

Part 1 General

1.1 REFERENCES

- .1 American Association of State Highway Transportation Officials (AASHTO)
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM F1216-09 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube.
 - .2 ASTM F1417-11a(2015) - Standard Test Method for the Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air.
 - .3 ASTM D 790-15e2 - Standard Tests Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulation Materials.
 - .4 ASTM D2990-09 – Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
 - .5 ASTM D5813-04(2012) – Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems.
 - .6 ASTM C923-02 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
- .3 Canadian Standards Association (CSA International)
 - .1 CSA B1800-02, Plastic Non-pressure Pipe Compendium - B1800 Series (Consists of B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .1 CSA B182.1-02, Plastic Drain and Sewer Pipe and Pipe Fittings.
 - .2 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
 - .3 CSA B182.11-02, Recommended Practice for the Installation of Thermoplastic Drain, Storm, and Sewer Pipe and Fittings.
- .4 City of Ottawa Special Provisions
 - .1 S.P. No. F4090 March 2014 – Cleaning and Televising of Sewers
 - .2 S.P. No. F4107 March 2015 - Cured-In-Place Pipe Liner Maintenance Hole to Maintenance Hole.
 - .3 S.P. No. F4107 March 2015 - Cured-In-Place Pipe Liner Maintenance Hole to Maintenance Hole.
- .5 Ontario Provincial Standard Specifications (OPSS)
 - .1 OPSS 409-November 2009 – Construction Specification for Closed-Circuit Television Inspection of Pipelines
 - .2 OPSS.MUNI.1010 - (November 2013) – Material Specification for Aggregates – Granular A, B, M and Select Subgrade Material.

1.2 DEFINITIONS

- .1 Section of relined sewer pipe: is defined as a length of liner installed and cured at one time and may include more than one (1) maintenance hole to maintenance hole sewer section.

1.3 SUBMITTALS

- .1 Submit the following within 14 working days from notice to proceed with work under this section.
 - .1 Manufacturer's material specification and installation procedure,
 - .2 CIPP Liner Design calculations for all pipe section installations.
- .2 Flow Management and Control Plan
 - .1 Submit plan showing flow control measures and impacts on the upstream sewer system.
 - .2 Provide details related to the continuous flow monitoring and include alternative flow management measures should the performance of the upstream system be affected.
- .3 Submit the following not more than 12 working days from the completion of the Pre-CIPP Liner Installation Closed Circuit Television (CCTV) inspection.
 - .1 Pre-CCTV Inspection Report in hardcopy and digital files.
- .4 Submit the following within 15 days of completion the CIPP liner installation for each section of relined sewer pipe.
 - .1 Curing process data and measurements,
 - .2 Cured-in-place liner test results.
 - .3 Quality Assurance Post CIPP Liner Installation CCTV inspection.

1.4 DELIVERY, STORAGE AND HANDLING

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

Part 2 Products

2.1 CURED-IN-PLACE PIPE LINER

- .1 Shall be fabricated from tube and resin materials that when cured will be chemically resistant to withstand exposure to storm sewage at continuous temperatures below 60° C, resistant to abrasion. The cured in place liner must be fully saturated with resin resulting in a homogeneous layer that is completely bonded to the host pipe.
 - .1 Maintenance Hole to Maintenance Hole Installation
 - .1 Liner Tube:
 - .1 Manufactured from one or more layers of flexible needled felt or equivalent non-woven material, capable of carrying resin, withstanding installation pressures and curing temperatures, and fully compatible with the resin system used. The liner material shall be able to stretch to fit irregular pipe sections and negotiate bends. The size of the tube must be able to tightly fit around the host pipe when installed and account for circumferential stretching during installation.
 - .2 The required liner wall thickness will be the greater of the relevant design thickness or 5mm.
 - .2 Resin:

- .1 General purpose, unsaturated, styrene based, thermosetting resin and catalyst system or an epoxy resin and hardener system compatible with the inversion process. Resin must cure in the presence of water and the initial temperature for cure shall be less than 82°C.
- .2 Minimum Structural Properties for installed and cured liner
 - .1 Flexural Strength: 31 MPa as per ASTM D790
 - .2 Flexural Modulus of Elasticity: 1724 MPa as per ASTM 790
 - .3 50 year creep reduction: 50% as per ASTM D2990.
- .3 Design Loads
 - .1 As per ASTM 1216, Appendix X1, Section X1.2.2 Fully Deteriorated Gravity Pipe Conditions:
 - .1 Dead load: Weight of soil overburden. This parameter is based on actual depth of cover (measured from surface to top of pipe).
 - .2 Live Load: HS20-44 as per AASHTO.

2.2 STORM SEWER SPOOL PIPE

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

2.3 LINER END SEAL

- .1 Flexible rubber gasket to meet the material requirements of ASTM C923-02.
- .2 Internal expansion bands – 304 Stainless Steel to meet to the material requirements of ASTM C923-02.

Part 3 Execution

3.1 PREPARATION

- .1 Confirm size of all existing pipes, prior to the manufacturing of tubes and liner. Record depths of sewers at each manhole and immediately report discrepancies to the Departmental Representative and await written instructions to proceed.
- .2 Submit copies of CIPP Liner Design calculations.

3.2 SEWER CLEANING

- .1 Clean existing sewer pipe to be re-lined with hydraulically powered equipment, high-velocity jet cleaners and vacuum pumper to ensure all debris is removed from pipe to be lined. A minimum of two passes of high-velocity jet cleaners will be required. Notify Departmental Representative if additional passes are required to fully clean the sewer and await instructions prior to proceeding with additional passes.

3.3 PRE-CIPP LINER INSTALLATION CCTV INSPECTION

- .1 Perform a color CCTV inspection of cleaned sewer immediately prior to commencing the CIPP liner installation.
 - .1 Maximum depth of flow in accordance with City of Ottawa Special Procedures S.P. No. F-4090.
 - .2 CCTV Camera requirements in accordance with OPSS 409.
 - .3 If CCTV inspection reveals debris still present in the sewer section to be relined, provide additional cleaning passes and re-CCTV until conditions are satisfactory.
 - .4 Submit CCTV inspection reports of pre-CIPP liner installation to Departmental Representative
 - .5 Report format for hard copy report and digital files to be in accordance with City of Ottawa Special Procedures S.P. No. F-4090.
 - .1 Provide two (2) hard copies of CCTV inspection report and two (2) copies of digital video files and report files on DVDs to the Departmental Representative.

3.4 FLOW MANAGEMENT AND CONTROL

- .1 Immediately in advance of the Pre-CIPP Liner CCTV inspection temporary plug upstream end of sewer section to be relined.
- .2 Contractor to be responsible to continually monitor the level of water in the upstream portion of the sewer.
- .3 Ensure that the plugged sewer has no adverse impact on the upstream infrastructures and buildings at all times.

3.5 CIPP LINER INSTALLATION

- .1 Installation of CIPP by inversion process to be in accordance with ASTM F1216.
- .2 Installation of CIPP Liner to be carried under dry weather flow conditions.
- .3 Install PVC storm sewer spool pipe in manhole to allow for continuous relining operation as shown.
- .4 Wet-out tube with resin under controlled conditions using vacuum and roller system to uniformly distribute resin throughout tube. Ensure volume of resin is sufficient:
 - .1 To fill all air voids in the tube material at nominal thickness and diameter,
 - .2 To take into consideration migration of resin into pipe cracks and joints,
 - .3 To account for resin loss due to polymerization shrinkage.
- .5 Insert wet-out tube into existing host pipe through existing maintenance hole using an inversion process and application of hydrostatic pressure head. Ensure tube inversions and installation process does not stretch the tube in excess of 5% of its original longitudinal length. Reline manhole to manhole.
- .6 Apply sufficient pressure to the tube to ensure it is supported tightly against the host pipe without damaging the pipe.
- .7 Cure liner with suitable heat source and water recirculation equipment that results in a uniform raise in water temperature, to the specified manufactures curing temperature and

duration. Ensure that during the duration of the curing process, suitable temperature gauges are in place to continually monitor the temperature of the liner, including at the interface of the liner and host pipe. Record temperature readings to satisfy manufacture requirements and provide copies of this measurement to the Contract Administer.

- .8 After initial cure is realized, raise temperature to the post-cure level recommended by resin manufacture. Maintain for duration specified by manufacture and record temperature readings required by resin manufacture. Provide copies of these measurements to the Contract Administer.
- .9 Conduct gravity leakage test during the liner cure in accordance with ASTM 1417. Provide results to Contract Administer.
- .10 Cool the CIPP liner to a temperature below 100°C before releasing hydrostatic pressure. Ensure release of static head does not create sufficient vacuum to damage newly installed liner.
- .11 Installed and cured liner should be continuous from manhole to manhole, free of dry spots, lifts and de-lamination.
- .12 At the manhole the liner should form terminations that are neat, free of obstruction and forming a tight seal to the pipe. Provide and cure additional resin compatible with the installation for form a tight seal.
- .13 Cut out all openings to laterals to full diameter of existing lateral. Brush finish lateral openings after cutting is complete. Remove debris from sewer.

3.6 LINER END SEAL

- .1 Cut new and existing liners sufficiently to allow for the insertion of the new liner end seal.
- .2 Install liner end seal as per the manufacturer's recommendations.

3.7 QUALITY ASSURANCE

- .1 Carry out closed circuit television (CCTV) of installed sewers.
 - .1 Submit one copy of CCTV inspection report to Departmental Representative for review. CCTV inspection report will be used by Departmental Representative in assessing acceptance of installed works. Carry out CCTV inspection in accordance with OPSS 409.
- .2 Material testing.
 - .1 For each section of relined sewer obtain samples of cured liner in accordance with City of Ottawa Special Procedures S.P. F-4107.
 - .1 Provide 5 sample specimens.
 - .2 Perform one (1) test for Flexural Strength and one (1) tests for Flexural Modulus of Elasticity. Contractor to use an accredited laboratory and follow the testing procedures outlined in ASTM D790.
 - .3 Perform one (1) test for liner thickness. Contractor to use an accredited laboratory and follow the testing procedures outlined in ASTM D5813.

- .4 Results of test to meet the minimum requirements as specified in the liner design specified by the manufacture and submitted by the contractor.

END OF SECTION