AMENDMENTS TO OPSS 410 (DEC 88)– CONSTRUCTION SPECIFICATION FOR PIPE SEWER CONSTRUCTION BY OPEN CUT METHOD

OPSS 410.07.01.12 is amended by the addition of:

Where existing storm and sanitary sewers do not exist, the following shall apply:

The locations of all proposed service connections shown on the contract plans are schematic only. Service connections shall be installed to the property line at the specific location requested by the individual property owner. In the event that the property owner fails to specify a specific location, the service connection shall be installed at a location specified by the Commissioner, this is usually being at the centre of the property.

Storm and sanitary service connections in a common trench shall be installed in accordance with the following, in order that they may be accurately identified at the property line at a later date:

a) The sanitary connection shall be on the right hand side of the storm connection, while facing the property from the main sewer, with a clear horizontal distance of 250 mm between outside pipe walls.

b) The sanitary connection elevation shall be lower than the storm connection elevation with a clear minimum vertical distance of 100 mm between outside pipe walls.

c) Should the pipe material specified in the contract be locally available in white and non-white colours, the sanitary service connection shall be non-white in colour and the storm service connection shall be white in colour. Should the pipe material specified in the contract not be locally available in white and non-white colours, the end of the sanitary service connection pipe shall be spray painted with a non-white colour, and the end of storm service connection shall be spray painted white.

OPSS 410.07.01.16.04 is amended by the addition of:

Exfiltration tests of gravity sewers will be required only when specified.

OPSS 410.09.01.01 is superseded by:

Measurement will be in metres horizontally over the centreline of the pipe when the grade of pipe is less than 10 % and in metres along the slope length of the pipe when the grade of the pipe is 10 % or greater.

Sewers will be paid for on a unit price basis per linear metre of sewer constructed, either single or dual sewer in trench as the case may be, and as stated in the Schedule of Unit Prices.

On storm and sanitary sewers in the same trench, measurements for payment will be made commencing from the outlet and measuring upstream along the storm sewer line, with all measurements being made from inside faces of exterior maintenance hole walls.

On storm and sanitary sewers in separate trenches, individual measurements for payment will be made on the storm sewer and on the sanitary sewer commencing from the outlet and measuring upstream along the sewer line, with all measurements being made from inside faces of exterior maintenance hole walls.

It is the intention of this specification that no payment will be made on the linear metre price bid for sewers for any pipe through any maintenance hole. All costs of any pipe between the inside faces of any maintenance holes are to be included in the lump sum price tendered for the maintenance hole.

Catch basin or ditch inlet leads shall be measured from the outside of the storm sewer at the point of connection to the inside face of the catch basin or ditch inlet at the point of connection.

CONSTRUCTION SPECIFICATION FOR PIPE SEWER CONSTRUCTION BY OPEN CUT METHOD

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410.01 SCOPE

This specification covers the requirements for constructing storm sewers, laterals, sanitary sewers and service connections in open cut.

410.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction:

OPSS 501 Compacting
OPSS 503 Site Preparation
OPSS 504 Preservation and Protection of Existing Facilities
OPSS 507 Restoration
OPSS 514 Trenching, Backfilling and Compaction
OPSS 517 Dewatering
OPSS 538 Shoring and Bracing

Ontario Provincial Standard Specifications, Material:

OPSS 1004 Aggregates - Miscellaneous
OPSS 1010 Aggregates - Granular A, B, M, and Select Subgrade Material
OPSS 1301 Portland Cement
OPSS 1350 Concrete (Materials and Production)
OPSS 1801 Corrugated Steel Pipe
OPSS 1820 Material Specification for Circular Concrete Pipe

Canadian Standards Association Standards:

A60.1-M1976 - Vitrified Clay Pipe
A60.3-M1976 - Vitrified Clay Pipe Joints

B137.3-M1986 - Rigid Poly(vinyl) Chloride (PVC) Pipe for Pressure Applications
B182.1-M1987 - Plastic Drain and Sewer Pipe and Pipe Fittings
B182.2-M1985 - Large Diameter, Type PSM PVC Sewer Pipe and Fittings
B182.3-M1983 - Large Diameter, Type IPS PVC Sewer Pipe and Fittings
B182.4-M1983 - Large Diameter Ribbed Poly(vinyl) chloride (P.V.C.) Sewer Pipe and Fittings

American Society for Testing and Materials Standards:

C 428-85 - Asbestos-Cement Nonpressure Sewer Pipe
C 507-M84- Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe
D 1869-78- Rubber Rings for Asbestos-Cement (1983) Pipe
D 2680-86- Acrylonitrile-Butadiene-Styrene (ABS) Composite Sewer Piping
D 1248-84- Specification for Polyethylene Plastic Molding and Extrusion Materials

Canadian General Standards Board Standards

41-GP-25M (October 1977) - Pipe, Polyethylene for the Transport of Liquids

410.03 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Backfill: means approved fill material used above cover material and below sub-grade, finished grade or original ground.

Bedding: means the material used to support the pipe.

Cover Material: means the material placed from the top of the bedding to the bottom of the backfill.

Native Material: means the material which was removed to form an excavation and which is no returned to the same excavation as backfill material.

Pipe Sewer: means an installation designed for the conveyance of sanitary sewage or storm

water using preformed or precast pipe sections, circular or non- circular in cross-section, laid end to end using suitable jointing material and connected by manholes for sanitary sewers and by manholes, catch basins; ditch inlets or other appurtenances for storm sewers.

Selected Native Material: means the material which was removed to form an excavation which is now accepted by the Engineer for return to the same excavation as backfill material.

Selected Native Site Material: means materia excavated on the project and accepted for use by the Engineer.

Spring Line: means a line horizontally bisecting the pipe.

Weakly Cemented Fill: means any combination of granular materials with low percentages of cement and/or other cementitious material such that the strength is in the order of 0.4 MPa at 28 days.

410.05 MATERIALS

410.05.01 General

Pipe size and class shall conform as shown in the Contract. Pipe material and size shall be selected in accordance with the terms of the Contract.

Fittings shall be suitable for and compatible with the class and type of pipe with which they will be used.

410.05.02 Corrugated Steel Pipe

Corrugated steel pipe, couplings and fittings shall be used for storm sewers only and shall conform to OPSS 1801.

410.05.03 Asbestos Cement Pipe Nonpressure

Asbestos cement pipe nonpressure and asbestos cement service connection pipe shall conform to ASTM C 428.

Joints shall conform to ASTM C 428 for couplings for sewer main pipe and couplings for service connection pipe. Rubber gaskets shall conform to ASTM D 1869.

On Storm Sewers it will be permissible to use polyethylene plastic couplings suitable in design and size for the pipe with which it is to be used, conforming to ASTM Designation D1248, Type 1 Class C Grade 5 Material, and finished to such dimensions as will provide tight joints when properly assembled.

Fittings shall conform to ASTM C 428.

410.05.04 Vitrified Clay Pipe

Vitrified clay pipe, fittings and service connection pipe shall conform to CSA Standard A60.1-M.

Joints shall conform to CSA A60.3-M for Type or 6 joints for sewer main pipe and Type 5 joints for service connection pipe.

410.05.05 Concrete Sewer Pipe

Circular concrete sewer pipes, and joints, shall conform to OPSS 1820.

Elliptical concrete sewer pipes and joints shall be used for storm sewers only and shall conform to ASTM C 507M.

410.05.06 Polyvinyl Chloride (PVC) Pipe

Polyvinyl chloride sewer main pipe and fittings shall conform to CSA B137.3, B182.2, B182.3, or B182.4 and shall have bell and spigot joints with rubber gaskets. Service connection pipe shall conform to CSA B182.1 and also have bell and spigot joints with rubber gaskets.

Pipe and fittings to be supplied by a plant certified by C.S.A.

410.05.07 Polyethylene (PE) Pipe

Polyethylene pipe and fittings shall conform to CGSB 41-GP-25M and shall either have bell and spigot push-on joints with rubber gaskets or thermal fused joints.

410.05.08 Acrylonitrile-Butadiene-Styrene (ABS) Composite Pipe

Acrylonitrile-Butadiene-Styrene (ABS) composite pipe and fittings shall conform to ASTM D 2680 and shall have solvent welded joints.

410.05.09 Acrylonitrile-Butadiene-Styrene (ABS) Pipe

Acrylonitrile-Butadiene-Styrene (ABS) service connection pipe shall conform to CSA B182.1 and shall either have bell and spigot push-on joints with rubber gaskets or solvent welded joints.

410.05.10 Pipe Bedding Materials

Granular Materials greater than 25 mm in size shall not be used for pipe bedding.

Bedding Material shall be as specified in the Contract.

Concrete bedding shall conform to OPSS 1350 with a nominal minimum 28 day strength of 15 MPa.

410.05.11 Cover Materials

Cover Materials greater than 25 mm in size shall not be used for cover.

Cover Material shall be as specified in the Contract, and where Native Material, Selected Native Material, and Selected Native Site Material is specified it shall be free from frozen lumps, cinders, ashes, refuse, vegetable or organic matter, rocks and boulders, or other deleterious materials.

410.05.12 Mortar

Mortar for joints shall be composed of one part normal Portland cement and two parts mortar sand wetted with only sufficient water to make the mixture plastic. The normal Portland Cement shall conform to of OPSS 1301 and the mortar sand shall conform to OPSS 1004.

410.07 CONSTRUCTION

410.07.01 Pipe Sewers and Service Connections

410.07.01.01 Site Preparation

When pipe sewer is to be installed beyond the limits of general grading operations, site preparation shall conform to OPSS 503.

410.07.01.02 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall conform to OPSS 504.

410.07.01.03 Protection Against Flotation

Damage to the pipeline due to hydrostatic pressure shall be prevented during construction and until completion of the works.

410.07.01.04 Cold Weather Work

All work shall be protected from freezing. Pipes and bedding materials shall not be installed on frozen ground.

410.07.01.05 Transporting, Unloading and Storing Pipe

Delivery, unloading and storage of pipes and fittings at the job site shall cause the least possible delay and hazard.

All pipes, specials, fittings and gaskets that are unsound or damaged shall be removed from the site and replaced.

Manufacturer's handling and storage recommendations shall be followed.

410.07.01.06 Dewatering

Dewatering shall conform to OPSS 517.

410.07.01.07 Trenching, Backfilling and Compacting

Trenching, backfilling and compacting shall conform to OPSS 514.

410.07.01.08 Shoring and Bracing

Shoring and bracing shall conform to OPSS 538.

410.07.01.09 Pipe Bedding

410.07.01.09.01 Placing Bedding

Bedding material shall be placed as shown in the Contract. The bedding shall be shaped true to line and grade, free from sags and high points. Where applicable bell holes shall be excavated.

Where concrete or weakly cemented fill bedding is specified, the pipe shall be supported on grade and aligned by solid concrete blocks having the same minimum compressive strength as the specified bedding, spaced so that no movement of the pipe occurs during concrete or weakly cemented fill placing.

If necessary, concrete bedding may be placed in two pours. The level of the first pour shall not be higher than 75 mm below the bottom of the pipe. The first pour shall be cured a minimum of 24 hours before the second pour is started.

A bond breaking agent shall be placed between the concrete bedding and any sheathing in a trench.

Granular bedding shall be uniformly compacted in layers not exceeding 200 mm in thickness. In the case of pipe arches granular bedding shall be compacted to 100% of maximum dry density or as shown in the Contract.

At pipe joints, bedding materials shall be left clear of the joints to permit their completion as specified elsewhere. After the connection has been completed, approved bedding material shall be placed under the joint and thoroughly tamped to the compaction specified. Bedding material shall not be taken from completed portions of the trench for this purpose.

410.07.01.09.02 Placing Cover Material

A 300 mm layer of cover material shall be provided above the pipe before using a mechanical compactor on top of the pipe. Power operated tractors or rolling equipment shall not be used.

However, cover materials shall be placed in uniform layers not exceeding 200 mm in thickness. Compaction shall conform to OPSS 501 with a minimum density of 95% of the maximum dry minimum density.

410.07.01.10 Installation of Pipes

410.07.01.10.01 General

Pipes shall be handled with special care during temperatures below freezing. Pipes shall not be exposed to localized high temperatures.

Pipe shall be lowered into the trench carefully.

Ends of pipe shall be kept clean.

Laying shall commence at the outlet end and proceed in the upstream direction with the socket ends of the pipe facing upgrade. Pipe shall be laid on the prepared bed, true to the line and grade as shown on the Contract Drawings. The barrel of each pipe shall be in contact with the shaped bed throughout its full length. The ends of the pipe shall be joined so that there is no unevenness along the inside.

Pipe shall be kept clean as work progresses. Water shall not be allowed to flow through the pipe during construction. The trench shall b kept dry and pipe shall not be laid in water. A removable watertight bulkhead shall be installed at the open end of the last pipe laid whenever work is suspended.

Pipe shall not be laid until the preceding pipe joint has been completed and the pipe is carefully embedded and secured in place.

The Authority may alter the elevation of the invert prior to installation of the pipe by 150 mm ± and any change within this limit shall not constitute a change in character of the work and no adjustment will be made to the payment as set forth in this specification.

410.07.01.10.02 Corrugated Steel Pipe

Rivetted corrugated steel pipe shall be laid with the inside circumferential laps pointing in the direction of the flow. The longitudinal laps shall be located in the upper half of the pipe. Helical corrugated steel pipe shall be installed so that the helix angle is constant for the total length of the installation and each pipe section shall be installed next to the previous section such that the lock seam forms a continuous helix.

Where paved invert pipe is to be installed, the paved portion of the pipe shall be carefully centred on the bottom throughout the length of the installation.

Corrugated steel pipe sections shall be jointed together by means of steel couplers supplied by

the pipe manufacturer. The couplers shall be installed to lap approximately equal portions of the pipe being connected and such that the corrugations or projections of the coupler properly engage the pipe corrugations. As the coupler is being tightened, it shall be tapped with a mallet to take up the slack. On bituminous coated pipe, the contacting surfaces of the coupler and pipe shall be lubricated with fuel oil, or a similar solvent, prior to tightening the coupler.

When specified, joint seals shall be installed immediately prior to installation of steel couplers.

Structural plate pipe may be assembled in the trench or at the side of the excavation. If the assembled structure has to be moved to its final position, it shall be moved in such a manner that no damage or distortion is caused to the structure.

When the structural plate pipe has been placed to the specified alignment and grade, all assembly bolts shall be retightened with a torque wrench to a minimum of -

a. 200 N ° m for 3.5 mm and 3.0 mm pipe;

b. 340 N ° m for heavier than 3.5 mm pipe.

410.07.01.11 Jointing

410.07.01.11.01 General

Joint surfaces shall be clean. Pipe ends and gaskets shall be lubricated with material recommended by the pipe manufacturer.

Manufacturer's instructions for jointing pipes shall be followed.

Pipes shall be kept parallel to previously laid pipe. Pipes shall be slung only at their centre.

Pipe shall be pulled or pushed only by hand or power operated winch. A backhoe shall not be used for pushing pipe.

Joints shall be prevented from opening after the pipe has been laid.

410.07.01.11.02 Jointing Asbestos Cement Pipe

The rubber ring shall be inserted and properly seated in the coupling groove. The entire circumference of the spigot shall be lubricated back to the stop shoulder.

The coupling shall be installed on the forward end of the pipe to be laid.

The pipe ends shall be aligned and the pipe shall be inserted into the coupling of the pipe already in place. The pipe shall be pulled or pushed "home" by bar, block assembly, lever or friction type puller assembly.

The position of the rubber ring shall be checked by using an approved feeler gauge all around the pipe. If the ring has been displaced, the coupling shall be removed and the rubber ring shall be corrected. All damaged rubber rings shall be replaced.

410.07.01.11.03 Jointing Vitrified Clay Pipe

Type 2 Joint - The spigot end shall be lubricated. The spigot shall be inserted firmly into the PVC collar. The pipe shall be pushed "home" using a pry bar or pipe puller.

Type 5 Joint - Pipe ends shall be lubricated for a distance at least equal to half the sleeve width. The sleeve/ring combination shall be pushed onto the lubricated pipe until it contacts the stop ring. The first pipe shall be laid with the spigot pointing upgrade. The next pipe shall be prepared as set out above in this paragraph. The pipe shall be entered into the sleeve of

the previously laid pipe until it contacts the stop ring.

Type 6 Joint - The O-ring shall be positioned in the groove of the spigot. The tension in the gasket shall be equalized. The spigot an the O-ring shall be lubricated. The spigot shall be entered firmly into the sleeve. The pipe shall be pushed "home" using a pry-bar and block assembly.

410.07.01.11.04 Jointing Circular Concrete Pipe

The gasket shall be positioned on the spigot of the pipe as follows:

Roll-On Gasket - the gasket shall be positioned at the end of the spigot. Lubrication shall not be used.

Single Offset Gasket - the gasket shall be positioned against the support shoulder with the fin(s) pointing away from the spigot. Tension in the gasket shall be equalized. The top of the gasket and the inside of the bell shall be lubricated.

Confined "O" Ring Gasket - after lubricating the groove the gasket shall be positioned in the groove. Tension in the gasket shall be equalized. The gasket and the inside of the bell shall be lubricated.

The pipe ends shall be aligned and the gasketed spigot shall be entered straight into the bell of the receiving pipe.

The spigot shall be pushed or pulled "home" by applying pressure evenly and slowly straight-on- down the centreline of the pipe.

Jointing pressure shall be maintained until cover material is placed and compacted sufficiently to prevent joints from opening.

410.07.01.11.05 Jointing Polyvinyl Chloride (PVC) Pipe

If gaskets are supplied separately, they shall be inserted in the groove of the bell end of the pipe.

The spigot shall be lubricated. The spigot end shall be inserted and pushed into the bell up to but not beyond the depth of the stop reference mark.

410.07.01.11.06 Jointing Polyethylene (PE) Pipe

Push-on joint - The neoprene "O" ring gasket shall be inserted in the groove of the spigot end. The bell of the previously laid pipe shall be lubricated. The spigot shall be aligned with the bell of the previous laid pipe so that the gasket is in contact with the flared bell surface around the entire circumference. The pipe shall be pushed "home" by bar and block or manual come-alongs The spigot shall be pushed into the bell up to but not beyond the circumferential depth mark.

Thermal Fusion Joint - Procedures recommended by the pipe manufacturer shall be followed.

410.07.01.11.07 Jointing Acrylonitrile-Butadiene-Styrene (ABS) Composite Pipe

Primer shall be applied on the spigot and inside the bell using a mop, brush or rag.

Primer shall not be poured on. Immediately following the application of the primer, cement shall be applied on the spigot and inside the bell using the same procedure as with the primer.

The spigot end shall be inserted into the bell end of the pipe already in place, twisted to manufacture's specifications and pushed into the "home" mark using a block and bar where

necessary. Excess cement shall be wiped off the pipe.

410.07.01.11.08 Jointing Acrylonitrile - Butadiene-Styrene (ABS) Pipe

Bell and Spigot Joint - The gasket shall be inserted in the groove in the bell end of the pipe if the gasket is supplied separately. The spigot shall be lubricated. The spigot end shall be inserted into the bell end of the pipe already in place and pushed into but not beyond the "home" mark.

Solvent Welded Joint - Primer shall be applied on the spigot and inside the bell using a mop brush or rag. Primer shall not be poured on. Immediately following the application of the primer, cement shall be applied on the spigot and inside the bell using the same procedure as with the primer. The spigot end shall be inserted into the bell end of the pipe already in place, twisted to manufacturers specifications and pushed into the "home" mark using a block and bar where necessary. Excess cement shall be wiped off the pipe.

410.07.01.12 Service Connections

Service connections shall be installed from the main sewer to the property line at locations indicated on the Contract Drawings or as directed by the Engineer.

Service connections to the main sewer shall be made using factory made tees or wyes strap-on-saddles or other approved saddles. Factory made tees or wyes shall be used for all service connections where the diameter of the main sewer is less than 450 mm or less than twice the diameter of the service connection.

Strap-on-saddles shall be installed before laying the pipe.

Holes in the main sewer shall be cut with approved cutters and shall be the minimum diameter required to accept the service connection saddle. If mortar- on saddles are used, the inside of the pipe shall be mortared at the connection.

Service connections shall be plugged at the property line with watertight caps or plugs. Plugs or caps shall be braced sufficiently to withstand test pressures.

410.07.01.13 Marking and Recording Service Connections

A painted temporary location marker consisting of a 50 mm x 75 mm stake or two short sections of lumber connected by a piece of heavy gauge wire shall be placed at the end of the plugged or capped service connection. The marker shall be placed from 300 mm below the finished grade to a point 300 mm above the plugged end of the service pipe.

A painted surface stake 50 mm x 75 mm x 450 mm long shall be placed after trench restoration.

Service connections shall not be backfilled until they have been inspected and measurements of location have been taken by the Engineer.

410.07.01.14 Connection to Existing Structures, Sewers and Service Connections

Where existing sewers and service connections are to be connected to sewers and service connections constructed under this contract proper jointing procedures shall be used.

Where a pipeline is to be connected into existing manholes, catch basins or ditch inlets, neat openings of the size necessary to accommodate the pipeline shall be made in the walls of the manholes, catch basins or ditch inlets, and the pipeline shall be securely an neatly grouted in place with non-shrink grout. The end of the pipeline shall be flush with the inside of the structure wall. Benching in existing manholes shall be altered to accommodate the flow in the new pipeline.

410.07.01.15 Restoration

When pipe sewer is installed beyond the limit of general grading operations, restoration shall conform to OPSS 507.

410.07.01.16 Quality Control - Sanitary Sewers

410.07.01.16.01 General

The field tests described in this subsection shall be performed in the presence of the Engineer. Leakage tests shall be carried out on completed sewers 1200 mm in diameter and smaller. There shall be no visible leakage for sewers larger than 1200 mm diameter.

Testing shall be performed using methods, materials and equipment satisfactory to the Engineer. Testing shall be carried out from manhole to manhole, including house service connections, as work progresses.

The construction of new mainline sewers shall not be proceeded with when three sections of the sewer installed by a crew have not been tested or have been tested and are unsatisfactory.

Leakage up to 25% in excess of the calculated limits will be approved in any test section provided that the excess is off-set by lower leakage measurements in adjacent sections such that the total leakage is within the allowable for the combines sections.

Sewer lines shall be repaired and retested as required until the test results are within the limits specified. Visible leaks shall be repaired regardless of the test results.

No part of the work will be accepted until the sewers are satisfactorily tested following completion of installation of service connections and backfilling.

410.07.01.16.02 Prequalification Leakage Tests

Prequalification leakage tests shall be carried out as either infiltration or exfiltration tests as required.

The test shall be performed on the first section of the sewer of each size, not less than 100 m in length, installed by each crew in order to prequalify the crew and material. Tests may be carried out prior to service connections being installed in the section being tested.

When tests are unsatisfactory, the test section shall be repaired and retested until satisfactory results are obtained.

410.07.01.16.03 Infiltration Test

Infiltration tests shall be conducted where the ground water level at the time of testing is 600 mm or more above the crown of the pipe of the highest service connection included in the section of sewer under test.

A watertight plug shall be installed at the upstream end of the test section.

Dewatering operations shall be discontinued for at least three days before the test.

The flow shall be allowed to stabilize and the rate of flow shall be measured.

The infiltration rate shall not exceed the maximum allowable infiltration calculated for the test section.

The allowable infiltration is 0.075 litres per millimetre diameter per 100 metres of sewer per hour.

410.07.01.16.04 Exfiltration Test

Exfiltration tests shall be conducted where the ground water table is lower than 600 mm above the crown of the pipe or the highest point of the highest service connection included in the test section.

The section of the sewer to be tested shall be isolated by temporarily plugging the downstream end and all incoming pipes of the upstream manhole.

The test section shall be slowly filled with water making sure that all air is removed fro the line. A period of 24 hours for absorption shall be allowed before starting the test except if exfiltration requirements are met b a test carried out during the absorption period.

Water shall be added to the pipeline prior to testing until there is a head of 600 mm over the crown of the pipe or, if required by the Engineer, 600 mm above the highest point of the highest service connection in the test section. The maximum limit of the net internal head on the line is 8 m. In calculating net internal head, allowance for ground water head, if any, shall be made.

The distance from the frame to the surface of the water shall be measured. After allowing the water to stand for one hour, the distance from the frame to the surface of the water shall again be measured. The leakage shall be calculated using volumes.

The leakage at the end of the test period shall not exceed the maximum allowable calculated for the test section.

The allowable leakage is 0.075 litres per millimetre diameter per 100 metres of sewer per hour. An allowance of 3.0 litres per hour per metre of head above the invert for each manhole included in the test section shall be made.

Manholes shall be tested separately if the test section fails.

410.07.01.16.05 Deflection Testing of Sewers

Ring deflection testing shall be performed on all sewers constructed using plastic pipe or ABS composite pipe.

A suitably designed device as defined below shall be pulled through the sewer to demonstrate that the pipe deflection does not exceed (0.15 DR)% of the base inside diameter of the pipe as defined in the CSA standard to which the pipe is made. The device shall be pulled manually through the pipe not sooner than 30 days after the completion of back filling and installation of service connections. For Acrylonitrile-Butadiene-Styrene (ABS) Composite Pipe, the device shall be 97% of the internal diameter of the pipe.

The suitably designed device shall be a mandrel, cylindrical in shape, and constructed with an odd number of evenly spaced arms or prongs (a minimum of 9 in number). The minimum diameter of the circle scribed around the outside of the mandrel arms shall be equal of the allowable computed deflected diameter 1.0 mm. The contact length (L) of the mandrel shall be measured between the points of contact on the mandrel arm or between sets of prongs. This length shall not be less than that shown in the following table:

Nominal Pipe Size (NPS)	L 9 (mm)
6	100
8	150
10	200

12	250
14	300
15	300
16	300
18	350
20	400
21	450
24	500
27	575

The mandrel shall be checked with a go-no-go proving ring. The proving ring shall have a diameter equal to the computed deflected diameter 0.1 mm. An acceptable mandrel shall not pass through the proving ring. The proving ring shall be fabricated from 6 mm minimum thick steel.

Any section of pipe that does not allow the mandrel to pass shall be considered to have failed the deflection test.

All sections of pipe that fail the deflection test shall be repaired and retested.

410.07.01.16.06 Low Pressure Air Testing

The Engineer may allow or require testing by use of air where water is not readily available, or the differential head in the test section is greater than 8 m, or freezing temperatures exist.

Air control equipment that includes a shut of valve, safety valve, pressure regulating valve, pressure reduction valve and monitoring pressure gauge with pressure range from 0 to 35 kPa with minimum divisions of 0.5 kPa and accuracy of approximately 0.25 kPa shall be provided.

Tests shall be conducted between two consecutive manholes. The test section shall be plugged at each end. One plug shall be equipped with an air inlet connection to fill the pipeline with air.

The test section shall be filled slowly until a constant pressure of 24 kPa is maintained. If the ground water is above the sewer being tested, the air pressure shall be increased by 3.0 kPa for each 300 mm that the ground water level is above the invert of the pipe.

The air pressure shall be stabilized for five minutes and then regulated to maintain it to 20.5 kPa plus the allowance for ground water, if any. After the stabilization period, the time taken for a pressure loss of 3.5 kPa shall be recorded.

The time taken for a pressure drop of 3.5 kPa shall not be less than the following limits:

Pipe Size (mm)	Minimum Time (Min.:Sec.)	Length for Minimum Time (metres)	Time for Longer length (secs.)
100	01:53	182	0.623 L
150	02:50	121	1.401 L
200	03:47	91	2.493 L
250	04:43	73	3.893 L
300	05:40	61	5.606 L
375	07:05	48	8.761 L
450	08:30	41	12.615 L

525		09:55		35		17.171 L
600		11:20		30		22.425 L
675		12:45		27		28.382 L
750		14:10		24		35.040 L
825		15:35		22		42.397 L
900		17:00		20		50.450 L

L is length of test section in metres.

If the length of the test section is greater than the Length for Minimum Time, the new time shall be calculated using the formula for Time for Longer Length.

If the results of an air test are marginal, the Engineer may require the section to be retested using water.

410.07.01.17 Cleaning and Flushing Pipe Sewers

All sewers shall be cleaned and flushed just prior to inspection and acceptance

410.09 MEASUREMENT FOR PAYMENT

410.09.01 Actual Measurement

410.09.01.01 Pipe Sewers

Measurement will be in metres horizontally over the centreline of the pipe when the grade of the pipe is less than 10% and in metres along the slope length of the pipe when the grade of the pipe is 10% or greater.

Measurement will be from centre to centre of manholes, catch basins, ditch inlets or from centre of manholes, catch basins, ditch inlet to the end of the pipe where no manhole, catch basin or ditch inlet is installed under this contract.

410.09.01.02 Service Connections

Measurement will be horizontally from the centreline of the main sewer to the end of the service connections.

410.09.02 Plan Quantity Measurement

410.09.02.01 Pipe Sewers

Measurement is by Plan Quantity, as may be revised by adjusted Plan Quantity in metres horizontally over the centreline of pipe when the grade of the pipe is less than 10% and in metres along the slope length of the pipe when the grade of the pipe is 10% or greater.

Measurement will be from centre to centre of manholes, catch basins, ditch inlets or from centre of manholes, catch basins, ditch inlet to the end of the pipe where no manhole, catch basin or ditch inlet is installed under this contract.

410.09.02.02 Service Connections

Measurement is by Plan Quantity as may be revised by adjusted Plan Quantity, horizontally from the centre line of the main sewer to the end of the service connections.

410.10 BASIS OF PAYMENT

410.10.01 Pipe Sewers - Item
Service Connections - Item

Payment at the contract price for the above item(s) shall be full compensation for all labour, equipment and materials to do the work.

Partial payment will be made for installed but untested or unsatisfactorily tested sewers. The portion of the unit price not paid will not be limited to the estimated cost of carrying out the testing. Factors such as soil conditions, quality of workmanship, depth of sewer and the estimated cost of carrying out repairs and making good all related damage will be taken into account.