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.1 Scope

1.1 General

This Specification covers the selection and installation requirements for various types of sewer pipe used in the City of Hamilton. All materials used for the construction and/or repair of sewers and laterals shall be selected from the latest Approved Product List (as published in The Roadway Authority).

1.2 Work Included

The Contractor shall, unless specified otherwise, supply all equipment, tools, and labour necessary to do the Work; this includes, load/unload, haul and provide all pipe sections, fittings, valves, maintenance holes, and related accessories. The Contractor shall also remove the pavement as stipulated, excavate the trenches and/or pits to the required dimensions, excavate, construct and maintain traffic safety controls including sheets/piles, braces and/or other supports to existing ground infrastructure where necessary. The Contractor is to provide proper surface and ground water drainage in the vicinity of the Work, which must provide and maintain the proper use of barricades, guards and warning lights where required. The Contractor is to lay and test the pipe, fittings, valves, and accessories including, the backfill and consolidation of trenches and pits; restore roadway surface, remove, and dispose of surplus excavated materials as stipulated. Moreover, the Contractor is to ensure the worksite is safe from tripping hazards, this includes all adjacent surfaces where the Work is being carried out.

.2 Responsibility of Materials

2.01 Material Furnished by the Contractor

All sewer materials furnished by the Contractor shall be new. Reuse of sewer pipe, components and appurtenances not permitted.

Unless otherwise noted in the Contract Documents, the Contractor shall supply all materials required to complete the Works. This will include but is not limited to:

- a) The proposed sewer pipe(s) complete with all connections, fittings, special appurtenances, thrust blocks, anchor blocks, tee's, bends, sleeves, and all lowering in accordance with the elevations and grades shown on the Contract Drawings.
- b) Workmanship and Material Quality Assurance: Testing procedures such as sewer pipe deflection of pipe including leakage testing shall be supplied by the Contractor as per in accordance with latest revision of OPSS.MUNI 410 & OPSS.MUNI 411 and as noted in the Contract Specifications.
- c) The Contractor shall be responsible for all material furnished by them and shall replace all such material found defective through their own manufacture and/or where damages occur while handling and/or during its delivery. This shall include the furnishing of all material and labour required for the replacement of installed material discovered defective prior to the final acceptance of the Work.

d) In addition to Form 200.04.06, all materials supplied by the Contractor shall be in accordance with the applicable current Approved Products List or Contract Specifications. Any material used that is not approved or not appropriate shall be removed and replaced by the Contractor at no cost to the City.

2.02 Safe Storage

The Contractor shall be responsible for the safe storage of material supplied by/to them and/or accepted by them, which is intended for the Work during its construction and/or prior its final acceptance by the Project Manager. All pipes, fittings and other accessories shall be kept free from dirt and foreign matter at all times. Valves and/or nodes shall be drained and stored in a manner that will protect them from damage and freezing.

2.03 Replacement of Damaged Material

Any material furnished by the City that becomes damaged after acceptance by the Contractor shall be replaced by the Contractor.

2.04 Removal of Defective Materials

Prior to acceptance of responsibility for safe storage by the Contractor, any material furnished by the City found to be defective shall be set aside and removed from the site or the Work by the City. All other defective materials furnished by the Contractor, shall be removed promptly from the site.

.3 Handling of Materials

3.01 Loading and Unloading

All pipe fittings, pipe, valves, maintenance holes' sections, and accessories shall be loaded and unloaded by lifting with hoists or skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped. Pipe handled on skidways shall not be skidded or rolled against pipe already on the ground.

3.02 Safe Storage

All pipe and appurtenances that are delivered and stored onsite must be done in a safe manner where it does not block or prevent access and egress of general pedestrians and roadway traffic.

.4 Approved Materials

4.01 General Standards

All sewer pipe, fittings and other materials shall be as listed on the Approved Products List, as amended. Materials shall meet the current version of the applicable standards, including but not limited to CAN/CSA, AWWA, ASTM, OCPA, and OPSS.

Pipe materials used for repairs or for minor modifications shall be compatible with the materials being worked on; these are to be selected from the Approved Products List.

For example: Acceptable pipe materials are concrete and polyvinyl chloride. High density polyethylene pipe (HDPE) is acceptable in project specific applications only.

4.02 OPSS Standards

OPSS.MUNI 410 pipe)	Pipe Sewer Installation in Open Cut (i.e.: Concrete
OPSS.MUNI 411	Specification for Clean/Flushing of Sewers, etc.
OPSS.MUNI 1820	Specification for Circular/Elliptical Concrete Pipe
OPSS.MUNI 1840	Specification for Non-Pressure PE Pipe Products
OPSS.MUNI 1841	Specification for Non-Pressure PVC Pipe
OPSS.MUNI 491	Specification for the Preservation/Protection of Facilities

The following table (TABLE 500-1) is a summary of the acceptable sewer pipe materials. This chart is for information purposes only and the use of any pipe material is subject to approval by the City prior to installation.

.5 Concrete Pipe

05.01 General

This section covers the requirements for the installation of storm and sanitary sewers, laterals, service connections, and concrete appurtenances in open cut trenches.

05.02 Standards and Specifications

All materials used for the construction of sewers and laterals shall be as noted in the Approved Product List for City of Hamilton (Refer to: The Roadway Authority website).

Concrete pipe materials used in sewer construction are to be supplied in accordance with OPSS.MUNI 1820; installed as per OPSS.MUNI 410 & be kept in be serviced as per OPSS.MUNI 411.

Pipe materials must be from a plant listed as certified under the Canadian Precast/Prestressed Concrete Quality Assurance Certification Program (CPCQA).

Pipe manufacturers shall provide the City all reasonable access that allows its representative(s) to verify that the pipe conforms to the City's specification. The pipe manufacturer shall also provide the required test specimens, labour and testing equipment to demonstrate that the proposed pipe materials meet the specification.

Costs for the verification of the above, including required testing of materials shall be at the expense of the pipe supplier and/or manufacturer.

05.03 Classes and Uses of Concrete Pipe

OPSS.MUNI 410 & OPSS.MUNI 1820 as amended by the following:
The classes of concrete pipe specified for various construction applications are outlined as follows:

- a) Reinforced Concrete Pipe:
ASTM Designation C-76, Class III, or CSA A257.2, 65-D
- b) Reinforced Concrete Pipe:
ASTM Designation C-76, Class IV, or CSA A257.2, 100-D
- c) Reinforced Concrete Pipe:
ASTM Designation C-76, Class V, or CSA A257.2, 140-D

Reinforced concrete pipe shall be used for the construction of storm sewers, manhole channels, and inlet chamber drains which require pipe with an internal diameter of 300mm and larger and meet CSA A257.2, 65-D, 100-D, 140-D. Non-reinforced Concrete Pipe shall meet CSA A257.1. Pipe joints and gaskets will be according to CAN/CSA A257.

05.04 Sulphate Resistant Portland Cement

Portland cement used in the manufacture of concrete pipe shall be Type HS High Sulphate Resistant and meet the requirements of OPSS.MUNI 1301 (Materials Specification for Cementing Materials). The type of cementing materials used shall be marked on each pipe in accordance with OPSS.MUNI 1301.

.06 Polyvinyl Chloride Pipe (PVC)

06.01 General

This specification covers the requirements for the use of non-pressure polyvinyl chloride (PVC) plastic pipe materials/products for sanitary and storm sewers, service connections, and pipe culverts.

06.02 Standards and Certification

All supplied PVC pipe materials shall meet OPSS 1841 and be in accordance with CAN/CSA-B1800 (CSA B182.2).

PVC SDR 35/28 pipe and are compliant with ASTM D3034 or ASTM F1760 and it must be third-party certified to CSA B182.2. Pipe having an SDR18 for use in sewer applications must be compliant with ASTM F1336.

06.03 Classes and Uses of PVC Pipe

The Standard Dimension Ratio (SDR) is the ratio of the average pipe diameter to the minimum wall thickness. The specified SDR values for main sewers and private drain laterals are as follows:

- a) SDR 35 for main sewer installations with a pipe diameter of 200mm up to and including 600mm.
- b) SDR 28 for private drains and laterals (150mm pipe diameter).

SDR18 compliant to ASTM F1336. The use of this pipe must be previously approved by the Project Manager. Used in areas where the risk of installation is deemed to be higher than normal; for example, sewers pipes to be installed adjacent to critical infrastructure crossings (i.e. ex. Watermains/other types of Forcemains), lift stations, pump stations and where pressure surges and/or transients may occur.

06.04 Material Inspection and Testing

Testing of PVC pipe products shall be according to the appropriate standard for which the product was produced. Pipe manufacturers shall provide the City's representative to verify that the pipe conforms to the City's Specification. Pipe suppliers/manufacturers shall provide the required test specimens, labour, and testing equipment in order to demonstrate that the quality of the

product meets or exceeds the industry standards.

The City reserves the right to make inspections and tests at such times as the Project Manager considers it necessary to ensure that all materials supplied are in accordance with the appropriate Specification. Any material(s) failing to comply with the requirements under the specification shall be rejected. The costs of all testing under this clause shall be at the expense of the pipe supplier and/or manufacturer.

06.05 Joints and Fittings

Sealing gaskets must meet the requirements of ASTM D3034 or ASTM F679, CAN/CSA-B1800 (CSA B182.2). In addition, the pipe joints must be able to withstand a minimum hydrostatic pressure of 345 kPa (50 psi) without leakage.

All fittings to be injection-molded gasketed PVC fittings to meet ASTM 3034 & ASTM F1336 as per CAN/CSA-B1800 (CSA B182.1). Fabricated fittings must conform to ASTM F1336 and CAN/CSA-B1800 (CSA B182.2). As a method of field verification, all fittings brought to the site must be labelled and/or be stamped from the manufacturing facility.

06.06 Pipe stiffness, negative air (vacuum) test and hydrostatic tolerance

Stiffness test methods must be as per ASTM D3034 and ASTM F679. The pipe stiffness shall be determined at 5 % deflection according to ASTM D2412.

The pipe stiffness shall meet 320 kPa (46 psi) requirements for SDR35 pipe and 625 kPa (90 psi) for SDR 28.

Joint assemblies shall be subjected to an internal vacuum of 74 kPa for 10 minutes without leakage.

.07 High Density Polyethylene (HDPE) Pipe

07.01 General

This Specification covers the requirements for pressure HDPE sewer pipe products. Contract Specific: Contractors may use this product under specific contractual guidelines. HDPE may be used where the use of rigid pipe systems is not suitable for their intended operation.

07.02 Standards and Specifications

For High Density Polyethylene (HDPE) sewer pipe materials, there are to be installed in accordance with OPSS.MUNI 412, Specification F714, Specification D3035, AWWA C906 and as amended in the Contract Specifications.

The requirements for the production of polyethylene pipe fittings shall be according to AWWA C906 (100 mm through 1600 mm diameter)

.08 Polyethylene (PE) Pipe (Storm use only)

08.01 General

This Specification covers the requirements for Dual Wall PE pipe systems (200mm to >900mm).

08.02 Standards and Specifications

PE pipe materials must be compliant with OPSS 1840 and be manufactured in accordance with AASHTO M252, AASHTO M294 or ASTM F2306, and having a minimum 320 KPa Pipe Stiffness. The use of this product is exclusive to storm/open drainage installations such as culverts on rural driveways and for channeled/closed-bottom roadway crossings.

.09 Vitrified (VC) Clay Pipe

09.01 General

This Specification covers the material requirements for VC pipe to be used for the conveyance of storm water, sewage, and industrial waste.

09.02 Standards and Specifications

VC pipe and fittings shall be extra strength and shall conform to the requirements of ASTM C-700 "Specifications for Extra Strength Vitrified Clay Pipe. Compression joint and fittings must comply with ASTM C425. The supplied pipe shall be of the best quality, vitrified, homogeneous in structure, free from cracks or other imperfections and must give a clear metallic ring when struck with a hammer.

09.03 Classes and Uses of VC Pipe

Extra strength - VC Pipe shall be used for the construction of the following installations:

- a) Storm sewers, sanitary sewers, and manhole channels up to and including pipe with an internal diameter of 250mm.

- b) Inlet chamber drains up to and including pipe with an internal diameter of 250mm, and inlet chamber drain risers up to and including pipe with an internal diameter of 250mm.
- c) Private sanitary drains and private sanitary drain risers for pipe with an internal diameter up to and including 250mm.
- d) Catch basin drains, catch basin drain risers, and manhole drop pipes for pipe up to and including an internal diameter of 250mm

09.04 Inspection and Testing

All VC Pipe shall be subject to the Bearing Strength Tests and hydrostatic pressure tests described in ASTM C-301. The City may select and test (at random) one length of pipe section for each 200m delivered to the project site. All fittings must conform to ASTM C-301. Stoppers shall be capable (while unbraced) to hold up to five (5) psi of air pressure. Built-in compression/flexible joints for VC Pipe and fittings must comply to ASTM C425. All pipe joints must provide a tight seal and be compatible with the size requirements of the host pipe/fittings.

.10 Excavation and Preparation of Trench

10.01 General

Bedding and backfill shall be conducted in accordance with the depths and widths specified on the standard drawings and/or on the Contract Drawings. OPSS.MUNI 401.07.10 is revised by the following:

10.02 Bedding

Bedding shall be Granular 'A' material conforming to Form 600, placed in accordance with SEW-300, SEW-301 and SEW-302. Granular 'A' bedding material shall extend to a minimum of 300mm above the top of pipe. Granular 'A' bedding material shall be compacted in accordance with Form 900. Bedding shall be shaped and compacted adequately to support pipe barrel and bells as required.

10.03 Backfill

Unless otherwise specified on the Contract Drawings or documents, trenches may be backfilled with select, approved native excavated earth materials from trenches. Where these materials are unavailable or deemed to be unsuitable, granular backfill shall be used. Where Granular backfill is used, it shall be Granular "A" or "B" Type II, shall conform to Form 600 and shall be compacted in accordance with Form 900.

The use of unshrinkable fill shall be employed where normal means cannot produce the required compaction of the material.

.11 Maintenance Holes

11.01 Drop Structures

A drop pipe shall be provided for a sewer entering a manhole at an elevation of 610 mm (24 in) or more above the manhole invert. Where the difference in elevation between the incoming sewer and the manhole invert is less than 610 mm (24 in), the invert shall be filleted or benched to prevent solids deposition. Drop manholes shall be constructed with an external drop connection. Internal drop connections are not permitted.

The entire outside drop connection shall be encased in concrete due to the unequal earth pressures that would result from the backfilling operation in the vicinity of the manhole.

.12 Sewer Laterals/Connections

12.01 Service Connections

Service connections for all new sewer mains must be made using factory made tees or wyes, or other previously approved appurtenance.

For repairs to existing sewer mains, factory made tees or wyes must be used for all service connections where the diameter of the main pipe sewer is less or equal than twice the diameter of the service connection. Where this is not the case, lateral connections to existing sewer mains must then be cored, and the size of the connection must meet the minimum diameter requirement of the service connection saddle.

All service connections installed for future use shall be kept plugged at the property line with watertight caps or plugs until the final connection are made. Plugs or caps must be braced and be able to withstand the hydrostatic and/or the air test as per this Form.

Where in row sanitary laterals are to be installed on any section of a sewer main, wye connections must be used at the main.

.13 Inspection and Testing

13.01 Initial and Final Inspections

The City is to carry out an initial inspection prior to acceptance of the Works, includes but is not limited to, mandrel testing, infiltration/exfiltration and water or low air pressure testing in accordance with the materials' industry Specifications.

A final visual inspection of the Works shall be completed; any deficiencies found are to be corrected prior to the expiration of the Guaranteed Maintenance Period. A CCTV inspection shall be conducted. In addition, a mandrel test shall be performed by the Contractor on all PVC sewers (sanitary and storm) in accordance the mandrel deflection testing. Additionally, a thorough inspection of all sewers appurtenances such maintenance holes and catch basins, ladder rungs, safety grates and platforms, benching and parging, and final adjustments.

13.02 Testing (General Provisions)

Leakage tests shall be carried out on completed pipe sewers 1,200 mm in diameter and smaller. There shall be no visible leakage for pipe sewers larger than 1,200 mm diameter. Testing shall be carried out from maintenance hole to maintenance hole, including house service connections as Work progresses.

Pipe sewers shall be repaired and retested, as required, until the test results are within the limits specified in this Specification. Visible leaks shall be repaired regardless of the test results.

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

13.03 Infiltration Test

As per OPSS 410.07.16.03, dewatering operations shall be discontinued at least three days prior to conducting the test and allow for the groundwater level to stabilize. Infiltration tests shall be conducted when the groundwater level at the time of testing is 600 mm or more above the crown of the pipe for the entire length of the test section. The test section is typically between adjacent maintenance holes.

A watertight bulkhead shall be constructed at the upstream end of the test section. All service laterals, stubs, and fittings shall be plugged or capped to prevent water entering at these locations. A V-notch weir or other suitable measuring device shall be installed at the downstream end of the test section. Infiltrating water shall be allowed to build up behind the weir until the flow through the V-notch has stabilized.

The rate of flow shall then be measured. The rate of flow shall not exceed the maximum allowable infiltration calculated for the test section. The allowable infiltration shall be calculated by the following:

$$\text{Allowable Infiltration} = \frac{0.075 \text{ L/mm diameter}}{100 \text{ m of pipe/hr}}$$

13.04 Exfiltration Test – Testing with Water or Air

As per 410.07.16.04, exfiltration tests shall be conducted when the groundwater level 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 test section is typically between adjacent maintenance holes. The test section of the pipe sewer shall be isolated by temporarily plugging the downstream end and all incoming pipes of the upstream maintenance hole. All service laterals, stubs, and fittings are plugged or capped to prevent water entering at these locations.

13.05 Hydrostatic Test

As per OPSS 410.07.16.04.02, the test section shall be slowly filled with water ensuring that all air is removed from the line. A period of 24 hours for absorption or expansion shall be allowed prior to starting the test, except if exfiltration requirements are met by a test carried out during the absorption period.

Water shall be added to the pipeline prior to testing until there is a head in the upstream maintenance hole of 600 mm minimum over the crown of the pipe or at least 600 mm above the existing groundwater level, whichever is greater. The maximum limit of the net internal head on the line is 8 m. In calculating the net internal head, allowance for groundwater head, if any, shall be made.

The distance from the maintenance hole 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 shall be calculated by the following:

$$\text{Allowable Infiltration} = \frac{0.075 \text{ L/mm diameter}}{100 \text{ m of pipe/hour}}$$

An allowance of 3.0 litres per hour per metre of head above the invert for each maintenance hole included in the test section shall be made.

Maintenance holes shall be tested separately if the test section fails.

13.06 Low pressure Air Test

As per OPSS 410.07.16.04.03, the Project Manager may approve pressure testing by use of air when water is not readily available or the differential head in the test section is greater than 8 m or when the test is obstructed by freezing temperatures.

Air control equipment that includes a shut off 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 maintenance holes. The test section shall be plugged at each end. One plug shall be equipped with an air inlet connection to fill the pipe sewer system with air.

The test section shall be filled slowly until a constant pressure of 24 kPa is maintained. If the groundwater is above the pipe sewer being tested, the air pressure shall be increased by 3.0 kPa for each 300 mm that the groundwater 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 groundwater, 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 times shown in Table 1. If the length of the test section is greater than the length for minimum time, the new testing time shall be a product of the length of test section multiplied by the time shown in **Table 1** for the appropriate size pipe.

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

13.07

Table 1: Exfiltration Test - Low Pressure Air Testing

Nominal Pipe Size (mm)	Minimum Time (min: sec)	Length for Minimum Time (min)	Time For Longer Length (sec)
100	1:53	182	0.623
150	2:50	121	1.140
200	3:47	91	2.493
250	4:43	73	3.893
300	5:40	61	5.606
375	7:05	48	8.761
450	8:30	41	12.615
525	9:55	35	17.171
600	11:20	30	22.425
675	12:45	27	28.382
750	14:10	24	35.040
825	15:35	22	42.397
900	17:00	20	50.450

13.08 Mandrel Deflection Testing

All sewers and maintenance holes must be flushed and cleaned prior to testing. A mandrel test shall be performed on all flexible pipe sewer mains in accordance with OPSS 438 which consists of a successful pass of the mandrel ("pig") pulled through the main. Notwithstanding OPSS 410, allowable deflections shall be a maximum of 5% for all pipe diameters tested.

13.09 Equipment Parameters

Mandrels used to inspect the flexible pipe sewers or culverts shall have been used exclusively for flexible pipe inspections.

Mandrels shall be cylindrical in shape and constructed with an odd number of evenly spaced arms or prongs, minimum nine in number. The rigid mandrel shall be constructed of a metal or a rigid plastic material that can withstand 1.38 MPa (200 psi) without being deformed.

The contact length 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 **Table 2**. The rigid mandrel may or may not have adjustable or collapsible legs, which would allow reduction in mandrel diameter during testing.

The minimum diameter of the circle scribed around the outside of the mandrel arms shall be equal to the allowable deflected pipe diameter ± 1 mm. Refer to **Table 3** for the allowable 5% deflective measurements for PVC and HDPE products.

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

13.10 **Table 2: Mandrel Contact Length**

Deflection Testing of Flexible Pipe Installations Nominal Pipe Size (mm)	Mandrel Contact Length (mm)
150	100
200	150
250	200
300	250
350	300
375	300
400	300
450	350
500	400
525	450
600	500

13.11 **Table 3: Allowable Deflection**

Nominal Pipe Size	Pipe Base Inside Dia.	Allowable Deflection 5%
mm	Mm	mm
SDR 28 PVC Pipe		
150	144.00	136.80
SDR 35 PVC Pipe		
200	196.11	186.30
250	245.16	232.90
300	291.86	277.27
375	357.25	339.39
450	436.64	414.81
525	514.77	489.03
600	579.11	550.15

13.12 **Submittal of Test Results**

The Contractor shall perform mandrel testing as appropriate for type of sewer material installed and to the satisfactory of the Project Manager. Mandrel shall be performed 30 days post sewer installation and backfill.

The following information shall be submitted to the Project Manager two weeks prior to the start of mandrel deflection inspection operations:

The name of the inspection firm staff member who will be responsible for conducting the mandrel deflection inspections of the flexible gravity pipe sewer or culvert installation

b) A separate sample inspection report.

c) The details of the accuracy verification system that is used to verify inspection accuracy.

Inspection reports submitted shall have at least the following information in the title or as otherwise specified:

- | | |
|---|----------------------------|
| i. Owner's Name | |
| ii. Contract Number or Project Name | iv. Region or Municipality |
| iii. Pipe Sewer or Culvert Identification Numbers | v. Road Name and Location |
| | vi. Inspection Day |

One clean set of the Contract Drawings showing maintenance hole numbers that coincide with the inspection report shall be returned to the Project Manager on completion of the inspection. The drawings shall be clearly annotated to show any discrepancies between the drawings and the inspection report. Such discrepancies shall be brought to the attention of the Project Manager during the inspection.

The drawings shall be clearly marked displaying the pipe deflection categories for all locations where pipe sewers or culverts were initially inspected.

13.13 Testing Requirements for HDPE Pipe

Testing Requirements for HDPE shall be in accordance with OPSS.MUNI 412. The test section should be slowly filled with water making sure that all air is removed from the line. A period of 24 hours for absorption should be allowed before starting the test except if exfiltration requirements are met by a test carried out during the absorption period.

Water should be added to the pipeline prior to testing until there is a head in the upstream manhole hole of 600 mm (NPS-24) minimum over the crown of the pipe or at least 600 mm (24 in) above the existing groundwater level, whichever is greater. The maximum limit of the net internal head on the line is 8 m (26 ft). In calculating net internal head, allowance for groundwater head, if any, should be made.

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

The leakage at the end of the test period should not exceed the maximum allowable calculated for the test section. In accordance with OPSS 410 allowable leakage is calculated as 0.075 L/mm diameter/100 metres of sewer pipe/hr. (8.1 US gal/inch diameter/mile of sewer pipe/hr.).

An allowance of 3.0 liters per hour per metre of head (0.24 US gal/hr./ft of head) above the invert for each manhole included in the test section should be made.

Manhole should be tested separately if the test section fails.

.14 Abandonments

14.01 Mainline Sewer

Abandonment of existing sewers where specified shall include pressure filling of the pipes with sand or grout and capping of the pipe ends with concrete. Where abandonment of sewer section terminates at a maintenance hole, the connection point at the maintenance hole shall be bulkheaded and be watertight.

The Contractor shall ensure that there are no "in-service" private drains connected to the sewer prior to beginning abandonment procedures.

Post abandonment of existing sewers shall be communicated and notified to Hamilton Water (Specifically Wastewater Collection) in order to perform any GIS updates and for general awareness.

14.02 Laterals

Laterals shall be abandoned at the mainline sewer as per Sewer & Drain Bylaw. The abandoned lateral shall be physically removed from within the limits of the ROW. Laterals up to 250mm diameter may be abandoned by pressure filling of the pipe with sand or grout and capping of the pipe ends with concrete, for the entire length within the right-of-way.

.15 Temporary Mainline Sewer and Lateral By-pass

15.01 General

This item shall include all costs to supply, **provide**, maintain and remove by-pass piping as required to complete the required Works. The Contractor shall provide by-pass piping in accordance with **this FORM**, City of Hamilton Sewer Bypass Guideline and the following requirements.

15.02 Submissions

The Contractor shall provide the proposed by-pass system layout proposal to the Project Manager for review and written approval. The Contractor shall not commence the installation of any by-pass materials until a written approval has

been granted. As the work progresses, the Contractor is required to review the by-pass system periodically, this includes the construction staging per the conditions provided in the written approval and shall provide revised drawings where required by the City.

15.03 Notification to Sewer Users:

The Contractor shall deliver and keep a record of delivery of City of Hamilton notices to all affected residents, industrial, commercial, and institutional establishments affect by the Work two (2) weeks prior. Affected parties shall include those affected by noise, traffic disruptions, blocked or limited access to approaches or driveways, and shall not be limited to those who are only connected to the sewer scheduled to be repaired.

The Contractor may at the same time distribute Contractor branded two-week notices. The Contractor shall deliver City notices twenty-four (24) to forty-eight (48) hours in prior all impending Works and/or sewer service interruption. The notice shall include names and phone numbers of the designated contact persons including an after-hours emergency number (local). Once the work is completed, the Contractor is to notify all affected parties that their lateral/sewer is back in service.

15.04 By-Pass Pipe and Materials

Materials such as pipe, hose and other appurtenances furnished by the Contractor for the temporary service pipe and connections to house services/branches, shall be approved by the Project Manager and be fully adequate to withstand the indicated system pressures including, the pipe system shall provide adequate tightness and be tested prior to being put into service.

15.05 Temporary Service to Users

Where the existing sewermain is to be placed out of service due to on-going repairs for an extended period of time, the contractor is to supply and install a temporary sewer bypass system. This system is to be installed above ground and be connected in a manner that provides sewer outflow services to all affected users.

.16 Laying and Jointing Sewer Pipe

16.01 Laying (Grades)

The Contractor shall supply and install the main sewer complete, in accordance with the lines, grades and elevations shown on the Contract drawings and shall include the continuous maintenance of existing flow of all mainline sewers and drains.

.17 Concrete and Mortar

17.01 Specification in Progress

.18 CCTV Sewer Inspections

18.01 Duty to report

Contractors performing sewer inspections of any type in the City of Hamilton shall notify the City's Project Manager or Designate immediately upon the discovery of any of the following:

- a) Evidence of cross connectivity between sanitary and storm systems. These may include:
 - i) Presence of sanitary items and/or feces in a storm sewer system. This may include evidence of everyday sanitary items, i.e. toilet paper, that would normally be present in combined or sanitary wastewater collection systems.
 - ii) Dry weather overflow from a combined or sanitary sewer into a storm sewer. This may include damaged overflow structures inside manholes or chambers that would normally only allow sanitary overflow into a storm system during wet weather events.
- b) Pipe or manhole structure collapse or danger of imminent collapse
- c) 50% or more pipe blockage after flushing and cleaning efforts have taken place
- d) Evidence of any utility cross-bores
- e) Missing or fractured/broken maintenance hole covers
- f) Surcharged maintenance holes
- g) Inability to locate or gain access to maintenance holes
- h) Any other site conditions that present health and safety concerns
- i) Where field observations contradict GIS Maps and/or as-built reports

18.02 Inspection Related Instructions

- a. All Works shall be in accordance with these Special Provisions and OPSS 409, with precedents being these Special Provisions.
- b. Unless otherwise specified, all sewer assessment and inspections must be in accordance with:
 - i. CSA PLUS 4012-10 "Canadian Standard Association Technical Guide - Visual inspection of Sewer Pipe"
 - ii. NASSCO PACP "Pipeline Assessment Certification Program" – for mainline inspections.
 - iii. NASSCO MACP "Manhole Assessment Certification Program" – for manhole inspections.

- iv. NASSCO LACP “Lateral Assessment & Certification Program” - for lateral inspections.
- c. Unless otherwise specified, the Contractor shall ensure that all sewers are completely clean and free of debris and ready for CCTV inspection.
- d. All CCTV inspection operators must hold a valid NASSCO Certification applicable to the type of inspection being performed.
- e. The CCTV camera and illumination system shall be capable of providing a clean, accurate colour and in-focus record of the sewers internal condition and the inspection shall not proceed while the lens is dirty. The sewer section shall be kept clear of fog and the inspection shall not proceed while fog is present in the pipe. Operators shall ensure picture quality and clarity is maintained during the entire inspection. Lighting and focus should be adjusted to sufficiently illuminate and observe the circumference of the pipe during inspection.
- f. Pan and tilt to observe features, including all connections and defects of the pipe only when the camera has stopped at the desired distance. Video footage with evidence of pan and tilt movements while the camera is traveling will not be accepted by the City for review and payment.
- g. Maximum speed of the camera during the inspection shall not exceed 10 metres/minute.
- h. Upstream and downstream pipe invert measurements taken from the surface must be performed prior to inspection. Measurements are to be obtained from the surface grade to the center of the channel at each access point, not the benching, and must be recorded into the appropriate fields of the CCTV inspection header information.
- i. The Contractor will be held responsible for damage to street surfaces, curbs, gutters, existing utilities, etc. that result from their negligence during any inspection. The Contractor shall repair, at their cost, any damage resulting there from, which shall be subject to approval by the City.
- j. In the event any inspection equipment becomes lodged, lost or out of control in any way, there must be a contingency plan in place that has been prepared for these circumstances. The contingency plan must include, but not be limited to, public health and property, crew safety, and operational integrity of the sewer system. Any and all costs associated with the execution of this plan shall be the sole responsibility of the proponent unless otherwise agreed to by the City’s Project Manager. No claim for lost time will be considered due to this occurrence.
- k. The Contractor, under the supervision of the Project Manager, or their representative, may install plugs in the sewers to prevent the flow of sewage during inspection for a

period of no longer than 10 minutes. The plugs must then be removed for a minimum of 10 minutes after which time they may be installed again for the period stated above. Plugs shall only be installed when and for the time period directed by the Project Manager where the existing flow hinders a proper inspection.

1. A sewer information screen in the format below shall be displayed for a minimum of 10 seconds at the start of all sewer inspections. Inspection shall not proceed while the information screen is being displayed. Example information screen below:

1	Contract No.: Cxx-xx-xx	Date: 20 Oct 2020
2	Asset ID / COMPKEY: 84322	Time: 16:00:00
3	Street Name: GRAHAM AVE S	Sewer Use: SS
4	Start MH ID: HM11E037	Finish MH ID: HM11E038
5	Start MH Address: 284 GRAHAM AVE S	Finish MH Address: 256 GRAHAM AVE S
6	Start MH Depth: 3.2m	Finish MH Depth: 3.4m
7	Survey Direction: D	Height: 300 mm
8	Material: VCP	Width: 300 mm
9	Segment Length: 80.4m	Pre-Cleaning: H
10	Weather: Dry	
11	CCTV Contractor: CCTV SPEC INC	

- m. During the inspection, clearly display ‘From’ and ‘To’ Manhole IDs, travel chainage in meters, date and time, and street name on the periphery of the screen. Arrange the information to minimize interference with the inspection image. Defect code and description should appear on the screen while ‘coding’ for at least 5 seconds.

- n. General data requirements for sewer main inspections shall be as follows:

Asset ID/Compkey	Only City of Hamilton assigned compkeys shall be used
Video Resolution	Minimum recorded video resolution must be 420 lines with an NTSC size of 720 x 480 at 29.97 frames/second
Video Format of digital CCTV	mp4
Timestamp	Time and date to be 24 hr military format for all settings
Database	Microsoft Access Database conforming to NASSCO data model
Sewer Main Video Files Naming Convention	Compkey_StartManhole_EndManhole_Date.mp 4e.g. 77230_HK07E062_HK07E063_20200624.mp4

Photograph Files Naming Convention	Compkey_Date_ObservationPosition_DefectCode.jpg e.g. 77230_20200624_11.5_HVV.jpg
PDF Inspection Report Naming Convention	Compkey_StartManhole_Date.pdf e.g. 77230_HK07E062_HK07E063_20200624.pdf

18.03 CCTV Reports and Submittals

- a) Unless otherwise specified the Contractor shall submit the following once all inspections are complete:
 - i. Microsoft Access Database structure shall be as specified in the latest NASSCO standard formatting for mainline (PACP), manhole (MACP), or lateral (LACP) inspections.
 - ii. Inspection videos
 - iii. PDF inspection reports
 - iv. Project tracking sheet as directed by the City’s Project Manager or Designate

- b) All submissions shall be made on a removable portable hard-drive or flash-drive (USB 3.0 compatible), of reliable quality and sufficient capacity to store the data set in its entirety. Inspection videos and reports shall be saved in separate folders and labelled accordingly. Hard drives will become the property of the City of Hamilton and will not be returned to the Contractor. All hard drives shall be properly labelled with the following submission information:
 - i. Contractor’s Name
 - ii. Contract Number
 - iii. Contact Person & Phone Number
 - iv. Date

- c) The Contractor is required to keep a record of all inspection material for the duration of five years from the date of inspection.

18.04 Occupational Health and Safety – Confined Space Entry

- a. The Contractor shall ensure that all aspects of the required Work are, at all times, in full and complete compliance with the Occupational Health and Safety Act, as amended.

- b. The Contractor shall provide approved equipment and training to personnel who enter confined spaces as may be required. The procedures the Contractor follows for Confined Space Entry must meet or exceed the requirements outlined by the Occupational Health and Safety Act.

18.05 Lateral Inspection and Asset Inventory and Data Format

- a. A Sewer Lateral-Private Portion refers to the drainpipe extending from a building on private property to the Sewer Lateral-Public Portion. The Sewer Lateral-Private Portion may be used to convey either storm water, sanitary sewage, or a combination of the two. **Figure 1** outlines the location of the Sewer Lateral-Private Portion.
- b. Unless otherwise specified, the Contractor shall inspect laterals from the mainline sewer only and up to the property line (public portion).
- c. Where sewer lateral inventory is not available, the Contractors will be required to generate lateral inventory based on conditions observed during inspection in relation to the existing mainline sewer inventory. **Figure 2** outlines the methodology for lateral ID creation.
- d. A lateral information screen in the format below shall be displayed for a minimum of 10 seconds at the start of all lateral inspections. Inspection shall not proceed while the information screen is being displayed. Example information screen below:
- e. General data requirements for lateral inspections shall be as follows:

18.06 **Figure 1: Sewer Lateral Inspection – Lateral ID Creation**

ID Components - Mainline Laterals(PACP Lateral Segment Reference field)
Starting Manhole ID_Chainage_Mainline ID_Direction of Lateral

Start Manhole ID: The Hansen Manhole ID (MH_ID*)
Chainage: Length in m to one decimal point from start manhole to lateral connection Mainline ID:
The Hansen Mainline ID (COMPKEY*)
Direction of Lateral: L – Left, R – Right
*City of Hamilton GIS layer field name reference

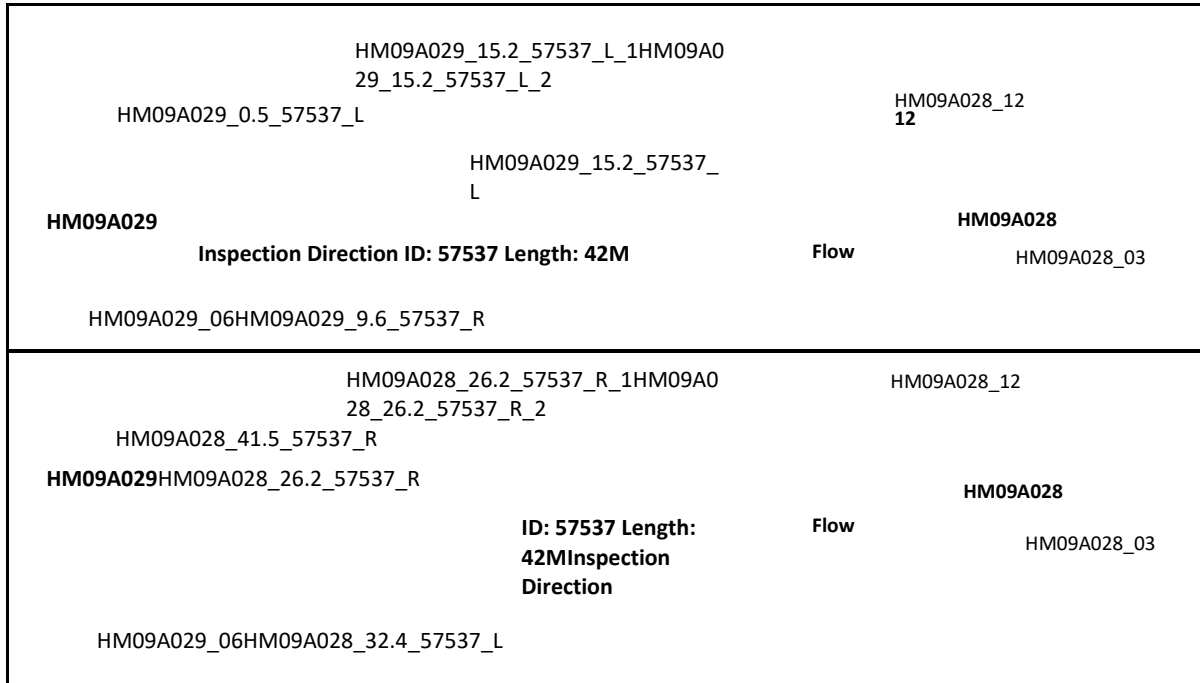
ID Components - Manhole Laterals
Manhole ID_Clock Position

Manhole ID: The Hansen Manhole ID Clock Position: North is 12o'clock



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18.07 **Figure 2: Sewer Lateral Inspection – Lateral ID Creation**



Asset ID	Lateral IDs will have the format: StartManhole_Chainage_Compkey_Direction of Lateral e.g. HK07E062_41.5_77230_R As outlined in Figure 2
Video Resolution	Minimum recorded video resolution must be 420 lines with an NTSC size of 720 x 480 at 29.97 frames/second
Video Format of digital CCTV	mp4
Timestamp	Time and date to be 24 hr. military format for all settings
Database	Microsoft Access Database conforming to NASSCO data model
Lateral Video Files Naming Convention	StartManhole_Chainage_MainlineID_Direction of Lateral e.g. HK07E062_41.5_77230_R.mp4 V3: additional suffix to indicate a post-rehab video e.g. HK07E062_41.5_77230_R_V3.mp4
Photograph Files Naming Convention	Compkey_Date_ObservationPosition_DefectCode.jpg e.g. HK07E062_41.5_77230_R.jpg
PDF Inspection Report Naming Convention	StartManhole_Chainage_MainlineID_Direction of Lateral e.g. HK07E062_41.5_77230_R.pdf V3: additional suffix to indicate a post-rehab video e.g. HK07E062_41.5_77230_R_V3.pdf

1	Contract No.: Cxx-xx-xx	Date: 20 Oct 2020
2	Sewer Main ID / COMPKEY: 84322	Time: 16:00:00
3	Lateral ID: HM11E037 3.2 84322 R	Sewer Use: SS
4	Start MH ID: HM11E037	Height: 150 mm
5	Chainage from Start MH: 3.2	Width: 150 mm
6	Address: 284 GRAHAM AVE S	Pre-Cleaning: H
7	Lateral Survey Direction: U	Weather: Dry
8	Material: VCP	
9	Segment Length: 10 m	
10	CCTV Contractor: CCTV SPEC INC	

.19 Asbestos pipe

- 19.01 Refer to: 'Contractors' Environmental Handbook'
- 19.02 Dust Mitigation During Construction & Demolition

.20 Sewer Use By-law

- 20.01 Specification Under Review

.21 Post-Construction Clean outs

- 21.01 Specification Under Review

.22 Inflows from storm events during construction and spills

- 22.01 Specification Under Review

.23 References

- 23.01 OPSS.MUNI 401
- 23.02 OPSS.PROV 410
- 23.03 OPSS.PROV 409
- 23.04 OPSS.MUNI 411
- 23.05 OPSS.MUNI 412
- 23.06 OPSS.MUNI 438
- 23.07 OPSS.MUNI 491
- 23.08 OPSS.MUNI 1820
- 23.09 OPSS.MUNI 1301
- 23.10 OPSS.MUNI 1841
- 23.11 ASTM D3034
- 23.12 ASTM F1760
- 23.13 ASTM F1336
- 23.14 STM D3034
- 23.15 CSA B182.2
- 23.16 CAN/CSA-B1800
- 23.17 Specification F714
- 23.18 Specification D3035
- 23.19 AWWA C906 and