

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 23 10 - Excavation, Trenching and Backfilling.
- .2 Section 32 11 23 - Aggregate Base Course.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM A48/A48M-03, Standard Specification for Gray Iron Castings.
 - .2 ASTM C478-08, Specification for Precast Reinforced Concrete Manhole Sections.
 - .3 ASTM D698-07e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³(600 kN-m/m³)).
- .2 Ontario Provincial Standard Drawings (OPSD)
 - .1 OPSD 400.020 (November 2007) – Cast Iron, Square Frame With Square Flat Grate for Catch Basins, Herring Bone Openings.
 - .2 OPSD 400.030 (November 2007) – Cast Iron, Square Frame With Square V Grate for Catch Basins, Herring Bone Openings
 - .3 OPSD 401.01 (November 2007) – Cast Iron, Square Frame with Circular Closed or Open Cover for Maintenance Holes.
 - .4 OPSD 405.020 (November 2003) – Maintenance Hole Steps Solid
 - .5 OPSD 701.010 (November 2009) – Precast Concrete Maintenance Hole 1200mm Diameter.
 - .6 OPSD 701.011 (November 2009) – Precast Concrete Maintenance Hole 1500mm Diameter.
 - .7 OPSD 701.012 (November 2009) – Precast Concrete Maintenance Hole 1800mm Diameter.
 - .8 OPSD 701.013 (November 2009) – Precast Concrete Maintenance Hole 2400mm Diameter.
 - .9 OPSD 701.014 (November 2009) – Precast Concrete Maintenance Hole 3000mm Diameter.
 - .10 OPSD 701.021 (November 2004) – Maintenance Hole Benching and Pipe Opening Details.
 - .11 OPSD 701.030 (November 2009) – Precast Concrete Maintenance Hole Components 1200mm Diameter Tapered Top and Flat Cap.
 - .12 OPSD 701.031 (November 2009) – Precast Concrete Maintenance Hole Components 1200mm Diameter Riser and Monolithic Base.
 - .13 OPSD 701.040 (November 2009) – Precast Concrete Maintenance Hole Components 1500mm Diameter Transition Cone and Slab.
 - .14 OPSD 701.041 (November 2009) – Precast Concrete Maintenance Hole Components 1500mm Diameter Riser and Monolithic Base.

- .15 OPSD 701.050 (November 2009) – Precast Concrete Maintenance Hole Components 1800mm Diameter Transition Slab.
 - .16 OPSD 701.051 (November 2009) – Precast Concrete Maintenance Hole Components 1800mm Diameter Riser and Base Slab.
 - .17 OPSD 701.060 (November 2009) – Precast Concrete Maintenance Hole Components 2400mm Diameter Transition Slab.
 - .18 OPSD 701.061 (November 2009) – Precast Concrete Maintenance Hole Components 2400mm Diameter Riser and Base Slab.
 - .19 OPSD 701.070 (November 2009) – Precast Concrete Maintenance Hole Components 3000mm Diameter Transition Slab.
 - .20 OPSD 701.071 (November 2009) – Precast Concrete Maintenance Hole Components 3000mm Diameter Riser and Base Slab.
 - .21 OPSD 704.010 (November 2004) – Precast Concrete Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers.
 - .22 OPSD 704.011 (November 2004) – High Density Polyethylene Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers.
 - .23 OPSD 705.010 (November 2004) – Precast Concrete Catch Basin 600 x 600mm.
 - .24 OPSD 708.020 (November 2006) – Support for Pipe at Catch Basin or Maintenance Hole.
- .3 Ontario Provincial Standard Specifications (OPSS)
- .1 OPSS 404 –November 2007, Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation.
 - .2 OPSS 1351-November 2004, Material Specification For Precast Reinforced Concrete Components for Maintenance Holes, Catch Basin, Ditch Inlet And Valve Chambers.
 - .3 OPSS 1853-November 2001, Material Specification For Rubber Adjustment Units for Maintenance Holes, Catch Basin, Ditch Inlet And Valve Chambers.
 - .4 OPSS 1854-November 2004, Material Specification For High Density Polyethylene Adjustment Units for Maintenance Holes, Catch Basin, Ditch Inlet And Valve Chambers.

Part 2 Products

2.1 MATERIALS

- .1 Precast catch basin units: to ASTM C478 and OPSD 705.010, complete with 600mm deep sump.
 - .1 Adjusting rings: to ASTM C478 and OPSD 704.010 or OPSD 704.011.
 - .2 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray iron castings: to ASTM A48/A48M, strength class 30B.
 - .3 Castings: coated with two applications of asphalt varnish.

- .4 Catch basin frames and covers:
 - .1 Within gutters: to OPSD 400.030.
 - .2 Elsewhere: to OPSD 400.020.
 - .3 Components: to ASTM C478M and OPSS 1351.
- .2 Precast manhole units:
- .1 1200mm diameter maintenance holes:
 - .1 Circular to ASTM C478 and OPSD 701.010,
 - .1 Storm Manholes: complete with 300mm sump as per OPSD 701.010.
 - .2 Sanitary Manholes: Benching as per OPSD 701.021.
 - .2 Top section: flat slab top type with opening offset for vertical ladder installation to OPSD 701.030.
 - .3 Components: to OPSD 701.031, ASTM C478 and OPSS 1351.
 - .2 1500mm diameter maintenance holes:
 - .1 Circular to ASTM C478 and OPSD 701.011.
 - .1 Storm Manholes: complete with 300mm sump refer to OPSD 701.010.
 - .2 Transition slab: flat slab type with opening offset for vertical ladder installation to OPSD 701.040.
 - .3 Components:
 - .1 Riser and Base Slab: to OPSD 701.041, ASTM C478 and OPSS 1351.
 - .2 Chimney:
 - .1 Riser: to OPSD 701.031, ASTM C478 and OPSS 1351.
 - .2 Top section: flat slab top type with opening offset for vertical ladder installation to OPSD 701.030.
 - .3 1800mm diameter maintenance holes:
 - .1 Circular to ASTM C478 and OPSD 701.012.
 - .1 Storm Manholes: complete with 300mm sump refer to OPSD 701.010.
 - .2 Transition slab: flat slab type with opening offset for vertical ladder installation to OPSD 701.050.
 - .3 Components:
 - .1 Riser and Base Slab: to OPSD 701.051, ASTM C478 and OPSS 1351.
 - .2 Chimney:
 - .1 Riser: to OPSD 701.031, ASTM C478 and OPSS 1351.
 - .2 Top section: flat slab top type with opening offset for vertical ladder installation to OPSD 701.030.
 - .4 2400mm diameter maintenance holes:
 - .1 Circular to ASTM C478 and OPSD 701.013.

- .1 Storm Manholes: complete with 300mm sump refer to OPSD 701.010.
- .2 Transition slab: flat slab type with opening offset for vertical ladder installation to OPSD 701.060.
- .3 Components:
 - .1 Riser and Base Slab: to OPSD 701.061, ASTM C478 and OPSS 1351.
 - .2 Chimney:
 - .1 Riser: to OPSD 701.031, ASTM C478 and OPSS 1351.
 - .2 Top section: flat slab top type with opening offset for vertical ladder installation to OPSD 701.030.
- .5 3000mm diameter maintenance holes:
 - .1 Circular to ASTM C478 and OPSD 701.014.
 - .1 Storm Manholes: complete with 300mm sump refer to OPSD 701.010.
 - .2 Transition slab: flat slab type with opening offset for vertical ladder installation to OPSD 701.070.
 - .3 Components:
 - .1 Riser and Base Slab: to OPSD 701.071, ASTM C478 and OPSS 1351.
 - .2 Chimney:
 - .1 Riser: to OPSD 701.031, ASTM C478 and OPSS 1351.
 - .2 Top section: flat slab top type with opening offset for vertical ladder installation to OPSD 701.030.
- .6 Joints: to be made watertight using rubber rings.
- .7 Ladder rungs: to OPSD 405.020.
- .8 Adjusting rings: to ASTM C478, OPSD 704.010 or OPSD 704.011, OPSS 1853 and OPSS 1854.
- .9 Frames, gratings, covers to dimensions as indicated and following requirements:
 - .1 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
 - .2 Gray iron castings: to ASTM A48/A48M, strength class 30B.
 - .3 Castings: coated with two applications of asphalt varnish.
 - .4 Manhole frames and covers:
 - .1 Storm Sewer:
 - .1 In lawn and paved areas: Type B open cover cast with perforations and complete with two 25 mm square lifting holes to OPSD 401.010.
 - .2 Sanitary Sewer: Type A closed cover with two 25 mm square lifting holes to OPSD 401.010
- .3 Granular bedding : Granular base material in accordance with Section 32 11 23 - Aggregate Base Course

Part 3 Execution

3.1 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 10 - Excavating Trenching and Backfilling and as indicated.
- .2 Obtain approval of Departmental Representative before installing, manholes.

3.2 INSTALLATION

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade, in accordance with OPSS 407. Maximum relative difference between specified invert elevations not to exceed 10mm.
- .2 Complete units as pipe laying progresses.
- .3 Set precast concrete base on 150 mm minimum of granular base material compacted to 100% maximum density to ASTM D698.
- .4 Precast units:
 - .1 Make each successive joint watertight with Departmental Representative approved rubber ring gaskets.
 - .2 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.
 - .3 Compact granular backfill to 95% maximum density to ASTM D698.
 - .5 Place frame and cover on top section to elevation as indicated. If adjustment required use concrete ring.
 - .6 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
 - .7 Refer to OPSD 708.020.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 01 21 00 – Allowances.
- .2 Section 03 30 05 - Cast-in-Place Concrete - Short Form.
- .3 Section 31 23 10 - Excavating, Trenching and Backfilling.
- .4 Section 32 11 23 – Aggregate Base Courses.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA).
 - .1 ANSI/AWWA C104/A21.4-95, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - .2 ANSI/AWWA C111/A21.11-00, Rubber-Gasket Joints for Ductile-Iron and Gray Iron Pressure Pipe and Fittings.
 - .3 ANSI/AWWA C150/A21.50-02, Thickness Design of Ductile-Iron Pipe.
 - .4 ANSI/AWWA C151/A21.51-02, Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - .5 ANSI/AWWA C153/A21.53-00, Ductile-Iron Compact Fittings for Water Service.
 - .6 ANSI/AWWA C217-04, Petrolatum and Petroleum Wax Tape Coatings for the Exterior of Connections and Fittings for Steel Water Pipelines.
 - .7 ANSI/AWWA C502-94, Dry-Barrel Fire Hydrants.
 - .8 ANSI/AWWA C509-94, Resilient-Seated Gate Valves for Water Supply Services.
 - .9 ANSI/AWWA C550-90, Protective Epoxy Interior Coatings for Valves and Hydrants.
 - .10 ANSI/AWWA C600-99 Installation of Ductile-Iron Water Mains, and Their Appurtenances.
 - .11 ANSI/AWWA C800-05, Underground Service Line Valves and Fittings.
 - .12 ANSI/AWWA C900-07, Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 Inch through 12 Inch (100 mm - 300 mm), for Water Transmission and Distribution.
 - .13 ANSI/AWWA C907-91, Polyvinyl Chloride (PVC) Pressure Fittings for Water – 4 in. through 8 in. (100mm through 200mm).
 - .14 AWWA Manual #17: Installation, Field Testing, and Maintenance of Fire Hydrants (M17), 3rd Edition, published January 1989.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A36/A36M-05a, Standard Specifications for Carbon Structural Steel.
 - .2 ASTM A 53/A 53M-06, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.

- .3 ASTM A325-00, Standard Specification for Structural Bolts, Steel, Heat Treated 120/105ksi Minimum Tensile Strength.
- .4 ASTM A512-96(2005), Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing.
- .5 ASTM A536 (1999), Standard Specification for Ductile Iron Castings.
- .6 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.
- .7 ASTM B88M-03, Standard Specification for Seamless Copper Water Tube.
- .8 ASTM C478-06b, Standard Specification for Precast Reinforced Concrete Manhole Sections Metric.
- .9 ASTM C578-06, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- .10 ASTM D698-00ae1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m³)).
- .11 ASTM D 1621-04a, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- .12 ASTM F593-02e2, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
- .13 ASTM F1674-96, Standard Test Method for Joint Restrain Products for Use with PVC Pipe.
- .3 American Society of Mechanical Departmental Representatives (ASME)
 - .1 ASME B1.20.1 1983 (R2001), Pipe Threads, General Purpose (Inch).
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.88-92, Gloss Alkyd Enamel, Air Drying and Baking.
- .5 Canadian Standards Association (CSA International)
 - .1 CSA B137 Series-09, Thermoplastic Pressure Piping Compendium, including update No. 1. (Consists of B137.0, B137.1, B137.2, B137.3, B137.4, B137.4.1, B137.5, B137.6, B137.8, B137.9, B137.10, B137.11 and B137.12).
 - .1 CSA B137.3-tenth edition, Rigid Polyvinylchloride (PVC) Pipe and Fittings for Pressure Applications.
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S520-1991, Hydrants.
 - .2 ULC S-513-1978, Threaded Couplings for 1½ and 2½ Inch Fire Hose
- .7 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 1351 (November 1999) Material Specification for Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets and Valve Chambers.
- .8 National Fire Protection Association (NFPA)
 - .1 NFPA 291 (2007): Recommended Practice for Fire Flow Testing and Marking of Hydrants

1.3 STANDARDS

- .1 All water main materials and workmanship to be in accordance with City of Ottawa Standards. W refers to City of Ottawa Standard drawings.

1.4 MATERIAL CERTIFICATION

- .1 Submit manufacturer's certification that pipe materials meet requirements of this section at least 1 week prior to commencing work. Include manufacturer's drawings, information and shop drawings where pertinent.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 00 10 - General Instructions.
- .2 Provide shop drawings for the following:
 - .1 Valve chambers.

1.6 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 00 10 - General Instructions.
- .2 Provide product data for the following:
 - .1 pipe
 - .2 fittings
 - .3 hydrants
 - .4 valves
 - .5 valve boxes
 - .6 retaining and restraining rings and associated hardware

1.7 RECORD DRAWINGS

- .1 Refer to Section 01 00 10 - General Instructions.

1.8 SCHEDULING OF WORK

- .1 Schedule Work to minimize interruptions to existing services.
- .2 Submit schedule of expected interruptions to Departmental Representative for approval and adhere to interruption schedule as approved by Departmental Representative.
- .3 Notify Departmental Representative minimum of 72 h in advance of interruption in service.
- .4 Do not interrupt water service for more than 4 h and confine this period between 18:00 and 07:00 h local time unless otherwise authorized.
- .5 Notify fire department of any planned or accidental interruption of water supply to hydrants.
- .6 Provide "Out of Service" sign on hydrants not in use.

Part 2 Products

2.1 PIPE

- .1 For Open Cut Installation
 - .1 Polyvinyl chloride pressure pipe to CSA B137.3 and AWWA C-900 for pipe sizes 305 mm diameter and less, Pressure Class 150, DR 18, cast iron outside dimensions, blue in colour and supplied with gaskets.
 - .1 Approved for use by the City of Ottawa.
 - .2 Push-on joints as per AWWA C-111, complete with vulcanized synthetic rubber gaskets.
 - .2 For Trenchless Installation
 - .1 Fusible Polyvinyl chloride pressure pipe: to AWWA C900 for pipe sizes 305 mm diameter and less and to AWWA C-905 for 406 mm diameter pipe, Pressure Class 150, DR 18, cast iron outside dimensions, blue in colour.
 - .1 Joints to be designed for use in horizontal directional drilling applications.

2.2 SERVICE CONNECTIONS

- .1 For Building Services 100mm diameter and larger:
 - .1 Material as noted:
 - .1 Ductile iron pipe: to ANSI/AWWA C151/A21.51, pressure class 52, cement mortar lined to ANSI/AWWA C104/A21.4.
 - .1 Push-on joints as per AWWA C-111, complete with vulcanized synthetic rubber gaskets.
 - .2 Polyvinyl chloride pressure pipe to CSA B137.3 and AWWA C-900, Pressure Class 150, DR 18, cast iron outside dimensions, blue in colour and supplied with gaskets.
 - .1 Approved for use by the City of Ottawa.
 - .2 Push-on joints as per AWWA C-111, complete with vulcanized synthetic rubber gaskets
- .2 For Building Services smaller than 100mm diameter:
 - .1 Copper piping: to ASTM B88M type K soft, annealed.
 - .1 Service saddles in accordance with City of Ottawa Standards.
 - .2 Service Post: to City of Ottawa Standards and W-35.
 - .3 Main stops shall be either plug or ball per AWWA C-800 and curb stops shall be ball valves in accordance with AWWA C-800.

2.3 FITTINGS

- .1 Fittings:
 - .1 Short body ductile iron fittings: to AWWA C-153.
 - .1 Cement lined per AWWA C-104.
 - .2 Mechanical or push-on joint.
 - .2 PVC fittings to AWWA C907 and CSA B137.3

- .1 Push-on joints

2.4 RESTRAINING AND RETAINING RINGS

- .1 For use on PVC pipe:
 - .1 The restraining devices shall meet the minimum requirements of ASTM F1674, have a working pressure of 1035 kPa complete with minimum 2:1 safety factor.
 - .2 Retaining rings are to be designed for use with their respective pipe and fitting size and class. The restraint mechanism shall incorporate a series of machined serrations on the inside diameter of the clamping ring.
 - .1 The rings are to be manufactured from high quality ductile iron per ASTM A536, Grade 65-45-12.
 - .2 T-bolts, clamping bolts and nuts, type 304 stainless steel per ASTM F593.
 - .3 Approved for use by City of Ottawa
- .2 For use on Ductile Iron Pipe:
 - .1 The restraining devices shall have a working pressure of 1035 kPa complete with minimum 2:1 safety factor.
 - .2 Rings shall be designed for use on mechanical joint bell ends and tee head bolts in accordance with AWWA C-111/ANSI A21.11 and AWWA C-153/A21.53. The restraining grip mechanism shall be provided by wedges, a double set screw locking system, or 360° grip-ring.
 - .3 The rings are to be manufactured from high quality ductile iron per ASTM A536, Grade 65-45-12.
 - .4 T-bolts, clamping bolts and nuts, type 304 stainless steel per ASTM F593.
 - .5 Approved for use by City of Ottawa.

2.5 COUPLINGS

- .1 Couplings designed to withstand a hydrostatic test pressure of 1035 kPa.
 - .1 Center Sleeve:
 - .1 Material:
 - .1 Steel sleeves - carbon steel as per ASTM A36/A53/A512, minimum yield strength of 207 MPa.
 - .2 Cast sleeves - ductile iron as per ASTM A536, grade 64-45-12.
 - .3 Finish: shop finish enamelled.
 - .4 Ends to be smooth inside surface for uniform gasket seating.
 - .1 Minimum lengths:
 - .1 203 mm pipe and smaller: 152 mm.
 - .2 305 mm pipe: 203mm.
 - .2 End Rings: ductile iron to ASTM A536.
 - .3 Nuts and Bolts: type 304 stainless steel per ANSI/AWWA C-111/A21.115, 25 mm diameter.

- .4 Gasket: grade 30 special compound rubber (SBR) recommended for water, salt solution, mild acids and bases with a temperature range between -40°C to +65°C.
- .5 Approved for use by City of Ottawa Standards.

2.6 VALVES

- .1 Valves to open clockwise.
- .2 Gate valves to ANSI/AWWA C509, resilient seated:
 - .1 Application - for use on all 152 mm and 305 mm diameter water main.
 - .2 Material - cast iron or ductile iron, non-rising stem, complete with 50 mm square operating nut in the vertical position, standard O-ring type steam seal.
 - .3 Pressure rating - minimum 1380 kPa.
 - .4 Joints:
 - .1 Mechanical joint ends - bell socket, plain end, and gland to ANSI/AWWA C-111, complete with cast iron gland rings, steel alloy bolts, and gaskets.
 - .2 Push-on joint ends - to ANSI/AWWA C-111.
 - .3 Finish: Two part spray epoxy coating or a fusion bonded epoxy coating, factory applied to exterior and interior surfaces in accordance with ANSI/AWWA C-550.

2.7 VALVE BOXES

- .1 Cast iron valve boxes: 130 mm screw type manufactured from good quality grey iron to City of Ottawa Standards.
- .2 Valve boxes to consist of six elements, base, bottom section, extension, top section, cap, and guide wheel, in accordance with City of Ottawa standard drawing number W-24

2.8 VALVE CHAMBERS

- .1 Precast reinforced concrete, components in accordance with OPSS 1351 and ASTM C 478M, and the following City of Ottawa standard drawings:
 - .1 Base section to W-5.
 - .2 Chamber section to W-6.
 - .3 Adjustment units to W-9.
 - .4 For Gate Valves:
 - .1 Circular Chamber W-3.
 - .2 Top section to W-8.
- .2 Ladder rungs to be cast integral with unit; field installation not permitted.
- .3 Frame and cover:

- .1 Manufactured from good quality grey iron and shall be solid with clean surfaces, free from scales, lumps, flaws, blow holes, or other defects. No plugging or filling of defects or other methods of correcting defects shall be permitted.
- .2 Castings minimum tensile strength of 138 MPa.
- .3 Castings to conform to dimensions of W-15 and W-16.
- .4 Cover to be marked "WATER"
- .5 Castings to be thoroughly coated with approved casting paint.

2.9 BALL VALVES

- .1 Ball valves for use on test tees:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class125, 860 kPa steam, WP = 1.4 MPa WOG.
 - .3 Connections: Screwed ends to ANSI B1.20.1 and with hex shoulders
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable hard chrome solid ball and teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.

2.10 WALL SEALS

- .1 Foundation wall seals: Modular casing seal. Model number, sizes, and number as recommended by manufacture and to approval of Departmental Representative.

2.11 HYDRANTS

- .1 Post type hydrants: dry barrel, compression, open against pressure, dry top, three way type with two 64mm hose outlet nozzles and one 127mm pumper outlet nozzle. Fire hydrant style as indicated.
- .2 Hydrants, to CAN/ULC-S520, ANSI/AWWA C-502, and approved for use by City of Ottawa.
- .3 Designed for a minimum working pressure of 1035 kPa.
- .4 The upper and lower barrels shall be ductile iron complete with breakable flange and breakable bolts.
- .5 Main valve: nominal diameter of valve opening shall be a minimum of 127 mm.
- .6 Drain valve: the hydrant is to be provided with a drain valve that closes as the main valve opens.
- .7 Inlet connection to be mechanical joint, 152mm bell at base of hydrant to ANSI/AWWA C-111/A21.11. The base configuration and mechanical joint to be designed to accept retaining/restraining devices for both AWWA C-150 CL 52 ductile iron pipe and ANSI/AWWA C-900, DR 18 PVC pipe hydrant leads.
- .8 Bury length: Type D of City of Ottawa Standards in accordance with W-19.

- .9 Hose outlet nozzle: 64 mm hose outlet nozzles conforming to ULC S-513 and approved for use by City of Ottawa.
- .10 Pumper Outlet Nozzle: approved for use by City of Ottawa.
- .11 Operator Nut: 32mm square, direction to open to be counter clockwise.
- .12 The hydrant is to be factory primed and finished painted. Hydrant finish paint: colour red, exterior enamel to CAN/CGSB-1.88.

2.12 CATHODIC PROTECTION

- .1 Anodes are to be attached to all new ductile iron fittings, ductile iron pipe, and valves. The size and type of anode to be in accordance with City of Ottawa Standards and W-39, W-40, W-41, and W-42, M. S. No. MW-19.9 and S.P. F-No. F-7093.

2.13 BOLT CORROSION PROTECTION

- .1 Anti-corrosion petrolatum paste, tape and mastic approved for use by City of Ottawa and in accordance with ANSI/AWWA C217.

2.14 HYDROSTATIC TEES

- .1 Ensure two test tees are provided in each valve chamber, upstream and downstream of the valve, as per W-34.
- .2 52mm diameter.

2.15 PIPE BEDDING AND SURROUND

- .1 Granular Base Material to Section 32 11 23 – Aggregate Base Course.

2.16 INSULATION

- .1 Expanded polystyrene: to CAN/CGSB-51.20, Type 4, with 275 kPa compressive strength to ASTM D 1621, shiplapped edges, thickness as indicated.

2.17 BACKFILL MATERIAL

- .1 Type 1 Fill: in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 PREPARATION

- .1 Clean pipes, fittings, valves, hydrants, and appurtenances of accumulated debris and water before installation. Carefully inspect materials for defects to approval of Departmental Representative. Remove defective materials from site as directed by Departmental Representative.
- .2 Ensure pipes delivered to site are provided with end caps and tamper evident seals.

- .3 Only remove end caps immediately before pipe is to be installed.

3.2 OPEN CUT TRENCH INSTALLATION

.1 Trenching

- .1 Do trenching and excavating work in accordance with Section 02315 - Excavating Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe of not less than 2.4 m from finished grade, as shown on drawings.

.2 Granular Bedding

- .1 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth of 150 mm 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% maximum density to ASTM D 698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.

.3 Pipe Installation

- .1 Lay pipes to ANSI/AWWA C600 and manufacturer's standard instructions and specifications. Do not use blocks except as specified.
- .2 Join pipes in accordance with ANSI/AWWA C600 and manufacturer's recommendations.
- .3 Bevel or taper ends of PVC pipe to match fittings.
- .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 3 m.
- .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 Departmental Representative.

- .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 Complete each joint before laying next length of pipe.
 - .15 Minimize deflection after joint has been made.
 - .16 Apply sufficient pressure in making joints to ensure that joint is completed to manufacturer's recommendations.
 - .17 Ensure completed joints are restrained by compacting bedding material alongside and over installed pipes or as otherwise approved by Departmental Representative.
 - .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.
- .4 Pipe Surround:
- .1 Upon completion of pipe laying and after Departmental Representative has inspected work in place, surround and cover pipes as indicated.
 - .2 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .3 Place layers uniformly and simultaneously on each side of pipe.
 - .4 Compact each layer from pipe invert to pipe spring line to 95% maximum density to ASTM D 698.
 - .5 From pipe springline to 300 mm above top of pipe hand tamp material. Do not use mechanical tampers directly over pipe where cover is less than 300 mm.
- .5 Backfill remainder of trench.

3.3 TRENCHLESS INSTALLATION

- .1 Directional Drilling
- .1 Install pipe by directional drilling methods where indicated and in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.
 - .2 Handle pipe using methods approved by Departmental Representative and in accordance with manufacturer's installation instructions. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
 - .3 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
 - .1 Pipe joints to be true to alignment and have uniform roll-back bead.

- .2 Allow joint to cool sufficiently, as recommended by pipe manufacturer, prior to removal of jointing pressure.
- .3 Joints to be inspected and approved by Departmental Representative prior to insertion.
- .4 Do not exceed maximum pipe deflection recommend by pipe manufacturer.

3.4 INSULATION

- .1 Install insulation in accordance with W-23.

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. Valves not to be supported by pipe

3.6 VALVE CHAMBERS

- .1 Use precast units as approved by Departmental Representative.
- .2 Construct units as indicated, plumb and centered over valve nut, true to alignment and grade, and not resting on pipe.
 - .1 For Gate Valves, Refer to W-3.
- .3 Set precast concrete bases on 150mm minimum compacted granular base material.
- .4 Set chamber section of precast unit on top of precast bases.
- .5 Set precast top section over chamber section.
- .6 Install adjustment units over valve chamber precast top. Set frame and cover directly on adjustment units. Do not use shims.
- .7 Plug lifting holes with precast concrete plugs set in cement mortar.
- .8 Place frame and cover on top section to elevation indicated. If adjustment is required use concrete ring.
- .9 Clean valve chambers of debris and foreign materials; remove fins and sharp projections.

3.7 WATER MAIN CROSSINGS

- .1 Prior to undertaking a crossing, daylight existing utility by means of vacuum excavation to confirm utility elevation and location.
- .2 Provide the clearances as indicated.

3.8 VALVE BOXES

- .1 Install as indicated to W-24.

- .2 Ensure valve boxes are centered over valve, vertical, and free of debris.

3.9 TEST TEES

- .1 Install test tees complete with ball valves as indicated and to accommodate flushing and disinfection, refer to W-34.

3.10 SERVICE CONNECTIONS

- .1 Install service lines complete with valves at locations shown in accordance with City of Ottawa Standards and W-33.
- .2 Install service into building as indicated.
- .3 For indicated new building water service entry, drill 13 mm pilot hole through foundation wall prior to coring opening to prove location and elevation.
 - .1 Firmly anchor coring machine on foundation wall and ensure it is plumb and aligned.
 - .2 Core new opening in foundation wall to accommodate pipe.
 - .1 For new ductile iron services core opening to accommodate service pipe complete with modular wall seal. Install modular wall seal in accordance with manufactures instructions.

3.11 HYDRANTS

- .1 Install hydrants at locations as indicated.
- .2 Install hydrants in accordance with AWWA Manual of Practice and in conformance with City of Ottawa Standards. Refer to W-18 and W-19.
- .3 Install 152 mm gate valve and cast iron valve box on hydrant service leads as indicated to be 152 mm and in accordance with W-19.
- .4 Handle hydrants with appropriate slings and harnesses to avoid damage to painted surfaces. Any damage to paint work is to repaired to the satisfaction of the Departmental Representative.
- .5 Set hydrants plumb, with hose outlets parallel with edge of pavement or curb line, with pumper connection facing roadway and breakable flange set at elevation of between 50 - 100 mm above final grade.
- .6 Restrain the hydrant lead at the tee connection to the main, on both sides of the valve, and at the base connection of the hydrant. In addition provide a concrete thrust block as indicated in W-19 against undisturbed soil.
- .7 Ensure the drain holes are kept open and surrounded with clear stone.
- .8 Place appropriate sign on installed hydrants indicating whether or not they are in service during construction.

3.12 RESTRAINED JOINTS

- .1 Restrain joints at all bends, tees, and valves in accordance with W-25.5 and W-25.6 and where otherwise noted.

3.13 CATHODIC PROTECTION

- .1 All fittings are to be provided with cathodic protection in accordance with W-39, W-40, W-41, and W-42.

3.14 BOLT CORROSION PROTECTION

- .1 Liberally apply anti-corrosion petrolatum paste tape and mastic to all exposed nuts and bolts.

3.15 TRACER WIRE

- .1 Install tracer wire in accordance with W-36.

3.16 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with City of Ottawa Standards F-7090-Commissioning of Watermains.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests.
- .3 Notify Departmental Representative at least 24 h in advance of all proposed tests. Perform tests in presence of Departmental Representative.
- .4 When testing is done during freezing weather, protect hydrants, valves, joints and fittings from freezing.
- .5 Open valves.
- .6 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.
- .7 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .8 Repeat hydrostatic test until all defects have been corrected and until leakage is within specified allowance for full length of watermain being tested.

3.17 BACKFILL

- .1 Refer to Section 31 23 10 - Excavating, Trenching, and Backfilling.

3.18 HYDRANT FLOW TESTS

- .1 Undertake fire flow tests as per AWWA Manual M17 at each hydrant upon completion of installation, witnessed by Departmental Representative. Notify Departmental Representative, a minimum of 48hours in advance prior to undertaking test.

3.19 PAINTING OF HYDRANTS

- .1 After installation, touch up factory applied paint to satisfaction of Departmental Representative.
- .2 Paint hydrant caps and bonnets in accordance with NFPA 291 based on flow test results.

3.20 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations shall be undertaken by the City of Ottawa. Contactor will be responsible for obtaining and coordinating the services of the City of Ottawa. The contractor shall include all costs in the tender amount and compensate the city for all related flushing and disinfecting fees. Refer to Section 01 21 00.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 23 10 - Excavating Trenching and Backfilling.
- .2 Section 32 11 23 - Aggregate Base Courses.
- .3 Section 33 05 14 – Manholes and Catch Basin Structures.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D698-00a, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³).
 - .2 ASTM F714-08, Standard Specification for Polyethylene Pipe (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - .3 ASTM D 2657-07, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B1800-02, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .1 CSA B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
 - .3 CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- .3 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 409-November 2009 – Construction Specification For Closed-Circuit Television Inspection of Pipelines

1.3 SUBMITTALS

- .1 Ensure certification is marked on pipe.
- .2 Submit manufacturers information data sheets and instructions in accordance with Section 01 00 10 - General Instructions.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's recommendations.

Part 2 Products

2.1 OPEN CUT PIPE

- .1 Plastic Pipe
 - .1 Type PSM Polyvinyl Chloride (PVC): to CSA-B182.2.
 - .2 Standard Dimensional Ratio (SDR): 35.
 - .3 Locked-in gasket and integral bell system.
 - .4 Nominal lengths: 4 m.

2.2 TRENCHLESS PIPE

- .1 Horizontal Directional Drilling Pipe
 - .1 High Density Polyethylene (HDPE): IPS, DR 11, Resin PE 3408 as per ASTM F417. Indicated nominal pipe size refers to inside pipe diameter.

.1 Pipe Size Equivalency Table for HDPE DR11

Pipe Size	Actual Inside Diameter	Actual Outside Diameter
200 mm	220.4 mm	270.1 mm
250 mm	261.4 mm	320.3 mm

- .2 Pipe to be free of concentrated ridges, discolouration, excessive spot roughness, pitting, varying wall thickness, free of cracks, over exposure to ultra violet light, foreign inclusions, and gashes, nicks, or abrasion in excess of 10% of the wall thickness.
- .3 Pipe joints: thermal butt fusion as per ASTM D2657.
- .4 HDPE pipe and fittings for sanitary sewers shall be extruded in green colour throughout its thickness.

2.3 PIPE BEDDING AND SURROUND MATERIALS OPEN CUT

- .1 Granular Base Material to Section 32 11 23 – Aggregate Base Course.

2.4 BACKFILL MATERIAL OPEN CUT

- .1 Type 1 Fill: in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 PREPARATION

- .1 Clean and dry pipes and fittings before installation.
- .2 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.2 OPEN CUT TRENCH INSTALLATION

- .1 Trenching
 - .1 Do trenching Work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

- .2 Do not allow contents of any sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth require approval of Departmental Representative prior to placing bedding material and pipe.
- .2 Granular Bedding
 - .1 Place bedding in unfrozen condition.
 - .2 Place granular bedding materials in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
 - .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
 - .4 Shape transverse depressions as required to suit joints.
 - .5 Compact each layer full width of bed to at least 95 % maximum density to ASTM D698.
 - .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.
 - .7 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.
- .3 Pipe Installation
 - .1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
 - .2 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
 - .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Maximum allowable variation from indicated pipe invert elevations as measured at the manholes and catch basins not to exceed 10mm.
 - .2 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
 - .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
 - .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
 - .6 Do not allow water to flow through pipe during construction, except as may be permitted by Departmental Representative.
 - .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
 - .8 Install plastic pipe and fittings in accordance with CSA B182.11.
 - .9 Pipe jointing:
 - .1 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .2 Align pipes before joining.
 - .3 Maintain pipe joints free from mud, silt, gravel and other foreign material.

- .4 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
- .5 Complete each joint before laying next length of pipe.
- .6 Minimize joint deflection after joint has been made to avoid joint damage.
- .7 At rigid structures, install pipe joints not more than 1.2 m from side of structure.
- .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .11 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Make watertight connections to manholes.
- .13 Use pre-manufactured Tees for service connections to sewers.
- .14 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.
- .4 Pipe Surround
 - .1 Place surround material in unfrozen condition.
 - .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 1.0 m of pipe.
 - .4 Place layers uniformly and simultaneously on each side of pipe.
 - .5 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum density to ASTM D698.
 - .6 Compact each layer from mid height of pipe to underside of backfill to at least 90 % maximum density to ASTM D698.
- .5 Backfill
 - .1 Use backfill which is not frozen.
 - .2 Refer to Section 31 23 10 – Excavating, Trenching and Backfilling.
 - .3 Place backfill material, above pipe surround, in accordance with Section 31 23 10 Excavating, Trenching and Backfilling up to grades as indicated.

3.3 TRENCHLESS INSTALLATION

- .1 Directional Drilling
 - .1 Install pipe by directional drilling methods where indicated and in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.
 - .2 Handle pipe using methods approved by Departmental Representative and in accordance with manufacturer's installation instructions. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.

- .3 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
 - .1 Pipe jointing to be butt fused in accordance with manufacturer's instructions and ASTM D2657.
 - .1 Pipe joints to be true to alignment and have uniform roll-back bead.
 - .2 Allow joint to cool sufficiently, as recommended by pipe manufacturer, prior to removal of jointing pressure.
 - .3 Joints to be inspected and approved by Departmental Representative prior to insertion.
 - .4 Do not exceed maximum pipe deflection recommend by pipe manufacturer.

3.4 FIELD TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Departmental Representative, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Television and photographic inspections:
 - .1 Carry out closed circuit television (CCTV) of installed sewers in accordance with OPSS 409.
 - .2 Submit one copy of CCTV inspection report to Departmental Representative for review. CCTV inspection report will be used by Departmental Representative in assessing acceptance of installed works.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American Association of State Highway Transportation Officials (AASHTO)
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM F1216-93, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube.
 - .2 ASTM F1417 Standard Test Method for the Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
 - .3 ASTM D 790-95a Standard Tests Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulation Materials.
- .3 City of Ottawa Special Provisions
 - .1 S.P. No. F4107 Cured-In-Place Pipe Liner Maintenance Hole to Maintenance Hole.
- .4 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 409-November 2009 – Construction Specification For Closed-Circuit Television Inspection of Pipelines

1.2 SUBMITTALS

- .1 Submit the following in accordance with Section 01 00 10 - General Instructions.
 - .1 Manufacturer's installation procedure,
 - .2 Design calculations,
 - .3 Curing process data and measurements,
 - .4 Cured-in-place liner test results.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's recommendations.

Part 2 Products

2.1 Cured-in-place pipe liner

- .1 Shall be fabricated from tube and resin materials that when cured will be chemically resistant to withstand exposure to domestic sewage at continuous temperatures below 60° C, resistant to abrasion. The cured in place liner must be fully saturated with resin resulting in a homogeneous layer that is completely bonded to the host pipe.
 - .1 Tube:
 - .1 Manufactured from one or more layers of flexible needled felt or equivalent non-woven material, capable of carrying resin, withstanding installation pressures and curing temperatures, and fully compatible with the resin system used. The outside layer of the tube is to be plastic coated

to facilitate insertion into host pipe. The inner layer of the tube is to consist of an impermeable plastic coating.

- .2 Resin:
 - .1 General purpose, unsaturated, styrene based, thermosetting resin and catalyst system or an epoxy resin and hardener system compatible with eh inversion process. Resin must cure in the presence of water and the initial temperature for cure shall be less than 82°C.
- .2 Minimum Structural Properties
 - .1 Flexural Strength: 31 MPa as per ASTM D790
 - .2 Flexural Modulus of Elasticity: 1724 MPa as per ASTM 790
 - .3 50 year creep reduction: 50% as per City of Ottawa S.P. No. F-4107 testing requirements.
- .3 Design Loads
 - .1 As per ASTM 1216, Section X1.2.2 Fully Deteriorated Gravity Pipe Conditions.
 - .1 Dead load: weight of soil overburden.
 - .2 Live Load: HS20-44 as per AASHTO.

Part 3 Execution

3.1 PREPARATION

- .1 Confirm size of all existing pipes, prior to the manufacturing of tubes. Immediately report discrepancies to the Departmental Representative and await written instructions to proceed.
- .2 Clean existing sewer pipe to be re-lined with hydraulically powered equipment, high-velocity jet cleaners and vacuum pumper to ensure all debris is removed from pipeline, as defined from manhole to manhole. A minimum of two passes of high-velocity jet cleaners will be required. Notify Departmental Representative if additional passes are required to fully clean the sewer.
- .3 Perform a color CCTV inspection of cleaned sewer in accordance with OPSS 409 and provide one copy of video inspection report to Departmental Representative in advance of re-lining. Immediately notify Departmental Representative of any observed deficiencies that would hinder the installation of the liner and await written instruction to proceed.

3.2 BY-PASS PUMPING

- .1 Temporary plug upstream end existing pipe to be relined.
- .2 The pump and bypass lines should be of adequate capacity to handle the average and peak sanitary flow
 - .1 Average flow: 0.94 l/s
 - .2 Peak sanitary flow: 1.41 l/s.
- .3 Provide a back-up pump on site. Back-up pump to be of same capacity as primary pump.
- .4 Contractor will be responsible to continually monitor performance of by-pass pumping.

3.3 INSTALLATION

- .1 Wet-out tube with resin under controlled conditions using vacuum and roller system to uniformly distribute resin throughout tube. Ensure volume of resin is sufficient:
 - .1 To fill all air voids in the tube material at nominal thickness and diameter,
 - .2 To take into consideration migration of resin into pipe cracks and joints,
 - .3 To account for resin loss due to polymerization shrinkage.
- .2 Insert wet-out tube into existing host pipe through existing maintenance hole using an inversion process and application of hydrostatic pressure head. Ensure tube inversions and installation process does not stretch the tube in excess of 5% of its original longitudinal length. Reline manhole to manhole.
- .3 Apply sufficient pressure to the tube to ensure it is supported tightly against the host pipe without damaging the pipe.
- .4 Cure liner with suitable heat source and water recirculation equipment that results in a uniform raise in water temperature, to the specified manufactures curing temperature and duration. Ensure that during the duration of the curing process, suitable temperature gauges are in place to continually monitor the temperature of the liner, including at the interface of the liner and host pipe. Record temperature readings to satisfy manufacture requirements and provide copies of this measurement to the Departmental Representative.
- .5 After initial cure is realized, raise temperature to the post-cure level recommended by resin manufacture. Maintain for duration specified by manufacture and record temperature readings required by resin manufacture. Provide copies of these measurements to the Departmental Representative.
- .6 Conduct gravity leakage test during the liner cure in accordance with ASTM 1417. Provide results to Departmental Representative.
- .7 Cool the Cast-in-place liner to a temperature below 100°C before releasing hydrostatic pressure. Ensure release of static head does not create sufficient vacuum to damage newly installed liner.
- .8 Installed and cured liner should be continuous from manhole to manhole, free of dry spots, lifts and de-lamination.
- .9 At the manhole the liner should form terminations that are neat, free of obstruction and forming a tight seal to the pipe. Provide and cure additional resin compatible with the installation for form a tight seal.
- .10 Cut out all openings to laterals to full diameter of existing lateral. Brush finish lateral openings after cutting is complete. Remove debris from sewer.

3.4 QUALITY ASSURANCE

- .1 Carry out closed circuit television (CCTV) of installed sewers.
 - .1 Submit one copy of CCTV inspection report to Departmental Representative for review. CCTV inspection report will be used by Departmental Representative in

assessing acceptance of installed works. Carry out CCTV inspection in accordance with OPSS 409.

.2 Material testing.

- .1 For each section of relined sewer obtain sufficient samples of cured liner to allow testing of 5 specimens flexural strength and 5 specimens for Flexural Modulus of Elasticity. Testing to be undertaken by an accredited laboratory and following the testing procedures outlined in ASTM D790, Test Method 1 Procedure 1. Results of test to meet the minimum requirements specified in 2.1.2. Provide copies of test result to Departmental Representative.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 31 23 10 - Excavating, Trenching and Backfilling.
- .2 Section 32 11 23 - Aggregate Base Course.
- .3 Section 33 05 14 – Manholes and Catch Basin Structures.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D698-07e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbf/ft³ (600 kN-m/m³)).
 - .2 ASTM F714-08, Standard Specification for Joints for Polyethylene Pipe (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
 - .3 ASTM D 2657-07, Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-A257 Series-03 Standards for Concrete Pipe and Manhole Sections (Consists of A257.0, A257.1, A257.2, A257.3, and A257.4).
 - .1 A257.2-03 Reinforced Circular Concrete Culvert, Storm Drains, Sewer Pipe, and Fittings.
 - .2 A257.3-03 Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections, and Fittings Using Rubber Gaskets.
 - .2 CSA B1800-02, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .1 CSA B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
 - .3 CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- .3 Ontario Provincial Standard Drawings (OPSD)
 - .1 OPSD 708.010 (November 2006) – Catch Basin Connection for Rigid Main Pipe Sewer.
 - .2 OPSD 708.030 (November 2006) – Catch Basin Connection for Flexible Main Pipe Sewer.
- .4 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 409-November 2009 – Construction Specification For Closed-Circuit Television Inspection of Pipelines
 - .2 OPSS 1840 (November 2006) – Material Specification For Non-Pressure Polyethylene Plastic Products.

1.3 SUBMITTALS

- .1 Submit product literature for storm sewer pipe and culverts in accordance with Section 01 00 10 – General Instructions.
- .2 Certification to be marked on pipe.

Part 2 Products

2.1 OPEN CUT PIPE

- .1 For pipe diameters up to and including 450mm diameter:
 - .1 Plastic Pipe:
 - .1 Type PSM Polyvinyl Chloride (PVC): to CSA-B182.2.
 - .2 Standard Dimensional Ratio (SDR): 35.
 - .3 Locked-in gasket and integral bell system.
 - .4 Nominal lengths: 4 m.
 - .2 For pipe diameters over 450mm diameter:
 - .1 Concrete Pipe:
 - .1 Reinforced circular concrete pipe and fittings: to CAN/CSA-A257, size as indicated, strength classification 140D, designed for flexible rubber gasket joints to CAN/CSA-A257.
 - .2 Lifting holes are not permitted.

2.2 TRENCHLESS PIPE

- .1 Horizontal Directional Drilling
 - .1 High Density Polyethylene (HDPE): IPS, DR 11, Resin PE 3408 as per ASTM F417. Indicated nominal pipe size refers to inside pipe diameter.

.1 Pipe Size Equivalency Table for HDPE DR11

Pipe Size	Actual Inside Diameter	Actual Outside Diameter
200 mm	220.4 mm	270.1 mm
250 mm	261.4 mm	320.3 mm
300 mm	328.1 mm	402.0 mm
375 mm	369.1 mm	452.2 mm
450 mm	451.1 mm	552.7 mm
525 mm	533.1 mm	653.2 mm

- .2 Pipe to be free of concentrated ridges, discolouration, excessive spot roughness, pitting, varying wall thickness, free of cracks, over exposure to ultra violet light, foreign inclusions, and gashes, nicks, or abrasion in excess of 10% of the wall thickness.
- .3 Pipe joints: thermal butt fusion as per ASTM D2657.
- .4 HDPE pipe and fittings for storm sewers shall be extruded in green colour throughout its thickness.

2.3 PIPE BEDDING AND SURROUND MATERIAL OPEN CUT

- .1 Granular base material: refer to Section 32 11 23 – Aggregate Base Course.

2.4 BACKFILL MATERIAL OPEN CUT

- .1 Type 1 Fill: in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.

Part 3 Execution

3.1 PREPARATION

- .1 Clean pipes and fittings of debris and water before installation, and remove defective materials from site to approval of Departmental Representative.

3.2 OPEN CUT TRENCH INSTALLATION

- .1 Trenching
 - .1 Do trenching Work in accordance with Section 31 23 10 - Excavating, Trenching and Backfilling.
 - .2 Do not allow contents of sewer or sewer connection to flow into trench.
 - .3 Trench alignment and depth to approval of Departmental Representative prior to placing bedding material and pipe.
- .2 Granular Bedding
 - .1 Place bedding in unfrozen condition.
 - .2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated up to spring line of pipe.
 - .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipes.
 - .4 Shape transverse depressions as required suiting joints.
 - .5 Compact each layer full width of bed to at least 95 % maximum density to ASTM D698.
 - .6 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted bedding material.
 - .7 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.
- .3 Pipe Installation
 - .1 Lay and join pipe in accordance with manufacturer's recommendations and to approval of Departmental Representative.
 - .2 Handle pipe-using methods approved by pipe manufacture.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
 - .3 Lay pipes on prepared bed, true to line and grade with pipe inverts smooth and free of sags or high points.

- .1 Maximum allowable variation from indicated pipe invert elevations as measured at the manholes and catch basins not to exceed 10mm.
- .2 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipes during construction except as may be permitted by Departmental Representative.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 Joints:
 - .1 Plastic pipe:
 - .1 Gaskets integral with pipe.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material. Lubricate gaskets before jointing is attempted.
 - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Do not install pipes with damaged or disturbed gaskets.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
 - .2 Concrete pipe:
 - .1 Install gaskets as recommended by manufacturer.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Remove disturbed or dirty gaskets; clean, lubricate and replace before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.

- .10 When any stoppage of Work occurs, restrain pipes, to prevent "creep" during down time.
- .11 Cut pipes as required for special inserts, fittings or closure pieces, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Make watertight connections to manholes and catch basins.
- .13 Use prefabricated saddles for connecting pipes to sewer pipes.
 - .1 Joints to be structurally sound and watertight.
 - .1 Catch basin connection to concrete pipe: to OPSD 708.10.
 - .2 Catch basin connection to plastic pipe: to OPSD 708.030.
- .14 Temporarily plug open upstream ends of pipes with removable watertight concrete, steel or plastic bulkheads.
- .4 Pipe Surround
 - .1 Place surround material in unfrozen condition.
 - .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thicknesses as indicated.
 - .1 Do not dump material within 1 m of pipe.
 - .4 Place layers uniformly and simultaneously on each side of pipe.
 - .5 Compact each layer from pipe invert to mid height of pipe to at least 95 % maximum density to ASTM D698.
 - .6 Compact each layer from mid height of pipe to underside of backfill to at least 90 % maximum density to ASTM D698.
- .5 Backfill
 - .1 Place backfill material in unfrozen condition.
 - .2 Place backfill material, above pipe surround, in accordance with Section 31 23 10 Excavating, Trenching and Backfilling, up to grades as indicated.

3.3 TRENCHLESS INSTALLATION

- .1 Horizontal Directional Drilling Pipe Installation: permitted for pipe sizes up to and including 525mm in diameter.
 - .1 Install pipe by directional drilling methods where indicated and in accordance with Section 31 23 10 - Excavating Trenching and Backfilling.
 - .2 Handle pipe using methods approved by Departmental Representative and in accordance with manufacturer's installation instructions. Do not use chains or cables passed through pipe bore so that weight of pipe bears on pipe ends.
 - .3 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
 - .1 Pipe jointing to be butt fused in accordance with manufacturer's instructions and ASTM D2657.
 - .1 Pipe joints to be true to alignment and have uniform roll-back bead.

- .2 Allow joint to cool sufficiently, as recommended by pipe manufacturer, prior to removal of jointing pressure.
- .3 Joints to be inspected and approved by Departmental Representative prior to insertion.
- .4 Do not exceed maximum pipe deflection recommend by pipe manufacturer.

3.4 TESTING

- .1 Repair or replace pipe, pipe joint or bedding found defective.
- .2 When directed by Departmental Representative, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.
- .3 Remove foreign material from sewers and related appurtenances by flushing with water.
- .4 Television and photographic inspections:
 - .1 Carry out closed circuit television (CCTV) of installed sewers in accordance with OPSS 409.
 - .2 Submit one copy of CCTV inspection report to Departmental Representative for review. CCTV inspection report will be used by Departmental Representative in assessing acceptance of installed works.

END OF SECTION