

## **PART 1 - GENERAL**

### **1.1 WORK INCLUDED**

- .1 This section specified requirements for constructing geothermal water mains and services. Work includes supply, installation and testing of pipe, hydrants, fittings and service connections, and flushing.

### **1.2 RELATED SECTIONS**

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

### **1.3 REFERENCES**

- .1 American Society for Testing and Materials International, (ASTM)
  - .1 ANSI/ASME B16.1-2010, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
  - .2 ANSI/AWWA C153/A21.53-2011, Ductile-Iron Compact Fittings for Water Service.
  - .3 ANSI/AWWA C502-05, Dry-Barrel Fire Hydrants.
  - .4 ANSI/AWWA C509-2009, Resilient-Seated Gate Valves for Water Supply Service.
  - .5 ANSI/AWWA C600-2010, Installation of Ductile Water Mains and Their Appurtenances.
  - .6 ANSI/AWWA C606-2011, Grooved and Shouldered Joints.
  - .7 ANSI/AWWA C800-2012, Underground Service Line Valves and Fittings.
  - .8 ANSI/AWWA C900-2008, Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. (100mm) Through 12 in.(300mm), for Water Distribution.
  - .9 ASME B18.2.1-2005, Square and Hex Bolts and Screws, Inch Series.
  - .10 ASTM A183-03(R2009), Carbon Steel Track Bolts and Nuts.
  - .11 ASTM A276-2010, Stainless and Heat-Resisting Steel Bars and Shapes.
  - .12 ASTM B62-2009, Composition Bronze or Ounce Metal Castings.
  - .13 CAN/ULC S701-2011, Thermal Insulation, Polystyrene, Board and Pipe Coverings.
  - .14 CAN/CSA B137 Series-2009, Thermoplastic Pressure Piping Compendium

### **1.4 SHOP DRAWINGS**

- .1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

### **1.5 CERTIFICATES**

- .1 Submit manufacturer's test data and certification that products and materials meet requirements of this Section in accordance with Section 01 33 00 – Submittal Procedures.

## **1.6 HANDLING AND STORAGE**

- .1 Handle and store pipe, valves and fittings, in such manner as to avoid shock and damage. Do not use chains or cables passed through pipe bore. Do not damage coatings or linings.
- .2 Store gaskets in cool location, out of direct sunlight, and away from petroleum products.
- .3 Store valves to prevent retention of water and damage by freezing.

## **1.7 SCHEDULING OF WORK**

- .1 Coordinate and organize work to minimize interruptions to existing services.
- .2 Notify Environmental Services Division (ESD) and Fire Department of any planned or accidental interruption to water service.

## **1.8 ELECTRICAL GROUNDING TO WATERMAINS**

- .1 As of January 1, 2009, the grounding of electrical services to watermains and water services is prohibited.
- .2 Where an electrical services is already grounded to an existing metallic watermain or service and the watermain or services is to be replaced by non-metallic piping, a new electrical grounding system is to be provided. The size and configuration of the new electrical grounding system is to be approved by the Chief Electrical Inspector, Department of Building & Property Management.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- .1 Diameter, material and strength class of pipe and fittings: as indicated.

### **2.2 POLYVINYL CHLORIDE PIPE AND FITTINGS**

- .1 Pipe: shall conform to AWWA C900 and certified to CSA B137.3 for sizes 100mm to 300mm and AWWA C905. Pipe shall be cast iron pipe equivalent OD's and be DR 18 (pressure class 235 psi). Pipe shall be Factory Mutual, ULC and ULI approved and NSF-61 certified. Pipe shall be delivered to site complete with capped ends.
  - 2 Molded Fittings: shall conform to AWWA C907 and certified to CSA B137.2 for sizes 100mm to 200mm and conform to AWWA C900 and certified to CSA B137.3 for sizes 250mm to 300mm. They should also be UL listed and FM approved.
  - .3 Fabricated Fittings: shall be made from segments of AWWA C900 DR 18 (pressure class 235 psi) pipe bonded together and over-wrapped with fiberglass-reinforced polyester. The fittings must meet the requirements of CSA B137.3.
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- .4 Lubricant: shall be non-toxic, water soluble and listed by the National Sanitation Foundation.
- .5 Pipe Restraints: restraints shall be same as for ductile iron but specifically designed for use on PVC pipe or PVC integral joint restraint.
- .6 Colour Coding: Pipe and fittings shall be color coded blue.

### **2.3 HYDRANTS**

- .1 Hydrants: dry barrel type, to AWWA C502, designed for working pressure of 1035 kPa with two 65 mm threaded hose outlets, one 100 mm threaded pumper connection, 150 mm riser barrel, 134 mm minimum diameter main valve and 150 mm mechanical joint inlet connection. Hydrants to open counter clockwise with an operating nut 32 mm square, threads to local connect to CAN4-S543. Provide metal caps. Depth of bury 2.5 m minimum to top of pipe. Provide two hose and one pumper nozzles. Hose nozzles to be two 2.5 inch nozzles, nominal size 3 7/32 inch Pumper nozzle to be nominal size 4 29/32 inch. Threads of connections to be compatible with responding Fire Department. Nozzles to be Storz type. Acceptable products: Clow Brigadier M67, Canada Valve Century, Mueller Centurion, Bibbly Ste Croix Sentinel.
- .2 Post Hydrants shall be non-freezing, self draining type with a 1.8m depth of bury. These hydrants will be furnished with a 50mm FIN Inlet. A non-turning operating rod, and shall open to the left. All working parts shall be bronze to bronze design and be sericable prom above grade with no digging. The outlet shall also be bronze and be 63.5mm NST. Hydrants shall be lockable to prevent unauthorized use. Acceptable products: Kupferle Foundry Co. #77 MounguArd Post Hydrant.

### **2.4 GATE VALVES**

- .1 Buried: to AWWA C500, minimum pressure rating 1035 kPa or AWWA C509 up to 300 mm, minimum working pressure rating 1380 kPa and as follows:
  - .1 Body: bronze with mechanical joint ends.
  - .2 Mechanism (AWWA C509): wedge disc with resilient rubber seat ring and machined seating surface, non-rising spindle, and O-ring seals.
  - .3 Direction of opening: counter-clockwise.
  - .4 Operating nut: 50mm square.
  - .5 Provide centering disc.
  - .6 All Valves 100mm and larger shall be: bronze body, non-rising stem; stainless steel nuts and bolts, mechanical joint, unless otherwise specified; fusion bonded epoxy resin coated to C550; O ring seals:
    - .1 Direction of opening: clockwise;
    - .2 Operating nuts: St. John's Standard.

## **2.5 VALVE BOXES**

- .1 ABS composite lower section, complete with ductile iron upper section, 125mm diameter. The minimum overlapping distance between the top of the ABS section and the bottom of the ductile iron section shall be 150mm. Acceptable products: Mueller MVB Composite Valve Box or equal.
- .2 Top of the box shall be marked "WATER".
- .3 Lugged to prevent turning and rolling of cover, and cover notched to suit.

## **2.6 GASKETS AND BOLTS FOR FLANGES**

- .1 Gaskets: unless otherwise specified, full face one piece red virgin rubber gaskets of 3mm thickness to be supplied for all flange joints.
- .2 Bolts: unless otherwise specified, all steel bolts and nuts to be American Standard threads of the coarse thread series, conforming to ANSI B18.2.1. Bolts, heads and nuts to be hexagonal. Length of any bolt to be such that it will not project beyond nut more than 10mm or less than 5mm and no bolt to be less than diameter of the hole in which it fits by more than 3mm. Bolts to be utilized for all flanged joints unless otherwise indicated. Studs or "stub bolts" may be used for certain connections only when approved by the Departmental Representative.

## **2.7 COUPLINGS**

- .1 Grooved and shoulder type: to AWWA C606 with malleable iron housing, halogenated butyl gasket and heat treated, plated carbon steel bolts and nuts to ASTM A183.
- .2 Collar type: steel with minimum pressure rating 1035 kPa, appropriate to the type and size of pipe being joined, epoxy-coated with type 316 stainless steel bolts and nuts.

## **2.8 THRUST RESTRAINT**

- .1 Thrust blocks and anchors: 20 MPa concrete and 15 M, Grade 400 reinforcing steel where indicated.
- .2 Mechanical joint restraint device: 100 mm to 600 mm) ductile iron follower gland to AWWA C153 and C111 with multiple wedge restraining mechanism, minimum pressure working rating 2410 kPa and minimum safety factor of 2:1. Lugs to have twist-off torque nuts.

## **2.9 INSULATION**

- .1 Insulation: to ULC S701, Type 4, extruded polystyrene.

## **2.10 MARKER STAKE**

- .1 Timber, 40 mm x 90 mm.
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## **2.11 GEOSYNTHETIC**

- .1 Synthetic fibre, rot proof, unaffected by action of oil or salt water and not subject to attack by insects or rodents. Non-woven construction, with minimum thickness of 2 mm and minimum density of 200 g/m<sup>2</sup>.

## **2.12 ANODE PACKS**

- .1 All sacrificial zinc anodes shall conform to ASTM B-418 Type II and shall be made of high grade electrolytic zinc, 99.99% pure. The standard anode size shall be 10.9 kg. (24lb.) and 1.2 metres (48'') in length, ZN 24-48. The anode lead wire shall be at least 3 metres of No. 10 AWG stranded copper wire having TWH blue insulation. The lead wire shall be connected to the steel core with silver solder.

## **2.13 PROTECTIVE COATING**

- .1 Anti-corrosion petrolatum paste, tape and mastic.

## **PART 3 - EXECUTION**

### **3.1 PREPARATION**

- .1 Carefully inspect products for defects and remove defective products from site.
- .2 Confirm pipe, fittings and valves are clean before installation.

### **3.2 TRENCHING, BEDDING AND BACKFILLING**

- .1 Do trenching bedding backfilling to Section 31 23 33.01 – Excavating, Trenching and Backfilling.

### **3.3 PIPE INSTALLATION**

- .1 Lay and join pipe, fittings, and valves as specified herein and according to manufacturer's published instructions.
  - .2 Lay pipe and fittings on prepared bed, true to line and grade indicated, within following tolerances:
    - .1 Horizontal Alignment: 150mm
    - .2 Vertical Alignment: 75mm
  - .3 Face bell ends in direction of laying. On grades of 5% or greater lay pipe up grade.
  - .4 Do not exceed maximum joint deflection recommended by manufacturer.
  - .5 Prevent entry of bedding material, water or other foreign matter into pipe. Use temporary watertight bulkheads when pipelaying is not in progress.
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- .6 Install gaskets in accordance with manufacturers published instructions. Use only lubricant supplied by manufacturer. During cold weather store gaskets in heated area to promote flexibility.
- .7 Align pipes carefully before joining.
- .8 Support pipes as required to promote concentricity until joint is properly completed.
- .9 Keep pipe joints free from mud, soil, gravel or other foreign materials.
- .10 Avoid displacing gasket or contaminating with soil, petroleum products or other foreign material. Remove, clean, reinstall and lubricate gaskets so disturbed.
- .11 Complete each joint before laying next length of pipe.
- .12 Where deflection at joints is permitted, deflect only after spigot is fully inserted in bell.
- .13 At structures provide flexible joint not more than 1 m from outside face of structure. Support pipe between structure wall and first joint with 20 MPa concrete.
- .14 Cut pipe as required for fittings or closure pieces, square to centerline, and as recommended by manufacturer. Do not damage pipe lining or coating and leave smooth beveled edge.
- .15 Provide concrete thrust blocks to undisturbed ground on all tees, bends, plugs and caps or as indicated. Construct as indicated and keep joints and couplings free of concrete.
- .16 Install mechanical joint restraint to AWWA C111 and tighten lug nuts until all wedges are in firm contact with pipe surface. Continue to tighten alternating between bolts until lug nuts twist off.
- .17 Install polyethylene tube or sheet on all ductile-iron pipe and fittings and install zinc anodes on all valves.

### **3.4 UNDERCROSSING**

- .1 Provide shop drawings showing proposed method of installation for pipe in undercrossing.
  - .2 Excavate working pit according to reviewed shop drawings.
  - .3 Dewater area of excavation and undercrossing.
  - .4 Place jacking, boring or tunneling equipment in working pit to approved line and grade of the proposed pipe.
  - .5 Install encasing pipe to proposed line and grade as indicated.
  - .6 Use mechanical or welded type joints for encasing pipe.
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- .7 After encasing pipe has been installed, check line and grade for approval.
- .8 Remove any soil that remains in the casing pipe.
- .9 Insert pipe into encasement pipe, starting from the working pit.
- .10 Place pipe one (1) length at time outside encasement pipe. Maneuver pipe into position.
- .11 Use approved blocking method to guide pipe in true alignment.

### **3.5 HYDRANT INSTALLATION**

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

### **3.6 VALVE CHAMBERS**

- .1 Construct valve chambers where and as indicated in accordance with applicable Sections. Do not allow valve chambers to rest upon pipe.

### **3.7 VALVES AND VALVE BOXES**

- .1 Install valves at locations indicated. Joints and bedding as specified for pipe and fittings.
  - .2 On direct buried valves, install valve boxes centered over operating nut, using centering disc, and true to line and grade.
  - .3 Use thrust anchors for valves greater than 150 mm on PVC.
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### **3.8 SERVICE CONNECTIONS**

- .1 Install services at locations indicated.
- .2 Do not tap closer than 1000 mm to adjacent service or pipe joint. Tap water main and install corporation stops at 2:00 o'clock or 10:00 o'clock positions using type of connection and tapping method appropriate for type, size and pressure of water main.
- .3 Lay service pipe from water main to curb stop in evenly graded trench with bedding as indicated.
- .4 Install curb stops at street line, or where indicated. Confirm that curb stop is properly oriented.
- .5 Leave corporation stop fully open. Operate curb stop to ensure flow, then close curb stop and leave closed.
- .6 Install service box over curb stop with top flush with finished grade.
- .7 Place temporary marker stake at end of each service lateral, extending from pipe end at pipe level to 600mm above grade. Paint exposed portion of stake BLUE with designation water in black.

### **3.9 HYDROSTATIC AND LEAKAGE TESTING**

- .1 Provide labour, equipment and materials required to perform hydrostatic and leakage tests.
  - .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests.
  - .3 Test after services are installed.
  - .4 Backfill prior to testing.
  - .5 Notify Departmental Representative at least 24 hours in advance of all proposed tests. Perform tests in presence of Departmental Representative..
  - .6 Open all valves in test section.
  - .7 Expel air from main by slowly filling with potable water. Install corporation stops at high points where no air vacuum release valves are installed. After testing, remove corporation stops and install plugs.
  - .8 Apply test pressure of 1035 kPa or pressure equal to 1.5 times working pressure, whichever is greater, measured at lowest point in test section. Conduct the test over a full two (2) hour period, maintaining a constant test pressure. No leakage is permitted by the test process.
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- .9 Locate and repair defects if test fails. Retest.
- .10 Repair visible leaks regardless of test results.

### **3.10 DISINFECTION**

- .1 When flushing has been completed to Departmental Representative approval, introduce strong solution of chlorine as approved by Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .2 Rate of chlorine application to be proportional to rate of water entering pipe.
- .3 Chlorine application to be close to point of filling water main and to occur at same time.
- .4 Operate valves, hydrants and appurtenances while main contains chlorine solution.
- .5 Flush line to remove chlorine solution after 24 hours.
- .6 Measure chlorine residuals at extreme end of pipe-line being tested. .7 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
  - .1 Take samples daily for minimum of two days.
  - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.
- .8 Take water samples at hydrants and service connections, in suitable sequence, to test for chlorine residual.
- .9 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
  - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.

### **3.11 FLUSHING**

- .1 Flush water mains to AWWA C651 and as herein specified. Notify Departmental Representative 24 hours in advance of flushing.
  - .2 Flush water mains with potable water through available outlets with sufficient flow to produce minimum velocity in water main of 1.5 m/s, for 10 minutes. Flush until foreign materials have been removed and water is clear.
  - .3 Slowly open and close valves to ensure thorough flushing.
  - .4 If satisfactory results cannot be achieved by flushing, swab pipes by approved methods and reflush.
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### **3.12 WATER MAIN MARKING**

- .1 All new water mains shall be marked using 3M Ball Marker technology(programmable). Marker balls shall be supplied by the contractor and installed at the following locations:
  - .1 Bends
  - .2 Tees
  - .3 Reducers
  - .4 Corporations
  - .5 Curb Stops
  - .6 Stub ends of pipes
  - .7 Or a Maximum Spacing of 30m
- .2 The balls shall be placed no deeper than 1.5 metres and located directly above the water main or fitting.
- .3 For curb stops tie straps shall be used to secure the marker ball to the street side of the curb stop box.
- .4 Prior to the start of the project, the Contractor shall contact the ESD and supply a copy of the construction drawings and a sufficient quantity of marker balls for the project. Upon review the drawings the ESD will program and identify the appropriate markers required for the project.
- .5 The Departmental Representative shall ensure that the appropriate marker balls are installed in their assigned location. The Departmental Representative shall also record the ID number and location of each marker ball on the As-Built drawings.
- .6 At completion of the project, the City will locate the markers and collect the data.
- .7 Marker balls cannot be re-programmed without re-excavation.

### **3.13 WATER SERVICES INSTALLATION**

- .1 Water services shall not be buried shallower than 1.8 metres and no deeper than 2.0 metres.
- .2 When a water service is installed by itself, then the end of the service shall be marked with a marker post, painted red and extending from the service invert to 600mm above finished grade. Each water service shall be suitably plugged or capped to prevent leakage and to prevent dirt or other harmful material from entering the pipe.
- .3 When new PVC mains are being installed, service tees are to be installed for each water service. Installed on mains 400mm and smaller. Service saddles are to be used on mains larger than 400mm. Direct tapping to connect a water service to a new main is prohibited.

### **3.14 CATHODIC PROTECTION**

- .1 Sacrificial anodes shall be installed at the following locations:
    - .1 At the connection point between a non-metallic watermain and the existing metallic watermain;
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- .2 All metallic fittings and bends;
  - .3 All metallic valves;
  - .4 All metal services.
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- .2 Anodes shall be installed horizontally, a minimum of 500mm to the side of the watermain and at a depth of 30mm below the watermain and shall be backfilled with native material.
  - .3 Anodes shall be installed complete with their cardboard container and enclosed selected backfill.
  - .4 The anode lead wire shall connected to the watermain, metallic fitting, valve, service. Sufficient slack shall be left in the wire to prevent any stress on either the anode or the wire-to-pipe connection during backfill and subsequent soil settlement.