

## 1.0 **GENERAL**

1.1 This Section refers to those portions of work related to supply and installation of geothermal and LDES mains, valves and valve boxes, fittings, service connections and related appurtenances. Where a supply/return facility is part of the contract, this section refers to those areas outside the facility from the connection point outside the facility walls.

1.2 All and any references made to MMCD will be considered applicable to the latest versions available. Any discrepancies between MMCD specifications referenced within this document and what is currently available will be reviewed and decided upon by the Consultant.

### 1.3 **Aggregate Samples**

- .1 Samples may be required. Submit samples in accordance with MMCD 35 05 17 1.3 Approvals.
- .2 Inform Consultant of proposed source of bedding materials and provide access for sampling at least 2 weeks prior to commencing work. Time is required for sieve analysis and Proctor Density calibration.

### 1.4 **Material Certification**

- .1 Products having CSA certification to be used where readily available. Certification by Standards Council of Canada approved independent third body that products conform to CSA standards is acceptable in lieu of CSA certification.
- .2 Submit manufacturer's test data and certification to consultant that pipe materials meet requirements of this section at least two (2) weeks prior to commencing work. Include manufacturer's drawings, information and shop drawings where pertinent.

## 2.0 **PRODUCTS**

### 2.1 **General**

- .1 Only one type of pipe material will be allowed throughout the contract unless specified otherwise or shown otherwise on Contract Drawings.
- .2 All products are specified by reference to approved specifications and/or standards. Refer to Supplementary Specifications and/or Contract Drawings for specified or approved manufacturers or trade names.
- .3 Contractor is to supply itemized list of all installed products including make, model #, size and class.
- .4 Refer to Contract Drawings for pipe material and pressure class.

## 2.2 Pipe, Joints, and Fittings

### .1 Polyvinyl Chloride (PVC) Pressure Pipe:

#### .1 Pipe:

- .1 Pipe to be manufactured to specifications for pipe size ranges as follows:
  - Pipes 100 to 300mm dia. - AWWA C900 SDR 25 or Series 160 DR 26
  - Pipes 350 to 1200mm dia. - AWWA C905 SDR 25 or Series 160 DR 26

AWWA C900 pipe to Pressure Class or AWWA C905 pipe to pressuring rating of DR26 pipe. Pipes to be certified by Canadian Standards Association for pipe size ranges below:

- Pipes 100 to 1200mm dia. – CSA B137.3.

- .2 ULC listed.
- .3 Cast iron pipe to be equivalent outside diameter.
- .4 To be compatible with specified mechanical joint and push-on joint fittings and valves without the use of special adapters.
- .5 Joints: Push-on integrally thickened bell and spigot type to ASTM D3139 with single elastomeric gasket to ASTM F477.
- .6 All Pipes to be white, not blue to distinguish from potable water pipes.

### .2 Steel Pipe:

- .1 Steel pipe diameter bigger than 100mm to ANSI/AWWA C200, Grade steel seamless.

- .1 Exterior finish: to ANSI/AWWA C203, hot applied coal tar enamel (Only for outside of building-in ground applications).
- .2 Interior finish: to ANSI/AWWA C210 standard, liquid epoxy coating systems for all pipe applications.
- .3 Pipe joints: to be flanged, hardware to be stainless steel for buried application. Flanges: to ANSI/AWWA C207, class B ring type.
- .4 Pipe fittings: to ANSI/AWWA C210 epoxy coated and exterior protected with hot applied coal tar enamel to ANSI/AWWA C203.

### .3 Fittings:

- .1 Ductile iron fittings to AWWA C110 suitable for pressure rating of 2415 kPa, cement mortar lined to AWWA C104.
- .2 Compact ductile iron fittings to ANSI/AWWA C153/A21.53-94, suitable for pressure rating of 2415 kPa, cement mortar lined to AWWA C104.
- .3 Flanged Joints:
  - .1 Flat faced conforming to the face dimension and drilling of ANSI B16.1, Class 125.
  - .2 On AWWA C110 fittings to AWWA C110 with minimum pressure rating 1035 kPa or higher as specified in Contract Documents.
  - .3 On AWWA C153 fittings to AWWA C153 with minimum pressure rating of 1723 kPa or higher as specified in Contract Documents.

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- .4 Flange gaskets to be manufactured from black natural rubber 3.175mm thick with layer of cotton on both sides.
  - .5 Bolts and nuts:
    - .1 Bolts to be carbon steel, Grade B to ASTM A307, heavy hex style, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110.
    - .2 Nuts and washers: Nuts to be carbon steel, Grade A to ASTM A563. Washers to be flat hardened steel to ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.
  - .6 Tie Rods and nuts:
    - .1 Tie rods to be continuous threaded, quenched and tempered alloyed steel to ASTM A354, Grade BC. To be zinc plated to ASTM B633 or cadmium plated to ASTM B766. Rod sizes are to be minimum 19mm diameter or greater as shown on the Contract Drawings.
    - .2 Nuts and internally threaded couplings to be zinc plated to ASTM B633 or cadmium plated to ASTM B766. Rod sizes are to be minimum 19mm diameter or greater as shown on the Contract Drawings.
  - .7 Fabricated steel pipe fittings: to AWWA C208 and AWWA C207 if flanged, interior and exterior protected with hot applied coal tar enamel to AWWA C203 or liquid epoxy coating to AWWA C210.
  - .8 Couplings and Flanged Coupling Adapters:
    - .1 General Requirements:
      - .1 Suitable for Pressure Class 160.
      - .2 Flanges and full face flange gaskets where applicable to Clauses of this Section.
      - .3 Anti-corrosion coating of interior and exterior centre sleeve and end rings to AWWA C219, AWWA C213, AWWA C210, or AWWA C550 as specified in Contract Documents.
      - .4 Compression gaskets to AWWA C219.
      - .5 Bolts and nuts high strength low alloy steel to be AWWA C111, stainless steel to be ASTM F593 or F738 for bolts and ASTM F594 or F836M for heavy hex nuts, as specified in Contract Documents. Rolled threads, fit and dimensions to AWWA C111.
      - .6 Ductile Iron castings to be ASTM A536, Grade 65-45-12.
    - .2 Plain end or transition coupling adapters as specified in Contract Documents.
    - .3 Flanged coupling adapters as specified in Contract Documents.
  - .9 Joint Restraint Devices: General Requirements:
    - .1 Ductile iron castings to ASTM A536.
    - .2 Anti-corrosion coating of ductile iron castings as specified in Contract Documents.

- .3 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in Contract Documents, stainless steel to ASTM F593 or F738 for bolts and ASTM F594 or F836 for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
  - .4 Restrainers for mechanical joints or push-on joints in ductile iron pipe as specified in Contract Documents.
  - .5 Joint restraint devices for PVC watermain to be Underwriter Laboratories of Canada (UL) or Factory Mutual (FM) approved.
- .10 Tapping Sleeves for branch connections 75mm and larger:
- .1 General Requirements:
    - .1 Location, type and Pressure Class as specified in Contract Documents. Exterior condition of existing water mains as found in the field may alter type and/or materials.
    - .2 To AWWA C219 for sleeve and gasket materials and generally for design, manufacture and performance.
    - .3 Flanges and flange gaskets to Clauses 2.2.4.7 and 2.2.4.8 of this Section and AWWA C207 and AWWA C208 for fabricated steel sleeves. Flange gaskets for use with epoxy coated flanges to be annular ribbed type.
    - .4 Anti-corrosion coating of fabricated carbon steel and ductile iron sleeve assemblies to AWWA C213 (Fusion bonded epoxy) or shop coated to AWWA C219 in field applied dressings are specified in the Contract Documents.
    - .5 Bolts and nuts high strength low alloy steel to AWWA C111 or as specified in Contract Documents, stainless steel to ASTM F593 or F738 for bolts and ASTM F594 or F836 for heavy hex nuts. Rolled threads, fit and dimensions to AWWA C111.
    - .6 Ductile iron castings to ASTM A536, grade 65-5-12.
    - .7 Flanged branches for welding to steel pipe mains to AWWA C207 and AWWA C208.
    - .8 Branches shall include a threaded test plug 19mm NPS minimum if tapping machine to be used does not have provision for pressure testing.
  - .2 Tapping sleeve for cast iron, ductile iron, asbestos cement, PVC to AWWA C900, prestressed concrete pressure pipe or steel mains for taps other than size-on-size:
    - .1 Split assembly to incorporate an annular gasket cemented or mechanically held in place on the branch end or split assembly incorporating ring seal and wrap around sleeve length gasket liner.
    - .2 Acceptable models: as specified in the Contract documents.
  - .3 Tapping sleeves for size-on-size taps on cast iron, ductile iron, and asbestos cement, PVC to AWWA C900, pre-stressed concrete pressure pipe or steel:
    - .1 Split assembly incorporating ring seal and wrap around sleeve length gasket/liner.
    - .2 Acceptable models: as specified in Contract Documents.
  - .4 Tapping sleeves for size-on-size tap on ductile iron pipe and PVC to AWWA C900 only:

.1 Acceptable models: as specified in Contract Documents.

.11 Repair clamps shall be constructed of 18-8 stainless steel passivated for corrosion resistance. Stainless steel components shall be Type 304 or 304L. All surfaces including weld areas shall be thoroughly cleaned of scale, grease or other contaminants. Welding must be performed in a controlled environment to prevent sensitization. Nuts and bolts shall be Type 304 18-8 stainless steel 5/8 x 11 NC rolled thread lubricated to prevent galling. Gasket shall be SBR (Buna) rubber per ASTM D2000.

## 2.3 Valves and Valve Boxes

.1 Mainline Valves - General Requirements:

.1 Valves to open counter clockwise.

.2 All valves to have manufacturers name, year of manufacture, size and working pressure on the bonnet or valve body.

.2 Mainline Gate Valves:

.1 Locations of valves shown on the Contract Drawings.

.2 To AWWA C500, for 75mm to 300mm to working pressure of 1380kPa; 400mm and larger to working pressure of 1035 kPa, gray cast iron or cast ductile iron body, bronze mounted solid wedge, or double disc, non-rising stem hub or flanged ends.

.3 To AWWA C509: 75mm to 300mm to working pressure 1380 kPa; Gray cast iron or ductile iron body, resilient seated, non-rising stem, hub or flanged ends.

.4 Stem seal to be O-ring type.

.5 Valves to be complete with 50mm square operating nut for underground service.

.6 Acceptable manufacturers are as specified in Contract Documents.

.3 Mainline Butterfly Valves:

.1 All butterfly valves shall be manufactured in accordance with the latest revision of AWWA C504 for Class 150B service.

All valves shall be either Henry Pratt Groundhog® as manufactured by the Henry Pratt Company or engineer approved equal and be approved for direct bury. Valves in sizes 3-24" shall have 304 stainless steel trim as standard.

.2 Valves to be complete with 50mm square operating nut for underground service.

.4 Plug valve:

.1 Flanged valve, cast iron body, class 125, to ANSI B16.1, valve seat to be pure nickel to machined smooth finish, tested in accordance with AWWA C504 suitable for vertical installation, complete with eccentric gear actuator.

.2 Valves to be complete with 50mm square operating nut for underground service.

.5 Blow-down or Blow-off Valves: 100mm to AWWA C800 for working pressure of 1035 kPa.

.6 Air Release, Air /Vacuum, and Combination Air Valves:

.1 Gray cast iron or ductile iron body.

- .2 Threaded or flanged connections.
- .3 Maximum working pressure 2070 kPa.
- .4 To AWWA C512
  
- .7 Mainline Valve Boxes:
  - .1 To be as specified in the Contract Documents: cast iron, top flange type service box, caps to read supply/return:
    - .1 Circular type to be as specified in Contract Documents.
    - .2 Valve box riser pipe to be 150mm diameter PRV DR 35 or better.
  
- .8 Check Valves
  - .1 To AWWA C508: 50 to 300mm to working pressure 1200 kPa: 400 to 500 mm to working pressure of 1035 kPa; gray cast iron or ductile iron cast iron body, clear waterway type, metal to metal seat, mechanical joint ends to AWWA C111 or flanged ends to AWWA C110.

## 2.4 Pipe Bedding and Surround Material

- .1 Granular material to Aggregates: General and following requirements:
  - .1 Crushed or screened stone, gravel or sand.
  - .2 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

| Sieve Designation | % Passing    |             |
|-------------------|--------------|-------------|
|                   | Stone/Gravel | Gravel/Sand |
| 25 mm             | 100          | -           |
| 12.5 mm           | 65-90        | 100         |
| 4.75 mm           | 35-55        | 80-100      |
| 2.00 mm           | -            | 50-90       |
| 0.425 mm          | 10-25        | 10-50       |
| 0.075 mm          | 0-8          | 0-10        |

- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to (MMCD) Section 03300 - Cast-in-Place Concrete.
- .3 Backfill Material.
- .4 As indicated.
- .5 Type 3, in accordance with Excavating, Trenching and Backfilling (MMCD).

## 3.0 EXECUTION

### 3.1 Preparation

- .1 Clean pipes, fittings, valves, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects to approval of Consultant. Remove defective materials from site as directed by Consultant.

### 3.2 Trenching

- .1 Do trenching work in accordance with MMCD 2009 Section 31 23 01 - Excavating, Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe of not less than 1.5m from finished grade or as indicated.
- .3 Trench alignment and depth require Consultant's approval prior to placing bedding material and pipe.

### 3.3 Granular Bedding

- .1 Place granular bedding material in uniform layers to a thickness of depth of 150mm below bottom of pipe.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% modified proctor density.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with MMCD 31 23 01 - Excavating, Trenching and Backfilling with compacted bedding material.

### 3.4 Pipe Installation

- .1 Lay pipes to ANSI/AWWA Manual of Practice and manufacturer's standard instructions and specifications. Do not use blocks except as permitted in 3.3.2.
- .2 Join pipes in accordance with AWWA Manual of Practice and manufacturer's recommendations.
- .3 Bevel or taper ends of PVC pipe to match fittings and manufacturers recommendations.
- .4 Handle pipe by methods recommended by pipe manufacturer. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
- .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 10mm in 3m.
- .6 Face socket ends of pipe in direction of laying. For mains on a grade of 2% or greater, face socket ends up-grade.
- .7 Do not exceed permissible deflection at joints as recommended by pipe manufacturer.
- .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.

- .9 Position and join pipes with equipment and methods approved by Consultant.
- .10 Cut pipes in an 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.
- .11 Align pipes carefully before jointing.
- .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.
- .13 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed or contaminated shall be removed, cleaned, lubricated and replaced before jointing is attempted again.
- .14 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Engineer.
- .15 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations. Ensure insertion line is visible and positioned according to manufacturer installation instructions.
- .16 Complete each joint before laying next length of pipe.
- .17 Minimize deflection after joint has been made.
- .18 When stoppage of work occurs, block pipes in an approved manner to prevent creep during down time.
- .19 Recheck plastic pipe joints assembled above ground after placing in trench to ensure that no movement of joint has taken place.
- .20 Do not lay pipe on frozen bedding.
- .21 Backfill remainder of trench.
- .22 Supply Pipes to be installed on the right looking at entrance to building. All pipes to be labelled LDES at regular intervals (3m).Landscape to be remediated.

### **3.5 Valve Installation**

- .1 Install valves to manufacturer's recommendations at locations as 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. Maximum length of pipe on each end of valve shall be 1m. Valves not to be supported by pipe.
- .3 Install underground post-type indicator valves as indicated.
- .4 Valve caps are to designate DES supply or return

### **3.6 Hydrostatic and Leakage Testing**

- .1 Tests apply to all watermains that will operate under pressure created by pumping system.



- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Consultant and UBCO operations at least 24 h in advance of all proposed tests. Perform tests in presence of Consultant.
- .4 Where any section of system is provided with concrete thrust blocks, conduct tests at least five days after placing concrete or two days if high early strength concrete is used.
- .5 Test pipeline in sections not exceeding 365m in length, unless otherwise authorized by Consultant.
- .6 Upon completion of pipe laying and after Consultant has inspected work in place, surround and cover pipes with approved granular material placed to dimensions indicated or directed by Consultant.
- .7 When testing is done during freezing weather, protect all unprotected and above ground valves, joints, gauges and fittings from freezing.
- .8 Strut and brace end caps, and blow off assemblies to prevent movement when test pressure is applied.
- .9 Fully open all valves pertaining to the tested section.
- .10 Expel air from main by slowly filling main with potable water. Install corporation stops at high points in main where no air-vacuum release valves are installed. Remove stops after satisfactory completion of test and seal holes with plugs.
- .11 Thoroughly examine exposed parts and correct for leakage as necessary.
- .12 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .13 Apply a leakage test pressure of 1034 kPa or 1.5 times working pressure (whichever is greater) after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 h.
- .14 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2 h.
- .15 Do not exceed allowable leakage of 0.016 L/mm diameter per 300m of pipe, including lateral connections, per hour.
- .16 Locate and repair defects if leakage is greater than amount specified.
- .17 Repeat test until leakage is within specified allowance for full length of watermain.

### **3.7 Surround Pipe**

- .1 Upon completion of pipe laying and after Consultant has inspected work in place, surround and cover pipes as indicated.
- .2 Place surround material in uniform layers not exceeding 300mm of compacted thickness as indicated. Do not dump material within 2m of pipe.

- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Hand tamp bedding from pipe invert to mid height of pipe to ensure no voids exist under pipe. Installer must ensure compaction effort does not alter designed pipe grading.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 95% modified proctor density.

### 3.8 Backfill

- .1 Place backfill material, above pipe surround, in uniform layers not exceeding 300mm compacted thickness up to grades as indicated.
- .2 Do not place backfill in frozen condition.
- .3 Under paving and walks, compact approved backfill to at least 95% modified proctor density and confirm results are verified and recorded by a Certified Geotechnical Consultant.
- .4 In other areas ensure compaction effort of approved to at least 90% modified proctor density and confirm results are verified and recorded by a Certified Geotechnical Consultant.

### 3.9 Flushing

- .1 Flushing shall be witnessed by the Consultant. Notify Consultant at least 4 days in advance of proposed date when operations will commence.
- .2 Flush water mains through available outlets with a sufficient flow of water until foreign materials have been removed and flushed water is clear, prior to connecting to existing system.
- .3 Flushing flows shall be as follows:

| <u>Pipe Size NPS</u> | <u>Min. Flow (L/s)</u> |
|----------------------|------------------------|
| 50mm                 | 6                      |
| 75mm                 | 14                     |
| 100mm                | 20                     |
| 150mm                | 38                     |
| 200mm                | 75                     |
| 250mm                | 115                    |
| 300mm                | 150                    |

- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves and service connections to ensure thorough flushing.

### 3.10 Surface Restoration

- .1 After installing and backfilling over watermains, restore surface to original condition or as directed by Consultant.

\*\*\*END OF SECTION\*\*\*