

**TECHNICAL SPECIFICATIONS  
CURED-IN-PLACE PIPE (CIPP) FOR MAINLINE RENEWAL**

**PART 1 - PRODUCTS**

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1.1 GENERAL

- A. It is the intent of this specification to provide for the reconstruction of pipelines and conduits by the installation of a resin-impregnated flexible tube that is either inverted or pulled into the original pipeline/conduit and expanded to fit tightly against said pipeline by the use of water or air pressure. The resin system shall then be cured by elevating the temperature of the fluid (water/air) used for the inflation to a sufficient enough level for the initiators in the resin to effect a reaction. The finished pipe shall be such that when the thermosetting resin cures, the total wall thickness shall be a homogeneous and monolithic felt and resin composite matrix that will be chemically resistant to withstand internal exposure to domestic sewage or stormwater.

1.2 QUALIFICATIONS

A. Product

1. The system proposed (materials, methods, workmanship) must be proven through previous successful installations to an extent and nature satisfactory to the Owner and the Engineer that is consistent with the size of the project being proposed. Since CIPP is intended to have a minimum 50-year design life, only products deemed to have this performance will be accepted.
2. CIPP liner material shall be as manufactured by Inliner Technologies, LLC in conjunction with Liner Products, LLC or approved equal.
3. All CIPP lining products shall comply with the latest versions of ASTM F1216 or ASTM F1743, including appendices.
4. The product shall have been successfully in service in an application similar to this for a minimum of 10 years.
5. The CIPP liner Manufacturer shall be ISO certified for tube manufacturing.

B. Installation Contractor

1. The Contractor shall be an approved installer of the CIPP material as determined by the material Manufacturer.
2. The installation Contractor shall have installed within the United States a minimum of 5,000,000 lineal feet of the same product being represented by the bidder.

3. The actual installation superintendent shall have a minimum of three years of CIPP installation experience and shall have directly supervised the installation of a minimum of 50,000 lineal feet of the CIPP product being represented by the bidder.
4. The installation contractor shall perform the wetout of the lining tubes internally. No third party wetout facilities or purchasing of a third party saturated tube shall be allowed.
5. The Contractor shall be ISO certified for installation of the product.

Failure to meet these minimum requirements shall render the bidder non-responsive for purposes of award.

### 1.3 REQUIRED SUBMITTALS

- A. Resin data
  - a. Corrosion testing results
  - b. Creep testing results
  - c. Filler identification
  - d. MSDS sheets
- B. Installation guidelines
- C. Curing guidelines
- D. ISO certifications
- E. Design calculations, signed and sealed by a registered, professional engineer
- F. Testing laboratory information

### 1.4 STRUCTURAL REQUIREMENTS

- A. Each CIPP shall be designed to withstand internal and/or external loads as dictated by the site and pipe conditions. When not specified by the Engineer in the contract documents, the host pipe shall be classified as either partially or fully deteriorated and the design thickness of the CIPP shall be arrived at using definitions and standard engineering methodology as found in ASTM F1216, Appendix X1.

The long-term modulus shall not exceed 50 percent of the short-term value for the resin system and shall be verifiable through testing. When no information is provided in the plans or specifications, soil modulus shall be assumed to be 1,000 psi and groundwater height shall be assumed to be at half the sewer depth. The thickness calculations, signed and sealed by a registered professional engineer, shall be submitted to the Engineer prior to CIPP installation.

The cured liner shall meet the following minimum strength requirements:

MINIMUM PHYSICAL PROPERTIES

Property	ASTM Test Method	Polyester System	Filled Polyester System
Flexural Strength	D790	4,500 psi	4,500 psi
Flexural Modulus (initial)	D790	250,000 psi	400,000 psi
Flexural Modulus (50-year)	D790	125,000 psi	200,000 psi
Tensile Strength <sup>(1)</sup>	D638	3,000 psi	3,000 psi

<sup>(1)</sup> For pressure piping applications only

1.5 MATERIALS

A. Liner Tube

1. The tube shall consist of one or more layers of a flexible needled felt or an equivalent nonwoven or woven material, or a combination of nonwoven and woven materials, capable of carrying resin, withstanding installation pressures and curing temperatures. The tube should be compatible with the resin system to be used. The material should be able to stretch to fit irregular pipe sections and negotiate bends. Projected changes in groundwater level, temperature and other loading factors shall cause no significant changes in the service characteristics or service life of the CIPP.
2. The liner shall be fabricated from materials which when cured, will be chemically resistant to reagents as defined in ASTM F1216, ASTM F1743, and ASTM D543.
3. The tube should be fabricated under controlled conditions to a size that, when installed, will tightly fit the internal circumference and the length of the original conduit. Allowances should be made for the longitudinal and circumferential stretching that occurs during placement of the tube. Maximum stretching allowances shall be as defined in ASTM F1216 or ASTM F1743. The Contractor shall verify the lengths in the field before cutting the liner to length. Individual liners can be made over one or more manhole to manhole sections.
4. The tube shall be uniform in thickness and when subjected to the installation pressures shall meet or exceed the designed wall thickness.
5. Any plastic film applied to the tube on what will become the interior wall of the finished CIPP shall be compatible with the resin system used, translucent enough that the resin is clearly visible, and shall be firmly bonded to the felt material.
6. At time of manufacture, each lot of liner shall be inspected and certified to be free of defects. The tube shall be marked for distance at regular intervals along its entire length, not to exceed five feet. Such markings shall also include the Manufacturer's name or identifying symbol.
7. The reinforcing material of the liner shall be of a needle interlocked felt formed into sheets of required thickness or other material approved by the Manufacturer.

8. Liners may be made of single or multiple layer construction where any layer must not be less than 1.5 mm thick. A suitable mechanical strengthener membrane or strip may be placed in between layers where required to control longitudinal stretching.

B. Resin Components

1. The resin system shall be a corrosion resistant polyester and catalyst system that when properly cured within the tube composite meets the minimum requirements given herein or those that are to be utilized in the design of the CIPP.
2. Flexural creep testing shall have been performed for the resin in accordance with ASTM D2990.
3. The resin used shall not contain fillers whose sole purpose is to reduce the quantity of resin utilized.
4. The Contractor shall submit the resin characteristics, including filler identification, to the Owner for approval prior to lining activities.

## **PART 2 - EXECUTION**

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### 2.1 GENERAL

- A. The Contractor shall deliver the liner to the site and provide all equipment required to insert and cure the liner within the host pipe. The Contractor shall designate a location where the tube will be vacuum impregnated prior to installation. If requested by the Owner, the Contractor shall notify the Engineer at least 48 hours prior to wet out to allow the Engineer to observe the materials and wet out procedure. All procedures to prepare the liner for installation shall be in strict accordance with the Manufacturer's recommendations.
- B. The liner shall be impregnated with resin not more than 168 hours before the time of installation and stored out of direct sunlight at a temperature of less than 70° F.

### 2.2 NOTIFICATION AND PREPARATION

- A. The Contractor shall notify all residents affected by this construction at least 24 hours prior to any service disruption affecting their service connection.
- B. The Contractor shall perform cleaning, videotaping, and inspection prior to installation of the CIPP. The Contractor, when required, shall remove all debris from within the pipe that will interfere with the installation of the CIPP. The Owner shall provide a dumpsite for such debris removed during the cleaning operations. Such site shall be provided at no cost to the Contractor.
- C. It shall be the responsibility of the Contractor to notify the Owner of line obstructions, offset joints or collapsed pipe that will prevent the insertion of the tube or significantly reduce the capacity of the sewer. The Owner with input from the Contractor shall determine the method of pipe repair required and shall address these concerns on a case-by-case basis.

- D. Protruding laterals or services shall be trimmed within one inch of the inside of the main sewer wall for sewers 8-inch to 12-inch in diameter and within one and one-half inch of the main sewer wall for sewers equal to or greater than 15-inches in diameter prior to lining. Trimming shall not cause damage to the lateral or service beyond the inside face of the main sewer.

### 2.3 BYPASS PUMPING

- A. The Contractor, when required, shall provide for the flow of sewage around the section or sections of pipe designated for repair. When possible, the bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall furnish all necessary pumping equipment, conduit, etc. to adequately, safely, and environmentally divert sewage flow around the work.
- B. When requested by the Engineer, the Contractor shall submit a general bypass plan detailing bypass locations, capacity, etc.

### 2.4 TELEVISION INSPECTION

- A. The Contractor shall provide television equipment capable of properly documenting the conditions as found within the pipe. Lighting for the camera shall illuminate the entire periphery of the sewer. The camera shall be radial view type capable of viewing 360° within the pipe and shall provide an unobstructed view of the full pipe.
- B. The taping shall begin with a clear identification of the televising location, upstream and downstream manhole designation, and pipe diameter. The televising tapes shall provide an accurate length measurement of the entire segment and of the distance to each lateral connection. The Contractor shall pan all lateral connections on both the pre and post televising tape.
- C. Reverse televising set-ups shall be utilized when line obstructions prevent full segment televising from the initial set-up direction.
- D. A pre-lining video shall be provided for every section of CIPP to be installed. The prelining video shall be placed immediately prior to the post-lining video on the submitted copy.
- E. A post-lining video shall be submitted to the Owner for approval. The videotapes shall be clearly and properly labeled.

### 2.5 INSTALLATION

- A. The CIPP shall be installed in accordance with the practices given in ASTM F1216 (for direct inversion installations) or ASTM F1743 (for pulled-in-place installations). The quantity of resin used for the tube's impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances being made for polymerization shrinkage and the loss of any resin through cracks and irregularities in the original pipe wall. A vacuum impregnation

process shall be used in conjunction with a roller system to achieve a uniform distribution of the resin throughout the tube.

- B. The resin-impregnated tube shall be installed into the host pipe by methods approved by the Manufacturer and proven through previous successful installations. The insertion method shall not cause abrasion or scuffing of the tube. Hydrostatic or air pressure (or a combination of the two) shall be used to inflate the tube and conform it against the walls of the host pipe. There will be no use of sewage in place of clean water for insertion of the tube, or for the curing of the liner.
- C. The tube is to be installed in a controlled manner at a rate sufficient to prevent damage to the tube. The installation rate shall not exceed 32 feet per minute. The installation head shall be such that, allowing for minor impact, at no time shall the hoop tension in the felt exceed 500 psi or the hoop stress in the polyurethane membrane exceed 8,000 psi.

## 2.6 CURING

- A. After tube installation is completed the Contractor shall supply a suitable heat source and recirculation equipment. The equipment shall be capable of delivering hot water or steam throughout the section to uniformly raise the temperature above the temperature required to effect a cure of the resin. This temperature shall be determined by the resin/catalyst system employed.
- B. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat supply. Thermocouples shall be placed between the tube and the host pipe in downstream manholes at or near the bottom to determine the liner temperature during cure. Water or air temperature in the pipe during the cure period shall be as approved by the resin Manufacturer.
- C. Initial cure shall be deemed to be completed when inspection of the exposed portions of cured pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm. The cure period shall be of a duration recommended by the resin Manufacturer, as modified for the installation process, during which time the recirculation of the heat and cycling of the heat exchanger to maintain the temperature continues.

## 2.7 COOL DOWN

- A. Cool down may be accomplished by the introduction of cool water or air into the installed liner to replace water or pressurized air being relieved from the manhole. The Contractor shall cool the hardened pipe to a temperature below 100° F before relieving the static head. A minimum period of post cure shall be maintained under a static head to provide a minimum hoop tension on the tube felt. Care shall be taken in the release of the static head so that a vacuum will not be developed.

## 2.8 FINISH

- A. The finished lining shall be continuous over the entire length of an insertion run between two manholes and be as free as commercially practical from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. The lining shall be homogeneous and as commercially free as practical of any leakage from the surrounding ground to the inside of the lined pipe.
- B. The layers of the finished 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 such that the knife blade moves freely between the layers. If separation of the layers occurs during testing of the field samples, new samples will be cut from the work. Any reoccurrence may be cause for rejection of the work.
- C. Where liner is installed through a manhole uninterrupted, the invert shall be maintained smooth through the manhole, with approximately the bottom half of the liner continuous through the manhole. The invert of the manhole shall be shaped and grouted as necessary to support the liner. The cost of this work shall be included in the CIPP unit price.
- D. During the warranty period, any defects which will affect the integrity or strength of the liner, collect solids, or reduce hydraulic flow capabilities of the product shall be repaired at the Contractor's expense in a manner mutually agreed upon by the Owner and the Contractor.

## 2.9 REINSTATE LATERALS AND SERVICES

- A. Accurate location of the lateral and service connections shall be made by inspection of the pre-installation videotape or sewer walk.
- B. After the liner has been installed, all existing active lateral sewers and services shall be reinstated unless otherwise indicated by the Owner or on the plans. The reinstatement of laterals and services shall be done without excavation unless otherwise specified by the Engineer. Reinstatement of laterals and services will be accomplished from the interior of the pipeline by means of a television camera directed cutting device or by direct man entry when feasible. All cut lateral and service connections shall be free of burrs, frayed edges, or any restriction preventing free flow of wastewater. Laterals shall be reinstated to a minimum of 90% of their original diameter and no more than 100% of their minimum diameter. The CIPP liner shall be tightly sealed at the cut openings with no gaps. All coupons cut from the liner as a result of reopening the lateral connections shall be retrieved from the sewer and accounted for by the Contractor.

## 2.10 QUALITY ASSURANCE PROCEDURES

- A. For each diameter installed or for every two thousand five hundred (2,500) lineal feet of liner installed, two (2) flat plate samples shall be processed and tested. The flat plate samples shall be constructed of same tube and resin material as the lining tubes, clamped between flat plates and cured in the downtube or, in the case of steam curing, specific apparatus for sample curing. As an alternative, restrained end samples may be used for

pipes eight to 18 inches in diameter provided the manhole invert configuration allows for such.

- B. Testing shall be completed by an accredited, independent, third party laboratory at the Contractor's expense. The Contractor shall submit the chosen laboratory with appropriate accreditation documentation for approval by the Owner prior testing. Testing results shall be provided to the Owner within seven (7) days of receipt of the results.
- C. When required, samples shall be conditioned and prepared in accordance with ASTM D618 and ASTM D5813 to ensure consistency in laboratory results.
- D. Thickness shall be measured in accordance with ASTM D5813, latest version, with only the structural portion of the CIPP being measured.
- E. Flexural testing shall be in accordance with ASTM D790, latest version, with only the structural portion of the CIPP being tested.
- F. For pressure application, tensile testing shall be in accordance with ASTM D638, latest version, with only the structural portion of the CIPP being tested.

### **PART 3 - PAYMENT**

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Payment for the work included in this section will be in accordance with the unit prices set forth in the proposal for the quantity of work performed. Progress payments will be made on the work performed during each monthly period.

When not defined, payment shall be broken down as follows:

- A. Mobilization and demobilization shall be paid for as one lump sum amount.
- B. CIPP shall be paid per lineal foot of each diameter rehabilitated as measured from center of manhole to center of manhole.
- C. Lateral reinstatement shall be paid per each lateral reinstated.
- D. Bypass pumping shall include all incidentals required for the pumping efforts and shall be included in the lineal foot pricing of the CIPP.
- E. Traffic control shall be paid for as one lump sum and shall include all incidentals required for traffic control.

All other incidental costs such as sample testing shall be included in the cost of these items.