

7/10/2013

CURED-IN-PLACE PIPE (CIPP) LINER

****From Weathersfield STP 0146(11)**

- xx. DESCRIPTION. This work shall consist of lining an existing pipe culvert(s) at the location(s) indicated in the Plans and as directed by the Engineer.
- xx. PRODUCT, MANUFACTURER/INSTALLER QUALIFICATION REQUIREMENTS. In order to minimize the risk to the Agency, only proven products with substantial successful long-term track records will be approved.

The following manufacturers are capable of supplying a pipe liner system that meets these specifications:

Insituform Technologies, Inc.
(Aegion Corporation)
17988 Edison Avenue
St. Louis, MO 63005
Tel.: 636-530-8000
Fax: 636-519-8010

Liner Products, LLC
1468 West Hospital Road
Paoli, IN 47454
Tel.: 812-723-0244
Fax.: 812-723-0405

SAK Construction, LLC
864 Hoff Road
O'Fallon, MO 63366
Tel.: 636-385-1000
Fax: 636-385-1100

All trenchless rehabilitation products and installers must be pre-approved. Requests for substitutions for the above shall be submitted to the Agency's office of Contract Administration a minimum of 10 days in advance of the bid opening date. Substitutions for the above after award shall be approved by the Resident Engineer.

Products and Installers seeking approval must meet all of the following criteria to be deemed commercially acceptable.

- (a) For a Product to be considered commercially proven, a minimum of five (5) successful projects of a similar size and scope of work shall be performed in the United States and documented to the satisfaction of the Agency.
- (b) For the Contractor or Contractor's Installer to be considered as commercially proven, the Contractor or Contractor's Installer must have had at least five (5) years active experience in commercial installation.

7/10/2013

- (c) The Contractor or Contractor's Installer must have successfully installed at least 152,400 meters (500,000 linear feet) of a similar cured-in-place product in the United States. Acceptable documentation of these minimum installations must be submitted to the Agency.
- (d) The Contractor's Superintendent(s) or Installer's Representative designated for this project must have had at least five (5) years of continuous active experience in the commercial installation of CIPP. This shall be documented to the Owner's satisfaction in the form of a resume of work experience detailing scope of work (length of installation and CIPP diameters), location of work, and reference contact information for each project listed.
- (e) The Manufacturer of the inversion liner Product must operate under a quality management system that is third party certified to ISO 9001 or other internationally recognized organization standards. Proof of certification shall be required for approval.
- (f) Third party test results for the rehabilitation product resin system supporting the long term performance and structural strength of the product shall be submitted for approval, and such data shall be satisfactory to the Agency. No product will be approved without independent third party testing verification.
- (g) For a Contractor or Contractor's Installer to be approved by the Agency, the Contractor must submit correspondence from the Manufacturer stating that the Contractor or Contractor's Installer is certified to install the Manufacturer's inversion liner Product.

xx. MATERIALS. Materials for the Cured-In-Place Pipe (CIPP) system shall meet the following requirements:

- (a) Tube. The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and shall meet the requirements of ASTM F 1216, Section 5.1; ASTM F 1743, Section 5.2.1; or ASTM D 5813, Sections 5 and 6. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.

The wet out tube shall have a uniform thickness that when compressed at installation pressures will equal or exceed the calculated minimum design CIPP wall thickness.

The tube shall be manufactured to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during installation, including inversion. Overlapped layers of felt in longitudinal seams that cause lumps in the final product shall not be utilized.

7/10/2013

The outside layer of the tube (before wet out) shall be coated with an impermeable polyurethane or polyethylene plastic coating. The coating shall be an impermeable, flexible membrane that will contain the resin and allow the resin impregnation (wet out) procedure to be monitored.

This coating shall form the inner layer of the finished pipe and is required for enhancement of corrosion resistance, flow, and abrasion properties.

The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers of any material. No material shall be included in the tube that may cause delamination in the cured liner. No dry or unsaturated layers shall be evident.

The wall color of the interior pipe liner surface after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be conducted.

Seams in the tube shall be stronger than the non-seamed felt material.

The tube shall be marked for distance at regular intervals along its entire length, not to exceed 3.0 meters (10 feet). Such markings shall include the manufacturer's name or identifying symbol. The tube shall be manufactured in the United States.

- (b) Resin. The resin system shall be a corrosion resistant polyester or vinyl ester, including all required catalysts or initiators, that when cured within the tube create a composite that satisfies the requirements of ASTM F 1216, ASTM D 5813, and ASTM F 1743, the physical properties herein, and those which are to be utilized in the submitted and approved design of the CIPP for this project. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification.

The resin shall be shipped directly from the resin manufacturer's facility to the CIPP wet-out facility. The resin shall not be sent to any intermediate mixing facility.

When requested by the Agency, the Contractor shall submit a Certificate of Authenticity from the resin manufacturer for each shipment to the wet-out facility to include the date of manufacture.

7/10/2013

- xx. STRUCTURAL REQUIREMENTS. The CIPP shall be designed in accordance with ASTM F 1216, Appendix X1. The CIPP design shall assume no bonding to the original pipe wall. Prior to commencing construction, the design calculations shall be submitted to the Agency for approval.

The Contractor or Contractor's Installer shall have performed long-term testing for flexural creep of the CIPP pipe material installed by its company. Such testing results are to be used to determine the long-term, time-dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (tube and resin) and general workmanship of the installation and curing as defined within relevant ASTM standard. A percentage of the instantaneous flexural modulus value (as measured by ASTM D 790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Retention values exceeding 50% of the short-term test results shall not be applied unless substantiated by qualified third party test data to the Agency's satisfaction. The materials utilized for the project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in the CIPP design.

The Enhancement Factor 'K' to be used in 'Partially Deteriorated' Design conditions shall be assigned a value of 7.

The layers of the CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If the layers separate during field sample testing, new samples will be required to be obtained from the installed pipe. Any reoccurrence may cause rejection of the work.

The CIPP material shall meet or exceed the minimum structural properties listed below (in accordance with ASTM D 790). The Contractor shall provide calculations and/or certifications where appropriate that the product meets or exceeds these values.

Property	Cured Polyester Composite	
	Minimum per ASTM F1216	Enhanced Resin
Modulus of Elasticity	1724 Mpa (250,000 psi)	2758 Mpa (400,000 psi)
Flexural Stress	31 Mpa (4,500 psi)	31 Mpa (4,500 psi)

The required structural CIPP wall thickness shall be based, as a minimum, on the physical properties above or greater values if substantiated by independent lab testing and in accordance with the design equations in Appendix X1, design considerations of ASTM F 1216, and the following design parameters:

- (a) Design Safety Factor (typically used value) = 2.0
- (b) Retention Factor for Long-Term Flexural Modulus to be used in Design = 50% - 75% (As determined by long-term tests described above and approved by the Engineer).
- (c) Ovality (calculated from X1.1 of ASTM F 1216).
- (d) Groundwater Depth (above invert of existing pipe) to be determined by the Contractor.
- (e) Soil Depth (above crown of existing pipe) to be determined by the Contractor.

Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

xx. TESTING REQUIREMENTS. A Type D Certification shall be submitted in accordance with Subsection 700.02 by the Contractor from the CIPP manufacturer for the CIPP materials.

- (a) Chemical Resistance. The CIPP shall meet the chemical resistance requirements of ASTM F 1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical testing requirements.
- (b) CIPP Field Samples. When requested by the Agency, the Contractor shall submit test results from field installations of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties meet those specified in the table included under STRUCTURAL REQUIREMENTS of this Section.

7/10/2013

- xx. HYDRAULIC CAPACITY. The CIPP shall have a minimum diameter as shown on the Plans. The hydraulic cross-section shall be maintained as large as possible.
- xx. INSTALLATION RESPONSIBILITIES FOR INCIDENTAL ITEMS. Temporary relocation of stream, when required, shall be performed in accordance with the requirements of TEMPORARY RELOCATION OF STREAM of Section 900.

Prior to installing the CIPP, the Contractor shall submit a Work Plan that will include necessary forming details, method of placement, methods of maintaining the location of the liner during installation operations, curing procedure, temperature monitoring method, and absorption, containment, collection, and disposal of curing water waste. The Work Plan shall be approved by the Engineer prior to commencing with the work.

The Contractor, when required, shall remove all internal debris and obstructions from the existing pipe, and perform any necessary repairs to existing pipe conditions that would interfere with the installation of the CIPP, in accordance with the manufacturer's recommendations and as directed by the Engineer.

Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections using close circuit television (CCTV) inspection techniques. The pipeline interior shall be carefully inspected and approved by the Agency to determine the location of any conditions that may prevent proper installation of CIPP. These shall be noted and corrected. A video and suitable written log for each line section shall be produced for later reference by the Agency.

It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of CIPP. If pre-installation inspection reveals an obstruction such as a dropped joint, or a collapse that will prevent the installation process, that was not previously evident and it cannot be removed by conventional cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Engineer prior to the commencement of the work and shall be considered as a separate pay item.

7/10/2013

xx. INSTALLATION. CIPP installation shall be performed in accordance with ASTM F 1216, Section 7, or ASTM F 1743, Section 6, and the following modifications:

- (a) Resin Impregnation. The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin during installation through cracks and irregularities in the original pipe wall, as applicable.
- (b) Containment. The Contractor shall place an impermeable sheet immediately upstream and downstream of the host pipe and under installation equipment to capture any raw spillage during installation and shall remove and properly dispose of any waste materials.
- (c) Tube Insertion. The wet out tube shall be positioned in the pipeline using either inversion or a pull-in method as defined within relevant ASTM standards previously stipulated. If pulled into place, a power winch should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.
- (d) Temperature. Temperature gauges shall be placed between the tube and the host pipe's invert position to monitor the temperatures during the cure cycle.
- (e) Curing. Curing shall be accomplished by utilizing hot water under hydrostatic pressure or steam pressure in accordance with the manufacturer's recommended cure schedule. A cool-down process shall be conducted that complies with the resin manufacturer's specification.

Cure water, cure condensate, and rinse water shall be disposed of properly via treatment plant disposal, due to temperature differential and the concentration of styrene.
- (f) Rinsing. The Contractor is required to thoroughly rinse the finished CIPP and properly dispose of collected rinse water.
- (g) Sealing. A watertight seal at the insertion and termination points in the drainage structure(s) shall be provided in accordance with the manufacturer's recommendations.

- xx. INSPECTION. CIPP samples shall be prepared for each installation designated by the Agency or approximately 20% of the project's installations. Pipe physical properties will be tested in accordance with ASTM F 1216 or ASTM F 1216 or ASTM F 1743, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in the table included under STRUCTURAL REQUIREMENTS of this Section, Table 1 of ASTM F 1216, or the values submitted to the Agency by the Contractor for this project's CIPP wall design, whichever is greatest.

Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F 1743 and paragraph 8.1.2 of ASTM D 5813. The minimum wall thickness at any point shall not be less than 87.5% of the submitted minimum design wall thickness as calculated per the minimum requirements.

Visual inspection of the CIPP shall be in accordance with ASTM F 1743, Section 8.6.

- xx. CLEANUP. Upon acceptance of the installation work and testing, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work.
- xx. METHOD OF MEASUREMENT. The quantity of Special Provision (Cured-In-Place Pipe Liner) of the size specified to be measured for payment will be the number of meter (linear feet) installed in the complete and accepted work.
- xx. BASIS OF PAYMENT. The accepted quantity of Special Provision (Cured-In-Place Pipe Liner) of the size specified will be paid for at the Contract unit price per meter (linear foot). Payment will be full compensation for furnishing, transporting, handling, and placing the materials specified; for submitting the required Work Plan; for cleaning and repairing the existing pipe prior to CIPP installation; for drilling the CIPP in the location of the vertical riser as well as maintaining and sealing the connection between the riser and the CIPP; for performing required materials sampling and testing; for performing video inspection of the completed lining; for cleanup of the project area; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.

When designated in the Contract Documents for a specific location, payment for work associated with access and staging or temporary relocation of stream will be made under Contract items 900.645 Special Provision (Temporary Access Road and Staging Areas, Culvert) and 900.645 Special Provision (Temporary Relocation of Stream), respectively.

7/10/2013

When not designated in the Contract Documents for a specific location, payment for work associated with access and staging or temporary relocation of stream will be included in the unit price bid for Contract item 900.640 Special Provision (Cured-In-Place Pipe Liner).

Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
900.640 Special Provision (Cured-In-Place Pipe Liner) (Existing X MM (X") Pipe)	Meter (Linear Foot)