



**CONSTRUCTION SPECIFICATION FOR GRAVITY PIPE AND SEWER
REHABILITATION BY CURED-IN-PLACE PIPE**

TABLE OF CONTENTS

460.01	SCOPE
460.02	REFERENCES
460.03	DEFINITIONS
460.04	DESIGN AND SUBMISSION REQUIREMENTS
460.05	MATERIALS
460.06	EQUIPMENT - Not Used
460.07	CONSTRUCTION
460.08	QUALITY ASSURANCE
460.09	MEASUREMENT FOR PAYMENT
460.10	BASIS OF PAYMENT

APPENDICES

460	Commentary
------------	-------------------

460.01 SCOPE

This specification covers the requirements for the rehabilitation of gravity pipe and sewer by the installation of a tight fitting cured-in-place pipe liner.

460.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

Use of this specification or any other specification shall be as specified in the Contract Documents.

460.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

460.02 REFERENCES

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

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

Ontario Provincial Standard Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 409	Closed-Circuit Television Inspection of Pipelines
OPSS 491	Preservation, Protection, and Reconstruction of Existing Facilities
OPSS 492	Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures
OPSS 517	Dewatering of Pipeline, Utility, and Associated Structure Excavation
OPSS 539	Temporary Protection Systems

CSA Standards

B64.5-07	Double Check Valve (DCVA) Backflow Preventers [Part of B64 Series-07, Backflow Preventers and Vacuum Breakers Compendium]
S6-14	Canadian Highway Bridge Code

ASTM International

D 638-14	Standard Test Method for Tensile Properties of Plastics
D 790-17	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
D 2990-17	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
F 1216-16	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

- F 1743-17 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
- F 2019-11 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)

American Water Works Association (AWWA)

- C510 Double Check Valve Backflow Prevention Assembly

460.03 DEFINITIONS

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

Cured-In-Place Pipe (CIPP) Lining means the rehabilitation of existing pipe in place by installation of a tube with one or more layers of flexible needled felt or an equivalent woven or non-woven material capable of carrying resin.

Resin means a general purpose, unsaturated, thermoset material and catalyst system or an epoxy material and hardener that is compatible with the inversion process.

460.04 DESIGN AND SUBMISSION REQUIREMENTS

460.04.01 Design Requirements

The engineering design shall be in accordance with ASTM F 1216 with the following criteria:

a) Design conditions:

- i. CIPP design shall assume fully deteriorated condition of the original pipe.
- ii. CIPP design shall assume no bonding to the original pipe wall.

b) Parameters for design:

- i. Design life of 50 years.
- ii. Safety factor of 2 on external load.
- iii. Groundwater depth is full soil depth, unless otherwise known.
- iv. Soil modulus of 6.9 MPa, unless otherwise known.
- v. Soil density of 2124 kg/m³, unless otherwise known.
- vi. Load according to S6-14 of 166.6kN.
- vii. Minimum ovality of 2%, unless otherwise known. If the host pressure pipe ovality exceeds 2% (for forcemains), the F1216 X1 fully deteriorated pressure pipe design should not be used and a different design method should be employed.
- viii. Minimum depth of 4 metres to top of pipe, unless otherwise known.

460.04.02 Submission Requirements

The design for the lining shall be submitted to the Contract Administrator for approval at least 14 Days prior to installation. The design calculations shall show technical assumptions, identify the design formulas used, and show the liner wall thickness.

The engineering design shall illustrate the installation conditions (i.e., depth of pipeline, water table, pipe invert and crown, ovality condition of host pipe, and full details of the parameters used).

Flow capacity calculations for the lined pipe shall be provided upon request of the Contract Administrator.

The design work shall bear the seal and signature of an Engineer.

The following information shall be submitted to the Contract Administrator at least 7 Days prior to commencing Work:

- a) A work plan outlining the schedule, procedures, and work site.
- b) A list of personnel, including backup personnel, with their qualifications and experience.
- c) A traffic control plan including pedestrian movements.
- d) A project-specific safety plan, confined space entry and emergency procedures. The company's safety manual should also be submitted.
- e) Sewer flow by-pass plan, when specified in the Contract Documents.
- f) Manufacturer's technical data containing complete information on:
 - i. Material composition, physical properties, and dimensions of the new product.
 - ii. Recommendations for transportation, handling, and storage.
 - iii. Repair of product damaged during installation.
 - iv. Installation details.
 - v. Product curing procedures listing the curing temperature and duration, including cool down time for the product.
- g) Contingency plans for the following potential conditions:
 - i. Damage to the existing service connections.
 - ii. Improper placement of the CIPP.
 - iii. Damage to the host pipe.
 - iv. CIPP's failure to achieve structural integrity.
- h) A sample letter to residents impacted by the work shall be submitted to the Contract Administrator for approval 14 Days prior to commencing the work. As a minimum, the letter shall include:
 - i. Contract number.
 - ii. Emergency contact name and number.
 - iii. Nature of work and expected service interruptions.
 - iv. Anticipated start date and duration.
 - v. Working hours.
- i) For heat cured systems, a detailed plan for managing curing effluent, including containment, flushing, sampling, testing, treatment and disposal.

460.05 MATERIALS

460.05.01 Liner

The CIPP liner material shall have the following minimum characteristics:

a) Initial Structural Properties of the Lining

- i. Flexural modulus 1,724 MPa according to ASTM D 790.
- ii. Flexural strength 31 MPa according to ASTM D 790.
- iii. Tensile strength, for pressure pipes only, 21 MPa according to ASTM D 638.
- iv. 50-year creep reduction according to ASTM D 2990.

b) Material Properties for Pipelines

The finished CIPP liner shall meet the chemical resistance requirements in accordance with ASTM F 1216 and shall be resistant to all chemicals and agents found in the liquid flow. .

460.05.02 Tube

The CIPP tube shall consist of one or more layers of flexible needled felt or an equivalent woven or non-woven material capable of carrying resin able to withstand installation pressures and curing temperatures and shall be compatible with the resin system used. The material shall be capable of stretching to fit irregular pipe sections and negotiate bends. The inner layer and the finished pipe surface shall have an impermeable plastic coating for enhancement of corrosion protection, flow, and abrasion properties of the liner. The tube shall be fabricated to a size that fits tightly to the internal circumference and the length of the original conduit, when installed.

The tube shall be marked at regular intervals not to exceed 1.5 m along its entire length with the manufacturer's name or identification symbol.

460.05.03 Resin

The CIPP resin shall meet the requirements of ASTM F 1216, ASTM F 1743, or ASTM F 2019.

460.05.04 Calibration Hose

If a calibration hose is used for inflation of the CIPP liner system, it shall comply with the requirements of ASTM F 1743.

460.05.05 Lubricant

The lubricant used shall be a non-toxic oil-based product that has no detrimental effects on the tube and does not support the growth of bacteria, and does not adversely affect the fluid to be transported. Lubricant shall not be used in processes with permeable coatings.

460.05.06 Double Check Valve Backflow Preventers

Double check valve backflow preventers shall be according to CSA B64.5 or AWWA C510.

460.07 CONSTRUCTION

460.07.01 General

The Contract Administrator shall be notified at least 48 hours in advance of starting work.

The exact size and length of all existing pipes to be rehabilitated shall be confirmed prior to undertaking the manufacturing of any tubes.

All required equipment shall be on-site and in satisfactory working order prior to commencing the installation of a lining section.

Work shall progress and continue as required to minimize downtime on pipelines and out-of-service periods on laterals.

At least 7 Days prior to any interruption in service, the Owner shall advise, in writing, all residents who may be affected by the rehabilitation process about the nature, duration, and expected date of any interruption in service and the contact information of the Contractor. The Contractor shall notify all affected residents or businesses of the specific time of the disruption to their service at least 24 hours in advance and shall endeavour to minimize their inconvenience. During the course of the rehabilitation and any associated service interruption, the residents shall be kept regularly informed regarding any matters that affect them.

460.07.02 Preservation and Protection of Existing Facilities

Preservation and protection of existing facilities shall be according to OPSS 491.

460.07.03 Transporting, Unloading, Storing, and Handling Materials

Manufacturer's recommendations for transporting, unloading, storing, and handling of materials shall be followed.

460.07.04 Trenching, Backfilling, and Compacting

Trenching, backfilling, and compacting for any access pits shall be according to OPSS 401.

460.07.05 Support Systems

Support systems shall be according to OPSS 404.

460.07.06 Dewatering

Dewatering shall be according to OPSS 517.

460.07.07 Temporary Protection Systems

The construction of temporary protection systems shall be according to OPSS 539.

Where the stability, safety, or function of an existing roadway, railway, watercourse, other works, or proposed works may be impaired due to the method of operation, protection shall be provided. Protection may include, but not be limited to, sheathing, shoring, and piling where necessary to prevent damage to such works or proposed works.

460.07.08 Temporary Service

460.07.08.01 Sewer Lining, Sewer Flow By-Pass Plan

When specified in the Contract Documents, during the execution of the work, the sewer flow shall be by-passed around the pipeline being relined.

Pumps and by-pass lines shall be of adequate capacity and size to handle all flows.

When interruption of sewer line flows is necessary to properly conduct the inspection and rehabilitation operations, acceptable methods of flow control shall be used. The Contractor is to make all necessary arrangements with the owners, property managers, and residents of each building. The Contractor shall contact all property owners or tenants or both to coordinate the repair work to the sewer and minimize any impact to the residents and businesses.

Unless otherwise specified in the Contract Documents, during the inspection and rehabilitation, sewer flows shall be bypassed in order to enable proper inspection of the pipe invert. After the work is completed, flows shall be restored to normal.

On all liner installation dates, the Contractor shall maintain a primary and stand-by by-pass pump and pump power supply on-site. Sufficient power supply and hoses shall be on-site in order to allow the pump to discharge into the next downstream sewer section. The stand-by by-pass pump and power supply shall be of an equal or better capability than the primary by-pass pump and power supply. Unless otherwise specified in the Contract Documents, no by-pass pumps or related equipment shall be disconnected or removed from the sewer or work site until after all service connections have been reinstated and the Contractor has recorded the post-installation video.

All by-pass pumping shall be in place and operational prior to the final pre-installation inspection. All by-pass pumping capacities and configurations shall be approved by the Contract Administrator prior to the actual liner installation date. When specified in the Contract Documents, all by-pass pumps and related equipment shall be silenced equipment or contained within an acceptable sound reduction structure.

460.07.09 Preparation of Existing Pipeline

A pre-installation inspection report shall be completed and submitted to the Contract Administrator prior to the commencement of the pipeline rehabilitation.

The existing pipeline to be rehabilitated shall be prepared in accordance with the manufacturer's requirements for CIPP installation. Debris, grease, and other deposits shall be removed from the pipeline. Any obstructions remaining after flushing and cleaning shall be removed without damaging the existing pipeline walls. All roots that interfere with the lining installation shall be removed. Any calcite build-up in the existing pipeline that interferes with the CIPP shall be removed by means that do not damage the existing pipeline walls. Protrusions from deposits such as calcite shall not exceed the maximum allowable values as specified in ASTM F 1216.

Existing protruding service laterals that interfere with the installation or performance of the liner shall be removed without damage to the lateral or the pipeline wall. Flail type equipment is not permitted for the removal of protruding laterals.

The Contractor shall also install a screen in the downstream maintenance hole in order to catch any material, including cut outs from service connection openings that may migrate downstream. Such material shall be removed from the maintenance hole.

If the pre-installation inspection reveals an obstruction such as a protruding service connection, a dropped joint, or a collapse that prevents the inversion process and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall attempt a trenchless technique to remove or repair the obstruction. Any necessary excavation shall be approved in writing by the Contract Administrator prior to the commencement of the work.

When the filling of voids is necessary to ensure structural integrity of the pipeline and to prevent bridging of the liner, the Contractor shall submit a detailed procedure outlining the process and materials to be used to fill the voids to the Contract Administrator for approval.

460.07.10 Closed-Circuit Television (CCTV) Inspection

CCTV inspection shall be according to OPSS 409.

Unless otherwise specified in the Contract Documents, two CCTV inspections of each pipeline section shall be completed as follows:

a) **Post Preparation Video Inspection**

After completion of the preparation of a pipeline section, a video inspection of the full length of the pipeline section shall be made and submitted to the Contract Administrator. Prior to the delivery of the 24-hour service interruption notice and any lining installation taking place, approval of the prepared section shall be obtained from the Contract Administrator.

b) **Post-Lining Final Video Inspection of Complete Rehabilitation**

After completion of all work required for the lining of the pipeline section, a video inspection of the full length of the pipeline section shall be made and submitted to the Contract Administrator for approval of the work.

The final video recording shall be submitted to the Contract Administrator for approval immediately upon completion of the work, but no more than 48 hours after the lining installation in each section.

The inside wall of the access point at each end of the pipeline section shall be clearly visible on the inspection videotape.

460.07.11 Cured-In-Place Pipe Lining Installation

The installation of the CIPP lining shall be according to the manufacturer's procedure.

Before installation begins, the Contractor shall obtain manufacturer's recommendations of the minimum pressure required to hold the tube tight against the existing pipes and the maximum allowable pressure, so as not to damage the existing pipe. Once the installation has started, pressure shall be maintained between the minimum and maximum pressures and documented until the installation has been completed.

The existing pipes shall be dewatered for any CIPP installation that does not use an inversion method to expand the tube against the pipe wall.

460.07.12 Curing

The CIPP installation shall be according to ASTM F 1216, ASTM F 1743, or ASTM F 2019. Qualified personnel shall monitor the curing process and maintain written records, including lining temperatures and internal pressure and/or UV light intensity and duration throughout the curing process. These records shall be made available to the Contract Administrator upon request.

The CIPP shall be inserted and cured in accordance with the manufacturer's parameters and procedures required for the process, or as specified in Contract Documents.

Readings shall be made and recorded at intervals as specified by the liner system manufacturer.

- a) **Heat Cured Systems:** Measure and record the interface temperature at the downstream and upstream ends of the liner as well as any accessible intermediate access points with a thermocouple at the crown and invert of the liner. The time required for the cure shall be determined by the temperature monitoring and shall be adjusted to suit the lengths, diameter, thickness, field conditions, and ambient temperature applicable to each pipe lining section.

- b) UV Cured Systems: Measure and record the inner surface temperature of the liner as well as the light intensity, number of lamps, and light duration during the curing process. The time required for the cure shall be as specified by the liner system manufacturer.

460.07.13 Cool-Down

For heat-cured systems, the CIPP shall be cooled as per resin manufacturer recommendations before relieving the hydrostatic head. Care shall be taken in the release of the static head so that a vacuum does not develop that could damage the newly installed CIPP. Prior to releasing the water used for curing the liner, the water shall be cooled to the ambient temperature as per manufactures specifications after which the water shall be managed in accordance with the detailed discharge plan.

460.07.14 Discharge Requirements

Prior to release to a receiver, it shall be confirmed that the quality of discharge meets the requirements of the receiver.

460.07.15 Inflation Bladder Removal

For pulled-in-place installation techniques where the inflation bladder is designed to not bond to the CIPP, all portions of the bladder material shall be removed from the CIPP.

460.07.16 Liner Termination

The liner termination at and through sections shall be neat and free of obstructions. If the liner termination fails to make a watertight seal with the existing pipe, a seal shall be applied at this point. The sealing process shall use a material compatible with the liner pipe.

In the case where the liner is installed through an existing maintenance hole, the liner shall be trimmed neatly and parged at the spring line of the liner and at the interface between the liner and any other existing sewers or service connections entering into the maintenance hole.

460.07.17 Service Connections and Lateral Reinstatements

Service connection and lateral reinstatement shall be made internally with appropriate remotely operated equipment. Excavation of connections or laterals shall not be allowed. Restored connection or lateral openings shall be cut neatly to full size without over-cutting. Cuts shall be smooth and without residual material left around the opening. Ragged edges or attached material shall not be allowed.

When sewer lateral flow has been interrupted, reinstatement of the lateral shall proceed urgently and with all possible speed to restore lateral flow. Laterals may be reinstated using an initial opening sufficient to restore flow, followed by completion to full reinstatement of 100% open within 24 hours.

460.07.18 Site Restoration

Site restoration shall be according to OPSS 492.

460.07.19 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

460.08 QUALITY ASSURANCE

When specified in the Contract Documents, testing shall be in accordance with the requirements of ASTM F 1216. A sample shall be taken from the cured liner at an access point, sufficient in size to meet the

requirements of ASTM D 790 and ASTM D 638. The testing of the sample shall be done by an independent testing laboratory approved by the Contract Administrator.

a) Finished Liner

CIPP samples shall be collected and prepared and physical properties tested in accordance with ASTM F 1216. The minimum number of samples shall be one per each diameter of pipe. Additional samples shall be taken at 500m intervals.

Leakage testing and visual inspection of the CIPP shall be in accordance with ASTM F 1216.

b) Resin

The Contractor shall provide the Owner with an infrared fingerprint of the approved resin for the project from the resin manufacturer.

The Contractor shall supply a sample of the resin when requested by the Contract Administrator. The Owner shall send a sample of the submitted resin from the project to a 3rd party testing laboratory for verification and confirmation.

460.09 MEASUREMENT FOR PAYMENT

460.09.01 Actual Measurement

460.09.01.01 Cleaning and Preparation of Host Pipe

Measurement for host pipe cleaning and preparation shall be by length in metres along the horizontal centreline of the host pipe between connecting points or, if there is no connecting point, to the end of the host pipe.

When the connecting point is a structure, measurement for host pipe cleaning and preparation shall be in metres to the centre of the structure.

460.09.01.02 Product Installation

Measurement for a product installation shall be by length in metres along the horizontal centreline of the product between connecting points or, if there is no connecting point, to the end of the product.

When the connecting point is a structure, measurement for a product installation shall be in metres to the centre of the structure.

460.09.01.03 Service Connection/Lateral Reinstatement

For measurement purposes, a count shall be made of the number of service connections made to the new product.

460.09.02 Plan Quantity Measurement

When payment is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

460.10 BASIS OF PAYMENT

**460.10.01 Product Installation, “*type, diameter, or use of product*” - Item
Service Connection/Lateral Reinstatement - Item**

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

Unless otherwise specified in the Contract Documents, compensation for all costs associated with the control of flow for sewers shall be included in the unit prices of the contract.

Any extraction of reaming tools or other equipment, including extraction by excavation, shall be the responsibility of the Contractor and shall be done at no extra cost to the Owner.

Costs associated with the filling of identified voids shall be as specified in the Contract Documents. Any additional work done for the filling of additional voids identified in the video inspection shall be paid as Extra Work. Filling of voids occurring as a result of Contractor's operations shall be done at no extra cost to the Owner.

460.10.02 Closed-Circuit Television Inspection

When the Contract does not contain a separate tender item for CCTV inspection, the Contract price for product installation shall include full compensation for all labour, Equipment, and Material to do the work of CCTV Inspection.

**Appendix 460, November 2018
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS**

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should specify the following in the Contract Documents:

- By-pass flow. (460.07.08.01)
- The desired format and contents of the report (document, video, or combination thereof). (460.07.09)
- CCTV inspection details. (460.07.10)
- The designer should consider if excessive debris is to be disposed as part of the contract, under separate pay item by weight. (460.07.23)
- Cost of filling voids that have been specifically identified. (460.10.01)
- Designer should specify which curing methods are permitted, and take into consideration the environmental impacts of the selected method. Steam curing may release styrene into the atmosphere. Water curing may release materials used in the lining process to the test water, which may then also be released to the waterbody and/or atmosphere.

The designer should determine if noise restrictions are required, if so, they should be specified in the Contract Documents. (460.07.08.01)

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.