

This section covers the requirements for constructing ~~storm sewers~~, sanitary sewers and service connections with bedding material to lines, grades and dimensions indicated or directed by the Owner.

PART 1 REFERENCES

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

American Association of State Highway and Transportation Offices (AASHTO)

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| <u>M36</u> | <u>Standard Specification for Corrugated Steel Pipe, Metallic Coated, for Sewers and Drains</u> |
| M196 | Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains |
| <u>M274</u> | <u>Standard Specification for Steel Sheet, Aluminum-Coated (Type-2), for Corrugated Steel Pipe</u> |
| ASTM International | |
| A760/A760M | Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains |
| <u>A796/A796M</u> | <u>Standard Practice for Structural Design of Corrugated Steel Pipe, Pipe Arches, and Arches for Storm and Sanitary Sewers and Other Buried Applications</u> |
| B209/209M | Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate |
| B745/B745M | Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains |
| C655/C655M | Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe |
| D698 | Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft ³ (600 kN·m/m ³)) |
| D3034 | Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| <u>F679</u> | <u>Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings</u> |
| F794 | Standard Specification for Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on |

Controlled Inside Diameter

AWWA

C301 Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
C302 Reinforced Concrete Pressure Pipe, Noncylinder Type
C303 Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type

CSA Group

A257 Standards for Concrete Pipe and Manhole Sections
A3000 Cementitious Materials Compendium
B137 **Thermoplastic Pressure Piping Compendium**
B1800 Thermoplastic Nonpressure Piping Compendium
B182.1 **Plastic drain and sewer pipe and pipe fittings**
B182.2 **PSM type polyvinylchloride (PVC) sewer pipe and fittings**
B182.6 **Profile polyethylene (PE) sewer pipe and fittings for leak-proof sewer applications**
B182.11 **Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings**
G401 Corrugated Steel Pipe and Buried Structures Products
PLUS 4012 **Technical Guide: Visual Inspection of Sewer Pipe**

Other

MSCC Water Research Centre (WRc), Manual of Sewer Condition Classification

NASSCO Certification

PART 2 GENERAL

2.1 SCHEDULING:

.1 Schedule Work to minimize interruptions to existing services and m-.
.2.1 Maintain existing sewage flows during construction.
.2 Submit schedule of expected interruptions for approval and adhere to approved schedule

.3 Notify the Owner 24 hours minimum in advance of any interruption in service.

2.2 SUBMITTALS

.1 Submit in accordance with Section - 01340 Shop Drawings, Samples and Submissions.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, and backfill and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Newfoundland and Labrador, Canada.

.2 Indicate on drawings proposed method for installing carrier pipe for undercrossing.

.4 Samples:

.1 Inform the Owner at least four (4) weeks before beginning Work, of proposed source of bedding materials and provide access for sampling.

.5 Certificates:

.3.1 Certification to be marked on pipe.

2.22.3 AS-BUILT DRAWINGS

.1 Provide data necessary to produce As-Built Drawings, including details of pipe material, invert elevations at maintenance holes and connections, location of tees, bends, clean-outs, maintenance holes, saddles, laterals and caps.

.2 Provide close-out documents, including directions of operating valves, list of equipment required to operate valves, details of pipe materials, location of air and vacuum release valves, and maintenance and operating instructions in accordance with Section 01720 – Closeout Submittals.

2.32.4 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01600 – Materials and Equipment.

- .2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .4.2 Store and protect pipes from damage.

PART 3 PRODUCTS

3.1 PIPE - GENERAL

- .1 Pipe shall consist of aluminized steel pipe type 2 or polymer laminated in accordance with the CSPI Performance Guideline for Corrugated Steel Pipe Culverts (300 mm to 3600 mm diameter), corrugated aluminum, PSM polyvinyl chloride, or corrugated polyethylene pipe of profile type and strength as specified in the unit price table.
- .2 Contractors are advised that consideration will be given to proposals to substitute aluminized steel type 2 pipe with corrugated polyethylene pipe for diameters of up to and including 600 mm. The pipe shall be of the type, strength and size specified in the MERX Schedule of Quantities and Prices.

3.13.2 CONCRETE PIPE

- .1 Non-reinforced circular concrete pipe and fittings in accordance with CSA A257, designed for flexible rubber gasket joints, mortar joints in accordance with CSA A257.
- .2 Reinforced circular concrete pipe and fittings in accordance with CSA A257, designed for flexible rubber gasket joints, mortar joints in accordance with CSA A257 and ASTM C655/C655M.
- .3 Lifting holes:
 - .1 Pipe 900 mm and less diameter: no lift holes.
 - .2 Pipe greater than 900 mm diameter: lift holes not to exceed two in a piece of pipe.
 - .3 As indicated, provide pre-fabricated plugs to seal lift holes air or water tight after installation of pipe.

3.2 HYPRESCON PIPE

- .1 Pipe and Fittings:

- .1 ~~Prestressed concrete pressure pipe, steel cylinder type, lined cylinder type in accordance with AWWA C301 (L).~~
- .2 ~~Prestressed concrete pressure pipe, steel cylinder type, embedded cylinder type in accordance with AWWA C301 (E).~~
- .3 ~~Reinforced concrete pressure pipe, non cylinder type in accordance with AWWA C302.~~
- .4 ~~Reinforced concrete pressure pipe, steel cylinder type, pre-tensioned in accordance with AWWA C303.~~

3.3 STEEL PIPE

- .1 ~~Corrugated steel pipe, fasteners and coatings in accordance with CSA G401.~~
- .2 ~~Corrugated steel pipe, fasteners and coatings in accordance with CSA G401 except that the zinc coating mass (total on both sides) shall not be less than 1220 gm/m² may be used as an alternative to bituminous coated corrugated steel pipe.~~
- .3 ~~Spiral rib steel pipe in accordance with ASTM A760/A760M and ASTM A796/A796M.~~

3.43.3 ALUMINIZED TYPE-2 AND POLYMER LAMINATE

- .1 ~~Aluminized or polymer laminated corrugated steel pipe, couplers, wyes, tees, bends, adapters, nuts and bolts shall conform to the requirements of the most recent revisions of the following specifications: AASHTO M274, AASHTO M36, ASTM A760/A760M, ASTM A762/A762M, ATSM A929/A929M and CSA G401 specification.~~
- .2 ~~Wall thickness as specified by the Owner in the MERX Schedule of Quantities and Prices, but not less than the table below.~~
- .3 ~~Polymer laminate corrugated steel pipe, couplers, wyes, tees, bends, adapters, nuts and bolts shall conform to the requirements of the most recent revisions of the CSA G401 specification. Wall thickness as specified by the Owner in the MERX Schedule of Quantities and Prices, but not less than the table specification below.~~

| Pipe diameter (mm) | Wall thickness (mm) | Corrugation |
|--------------------|---------------------|------------------------|
| 150 to 500 | 1.6 | Any |
| 600 to 1200 | 2.0 | 63 mm x 13 mm helical |
| 1400 to 1800 | 2.0 | 125 mm x 25 mm helical |
| 2000 to 2400 | 2.8 | 125 mm x 25 mm helical |

| | | |
|---------------------------|----------------------------|-------------------------------|
| <u>2700 to 3600</u> | <u>3.5</u> | <u>125 mm x 25 mm helical</u> |
| <u>Pipe diameter (mm)</u> | <u>Wall thickness (mm)</u> | <u>Corrugation</u> |
| <u>100 - 500</u> | <u>1.6</u> | <u>Any</u> |
| <u>600 - 1200</u> | <u>2.0</u> | <u>Any</u> |
| <u>1400 -1800</u> | <u>2.0</u> | <u>125 mm x 25 mm</u> |
| | <u>3.5</u> | <u>68 mm x 13 mm</u> |
| <u>2000 - 2400</u> | <u>2.8</u> | <u>125 mm x 25 mm</u> |
| | <u>4.2</u> | <u>68 x 13 mm</u> |
| <u>2401- 3600</u> | <u>3.5</u> | <u>125 x 25 mm</u> |

.3.4 Provide water-tight cut-off collars as indicated on the contract drawings.

.4.5 Pre-fabricated end sections, wing walls as indicated on the contract drawings.

3.53.4 ALUMINUM PIPE

.1 Corrugated Aluminum Pipe and couplers shall be manufactured from coil alloy Alcad 3004-H34 with 7072 cladding and conform with the latest revisions of the following specifications: AASHTO M196, ASTM B745/B745M, ASTM B209/B209M.

.4.2 Wall thickness as specified by the Owner in the MERX Schedule of Quantities and Prices, but not less than:

| <u>Pipe diameter (mm)</u> | <u>Wall thickness (mm)</u> | <u>Corrugation</u> |
|---------------------------|----------------------------|-----------------------|
| 300 to 1000 | 1.91 | Any |
| 1200 to 1800 | 2.67 | 76 mm x 25 mm helical |
| 2000 to 2400 | 3.43 | 76 mm x 25 mm helical |

.2.3 Contact pipe manufacturer for recommended wall thickness on pipe diameters larger than 2400 mm.

.3.4 Provide water-tight cut-off collars as indicated on the Contract Drawings.

.4.5 Pre-fabricated end sections, wing walls as indicated on the Contract Drawings.

.5.6 Corrugated aluminum pipe shall be acceptable for use in salt water environments.

3.63.5 PLASTIC PIPE

.1 Type PSM Polyvinyl Chloride (PVC): To ASTM D3034.

- .1 Standard Dimensional Ratio (SDR): 35 unless otherwise indicated.
- .2 Locked-in gasket and integral bell system.
- .3 Nominal lengths: 4 to 6 m.
- .4 320 kPa pipe stiffness
- .5 Profile wall not to be used for diameters less than 300 mm.

- .1 Profile wall PVC in accordance with CSA B1800 and ASTM F794.

- .1 Smooth wall polyvinyl pipe and fittings in accordance with ASTM D3034 and ASTM F679. Plastic pipe and fittings in accordance with CSA B1800 for 100 / 125 / 150 mm sizes, and for 200 mm to 675 mm sizes. Standard Dimensional Ratio (SDR): 35 for mains and SDR 28 for service pipe, unless otherwise indicated on the contract drawings, with locked-in gasket and integral bell system. Nominal lengths: 4 to 6 m.
- .2 Profile wall polyvinyl chloride pipe with locked-in gasket and integral bell system. Pipe and fittings to be certified in accordance with CSA B1800 and ASTM F794. Pipe stiffness to be 320 kPa for sanitary sewer mains, this pipe not to be used for diameters less than 300 mm. Pipe stiffness to be minimum 210 kPa for storm sewer drains. Nominal length 4 m.

3.6 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: To CSA B182.2.
- .2 Plastic pipe: To CSA B182.1, with push-on joints.
- .3 Standard Dimensional Ratio (SDR): 28 unless otherwise indicated.

3.7 HIGH DENSITY POLYETHYLENE PIPE

- .1 Pressure pipe in accordance with CSA B137 to be supplied in 12.2 metre lengths, iron pipe size. All polyethylene pressure pipe to be joined by means of thermal butt fusion or socket fusion, in accordance with the recommendations of the manufacturer. Approved butt fusion equipment to be used and all work to be carried out by workers skilled in the use of such equipment.
- .2.4 Corrugated, double wall pipe in accordance with CSA B1800 for storm sewers. Pipes to have a smooth inner wall. Pipes may be bell and spigot style or plain end fastened with a coupling recommended by the manufacturer. Pipe stiffness to be minimum 210 kPa.

3.83.7 CEMENT MORTAR

- .1 Portland cement in accordance with CSA A3000, normal type 10.

.2 ~~-Mix mortar: one part Portland by volume of cement to two parts of clean, sharp sand mixed with minimum amount of dry. Add only sufficient water after mixing to obtain give optimum consistency for placement.~~

.4.3 ~~-Do not use additives.~~

3.9 CORRUGATED ALUMINUM PIPE

.1 ~~Corrugated Aluminum Pipe and Couplers, manufactured in accordance with AASHTO M196, ASTM B745/B745M, ASTM B209/B209M Alloy Alcad 3004 II34.~~

3.8 PIPE BEDDING AND SURROUND MATERIALS

.1 ~~Granular material to Section 02226 – Aggregate for Earthworks and the following requirements:~~

.1 ~~Crushed or screened stone, gravel or sand.~~

.2 ~~Gradations to be within limits specified when tested to ASTM C 136/C 136M and ASTM C 117.~~

.2 ~~Sieve sizes: To CAN/CGSB-8.1 or CAN/CGSB-8.2~~

.3 ~~Concrete mixes and materials for cradles, encasement, supports: to Section 03300 - Cast-in-Place Concrete.~~

3.9 BACKFILL MATERIAL

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

PART 4 EXECUTION

4.1 EXAMINATION

.1 ~~Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sewer pipe installation in accordance with manufacturer's written instructions.~~

.1 ~~Visually inspect substrate in presence of the Owner.~~

.2 ~~Inform the Owner of unacceptable conditions immediately upon discovery.~~

4.1.3 ~~Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Owner.~~

.1 ~~Temporary Erosion and Sedimentation Control:~~

- ~~.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction or sediment and erosion control drawings or plan, specific to site, whichever is more stringent].~~
- ~~.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.~~
- ~~.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.~~

4.2 PREPARATION

- ~~.1 Clean pipes and fittings of debris and water before installation.~~
- ~~.1.2 Inspect materials for defects before installing. Remove defective materials from site.~~
- ~~.2.3 Clean and dry pipes and fittings before installation.~~
- ~~.3.4 Obtain Owner's approval of pipes and fittings prior to installation.~~
- ~~.4.5 Establish location and extent of known service lines and complete any Work with or around existing underground services as per Section 01005 – General Instructions.~~

4.3 TRENCHING AND BACKFILLING

- ~~.1 Do trenching and backfill work in accordance with Section 02223 – Excavating, Trenching and Backfilling.~~
- ~~.2 Protect trench from contents of sewer or sewer connection.~~
- ~~.3 Trench alignment and depth as well as condition of trench bottom require Owner approval prior to placing bedding material and pipe.~~
- ~~.4 Do not backfill trenches until pipe grade and alignment have been checked and accepted and infiltration and exfiltration test results are within the limits specified. If the pipe is backfilled for any reason prior to testing, accept responsibility to meet the tests or to re-excavate and repair the line and pay all costs.~~
- ~~.5 Separation between Sewers and Water Mains shall be in accordance with Section 02713 – Water Mains.~~
- ~~.6 Separation at service connections shall be in accordance with Section 02713 – Water Mains.~~

4.4 CONCRETE BEDDING AND ENCASEMENT

- .1 Do concrete work in accordance with Section 03300 – Cast-in-Place Concrete. Place concrete to details indicated or directed by Owner.
- .2 Pipe may be positioned on concrete blocks to facilitate placing of concrete.
 - .1 ~~-When necessary, R~~igidly anchor or weight pipe to prevent flotation when concrete is placed ~~if necessary~~.
 - .2 Do not backfill over concrete within 24 hours after placing.

4.5 GRANULAR BEDDING

- .1 Place granular bedding materials in unfrozen condition and in accordance with details specified or directed.
- .2 Place granular bedding material 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 barrel of pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to ~~suits joints within bell if bell and spigot pipe is used~~.
- .5 Compact each layer full width of bed to ~~a minimum of at least~~ 95 % of corrected maximum dry density, ~~where the maximum dry density is determined~~ in accordance with ASTM D698 and corrected as specified in Section 02501 – Corrected Maximum Dry Density-Method D.
- .6 Fill excavation below bottom of maintenance holes or structures with specified bedding material or common backfill as directed by the Owner.

4.6 INSTALLATION

- .1 All pipes shall be handled with care so as not to damage the pipes or their protective coatings. Each pipe shall be inspected for defects before being lowered into the trench. Any pipe that is defective or unsound, in the opinion of the Owner, shall not be incorporated into the Work.
- .2 Lay and join pipes in accordance with manufacturer's recommendations.
- .3 Handle pipe ~~using methods approved by the Owner with approved equipment~~.

.1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.

.2.4 Use laser-type instrument to control line and grade for sewers unless otherwise approved by the Owner.

.5 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.

.1 -Ensure barrel of each pipe is in contact with shaped bed throughout its full length.

.6 Commence laying at outlet and proceed in upstream direction with bell ends of pipe facing upgrade.

.3.7 Lay corrugated steel pipe:

.1 With outside circumferential laps facing upgrade and longitudinal laps or seams at side or quarter points.

.2 With longitudinal centre line of paved invert coinciding with flow line.

.8 Joint deflection permitted within limits recommended by pipe manufacturer.

.4.9 Check alignment between maintenance holes as each portion is laid by means of a strong light shone through the pipe from maintenance hole to another. If less than half the full pipe cross-section at the light source is visible at the other end, realign pipes at no additional cost to the Contract, if so directed by the Owner.

.5.10 Do not allow water to flow through pipe during construction, except as may be permitted by Owner.

.6.11 Whenever Work is suspended, install a removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.

.7.12 Position and join pipes by approved methods. Do not use excavating equipment to force pipe sections together.

.8.13 Install PVC pipe and fittings in accordance with CSA B182.111800 and Uni-Bell.

.9 Joints:

.1 Corrugated steel pipe:

.1 Install flexible sealing rings where called for.

.2 Match corrugations or indentations of coupler band with pipe sections before tightening.

.3 Tap coupler firmly while tightening, to take up slack and ensure a snug fit.

.4 Ensure bolts are inserted and tightened.

.10.14 Pipe Joining:

- .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 carefully 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. Use only manufacturers recommended lubricant.
- .6 Complete each joint before laying next length of pipe.
- .7 Minimize joint deflection after joint has been made to avoid joint damage.
- .8 At rigid structures, install pipe joints not more than 600 mm from side of structure.
- .8.9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .9.10 Concrete pipe joints:

- .1 Pipe Interior: Circular pipes 700 mm in diameter and larger, and arch or elliptical pipe equivalent to 900 mm diameter or larger shall have interior gap between ends of adjacent pipes filled with mortar. Apply mortar a minimum 7 calendar days after backfilling has been completed to allow pipe settlement to occur. Finish interior surface of joints smooth.
- .2 Pipe Exterior: For bell and spigot pipe, mortar to be used for caulking outside of joints. Press and caulk mortar into place. Allow mortar to set minimum of one hour before backfilling.

- .10 Hyprescon pipe joints:

- .1 Joints:

- .1 ~~Bell and Spigot steel joint rings with confined O-rings, mortar protected.~~

- .11.15 ~~When stoppage of Work occurs, b~~lock pipes as directed ~~the Owner~~ when any stoppage of work occurs to prevent creep during down time.

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

- .17 Cut pipes ~~in a neat manner, at right angles to the axis of the pipe or~~ as required for special inserts, fittings or closure pieces in a neat manner, as recommended by pipe manufacturer, without damaging pipe or its coating and to leave a smooth end at right angles to axis of pipe.

.13.18 At maintenance holes, the pipe shall be cut so that the pipe ends will not project more than 300 mm in from the walls of the catch basin.

.14.19 Make watertight connections to maintenance holes or other structures.

Provide details of proposed method of installing pipe stubs in structure walls to ensure a watertight joint. In the case of precast maintenance hole bases an integral joint gasket may be cast in the maintenance hole wall to receive the pipe stub. In the case of cast-in-place maintenance hole bases, the exterior pipe surface in contact with the structure wall shall be roughened or treated to provide a bond with the concrete. Any grout used to be non-shrink type.

.15.20 Use prefabricated saddles or approved field connections for connecting pipes to existing sewer pipes. Joint of saddle to pipe shall be structurally sound and watertight.

.16.21 Leave joints and fittings exposed for ex-filtration testing. Provide protection when required. If it is necessary to backfill sections of the sewer prior to testing, take full responsibility and bear all costs for any additional excavation and backfill to expose pipe, fittings or joints that may be necessary.

.17.22 ~~When infiltration and exfiltration test results are acceptable to Owner, backfill remainder of trench in accordance with Section 02223.~~

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

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

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

4.7 PIPE SURROUND

.1 ~~Place surround material in unfrozen condition.~~

.2 ~~Upon completion of pipe laying, and after the Owner has inspected pipe joints, surround and cover pipes as indicated.~~

.1 ~~Leave joints and fittings exposed until site testing is completed.~~

.3 ~~Hand place granular material in uniform layers not exceeding 150 mm thick to minimum 300 mm over top of pipe.~~

.1 ~~Dumping of material directly on top of pipe is not permitted.~~

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

- .5 Compact each layer from pipe invert to mid height of pipe to a minimum 95 % maximum dry density in accordance with ASTM D698.
- .20.6 When site infiltration and ex-filtration test results are acceptable to Owner, backfill remainder of trench in accordance with Section 02223, place surround material at pipe joints.

4.8 BACKFILL

- .1 Do not backfill trenches until pipe grade and alignment have been checked and accepted and infiltration and ex-filtration test results are within the limits specified. If the pipe is backfilled for any reason prior to testing, accept responsibility to meet the tests or to re-excavate and repair the line and pay all costs.
- .2 When infiltration and ex-filtration test results are acceptable to Owner, backfill remainder of trench in accordance with Section 02223 – Excavating, Trenching, and Backfilling.
- .3 Place backfill material in unfrozen condition.
- .4 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .5 Under paving and walks, compact backfill to a minimum of 95 % maximum dry density to ASTM D698.
 - .1 In other areas, compact to at least 90 % maximum dry density to ASTM D698.

4.74.9 SERVICE CONNECTIONS

- .1 Install pipe in accordance with CSA B182.1100 and manufacturer's standard instructions and specifications.
- .2 Maintain grade for 100 and 125 mm diameter sewers at 1 vertical to 50 horizontal unless directed otherwise by the Owner.
- .3 Service connections to main sewer shall be approved tees including bends. "Inserta Tee" system, or approved equal, may be used.
 - .1 Do not use break-in and mortar patch-type joints.
- .4 Service connections for Type PSM Poly (PVC) pipe to be certified in accordance with CSA B1800, depending on wall type and diameter.
- .5 Service connection pipe: shall Not to extend into interior of main sewer.
- .6 Make up required horizontal and vertical bends from 45 degree bends or less, separated by a straight section of pipe with a minimum length of four (4) pipe diameters.

.1 -Use long radius bends where applicable. 100 mm long radius bends shall have a minimum radius of curvature of 600 mm. 150 mm long radius bends shall have a minimum radius of curvature of 900 mm.

.5.7 Plug service laterals with watertight caps or plugs as approved by the Owner.

.8 Place location marker at ends of plugged or capped unconnected sewer lines.

.1 Each marker shall consist of a 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.

.4.2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

.6.9 Install service connections before carrying out infiltration and ex-filtration tests.

4.84.10 FIELD TESTING

.1 Repair or replace pipe, pipe joint or bedding found defective.

.4.2 When directed by the Owner, draw tapered wooden plug with diameter of 50 mm less than nominal pipe diameter through sewer to ensure that pipe is free of obstruction.

.2.3 Prior to video or photo CCTV inspection remove foreign material from sewers and related appurtenances by flushing with water.

.4 Perform infiltration or ex-filtration testing as soon as practicable after jointing and bedding are complete, and service connections have been installed.

.3.5 Do infiltration and exfiltration test to ASTM C828.

.6 Complete infiltration and/or ex-filtration testing as specified herein and as directed by the Owner.

.1 Perform tests in presence of the Owner.

.2 Notify the Owner 24 hours in advance of proposed tests.

.4.3 For rehabilitation projects where sanitary sewers are being installed and immediately put into use, i.e. existing services are being connected as the sewer is being laid, infiltration and/or ex-filtration testing is not required.

.4.7 Carry out tests on each section of sewer between successive maintenance holes including service connections.

.5.8 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.

.6.9 Ex-filtration test:

- .1 Fill test section with water ~~to in such a manner as to allow~~ displacement of air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
- .2 Immediately prior to test period, add water to pipeline until there is a head of one (1) metre over interior crown of pipe measured at highest point of test section or water in maintenance hole is 1500 mm above static ground water level, whichever is greater.
- .3 Duration of ex-filtration test shall be one (1) hour.
- .4 Water loss at end of test period shall not exceed maximum allowable ex-filtration over any section of pipe between maintenance holes.

.7.10 Infiltration test:

- .1 Conduct infiltration test in ~~addition to ex-filtration test, in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.~~
- .2 ~~Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.~~
- .3 Install a watertight plug at upstream end of pipeline test section.
- .4 Discontinue pumping operations for at least three (3) calendar days before test measurements are to commence and during this time keep thoroughly wet at least one third (1/3) of pipe invert perimeter.
- .5 Prevent damage to pipe and bedding material due to flotation and erosion.
- .6 Place a 90 degree V-notch weir, or other measuring device approved by the Department of Environment and Climate ChangeOwner in invert of sewer at each maintenance hole.
- .7 Measure rate of flow over a minimum of one (1) hour, with recorded flows for each five (5) min interval.

.8.11 Infiltration ~~and~~ /ex-filtration: ~~shall not~~ Not to exceed 4.63 litres per millimetre of internal pipe diameter per kilometre per 24 hours which are the following limits in litres per hour per 100 m of pipe, including service connections.

| Internal Pipe Diameter (mm) | Maximum Amount (L/hr/100 m) |
|-----------------------------|-----------------------------|
| 100 | 1.93 |
| 150 | 2.89 |
| 200 | 3.86 |

| Internal Pipe Diameter (mm) | Maximum Amount (L/hr/100 m) |
|-----------------------------|-----------------------------|
| 250 | 4.83 |
| 300 | 5.79 |
| 350 | 6.75 |
| 400 | 7.72 |
| 450 | 8.68 |
| 500 | 9.65 |
| 550 | 10.61 |
| 600 | 11.58 |
| 700 | 13.51 |
| 800 | 15.44 |
| 900 | 17.37 |

.9.12 Repair and retest sewer line as required, until test results are within limits specified at no additional cost to the Contract.

.13 Repair visible leaks regardless of test results.

.14 Television and photographic inspections:

.1 Carry out inspection of installed sewers by video camera, digital camera or by other related means and in accordance with Section 02300 – CCTV and Camera Inspection.

.4.2 Provide means of access to permit the Owner to do inspections.

.10.15 Carry out any retesting of sewer sections that have previously passed exfiltration and/or infiltration tests, as directed by the Owner. If any sewer section passes this initial retest, additional payment will be made for such retest of that section. If any sewer section does not pass this initial retest, repair and retest such sewer as required until test results are again within limits specified, at no additional cost to the Contract.

.11 A sewer section is defined as the length of pipe between successive maintenance holes.

.12.16 Deflection Test for PVC Pipe

.1 Carry out a deflection test on all sections of the sewer. The maximum allowable deflection under fully backfilled and compacted trench conditions shall not exceed 5 % before 30 calendar days and 7.5 % after 30 calendar days.

.2 Locations with excessive deflection shall be repaired and/or the pipe replaced at the Contractor's expense. The equipment used for the deflection test shall be that as recommended by the manufacturer, and may include an Electronic Deflectometer or a Rigid "Go-No-Go" Device. For the purpose of deflection measurement, the base inside diameters and the deflection mandrel dimensions are provided in the following table. To ensure accurate testing the lines shall be thoroughly cleaned. As shown below in the table for base inside diameters and deflection mandrel dimensions PVC SDR-35 (ASTM D3034).

| Nominal Size | Base Inside Diameter (mm) | 5 % Deflection Mandrel (mm) | 7.5 % Deflection Mandrel (mm) |
|--------------|---------------------------|-----------------------------|-------------------------------|
| 200 | 194.69 | 185 | 180 |
| 250 | 242.9 | 230.8 | 224.6 |
| 300 | 288.57 | 274 | 266.9 |
| 375 | 353.01 | 335.4 | 326.6 |

.3 For nominal sewer sizes not shown in above table the Mandrel dimensions shall be calculated as follows:

$$\text{Mandrel O.D.} = \frac{100 - Y}{100} \times \text{Base I.D.}$$

Where:

Y = Deflection Limit in %

4.11 CCTV AND CAMERA INSPECTION OF PIPELINES

.1 Complete television and camera inspections in accordance with Section 02300 – CCTV and Camera Inspection.

.13 CCTV INSPECTION OF PIPELINES

.14 The following information shall be submitted to the Owner ten business days prior to the start of the CCTV inspection operations:

.1 A copy of the CCTV operator's NASSCO Certification Certificate. A copy of said certificate is required for each CCTV operator working on the Contract. Operators shall have been certified or re-certified within the three years prior to the start of the Contract.

.2 A sample inspection report, resolution tests of digital video recording format, and digital data file. One submission is required for each camera proposed for use on the work. The camera make, model, and serial number shall be clearly identified on each video recording.

.3 The details of the coding accuracy verification system that is to be used to verify inspection accuracy shall be submitted for approval.

.15 Media storage and report presentation shall be cloud based unless prior approval is granted by the Department. All software will be NASSCO import/export certified (refer to www.nassco.org for a full list of compatible software).

.1 Digital storage device (if approved) will be a minimum USB 2.0 or higher compatibility shall be placed inside envelopes with labels displaying the following information:

- .1 Owner's Name
- .2 Contract Number or Project Name
- .3 Sewer Identification Number
- .4 City or Town
- .5 Street Name
- .6 Inspection Date
- .7 Consultant's/Contractor's name

.16 Inspection Report

.1 The report shall include a standard cover sheet showing the following:

- .1 Location
- .2 Performed By
- .3 Date
- .4 Contractor

.2 The report shall include a completed Index Page with the headers:

- .1 Street Name, From M.H. No., To M.H. No., Page No.

.3 Whether inspected at the same time or not, the complete report will be presented together, from upstream to downstream maintenance hole.

.4 For video inspection results and findings, the heading will state:

- .1 the street name
- .2 the maintenance hole numbers applicable to this section
- .3 the reference drawing number
- .4 prevailing weather on the day of the inspection
- .5 statement of soil condition in area of inspection, e.g., dry, wet, saturated, frozen
- .6 the date of the inspection

.5 The key plan will consist of a small drawing (not to scale) showing the appropriate location of the two maintenance holes in relation to any nearby reference points such as houses (with corresponding

civic numbers), telephone poles (with corresponding pole numbers), etc. This drawing will denote:

- .1 the maintenance hole numbers
- .2 the horizontal distance between the maintenance holes
- .3 the direction of sewer flow
- .6 The report shall include photographs of:
 - .1 pipe joints that display gaps, spread, or offset;
 - .2 signs of infiltration; protruding service lines; crushed, broken or cracked pipe;
 - .3 variance of the grade of the pipe section; and
 - .4 gravel or debris or other blockages which may impede flow.
- .7 All photographs will be labelled and have a corresponding labelled description for the photograph.
- .8 All photographs will be numbered in order. This number will appear beside them and will be the same number referred to in the description.
- .9 The last page of the report will consist of an area sewer plan to scale, showing the street inspected for the report and applicable maintenance numbers.
- .10 Typical Key Plan Templates for Inspection Report

DEPARTMENT PROJECT NO.:

MUNICIPALITY:

STREET NAME:

FROM MH# _____ TO MH# _____

REFERENCE DRAWING: _____ LINE SECTION LENGTH: _____

DATE: _____ PIPE SIZE: _____

WEATHER CONDITION: _____ PIPE MATERIAL: _____

PIPE SECTION LENGTH: _____ PIPE MATERIAL TYPE: _____

| Sketch | Line length (m) | Photo # | Tape reference (hours, minutes) | Observations |
|--------|-----------------|---------|---------------------------------|--------------|
| | | | | |

- .17 Digital photograph files shall meet or exceed a resolution of at least 800 x 600 pixels.
- .18 Survey and camera equipment used to inspect water mains shall have been used exclusively for work in water mains only.

.19 The survey vehicle shall contain a separate area for viewing, recording, and controlling the CCTV operation. The viewing and control area shall be insulated against noise and extremes in temperature. External and internal sources of light shall be controlled in a manner as to ensure the light does not impede the view of the monitor screen. Seating accommodation for one person shall be provided in addition to the operator seating to clearly view the monitor screen. All equipment used within the pipeline shall be stored outside the viewing, recording, and control area. The vehicle shall include a cell phone or suitable alternative as agreed by the Owner for the duration of the work.

.20 The surveying equipment shall be capable of surveying a length of pipeline up to:

- .1 300 m when entry to the pipeline may be obtained at each end of the pipeline.
- .2 30 m when rodding is used.
- .3 150 m when a self propelled unit is used when entry is at only one end of the pipeline.
- .4 200 m when being towed.

.21 Work shall not commence in a work shift until the Owner is satisfied that all items of the survey equipment have been provided and are in full working order. Each survey unit shall contain a means of transporting the CCTV camera in a stable condition through the pipeline.

.22 When the CCTV camera is towed by winch and cable through the pipeline, all winches shall be stable during the entire CCTV inspection. All cables shall be of steel or of an equally non-elastic material to ensure the smooth and steady progress of the CCTV camera.

.23 Each unit shall carry sufficient number of guides and rollers so that, when surveying, all cables are supported away from pipe and maintenance hole edges. All CCTV cables and lines used to measure the camera's location within the pipeline shall be maintained in a taut manner and set at right angles, when possible, to run through or over the measuring equipment.

.24 The electronic systems, television camera, and monitor shall be of adequate quality to enable the following to be achieved:

- .1 Camera: the pan and tilt camera shall have the capability of panning the pipe at 360 degrees with tilt capability of 275 degrees to ensure complete inspections and view of all laterals and deficiencies.
- .2 Resolution: the live picture shall be visible with no interference and capable of registering a minimum number of lines of resolution at the periphery as indicated below:

- .1 Fixed view camera 350 lines of resolution.
- .2 Pan and tilt camera 400 lines of resolution.
- .3 Colour Constancy: the lighting shall be set prior to commencing the survey to ensure the camera provides optimum results when used with its own illumination source. To ensure colour constancy, no variation in illumination shall take place during the survey.
- .4 Focus, Iris, and Illumination: the adjustment of focus and iris shall allow optimum picture quality to be achieved and shall be remotely operated. The illumination shall be such as to allow an even distribution of the light around the pipeline perimeter without the loss of contrast or flare out of picture shadowing.
- .5 Monitor: monitors shall be a minimum size of 21 inches and shall support resolution equal to or greater than the corresponding video camera resolution.
- .6 Digital Video Recorder: digital video recorders shall be able to capture in colour from the live video source with the following requirements:
 - .1 MPEG-2 or higher or as required by Owner.
 - .2 Minimum recorded video resolution shall be 420 lines.
 - .3 NTSC 720 x 480 @ 29.97 frames per second.
 - .4 The compression technology (codec) used in creating the MP4 digital video recordings shall be fully compatible with all the mainstream video players listed below:
 - .1 Windows Media Player, Windows and Mac
 - .2 Apple QuickTime Player, Windows and Mac
 - .3 VideoLAV VLC Player, Windows and Mac
 - .4 Video files that do not play properly and completely on all the above players will not be accepted and will require re-doing the CCTV inspection or other corrective procedure. Ensure that the entire inspection of a particular sewer or maintenance hole is contained on the same USB media. Record reverse set up inspections of a sewer immediately after the original inspection where possible.
- .25 When specified in the Contract Documents, pipelines shall be cleaned and flushed immediately prior to CCTV inspection.
- .26 Prior to the start of the CCTV inspection, the resolution of digital MPEG video playback for each camera shall be confirmed by recording a resolution chart approved by the Owner, using the following procedure:
 - .1 Set up the camera as is done for the actual inspection.

.2 Show the camera being introduced and reaching its final position for the test.

.3 Fill the monitoring screen with the resolution chart.

.4 Illuminate the resolution chart evenly and uniformly without reflections ensuring that the illumination source accurately simulates the lighting used in the sewer.

.5 Record a test video for 30 seconds.

.6 Identify the camera make, model, and serial number on the recording.

.7 Record the test at the start of a digital recording.

.8 The resolution test shall be submitted to the Owner.

.27 Prior to commencement of the CCTV inspection, a formal coding accuracy verification system shall be developed and submitted to the Owner and implemented when approved.

.1 The coding accuracy shall be based on accuracy as a function of the number of defects or construction features not recorded, and the correctness of the coding and classification shall be recorded. Coding accuracy is to satisfy the following requirements:

.1 Header accuracy - 95 %

.2 Detail accuracy - 85 %.

.2 Verification of coding accuracy shall be completed on a random basis on a minimum of 10 % of the inspection reports. A minimum of two accuracy verifications shall be completed for each operator for each week working and submit the results to the Owner for review.

.28 Inspections not satisfying the accuracy requirements shall be re-coded to meet the accuracy requirements and the accuracy of the inspections, immediately preceding and following the non-compliant inspection, shall be verified. This process shall be repeated until the preceding and subsequent inspections meet the accuracy requirements.

.29 Coding accuracy checks shall be submitted to the Owner along with the corresponding video recording.

.30 The work shall include a CCTV inspection of the pipeline and the preparation of all video, digital, and written reports. A certified, trained, and competent CCTV operator shall be used to operate the inspection equipment and code the inspection.

.31 A fixed camera may be used for pipelines less than 300 mm in diameter. For pipelines equal to or greater than 300 mm, a pan and tilt camera shall be used. Each camera shall have an accepted sample submissions report

prior to being used for inspection work. The camera lens shall be kept clean at all times during the inspection.

.32 Flow control measures as specified in the Contract Documents shall be implemented to ensure a minimum of 80 % of the height of the pipeline is visible for the entire inspection and shall be approved by the Owner.

.33 All fog shall be evacuated from the pipeline and the pipeline kept clear of fog during the inspection.

.34 At the start of each pipeline being surveyed, the length of pipeline from zero chainage up to the cable calibration point shall be recorded and reported in order to obtain a full record of one of the following:

- .1 Pipe sewer length from the inside face of the maintenance hole to the inside face of the next maintenance hole or outlet end of the pipe sewer.
- .2 Pipe culvert length from one end of the pipe culvert to the other; or
- .3 Water main length from the valve pit entry point to the valve pit exit point or termination of the cement mortar lining.

.35 The position metre reading entered on to the data display at the cable calibration point shall allow for the distance from the start of the survey to the cable calibration point so that the metre reading at the start of the survey is zero.

.36 In the case of surveying through a maintenance hole when a new header sheet is required, the metre reading shall be set at zero with the camera focused on the outgoing pipe entrance.

.37 At the start of each maintenance hole length, a data generator shall electronically generate and clearly display on the viewing monitor and video recording, a record of data in alphanumeric form containing the following minimum information:

- .1 Automatic update of the camera's metre reading position in the pipeline from adjusted zero.
- .2 Pipeline dimensions.
- .3 Maintenance hole and pipe length reference numbers.
- .4 Date of survey.
- .5 Road name and location.
- .6 Direction of survey.
- .7 Time of start of survey.
- .8 Pipeline use.

.38 Once the survey of the maintenance hole length is underway, an automatic update of the camera's metre reading position in the pipeline from zero in metres and tenths of a metre shall be continually displayed.

.39 The camera shall be stopped when defects are being noted on the coding sheet. Defects in each pipeline length shall be coded according to the standard being used (i.e., CSA Plus 4012, NASSCO Canadian Edition of the Pipeline and Assessment Certification Program (PACP), or WRc) or as specified in the Contract Documents. Any variation from the manual shall be noted in the survey report.

.40 The survey shall be restarted at the opposite end of the pipeline if a blockage or obstruction is encountered.

.41 Inspections shall be recorded in colour.

.42 Digital video recordings may be saved to a computer hard drive and transferred to a portable hard disk drive, compact disc, or digital video for submission.

.43 A digital format video recording of an inspection shall be produced in colour from a first generation recording by one of the following methods:

- .1 A computer system and a video capture card shall be used to capture the recording continuously, regardless of the progression of the inspection. Prior to submission, the raw digital data shall be edited to remove pauses when the inspection progress was not continuous.
- .2 A computer system and a video capture card shall be used to intermittently capture the recording. Prior to submission, the raw digital file shall be edited to form one continuous file.
- .3 Specialized video recording equipment capable of pausing and resuming live recording shall be used to capture original recording. A single file is to be produced for submission.

.44 Video capture equipment shall be capable of capturing digital video from first generation recordings with no frame loss.

.45 Non-linear video editing software shall be used to edit digital videos. Edited digital files shall not be recompressed.

.46 The camera lens shall be positioned centrally in a circular pipeline and at two-thirds of the vertical dimension in a non-circular pipeline with a positioning tolerance of $\pm 10\%$ of the vertical pipeline dimension. In all instances, the camera lens shall be positioned looking along the longitudinal axis of the pipeline.

.47 Position the centre of the camera lens in the centre of circular and egg-shaped sewers and maintenance hole risers.

.48 The travelling speed of the camera in the pipeline shall be limited to:

- .1 0.1 m/s for pipeline of diameter less than 200 mm;

- .2 0.15 m/s for diameters exceeding 200 mm but not exceeding 310 mm; and
- .3 0.20 m/s for diameters exceeding 310 mm.

.49 A suitable metre-reading device shall be used that enables the cable length to be accurately measured to indicate the location of the camera. The metre-reading device shall be accurate to $\pm 1\%$ of the length of the sewer being surveyed. The tolerance shall be demonstrated using one or both of the following methods in conjunction with a linear measurement audit form that shall be completed each day during the survey:

- .1 Cable calibration device.
- .2 Tape measurement of the surface distance between maintenance holes.

.50 If the accuracy of the measuring device fails, it is to be replaced. The Owner may require that the lengths of pipeline first inspected with the original measuring device be resurveyed using the new measuring device.

.51 Survey reports shall be submitted to the Owner in the following formats, with the noted number of copies, within 10 business days of the completion of the fieldwork:

- .1 3 copies of the printed survey report.
- .2 2 portable hard disk drives, other digital storage devices and software database as specified in the Contract Documents, each containing the identical survey report information as in the printed copies.
- .3 2 copies of the digital video recording.

.52 Entire inspections shall be contained within one digital file on a digital storage device, as applicable. When possible, reverse set-up inspections shall be recorded immediately after the original inspection. Each digital file shall contain the file name, as specified by the Owner and may include the following:

- .1 Tender number
- .2 E <Entity number>
- .3 F <From entity number>
- .4 T <To entity number>
- .5 Street Name
- .6 M <Measured length>
- .7 I <Inspected length>
- .8 <Inspection direction: DS or US>
- .9 <Letter designating inspection sequence> .MPEG

For example: 910-200-E5329-F5328-T5350-BERRY-M100.0 I39.2
US B.MPEG indicates that this is the second or "B" partial
inspection of this entity, 39.2 m long.

- .53 All required header information fields shall be completed and verified for correctness. The software used to produce the survey report shall not allow the operator to continue inputting information until the preceding field has been completed. The report shall be machine printed and presented according to the standard used.
- .54 All dimensions in the survey report shall be metric.
- .55 The survey report shall identify major defects and shall include photographs when the need for photographs is specified in the Contract Documents.
- .56 One clean set of the Owner's drawings showing maintenance hole numbers that coincide with the coding sheets and videotapes shall be returned to the Owner on completion of the survey. The drawings shall be clearly annotated to show any discrepancies between the drawings and the survey report. Such discrepancies shall be brought to the attention of the Owner during the survey.
- .57 Management of excess material shall be as specified in the Contract Documents.

4.94.12 QUALITY ASSURANCE

- .1 Upon submission, printed and digital inspection reports, and digital MPEG video recordings, magnetic data files, and coding accuracy checks shall be reviewed to ensure compliance with the Contract Documents. The Owner may adjust the frequency of reviews based on the results of previous reviews.
- .2 Submittals shall be reviewed by the Owner and their acceptance confirmed within 10 business days of submission. Only inspections with minimum accuracy for header information of 95 % and minimum detail accuracy for defects and features of 85 % will be accepted. Non-compliant submissions will be returned for correction. Corrected submissions shall be returned to the Owner for review within 5 business days.
- .3.1 Operators failing to meet the coding accuracy requirements on two occasions shall not be permitted to code on the remainder of the Contract, unless they successfully re-attain NASSCO qualification based on the standard being used, that is to say the Canadian Edition of PACP or WRe.
- .4.2 Re-perform sewer inspections where the Owner has determined the requirements of this specification have not been satisfied.

.5.3 Correct non-compliant inspection submissions and resubmit the corrected inspections to the Owner within 5 business days.

.6.4 Repeat the process until the inspection submissions are accepted by the Owner.

PART 5 PAYMENT

5.1 MEASUREMENT FOR PAYMENT

.1 Sanitary sewer ~~and storm sewer~~ will be measured through fittings and maintenance holes after the work is completed.

.1 Measurement will be made from centre to centre of maintenance holes, catch basins, and ditch inlets or;

.2 from centre of maintenance holes, catch basins, and ditch inlets to the end of the pipe where no maintenance hole, catch basin or ditch inlet is installed under this contract.

.3 Measurement will be horizontally.

.1 ~~-~~ in metres over the centre line of the pipe when the grade of the pipe is less than 10 % and:

.2 ~~in~~ in metres along the slope length of the pipe when the grade of the pipe is 10 % or greater, for each size pipe and depth class supplied and installed.

.4 No deduction for pipe up to and including nominal diameters of 300 mm will be made. Calculation of deduction will be made for pipe end area, based on the nominal diameter, for pipes in excess of 300 mm nominal diameter.

.2 For service connections, measurement will be made in metres horizontally:

.1 where the grade is less than 10 % and along the slope length of the pipe

.2 when the grade is 10 % or greater, from the centre line of the main sewer to a point vertically above the end of the service connections of each size and class of pipe supplied and installed.

.3 The length of long radius bends will not be included as service pipe.

.3 Measurement of long radius bends on service connections shall be by the each.

~~.4.1 No deduction for pipe up to and including nominal diameters of 300 mm will be made. Calculation of deduction will be made for pipe end area, based on the nominal diameter, for pipes in excess of 300 mm nominal diameter.~~

.5.4 Tees, caps, plugs and other fittings will be measured by each unit.

.6 ~~Measurement for a Closed Circuit Television (CCTV) inspection of pipeline shall be measured in metres on the ground surface along the centreline of the pipe sewer from the centre of one drainage structure to the centre of another drainage structure or outlet end of the pipe sewer. Measurement for pipe culverts shall be from one end of the pipe culvert to the other end of the pipe. In the event that a CCTV inspection is terminated due to a blockage or collapsed pipe or the pipe is inaccessible, measurement shall be in metres for the actual length of pipeline inspected as determined from the chainage indication on the record media.~~

.7.5 Breaking into and connecting to existing maintenance holes~~s~~ will be measured by each such connection.

.8.6 Locating and connecting to existing sewer mains and stubs will be measured by each such main and stub connection.

5.2 BASIS OF PAYMENT

.1 All costs associated with the work outlined in this specification shall be deemed to be included in the appropriate unit and lump sum prices quoted as outlined in the Measurement for Payment subsection of this section and as included in the MERX Schedule of Quantities and Prices.

.2 Payment will be made to the maximum of 90 % of the value of sewers, fittings and appurtenances until the system (or sections of the system, if payment approved by the Owner) has passed all tests. The 10 % retained shall be called the sewer test allowance.

.3 Excavation and backfill will be measured in accordance with Section 02223 – Excavating, Trenching and Backfilling.

.4 Granular bedding material will be measured in cubic metres of material incorporated into the work in accordance with Section 02223 – Excavating, Trenching and Backfilling.

.5 Concrete bedding, head walls, and encasement of pipes will be measured in accordance with Section 03300 – Cast-In-Place Concrete.

.6 Measurement for CCTV and TV camera inspection will be measured in accordance with Section 02300 – CCTV and Camera Inspection by the metre of pipe inspected and accepted.

.7 ~~Infiltration and/or exfiltration tests do not apply to corrugated storm sewer pipe unless otherwise specified.~~

Not For Construction