

## SECTION 18

### REHABILITATION OF SANITARY SEWER MAINS BY THE CURED-IN-PLACE PIPE (CIPP) METHOD

#### 18.01 SCOPE:

It is the intent of this specification to define the approved methods and materials for the trenchless rehabilitation of existing sanitary sewer lines by the Cured-In-Place (CIPP) process.

These specifications form a part of the Contract Documents and shall govern for rehabilitating sewer mains and laterals by the cured-in-place pipe (CIPP) process. The work covered in this section includes the furnishing of all plant, labor, equipment, appliances and materials and performing all operations in connection with the complete rehabilitation of the existing deteriorated sanitary sewer system piping.

The CIPP process is defined as the reconstruction of sanitary sewer pipe by the installation of an epoxy vinyl ester or polyester, thermosetting resin, vacuum impregnated flexible polyester felt fiber tube, having an impermeable inner surface. The resin impregnated tube shall be formed to the hose pipe by means of a water column. Curing shall be accomplished by circulating hot water throughout the length of the tube in accordance with the specified curing schedule supplied by the resin manufacturer. The CIPP shall extend the full length of the pipe reach being rehabilitated and shall provide a structurally sound, impermeable, jointless, close-fitting, pipe that when cured is mechanically bonded to the host pipe.

The Contractor shall complete all work in strict accordance with all applicable current OSHA standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space. It shall be the Contractor's responsibility to comply with OSHA Standards and Regulations pertaining to all aspects of the work.

When required for acceptable completion of the pipe rehabilitation or replacement, the Contractor shall provide bypass pumping for continuous sewage flow around the section(s) of pipe designated for the installation of replacement pipe. The pump bypass lines shall be of adequate capacity and size to handle

the flow in accordance with Section 12.22 in the Standard Specifications.

Installation methods and materials shall conform to ASTM F 1216 in addition to these specifications.

#### 18.02 MATERIALS:

**A. Resin:** The Contractor shall furnish a manufacturer epoxy vinyl ester or polyester resin series resin and a compatible catalyst system to accommodate the environment of the existing sanitary sewer system. The resin manufacturer shall provide the Contractor with their recommended curing cycle and shall submit data to the Engineer for approval. The CIPP when cured shall have the following minimum values when tested in accordance with ASTM F 1216. Testing shall be performed by an independent testing laboratory approved by the Engineer:

Physical Characteristic	Minimum Values	Test Method
Flexural Strength	4,500 psi	ASTM D 790 mod.
Modulus of Elasticity	250,000 psi	ASTM D 790 mod.
Chemical Resistance	loss not to exceed values for required strength &	ASTM D 453

Certified copies of all test reports on the properties of the selected resin, and the resulting field liner coupons performed by the independent testing laboratory shall be submitted to the Engineer. A minimum of two (2) structural tests shall be performed from each installation run and one chemical resistance test per run for quality. All testing costs shall be included in the related contract unit price for CIPP.

**B. Tube:** Tube material shall be supplied by the system licensor to the Contractor in accordance with Section 5.1 of ASTM F 1216-89 (latest revision).

**C. CIPP Wall Thickness:** The minimum CIPP thickness shall be structurally adequate to

accommodate the following physical conditions of the existing pipe to be rehabilitated:

1. All pipes shall be considered fully deteriorated.
2. All pipes shall be subjected to soil load of 120 lbs./c.ft., with applicable live load, and water table five (5) feet below the top of the ground.
3. All pipes shall have a minimum of 2% ovality in the circumference.

The following liner thicknesses shall be maintained as a minimum:

TABLE 18-1 TYPICAL LINER THICKNESS			
SEWER DIAMETER	PIPE INVERT DEPTH UP TO 10'	PIPE INVERT DEPTH 10' - 15'	PIPE INVERT DEPTH 15' & OVER
6"	4.5 mm	4.5 mm	4.5mm
8"	6.0 mm	6.0 mm	6.0 mm
10"	6.0 mm	6.0 mm	7.5 mm
12"	6.0 mm	7.5 mm	9.0 mm
15"	7.5 mm	9.0 mm	10.5 mm
18"	9.0 mm	12.0 mm	13.5 mm
21"	10.5 mm	13.5 mm	15.0 mm
25"	12.0 mm	15.0 mm	16.5 mm
30"	15.0 mm	18.0 mm	21.0 mm
36"	16.5 mm	21.0 mm	24.0 mm
42"	19.5 mm	24.5 mm	28.5 mm
48"	22.5 mm	28.5 mm	33.0 mm

The Contractor shall verify the liner thicknesses included in Table 18-1 for correctness and advise

of any variations required to accommodate the selected process and structural requirements. No additional compensation will be allowed for these variations. Any proposed adjustments to the liner wall thickness or installation procedures shall be submitted by the Contractor to the Engineer for approval including design criteria, calculations and other information required to ensure the structural and hydraulic capacity of the proposed liner materials.

**18.03 CONSTRUCTION PROCEDURES:**

**A. General:** The following construction procedures shall be performed as a minimum. Additional procedures shall be performed to accommodate actual conditions. The general procedure shall include the following:

1. Hydraulically clean existing piping.
2. Video inspect existing piping and locate existing laterals.
3. Remove line obstructions, where applicable.
4. Perform CIPP process.
5. Reconnect existing active laterals.
6. Perform smoke test.
7. Video inspect rehabilitated pipe.

**B. Preinstallation:** The following preinstallation procedures shall be completed, as a minimum.

1. **Cleaning Existing Piping:** Existing piping scheduled to be rehabilitated shall be hydraulically cleaned prior to videoing.
2. **Video Inspection:** A video (television) internal inspection of the cleaned existing piping shall be performed by a pan and tilt camera to assure that the piping is clean and conditions of the main and laterals are acceptable for lining. One (1) video tape of the internal piping shall be provided to the Engineer for the Owner's records. Bypass pumping and piping shall be performed by the Contractor when required to adequately view the existing piping conditions.
3. **Line Obstructions Removal:** The Contractor shall remove any obstructions from within the sewer main that can be removed without excavation. Obstruction requiring excavation for removal shall be performed by the Contractor where video (television)

inspections reveal heavy solids, dropped joints, protruding service connections, or collapsed pipe, that cannot be removed by conventional sewer cleaning equipment preventing completion of the inversion process. Point repairs shall be performed for areas of heavy solids, dropped joints, or collapsed pipe in accordance with applicable sections of these Specifications. Removal of protruding service connections shall be performed for areas with protruding service taps or laterals in accordance with applicable sections of these Specifications.

C. **CIPP Installation:** The contractor shall submit a detailed description of the proposed techniques and procedures for rehabilitation the existing piping. The Contractor shall submit details to the Engineer for approval prior to beginning work. The format shall generally conform to the following:

1. **Wet Out:** The Contractor shall designate a location where the felt tube will be impregnated (“wetted out”) with resin using distribution rollers and vacuum, to thoroughly saturate the felt tube prior to its dispatch for installation. The Contractor shall inform the Engineer, in advance, to inspect the materials and the wet out procedure. A catalyst system or additive(s) compatible with the resin and tube, may be used as per the manufacturer’s recommendation provided they will not impair or reduce the resin’s quality to withstand the minimum chemical resistance criteria.
2. **Insertion:** The wetted out tube shall be transported and kept in a refrigerated truck, until it is inserted through an existing manhole by approved techniques/process of the installer or the Contractor. The insertion area, equipment platform, etc., shall be securely protected, and all damaged yards, driveways, walks, etc. shall be repaired, at no cost to the Board.
3. **Curing:** After the insertion is completed, the Contractor shall use a hot water recirculation system, capable of delivering desired heat uniformly throughout the section, for a consistent cure of the resin. All Board water used shall be from metered supply and paid for to the Board through the regular billing system. The curing temperatures shall be as recommended by the resin/catalyst system of

the resin manufacturer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing heat source. Another such gauge shall be placed between the impregnated tube and the invert to the original pipe at the manhole(s) to determine the temperatures during the resin curing process. Initial cure shall be considered completed when the exposed portions of the felt tube pipe appear to be hard, and the remote sensing device indicates the temperatures to be adequate, as recommended by the resin/catalyst system manufacturer, and approved by the Engineer. Curing temperatures and duration shall comply with previously submitted data and information.

4. **Cool Down:** The Contractor shall cool the hardened pipe to a temperature below 100 degrees Fahrenheit, before relieving the water column. Cool water may be added to the water column while draining hot water from a small hole at the opposite end of the CIPP, so that a constant water column height is maintained until cool-down is completed. Care shall be taken in the release of the water column so that a vacuum will not be developed, that could damage the newly installed pipe. Coupon samples shall be obtained for testing. The cool down process may vary depending on the installation technique of the manufacturer/Contractor.
5. **Finished Pipe:** The finished CIPP shall be continuous over the entire length from manhole to manhole and be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles and other deformities. The liner passing through or terminating in a manhole shall be carefully cut out (also for samples) in a shape and manner approved by the Engineer. The invert and benches shall be streamlined and improved for smooth flow. The area/annular space between existing and the CIPP shall be sealed with approved materials in an approved manner described later. It shall also meet the leakage requirements of pressure test specified later. Any defect, which will affect the integrity or strength of the pipe, discovered during the warranty period shall be repaired at the Contractor’s expense.

#### 18.04 CONSTRUCTION METHODS:

- A. **Sealing and Benches in Manhole:** The CIPP shall make a tight fitting seal with the existing pipe(s) in the manhole. One-half inch (1/2") diameter activated oakum band soaked in Scotch seal 5600 or equal shall be applied circumferentially near the annular space touching the end of existing pipe and properly encased with a cement based mortar. The top half of the pipe shall be neatly cut off, at least four (4) inches away from the walls. Breaking or shearing pipe will not be allowed. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines or channels, if any. The channel cross-section shall be U-shaped with a minimum height of one-half pipe diameter to three-fourths of the pipe diameter for fifteen (15) inches and larger. The side of the channels shall be built up with mortar/concrete to provide benches at a maximum of 1 in 12 pitch towards the channel.

CIPP and the existing pipe in the manhole shall be sealed as above before proceeding on to the next manhole section and all manholes shall be individually inspected for liner cut-offs, benches and sealing works.

The connection between the cured-in-place pipe and the existing manhole shall be sealed to eliminate all ground water infiltration into the sanitary sewer system at this connection.

- B. **Service Reconnections:** The exact location and number of service connections shall be determined from TV tapes and/or in the field. It shall be the Contractor's responsibility to accurately field locate all existing service connections whether in service or not. The Contractor shall reconnect all service connections to the liner pipe including those from unoccupied, abandoned or vacant lot, unless directed otherwise by the Engineer. Each vacant lot shall also be provided with one service connection location, at an approved location. All service connections shall be completed in such a manner as to allow for future rehabilitation of the lateral by various methods. The Contractor shall be responsible for restoring/correcting, without any delay, all missed or faulty reconnections, as well as for any damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners. All services which are reconnected to rehabilitated liner shall be

shown on the "As Built Drawings" with the exact distance from the nearest downstream manhole.

All existing service connections shall be reconnected either by Excavation method or by Remote TV Controlled Cutting Device method as below:

1. **Service Connection by Excavation:** All existing service connections shall be excavated at the exact location as exposed. They shall be disconnected at the joints. The existing sewer, now the carrier pipe for the liner, shall be carefully broken/removed to expose the liner to the extent necessary. The liner pipe shall not be damaged and shall be allowed to normalize to ambient temperature and cool down before a 4 or 6 inch diameter hole is drilled out. This coupon shall be retrieved and delivered to the Engineer for inspection of the liner thickness at that location. The cut out hole section in the liner shall be coated with approved resin/epoxy, which will cure at the ambient temperature.

A pre-fabricated polyethylene saddle or approved equal fitting shall be installed over the cut out. The saddle shall be a one-piece saddle equipped with a neoprene gasket so that a complete seal is accomplished when the strap-on saddle is tightened with two (2) stainless steel bands, one on each side. The stub-out attached to the saddle must protrude into the liner a distance equal to the wall thickness of the liner. The new 6", or 8" stubout, or lateral, shall be connected to the existing service line by a rubber coupling with stainless steel bands, as manufactured by "Mission" or an Engineer approved equal.

The flexible coupling shall be secured to the existing service lateral and new stub and/or stack with stainless steel bands. The entire exposed service connection shall be encased in cement stabilized sand a minimum of 6" below and 12" above and on the sides of the pipe at a cost incidental to service connection. The service connections shall be tested by the Contractor and approved by the Engineer before backfilling.

Gasketed PVC sewer pipe (ASTM D-3034, SDR 26) may be used for all stubs. PVC saddles

with neoprene gaskets may be used in lieu of polyethylene saddles.

A service reconnection by excavation shall consist of the removal and replacement of any cracked, offset, or leaking existing service line up to a distance of eight feet (8 ft.) from the center of the new liner measured horizontally. Eight (8) inch diameter services shall be connected to the lined sanitary sewer main by the construction of a new manhole.

Abandoned or Dead service connections that need not be reconnected shall be paid only for the excavation quantity by machine or hand, which quantity shall not exceed the minimum excavation required for Point Repair at the location.

One or more homes discharging into a common connection shall be considered as one service connection.

2. **Service Connection by Remote Cut:** Service connections may be performed by TV controlled Remote Cutting Device as an alternate. They shall be made by experienced operators so that no blind attempts or holes are made in the liner pipe. Location shall be verified carefully with earlier tapes for accuracy, especially where dimples are not defined or clearly ascertained. The Engineer reserves the right to require service connection by excavation at certain or all locations, at no additional cost to the Owner, if the quality, workmanship, and approval rating for remote cut is poor and not satisfactory. The excavated service connection shall be performed as shown in Appendix L.

The remote cut shall be smooth and circular in nature as seen by a 360 degree TV camera. The hole shall be a maximum of 100% and a minimum of 90% of the service pipe diameter. It shall be properly aligned and be concentric to the existing connection. The locations of all remote cuts shall be verified carefully to match earlier tapes for their exact locations. Excess, wrong holes, or trial cuts shall be considered unacceptable and shall be properly repaired at no additional cost to the Owner. Excess resin build up is unacceptable and shall be removed. The Project Engineer and Owner's staff shall review all service connections. The Engineer

may check the completed remote connections for the minimum 90% requirement by excavation of the site, if necessary. Defective connections shall be properly repaired at no additional cost to the Board.

3. **Removal of Protruding Service Connections:** Protruding service connections or laterals that prevent the proper insertion of the liner shall be removed to allow the liner to pass through the existing sanitary sewer pipe. This shall be completed by a remote cutting device without excavation where applicable. This procedure shall be paid for as part of the lining cost.

#### **18.05 POST TELEVISIONING OF COMPLETED SECTIONS:**

The Contractor shall provide to the Owner a color video tape taken by a 360 degree radial view camera for close up view showing the completed work, including the condition of the restored taps and lateral condition. Two (2) television inspection reports and one (1) set of video tapes shall be provided to the owner in accordance with 12.32 of the Standard Specifications.

The pre-rehab and post-rehab video tapes shall be dubbed onto one tape so that the post-rehab footage will directly follow the pre-rehab footage for each segment of main rehabilitated. Sewer main segments determined from pre-rehab video as not needing lining shall be on a separate tape from those mains lined.

#### **18.06 CIPP CONTRACTOR QUALIFICATIONS:**

Cured-in-Place Pipe (CIPP) construction shall be performed in accordance with these specifications and by the methods practiced by Inliner U.S.A., Insituform of North America, or similar system approved by the Engineer. The CIPP Contractor shall provide evidence and references for successfully installing a minimum of 150,000 linear feet of CIPP in the United States of America.

#### **18.07 WARRANTY:**

All liner installations shall be warranted to be free from defects in materials and workmanship for a period of five (5) years from the date of project

acceptance. Should a defect occur during this five (5) year period that is attributable to the liner installation or materials, then this defect shall be repaired within four 940 weeks from the date of defect notification to the Contractor at no additional cost to the Owner. The Contractor shall also provide documentation that the specified material to be used has been successfully installed 500,000 linear feet of pipe in the United States of America and has been in place for a minimum of five (5) years. Documentation of the above two (2) requirements shall be included with the bid proposal.

The Contractor shall be responsible for all required repair costs associated with a liner failure during the warranty period including all cost associated with lateral backups into buildings and all other property damage.

END OF SECTION