 – Concrete Reinforcement and 03300 – Cast-in-Place Concrete.

.2 Precast concrete sections in accordance with ASTM C478/C478M. Ladder rungs be cast integral with unit; field installation not permitted.

.3 Valve chamber frames and covers: grey iron castings, minimum tensile strength 200 MPa to AASHTO M105 with two coats, shop applied, approved asphalt coating with a mass of approximately 215 kg per set.

.1 Design and dimensions to be as indicated.

.4.2 Cover to be marked WATER.

.3.4 Jointing materials:

- .1 Manufacturer's rubber ring gaskets,
- .2 Mastic joint filler,
- .3 Cement mortar or,
- .4 Combination of above types.

.4.5 Mortar: aggregate and masonry cement in accordance with CSA A3000.

.6 Ladder rungs for valve chambers to: be galvanized steel or an aluminum alloy.

.1 Galvanized steel ladder rungs shall conform to the requirements of CSA Standard G30.18, No.25M billet steel deformed bars hot dipped galvanized to ASTM A123/A123M

.2 Aluminum alloy rungs in accordance with ASTM B221, Alloy 6351, Temper T6.

.3 Ladder rungs to be safety pattern (drop step type), 20 mm diameter deformed rail steel bars in accordance with CSA G30.18, hot-dipped galvanized after fabrication in accordance with CSA A3000. Rungs are to be safety pattern.

3.43.5 SERVICE CONNECTIONS

.1 The minimum size of a water service connection shall be 19 mm diameter.

.2 Copper tubing in accordance with ASTM B68/B68M, type K, annealed for service laterals up to 50 mm in diameter.

.3 Ductile iron pipe in accordance with AWWA C151/A21.51, pressure class 150, for service laterals 100 mm diameter or greater.

.4 Polyvinyl chloride pressure pipe in accordance with CSA B137, type 1120 series 160 unless otherwise specified in the MERX Schedule of Quantities & Prices.

.5 Polyethylene pipe in accordance with:

.1 ASTM F714, Type PE, series DR 11, unless otherwise specified.

.2 90 mm to 1600 mm: to CGSB 41-GP-25M, type PE, series 250.

.5 with AWWA C901 pressure class 160 or in accordance with CSA B137, unless otherwise specified in the MERX Schedule of Quantities and Prices.

~~.6 Cross linked polyethylene pipe in accordance with CSA B137, ASTM F877, PP1 TR-4, NSF/ANSI Standard 14 and NSF/ANSI Standard 61, with co-extruded UV shield to allow exposure to natural sunlight for up to 1 year. The minimum degree of cross linking shall be 80 %.~~

~~.7.6 Crossed linked polyethylene pipe (PEX) in accordance with AWWA C904, certified to CSA B137.5, and conform to ASTM F876, ASTM F877, and ASTM F2023, NSF/ANSI Standard 14 and 61, and CSA B137. Pipe to have CTS outer diameter, with operating pressure of 160 psi at 23 ° C / 73.4 ° F, 100 psi at 82 ° C / 180 ° F, and 80 psi at 93 ° C / 200 ° F. Pipe to be marked with manufacturing date, and footage every five feet.~~

~~.8.7 Polyethylene/Aluminum/Polyethylene composite pipe in accordance with CSA B137.9, AWWA C903 and ASTM F1282. Compression fittings to be as per manufacturers specifications and suitable for underground service (red brass).~~

~~.9.8 Copper tubing pipe joints: to be flared or compression type suitable for 1 MPa working pressure.~~

~~.10.9 PVC joints: to be bell and spigot to manufacturer's specifications.~~

~~.11.10 Polyethylene pipe joints: to be thermal butt fusion welded or socket fusion welded.~~

~~.12.11 Joints for ductile iron pipe: to be push-on joints in accordance with AWWA C111/A21.11. Rubber gaskets in accordance with AWWA C111/A21.11.~~

~~.13.12 Brass corporation stops: red brass in accordance with ASTM B62 flared or compression type having threads in accordance with AWWA C800, pressure rated for 1050 kPa.~~

~~.13 Brass inverted key-type curb stops in accordance with ASTM B62 flared or compression type with drain, (unless otherwise indicated otherwise in contract documents).~~

~~.1 Curb stops to have 1.5 to 1.8 m adjustable bituminous coated, cast iron service box with stem to suit depth of bury.~~

~~.2 Top of cast iron box marked "WATER".~~

~~.14.3 The top brass stem on curb stops must be capable of withstanding a 75 foot-pound torque test.~~

~~.15.1 Tappings of ductile iron may be threaded without service clamps. Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used. Tappings to conform to following:~~

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

.16.14 ~~Polyethylene~~ tapping tees or multi-saddle tees: for ~~Polyethylene~~ pipe. Tees to be socket fused to pipe up to 150 mm NPS

.15 Service connections ~~lamps~~ for ~~PE or PVC~~ pipe:

.1 ~~S~~ervice connections less than 100 mm: corporation stop, tapped to main using AWWA threads, complete with stainless service saddle. Service saddle to consist of circumferential band type complete with side bars and fingers, keeper bar, stud bolts, nuts, washers and gaskets.

.2 Service connections 100 mm and over: use tee fitting or tapping valve and sleeve.

.16 Bronze type service clamps: for PVC pipe service connections.

.1 ~~Service clamps~~ to be of ~~double~~ strap-type, with confined "O" ring seal cemented in place.

.17.2 Clamps to be tapped with threads in accordance with AWWA C800.

.18.17 Tee connections: for services above 25 mm. Tee connections to be fabricated of same material and to same standards as specified pipe fittings and to have ends matching pipe to which they are joined.

.19 ~~Copper couplings to be in accordance with AWWA C800.~~

.18 ~~Stainless steel liners of plastic pipe where pipe is used with compression fittings. Size as indicated.~~

3.53.6 HYDRANTS

.1 Hydrants shall conform to the requirements of AWWA C502 and shall be UL listed and FM approved.

.2 Post type hydrants in accordance with UL listed CAN-S520; designed for maximum working pressure of system with two 65 mm threaded hose outlets, one 100 mm ~~pumper connection~~~~steamer port~~, 150 mm riser barrel, 125 mm bottom valve and 150 mm connection for main.

.1 Hydrants to open counterclockwise, threads, outlets and operating nut to local standard unless otherwise specified ~~in the MERX Schedule of Quantities and Prices~~.

.2 Provide key operated gate valve located 1 m from hydrant unless otherwise specified ~~in the MERX Schedule of Quantities and Prices~~.

.3 Minimum depth of bury to top of hydrant lead is 1800 mm unless otherwise specified ~~in the Project Documents~~.

.2.4 Post hydrants to be used in all locations where Fire Flows are not able to be obtained.

.4.3 Paint hydrants in accordance with the following colour code:

Flow Rate	Reflective Colour	CGSB 1-GP-12C Colour Chart
Under 38 L/s	RED	509-102
38 to 75 L/s	ORANGE	508-103
Over 75 L/s	GREEN	503-107

3.63.7 PIPE BEDDING ~~SURROUND~~ MATERIALS

.1 Granular material in accordance with Section 02223 – Excavating, Trenching and Backfilling, for granular bedding.

.2 Concrete ~~mixes and materials~~ required for ~~bedding~~ cradles, encasement, supports, thrust blocks and cut-off walls all in accordance with Section 03300 – Cast-in-Place Concrete, strength 25 MPa.

3.8 BACKFILL MATERIAL

.1 As indicated.

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

3.73.9 PIPE DISINFECTION

.1 Sodium hypochlorite, calcium hypochlorite, or liquid chlorine in accordance with AWWA B300 and AWWA B301 to disinfect water mains.

.2 Swab all lines before disinfecting.

.2.3 Disinfect water mains in accordance with ANSI/AWWA C651.

3.81.1 TOOLS AND EQUIPMENT

.1 Supply as directed by the Owner.

- ~~.1 One service post wrench for curb stops.~~
- ~~.2.1 One tee handle operating keys for valves.~~
- ~~.3.1 One wrench for operating fire hydrant operating nut.~~

PART 4 EXECUTION

4.1 EXAMINATION

- .1 Verification of Conditions: Verify that conditions of substrates previously installed under other Sections or Contracts are acceptable for distribution piping installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrates 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 Clean pipes, fittings, valves, hydrants and appurtenances of accumulated debris and water before installation.
 - .1 Carefully inspect materials for defects.
 - .2 Remove defective materials from site.
- .2 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 and backfill work in accordance with Section 02223 – Excavating, Trenching and Backfilling.
- .2 Trench depth to provide minimum coverage over pipe of 1.8 m from finished grade or as indicated.
- .3 Trench alignment and depth require the Owner's approval prior to placing bedding material or pipe.
- .4.1 Do not backfill trenches until installed work has been checked and accepted by the Owner.

4.4

WATER AND SEWER SEPARATION REQUIREMENTS

.5.1 **Sewer and Water Main Vertical Separation:** When it is not practical to maintain a separate trench and a minimum horizontal separation distance of 3.0 m (minimum), the crown of the sewer should be at least 0.45 m below the invert of the water main and separated by in situ material or compacted backfill. Joints should be offset as much as possible between sewers and water mains.

- .1 Where this vertical separation cannot be obtained, the sewers should be constructed of water main quality pipe, pressure tested in place at a pressure of 350 kPa (50 psi) without leakage in accordance with CSA B137.
- .2 In rock trenches, drainage should be provided to minimize the effects of impounding of surface water and/or the leakage from sewers in the trench.

.6.2 **Sewer and Water Main Crossings:** Water mains should cross above sewers wherever possible. Whether the water main is above or below the sewer, a minimum vertical distance of 0.5 m between the outside of the water main and the outside of the sewer should be provided to allow for proper bedding and structural support of the water main and sewer pipes. Sufficient structural support for the sewer pipes should be provided to prevent excessive deflection of the joints and settling.

- .1 The length of water pipe should be centred at the point of crossing so that joints in the water main will be equidistant and as far as possible from the sewer. The crossing should be perpendicular if possible.
- .2 When it is impossible to obtain proper horizontal and vertical separation as stipulated above, one of the following methods should be specified:
 - .1 The sewer should be designed and constructed equal to the water pipe and should be pressure tested at 350 kPa (50 psi) to assure watertightness; or
 - .2 Either the water main or the sewer line should be encased in a watertight carrier pipe that extends 3 m (10 ft) on both sides of the crossing, measured perpendicular to the water main.

.7.3 Where possible, the above separation requirements shall be applied to service connections as well.

4.34.5 CONCRETE BEDDING, ~~CUT-OFF WALLS~~ AND/OR ENCASEMENT

- .1 Do concrete work in accordance with Section 03300 – Cast-in-Place Concrete. Place concrete to details indicated or directed.
- .2 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.
- .3 Do not backfill over concrete within 24 hrs after placing concrete.

4.44.6 GRANULAR BEDDING

- .1 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth details-as indicated ~~or directed~~.
- .2 Shape bed true to grade to provide continuous uniform bearing surface for pipe exterior. Do not use blocks when bedding pipe.
- .3 Shape transverse depressions in bedding as required to make joints.
- .4 Compact each layer full width of bed to at least 95 % maximum dry density in accordance with ASTM D698, Method D.
- .5 Fill any excavation below level of bottom of specified bedding in accordance with Section 02223 – Excavating, Trenching and Backfilling.

4.54.7 PIPE INSTALLATION

- ~~.1 Water service laterals shall terminate at the Right of Way or when specified to 1.5 metres outside the building wall. Cap or seal end of pipe and place temporary marker to locate pipe end.~~
 - .1 Lay and join ductile iron pipe in accordance with AWWA C600, manufacturer's standard instructions and specifications.
 - .1 Do not use blocks except as permitted in Concrete Bedding and Encasement subsection 4.3.2 of this specification.
 - .2 Torque wrench to be used for all mechanical joint bolts.
 - .2 Bevel or taper ends of PVC pipe to match fittings.
 - .3 Handle pipe by approved methods. 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.

4.3 Correct pipe that is not in true alignment or grade or pipe that shows differential undue settlement after installation greater than 10 mm in 3 m.

.5 Face socketbell ends of pipe in direction of laying and For mains on a grade of 2 % or greater, face socket bell ends upgrade.

.6 Do not exceed permissible deflection at joints as recommended by pipe manufacturer. Any deflection should be taken after the joint is assembled.

.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.

.7.2 Bulkhead to remain in place until all water removed from trench.

.8 Position and join pipes with approved equipment and methods approved by the Owner.

.9 Remove all defective pipe from the site of the works.

.10.9 Cut pipes, as required, for special fittings or closure pieces, in a neat manner as recommended by pipe manufacturer, without damaging pipe or its coating and to leave a smooth end at right angles to axis of pipe. Flame cutting and burning of pipe not permitted. File smooth any sharp edges which might damage the gasket.

.11.10 Align pipes carefully before jointing.

.12.11 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 Gaskets so disturbed or contaminated shall be removed

.43.2, Cleaned, lubricated and replaced before jointing is attempted again. Use only manufacturers recommended lubricant.

.14.13 Complete each joint before laying next length of pipe.

.15.14 Minimize deflection after joint has been made.

.16.15 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations. Carefully follow all assembly instructions of manufacturer. Provide the Owner with a copy of these instructions.

.17.16 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by the Owner. Backfill to prevent flotation or as directed by the Owner.

.18.17 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.

.19.18 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.

.20.19 Do not lay pipe on frozen bedding.

.21.20 ~~Protect hydrants, valves and appurtenances from freezing.~~

.22 ~~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.~~

.23 ~~Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping of material directly on top of pipe is not permitted.~~

.24 ~~Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.~~

.25 ~~Compact each layer to at least 95 % maximum density in accordance with ASTM D698, Method D.~~

.26.21 ~~Surround and cover joints and fittings with granular material placed and compacted as specified herein. Backfill remainder of trench in accordance with Section 02223 Excavating, Trenching and Backfilling.~~

.27.22 Install HDPE pipe to manufacturer's recommendations.

4.64.8 VALVE INSTALLATION

- .1 Install valves to manufacturer's recommendations at locations indicated.
- .2 Support valves located in valve boxes or valve chambers by means of concrete blocks, located between valve and solid ground. Bedding same as adjacent pipe. Minimum length of pipe on each end of valve shall be one full pipe length or 1 m at stub connection at Tee. Valves shall not be supported by pipe.

4.74.9 VALVE CHAMBERS

- .1 Use cast-in-place or precast units as indicated and approved by the Owner.

- .2 Construct units as indicated, plumb and centred over valve nut, true to alignment and grade, and not resting. ~~Valve chambers shall not rest on pipe.~~
- .3 Place reinforcing steel and miscellaneous metals required to be embedded in concrete to details indicated and in accordance with Section 03200 – Concrete Reinforcement.
- .4 Cast bottom slabs for precast units~~base~~ directly on undisturbed ground or when permitted by the Owner, set a precast concrete slab~~base~~ on 150 mm minimum compacted granular material as indicated~~compacted to 95 % maximum density~~ in accordance with ASTM D698, Method D.
- .5 Set bottom section of precast unit in bed of cement mortar and bond to bottom slab.
 - .1 Make each successive joint watertight with approved rubber ring gaskets, mastic joint filler, cement mortar, or combination thereof.
- .6.6 Clean surplus mortar and joint compounds from interior surface of valve chamber as work progresses.
- .6.7 Plug lifting holes with precast concrete plugs set in cement mortar, mastic compound or mortar as indicated or approved by the Owner.
- .7.8 ~~Set frame and cover to required elevation to frame with cement mortar, parge and trowel smooth and use concrete slab for setting frame and cover only if authorized in writing by the Owner. Water proof chambers in accordance with Section 02601 – Maintenance Holes and Catch Basin Structures.~~
- .8.9 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.
- .9.10 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.
- .10.11 Test chambers ~~for infiltration and exfiltration~~ in accordance with Section 02601 - Maintenance Holes and Catch Basin Structures.

4.84.10 LOCATION OF CURB STOPS

- .1 Water service laterals shall terminate at the Right-of-Way or when specified to 1.5 metres outside the building wall. Cap or seal end of pipe and place temporary marker to locate pipe end.
- .4.2 Unless otherwise designated by the Owner, curb stops will be installed by the Contractor within 1.5 m of the road right-of-way off the property line. Curb stops may be located on private property where special conditions exist upon approval of the Owner.

4.94.11 SERVICE CONNECTIONS

- .1 Install service connections before carrying out hydrostatic and leakage test of water main.
- .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 building.
- .3 Tappings on ductile iron or PVC C900 pipe, may be threaded without service clamps.

- .1 Double strap service connections with galvanized malleable iron body and neoprene gasket cemented in place may be used. Do not use galvanized malleable iron in corrosive soils.
- .2 Tappings for PVC C900 to conform to following:

Pipe Diameter (mm)	Maximum Tap Without Clamp (mm)	Maximum Tap With Clamp (mm)
100	20	25
150	20	40
200	25	50
250	25	50
300	40	75

- .4 Tappings on PVC pipe to be either PVC valve tees or bronze type service clamps, strap type with "O" ring seal cemented in place.
- .5 Tappings for PE pipe: PE tapping tees or multi-saddle tees.
- .6 Employ only competent workers equipped with suitable tools to carry out tapping of mains, cutting and flaring of pipes.
- .7 Install single and multiple tap service connections on top half of main, between 45 degrees and 90 degrees measured from apex of pipe.
- .8 Tap main at 2:00 o'clock or 10:00 o'clock position only; for services up to 32 mm. Do not tap pipe closer to a joint nor closer to adjacent service connections than recommended by manufacturer, or 1 m minimum, whichever is greater.
- .9 Tap NPS 1-1/2" and 250 mm services at 9:00 o'clock or 3:00 o'clock position to keep gooseneck below frost.
- .10 Leave corporation stop valves fully open.
- .11 To relieve strain on connections, install service pipe in "Goose Neck" form "laid over" into horizontal position.

.6.12 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings or use fittings with built in liner.

.13 Install curb stop with corporation box on services 50 mm or less in diameter.

.1 Equip larger services with a gate valve and cast iron box.

.2 Set box plumb over stop and adjust top flush with final grade elevation.

.7.3 Leave curb stop valves fully closed.

.14 Place temporary location marker at ends of plugged or capped unconnected water lines.

.1 Each marker to consist of a 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.

.8.2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

.9.15 The location of existing water services shall be located as work progresses and new water service lines shall be installed with new curbs stops at property line or Owner's road right-of-way boundaries and/or the appropriate tie in location to the existing line will be determined in the field, as identified by the Owner's Representative on site. Following acceptance by the Owner of the water system, the new individual service lines are to be connected to the existing service lines and visually inspected for leakage by the Owner's Representative prior to backfilling.

4.104.12 HYDRANTS

- .1 Install hydrants at locations specified or directed in accordance with AWWA M17.
- .2 Install gate valve and cast iron valve box on hydrant service leads as specified.
- .3 Set hydrants plumb, with hose outlets parallel with edge of payment or curb line, with pumper connection facing roadway and with body flange set at elevation of 150 mm above final grade.
 - .3.1 When placed behind the curb, no part of the hydrant shall be closer than 150 mm or farther than 300 mm from the gutter face of the curb or future curb. When between curb and sidewalk or on lawn behind sidewalk no part of the hydrant shall be closer than 150 mm, to the sidewalk.
- .4 Place concrete thrust blocks as indicated and specified ensuring that drain holes remain unobstructed, unless specified in the contract that drain holes should be plugged.

- .5 Install drain plug in areas of high groundwater when directed by the Owner. After testing and prior to turn over to the owner, pump down water in barrels of plugged hydrants.
- .6 To provide proper draining for each hydrant, excavate a pit measuring not less than 1 x 1 x 0.5 m deep and backfill with coarse gravel or crushed stone to a level 150 mm above drain holes.
- .7 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.
- .8 Install hydrant marker post as detailed on the contract drawings.
- .9 Disassembly or reassembly of hydrants may only be carried out by properly trained personnel. Hydrants that have been disassembled after leaving the manufacturer's facilities must be pressure tested after reassembly in accordance with AWWA M17.

4.114.13 THRUST BLOCKS AND RESTRAINED JOINTS

- .1 Do concrete work in accordance with Section 03300 – 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 specified or as directed by the Owner.
- .3 Keep joints and couplings free of concrete.
- .4 Do not backfill over concrete within 24 hours after placing.
- .5 Install joint restraints with or without thrust blocks where indicated on the plans and specifications or where required by the Owner.
 - .1 Joint restraints shall be of the same pressure rating as the pipes to be joined and restrained.
 - .2 Installation of joint restraints shall be in accordance with the manufacturer's instructions for the types of pipes to be joined and restrained.
 - .3 All components of joint restraints shall be corrosion resistant or suitably protected from corrosion and be approved by the Owner.

4.124.14 HYDROSTATIC PRESSURE TEST

- .1 Do tests in accordance with ANSI/AWWA C600.
- .2 Provide labour, equipment, and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Owner at least two (2) working days in advance of proposed tests. Perform tests in presence of Owner.

- .4 Where section of system is provided with concrete thrust blocks, conduct test at least five (5) days after placing concrete or two (2) day if high early strength concrete is used.
- .5 Test pipelines in sections not exceeding 365 m in length, unless otherwise authorized by the Department of Environment and Climate Change.
- .6 Upon completion of pipe laying and after Owner has inspected Work in place, ~~S~~surround and cover pipes between joints and fittings with approved granular material placed to dimensions and compacted as indicated ~~specified herein~~.
- .7 Leave hydrants, valves, joints and fittings exposed.
- .8 When testing is done during freezing weather, ~~P~~protect hydrants, valves, joints, and fittings ~~appurtenances~~ from freezing.
- .9 Strut and brace caps, bends, tees, and valves, to prevent movement when test pressure is applied.
- .10 Open valves.
- .1 After the pipe has been laid and backfilled and following the installation of service pipes and fittings, all newly laid pipe, or valved section thereof, shall be subjected to a hydrostatic pressure of 150 % of normal operating 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 1 hour. Where hydrants are in the test section, the test shall be made against the closed hydrant valve.
- .11 Before applying the test pressure, all air shall be expelled from the pipe by slowly filled each valve section or main with water.
 - .1 Install corporation stops at high points in main where no air vacuum release valves are installed. ~~If permanent air vents are not located at all high points the Contractor shall install corporation cocks at such points so the air can be expelled, the corporation cocks shall be closed and the test pressure applied.~~
 - .2 Remove stops after satisfactory complete of test and seal holes with plugs.
- .12 Fill concrete pipe at least 24 hours before testing to allow water absorption by pipe material.
- .13 Thoroughly examine exposed parts and correct for leakage as necessary.
- .14 After the pipe has been laid and backfilled and following the installation of service pipes and fittings, all newly laid pipe, or valved section thereof, shall be subjected to Apply a hydrostatic pressure of 150 % of normal operating 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 1 hour.

- .1 Where hydrants are in the test section, the test shall be made against the closed hydrant valve.
- .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 Owner. The pump, pipe connection and all necessary apparatus shall be furnished by the Contractor.
- .3.15 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 cocks at such points so the air can be expelled, the corporation cocks shall be closed and the test pressure applied.
- .4.1 The pressure test shall be of a duration of at least 2 hours and the pressure shall not vary by more than +/- 35 kPa.
- .5.16 Hydrostatic Pressure testing of PE pipe to be carried out as per Manufacturer's recommendations.
- .6.17 Hydrostatic Pressure testing of HDPE pipe.
 - .1 Water is to be used as the pressure medium. Testing can be done before or after the pipe is placed in the trench. If the pipe must be backfilled before it is tested, the mechanical joints may be exposed for visual inspection during testing.
 - .2 Pipe should be tested at a pressure of 1.25 times the nominal operating to 1.5 times the design rated pressure of the system. When test pressure is applied, polyethylene pipe will expand slightly due to elasticity and Poisson effects. To compensate for expansion, make-up water is added during the initial expansion phase. The amount of make-up water (expansion allowance) will vary because expansion is not linear. Contractor to follow ASTM F2164 or PPI TN-46 guidelines for pressure testing HDPE pipe (1.5 times series number) at the lowest point in the system. To compensate for initial pipe stretch, a period of 3 hours is required to pressurize the pipe plus 1 hour during which time the required pressure is maintained before the test period is started. Unless a high volume high pressure pump is used, it is sometimes difficult to raise the pressure within the allowable time.
 - .3 After the completion of the initial expansion stage, i.e. a total of four hours, the pressure should be at the required level and the test period should commence. This period should not exceed 3 hours. After the test period, a measured amount of make-up water should be added to return the pipe to the test pressure. The amount of

make-up water should not exceed the allowance given in the following table:

Nominal Pipe Size		Allowance for Expansion (Litres/100 metres of pipe)		
mm	inches	1-hour test	2-hour test	3-hour test
75	3	1	2	4
100	4	2	4	5
150	6	4	7	11
200	8	6	12	19
250	10	10	16	26
275	11	12	25	37
300	12	14	29	42
350	14	17	35	52
400	16	21	41	62
450	18	27	53	81
500	20	35	68	99
550	22	43	87	130
600	24	56	111	168
700	28	68	138	209
800	32	87	178	267
900	36	112	224	335
1000	40	137	273	410
1200	48	186	335	534

.7.4 Under no circumstances should the total time under test exceed 8 hours at 2 times the pressure rating. If the test is not completed because of leakage or equipment failure, the test section should be permitted to "relax" for 8 hours prior to the next testing sequence.

.8.5 Testing for leakage can be done by developing the test pressure (described above) for a period of 4 hours and then dropping the pressure by 69 kPa (10 psi). If the pressure remains steady for one hour this indicates that there is no leakage in the system.

.18 **Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.**

.19 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.

.20 Repeat hydrostatic test until defects have been corrected.

.9.21 All faulty or leaking connections shall be corrected at the Contractor's expense.

4.134.15 LEAKAGE TEST

.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.

.2 Apply leakage ~~The pressure test of a minimum of the design working pressure after completing backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, shall be of a duration for a period of at least two (2) hours.~~

.1 ~~and~~ ~~T~~he pressure shall not vary by more than +/- 35 kPa.

.2.3 "Leakage" shall be defined as the quantity of water that must be supplied into the newly laid 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.

.3.4 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.

.4.5 Allowable leakage for joints is calculated as follows:

$$L = \frac{NDP^{0.5}}{128}$$

Where:

L = the allowable leakage in L/hr

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

D = the nominal diameter of the pipe in metres

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

.5.6 Allowable leakage for closed metal seated valves shall be 0.00121 L/hr/mm of nominal valve size.

.7 If any test of pipe discloses leakage greater than the allowable, the Contractor shall, at their own expense, locate and repair the defective joints until the leakage is within the specified allowance. All joints until the leakage is within the specified allowance. All visible leaks are to be repaired regardless of the amount of leakage.

.6.8 Repeat test until leakage is within specified allowance for full length of water main.

4.16 PIPE SURROUND

- .1 Upon completion of pipe laying and after the Owner has inspected work in place, surround and cover pipes as indicated.
- .2 Hand place surround material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe. Dumping of material directly on top of pipe is not permitted.
- .3 Place layers uniformly and simultaneously on each side of pipe to prevent lateral displacement of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer to at least 95 % maximum dry density in accordance with ASTM D698.
- .6 Compact each layer from pipe invert to mid height of pipe to at least 95 % of corrected maximum dry density, where the maximum dry density is determined in accordance with to ASTM D698 and corrected as specified in Section 02501 – Corrected Maximum Dry Density
- .7 Compact each layer from mid height of pipe to underside of backfill to at least 90 % of corrected maximum dry density, where the maximum dry density is determined in accordance with to ASTM D698 and corrected as specified in Section 02501 – Corrected Maximum Dry Density.

4.17 BACKFILL

- .1 Backfill remainder of trench in accordance with Section 02223 – Excavating, Trenching and Backfilling.
- .2 Do not backfill trenches until installed work has been checked and accepted by the Owner.
- .3 Place backfill material, above pipe surround, in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .4 Do not place backfill in frozen condition.
- .5 Under paving and walks, compact backfill to at least 95 % corrected maximum dry density, where the maximum dry density is determined in accordance with to ASTM D698 and corrected as specified in Section 02501 – Corrected Maximum Dry.
 - .1 In other areas, compact to at least 90 % corrected maximum dry density, where the maximum dry density is determined in

accordance with to ASTM D698 and corrected as specified in
Section 02501 – Corrected Maximum Dry Density.

4.18 HYDRANT FLOW TESTS

.1 Conduct flow tests on every hydrant to determine fire flows before painting hydrant caps and ports.

4.19 PAINTING OF HYDRANTS

.1 After installation, paint hydrants [red][yellow].
.2 After hydrant flow tests, paint caps and ports to meet colour selections approved by authority having jurisdiction.

4.144.20 FLUSHING AND DISINFECTING

.1 Flushing and disinfecting operations shall be witnessed by the Owner.
.1 Notify the Owner at least 4 business days in advance of proposed date when disinfecting operations will commence.
.2 ~~Disinfection of water mains shall be done in accordance with AWWA C651.~~
.2 Prior to being disinfected/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 Owner 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 ~~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.~~
.3.4 Flushing flows shall be as follows:

Pipe diameter (mm)	Minimum flow (L/s)
150 and below	38
200	75
250	115
300	150
350	200
400	250

- .5 Provide connections and pumps for flushing as required.
- .6 Open and close valves, hydrants and service connections to ensure thorough flushing.
- .4 Water from existing distribution system, or other approved source of supply, shall be made to flow at a constant measured rate into the newly laid water mains and hydrant leads.
- .7 Disinfection of water mains shall be done in accordance with AWWA C651 and the Department of Environment and Climate Change, Water Resources Management Division.
- .8 When flushing has been completed to the Owner's approval, introduce strong solution of chlorine as approved by the Owner into water main and ensure that it is distributed throughout entire system.
- .9 At a point not more than 3 m 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.
 - .5.1 To assure that this concentration if provided, measure the chlorine concentration at regular intervals.
- .10 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.
- .11 Chlorine application shall not cease until the entire main is filled with heavily chlorinated water.
 - .1 The chlorinated water shall remain in the main for at least 24 hours, during which time all valves and hydrants in the section treated shall be operated in order to disinfect the appurtenances.
 - .2 At the end of this 24 hours period, the treated water in all portions of the main shall have a residual of not less than 10 mg/l free chlorine.
 - .3 Measure chlorine residuals at extreme end of pipe-line being tested.
- .12 Perform bacteriological tests on water main, after chlorine solution has been flushed out and before water main is placed in service.
 - .1 Take samples daily for minimum of two (2) days.
 - .2 Samples shall show the absence of coliform organisms, disinfection shall be repeated until satisfactory samples have been obtained
 - .3 Should contamination remain or recur during this period, repeat disinfecting procedure until satisfactory samples have been obtained.

- .4 Specialist contractor to submit certified copy of test results.
- .13 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
- .7 After the final flushing and before the water main is placed in 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.
- .14 The Contractor shall get approval of the governing agency or agencies before the heavily chlorinated water can be discharged into storm, sanitary or other receiving systems.
 - .1 If the heavily chlorinated water cannot be accepted by nearby storm, sanitary or other receiving systems, the water shall be discharged into tanks and disposed of at an approved site.
 - .2 The cost associated with disposing of heavily chlorinated water shall be borne by the Contractor.
- .15 Provide certification of test acceptance.

4.154.21 SWABBING

- .1 Appropriately sized and designed water main swabs shall be inserted into the 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 the valves and hydrants.

PART 5 PAYMENT

5.1 MEASUREMENT FOR PAYMENT

- .1 Water mains will be measured in metres of each type, class, size, and insulation of pipe installed through valves and fittings, including hydrant leads, after the work has been 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
 - .2 in metres along the slope length of the pipe when the grade of the pipe is 10 % or greater.
 - .2.3 No deduction for pipe up to and including nominal diameters of 300 mm will be made. Calculation of deduction will be made for

pipe end area, based on the nominal diameter, for pipes in excess of 300 mm nominal diameter.

- .2 For service connections, measurement will be made horizontally from the point of connection to the water main through curb valve and adjustable valve box to a point vertically above the end of the service connections.
- .3 Hydrants, to the specified depth of bury in the MERX Schedule of Quantities and Prices, will be measured in units installed including the hydrant marker post and concrete support base as detailed.
- .4 All fittings, sounding points/markers and appurtenances will be measured by units installed.
- .5 Hydrant extensions will be measured by the units installed and shall include all fitting and bolting required to make the extension a functional part of the hydrant.
- .6 If colour coded painting of hydrants is required, payment shall be made by the each as specified in the MERX Schedule of Quantities & Prices.
- .7 Valves not in chambers will be measured in units installed including valves and valve boxes.
- .8 Valve chambers will be measured in units installed ~~complete~~ including frames and covers, valves, piping, clamps and appurtenances.
- .9 ~~Granular bedding material will be measured in cubic metres of material incorporated into the work in accordance with Section 02223 Excavating, Trenching and Backfilling. No deduction for pipe up to and including nominal diameters of 300 mm will be made. Calculation of deduction will be made for pipe end area, based on the nominal diameter, for pipes in excess of 300 mm nominal diameter.~~
- .10 Joint restraints, combination air release – vacuum relief valves, valve box extensions, and adjustments to existing valve boxes to grade will be measured by the each.
- .11 Swabbing of water main shall be measured by metre of line swabbed, and accepted by the Owner, for each size of pipe cleaned.
- .12 Locating existing water main to be measured by the each.
- .13 Connecting to existing water main to be measured by the each. This item shall include all fittings as necessary to join the new service to the existing service, removal of the existing curb stop/curb stop box and delivery to the Owner or Owner's depot, and any additional location and excavation after testing is complete and accepted by the Owner's Representative to make the connection to existing laterals.

- .1 The cost of testing to make new water services connections to the existing service laterals is to be included in the item.
- .14 Rigid insulation buried over or around the pipe will be measured by the linear metre for each detail type. 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.

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 water mains, hydrants, valves, fittings and appurtenances until the system, or sections of the system if payment approved by the Owner, has passed all hydrostatic leakage tests. The 10 % retained shall be called the water testing allowances.
- .3 Trenching and backfilling will be measured in accordance with Section 02223 – Excavating, Trenching and Backfilling.
- .4.4 Granular bedding material will be measured in cubic metres of material incorporated into the work in accordance with Section 02223 – Excavating, Trenching and Backfilling.
- .4.5 Concrete for bedding, thrust blocks, encasement of pipes, supports and cut-off walls will be measured in accordance with Section 03300 – Cast-in-Place Concrete.