CONSTRUCTION SPECIFICATION FOR SEWER PIPELINE AND CULVERT REHABILITATION BY PVC FOLD AND FORM LINER

TABLE OF CONTENTS

465.01 SCOPE

This specification covers the requirements for the rehabilitation of sewer pipelines and culverts by the installation of a continuous and tight-fitting PVC Fold and Form Liner (FFL) for structural or non-structural applications.

465.01.01 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.

465.01.02 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.

465.02 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 Standards Specifications, Construction

OPSS 401	Trenching, Backfilling, and Compacting
OPSS 404	Support Systems
OPSS 409	Closed-Circuit Television Inspection of Pipelines

ASTM International

D 638-08	Standard Test Method for Tensile Properties of Plastics
D 790-07e1	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
D 2990-09	Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
F1871-11	Folded/Formed Poly (Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation
F1504-14	Standard Specification for Folded Poly (Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation
F1867-06	Standard Practice for Installation of Folded/Formed Poly (Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation
F1947-10	Standard Practice for Installation of Folded Poly (Vinyl Chloride) (PVC) Pipe into Existing Sewers and Conduits

CSA Standards

S6-14	Canadian Highway Bridge Code

465.03 DEFINITIONS

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

Non-Structural Liner means a liner that does require assistance from the host pipe to support external loads.

PVC Fold and Form Lining means the rehabilitation of gravity sewers and culverts by installation of a PVC Fold and Form Liner system within an existing pipe.

Structural Liner means a liner that does not require assistance from the host pipe to support external loads.

465.04 DESIGN AND SUBMISSION REQUIREMENTS

465.04.01 Design Requirements

The engineering design shall be in accordance with ASTM F 1867 or ASTM F1947 with the following criteria:

a) Design conditions:

   i. PVC Fold and Form design shall assume partially or fully deteriorated condition of the original pipe.
   ii. PVC Fold and Form design shall assume no bonding to the original pipe wall.

b) Parameters for design:

   i. Minimum design life of 50 years.
   ii. Safety factor of 2 on external loads.
   iii. Groundwater depth is full soil depth, unless otherwise known.
   iv. Soil modulus of 6.9 MPa, unless otherwise known.
   v. Soil density of 2140 kg/m3, unless otherwise known.
   vi. Load as per S6-14 of 166.6 kN.
   vii. Minimum ovality of 3% unless otherwise known.
   viii. Minimum depth of 4m to invert unless otherwise known.
   ix. Maximum nominal pipe size of 900mm.

Pipe installation forces or pressures shall be limited so as not to stretch the tube longitudinally by more than 5% of the original length. The flexible liner shall be fabricated to a size that neatly fits the internal circumference of the host pipe. Allowance shall be made for circumferential stretching during insertion.

465.04.02 Submission Requirements

Working Drawings for the lining shall be submitted to the Contract Administrator for approval, minimum of 14 Days prior to installation. The design flow calculations shall show technical assumptions, identify the design formulas used, and show minimum finished inside diameter. The ovality condition used in the calculations shall be within manufacturer's tolerance for the liner product.

Working Drawings shall graphically illustrate the installation conditions (including, depth of pipeline, water table depth, pipe invert and crown, and full details of the parameters used).

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

The following information shall be submitted to the Contract Administrator, minimum of 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 vehicle and pedestrian traffic control plan.

d) Safety plan, including the company safety manual and emergency procedures.

e) Product by-pass or temporary supply system plans, including methods, with a list of equipment to be used.

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 and connection details.
   v. Processing pressures.
   vi. Product post-processing procedures listing the temperature and duration, including cool down time for the product.
   vii. Temporary insertion load (pulling force).
   viii. Procedure for filling voids for the structural integrity of the liner system.

g) Contingency plans for the following potential conditions:

   i. Damage to the existing service connections.
   ii. Improper placement of the PVC Fold and Form Liner.
   iii. Damage to the host pipe.
   iv. The liner’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, minimum of 14 Days prior to commencing the work.

465.05 MATERIALS

465.05.01 Liner

The PVC Fold and Form Liner material shall be 3rd party certified to ASTM F1871 or ASTM F1504 by a certification agency accredited by the Standards Council of Canada, and shall have the following minimum physical properties:

a) Flexural strength of 28 MPa according to ASTM D790.

b) Flexural modulus of 1,000 MPa according to ASTM D790.

c) Tensile strength of 25 MPa according to ASTM D638.

d) 50-year creep reduction as per ASTM D2990.

465.07 CONSTRUCTION

465.07.01 General

The Contract Administrator shall be notified, minimum of 48 hours in advance of starting work.

The exact size and length of all existing pipes to be rehabilitated shall be confirmed prior to installation. 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, all residents and businesses 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, shall be advised in writing. In addition, all affected residents and businesses shall be notified 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.

Testing shall be carried out as specified in the Contract Documents to confirm that each service connection is live.

465.07.02 Preservation and Protection of Existing Facilities

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

465.07.03 Transporting, Unloading, Storing, and Handling Materials

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

465.07.04 Trenching, Backfilling, and Compacting

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

465.07.05 Support Systems

Support systems shall be according to OPSS 404.

465.07.06 Dewatering

Dewatering shall be according to OPSS 517.

465.07.07 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 sheathing, shoring, and piling where necessary to prevent damage to such works or proposed works.

465.07.08 Temporary Service

465.07.08.01 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. Make all necessary arrangements with the owners, property managers, and residents of each building. All property owners or tenants or both shall be contacted to coordinate the repair work to the sewer and minimize any impact to the residents and businesses.

When specified in the Contract Documents, during the inspection and rehabilitation, sewer flows shall be shut off 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, a primary and stand-by by-pass pump and pump power supply shall be maintained 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. 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.

465.07.09 Preparation of Existing Pipeline

A pre-installation inspection shall be completed in the presence of 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 PVC Fold and Form Liner 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 PVC Fold and Form Liner 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.

A screen shall be installed 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 lining process and the obstruction cannot be removed by conventional sewer cleaning equipment, then a trenchless technique shall be attempted to remove or

repair the obstruction. Any necessary excavation shall be approved in writing by the Contract Administrator prior to the commencement of such excavation.

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

465.07.10 Access Pits

When possible, existing maintenance holes shall be used as access pit locations. Access pit locations shall be approved by the Contract Administrator prior to the beginning of construction.

465.07.11 Closed-Circuit Television (CCTV) Inspection

CCTV inspection shall be according to OPSS 409.

A Post Preparation Video Inspection and a Post-Lining Final Video Inspection of Complete Rehabilitation shall be completed for each pipeline section.

465.07.11.01 Post Preparation Video Inspection

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

465.07.11.02 Post-Lining Final Video Inspection of Complete Rehabilitation

After completion of all work required for the lining of the pipeline section, a CCTV inspection of the full length of the pipeline section shall be performed and a report 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 video.

465.07.12 PVC Fold and Form Lining Installation

The installation of the PVC Fold and Form Liner shall be according to the manufacturer's recommendations.

Before installation begins, the manufacturer's recommendations shall be obtained for 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 until the installation has been completed.

The existing pipes shall be dewatered prior to installation.

465.07.13 Processing

The PVC Fold and Form Liner installation shall be according to ASTM F1867 or ASTM F1947. Qualified personnel shall monitor the processing phase and maintain written records, including boiler monitor graphs, water temperatures and lining temperatures throughout the curing process. These records shall be made available to the Contract Administrator upon request.

The PVC Fold and Form Liner shall be inserted and processed in accordance with the manufacturer's parameters and procedures.

Liner external surface temperatures at access points shall be measured.

The time required for the processing 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.

465.07.14 Cool-Down

The PVC Fold and Form Liner shall be cooled to a temperature below 38 °C before relieving the pressure. Cool-down may be accomplished by the introduction of air into the PVC Fold and Form Liner to replace steam used during processing.

465.07.15 Inflation Plug Removal

Once processing and cool-down have been completed, the inflation plugs shall be removed.

465.07.16 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 interface between the liner and any other existing sewers or service connections entering into the maintenance hole.

465.07.17 Testing

When specified in the Contract Documents, testing shall be in accordance with the requirements of ASTM F1867 or ASTM F1947. A sample shall be taken from the processed liner obvert at an access point, sufficient in size to meet the requirements of ASTM D 790. The testing of the sample shall be done by an independent testing laboratory approved by the Contract Administrator.

465.07.17.01 Finished Liner

When required, a cylindrical sample of the lining of at least 200 mm in length, for each section of lining, shall be provided to the Contract Administrator. The sample shall be taken from lining that extends into an access point on the section. A suitable form shall be used to create the sample so that the conditions of making the sample are as close as possible to the installation and processing conditions for the corresponding section of pipe being lined.

PVC Fold and Form samples shall be prepared and physical properties tested in accordance with ASTM F1867 or ASTM F1947.

Visual inspection of the PVC Fold and Form liner shall be in accordance with ASTM F1867 or ASTM F1947.

465.07.18 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 permitted.

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.

465.07.19 Site Restoration

Site restoration shall be according to OPSS 492.

465.07.20 Management of Excess Material

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

465.09 MEASUREMENT FOR PAYMENT

465.09.01 Actual Measurement

465.09.01.01 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.

465.09.01.02 Lateral Reinstatement

For measurement purposes, a count shall be made of the number of laterals reinstated.

465.09.02 Plan Quantity Measurement

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

465.10 BASIS OF PAYMENT

465.10.01 *Product Installation, "type, diameter, or use of product" – Item*
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.

The control of flow for sewers shall be done.

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

465.10.02 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 465-A, 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:

- Service connection testing. (465.07.01)

- Sewer lining, by-pass of flow for sewers. (465.07.08.01)

- Sound reduction. (465.07.08.01)

- Maximum allowable values for protrusions. (465.07.09)

- Costs associated with the filling of identified voids (465.10.01)

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.