

SECTION 027614
CURED-IN-PLACE-PIPE (CIPP) FOR REHABILITATION OF
GRAVITY WASTEWATER LINE

1. SCOPE

This specification shall govern for all work necessary for installing CIPP required to complete the project.

2. REFERENCE SPECIFICATIONS

This specification references ASTM D5813, ASTM F1216, ASTM D 2122, ASTM C581, and ASTM D790 which is made a part hereof by such reference and shall be the latest edition and revision thereof. ASTM F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube, shall govern when not addressed by this specification.

3. GENERAL

The CIPP shall be installed in an existing pipe and designed to provide chemical resistance, prevent exfiltration and infiltration, and support all external loads acting on it. The process is defined as the rehabilitation of wastewater lines by pull-in or inversion of a thermosetting resin impregnated flexible tube into existing wastewater pipe, with one layer or more, capable of carrying resin, withstand installation pressure and curing temperature, utilizing a water column. Curing is accomplished by circulating hot water (or other approved fluid) throughout the length of the new tube to cure the thermosetting resin into a hard impermeable pipe with the plastic coated outer layer that is compatible with the resin system used. The new pipe shall extend the full length of the original pipe (i.e. from manhole to manhole), and shall provide a structurally sound, jointless, closefitting, Cured-In-Place-Pipe without delamination or lifts, and with uniformly smooth interior providing hydraulic flow equal to or greater than the existing wastewater pipe in original condition.

4. MATERIALS

Only materials from pre-approved manufacturers shall be allowed for this work. Pre-approved manufacturers are, Insituform, Inliner, and U-liner.

CIPP shall be properly sized Type III cured-in-place thermosetting resin wastewater pipe in accordance with ASTM D5813. The tube shall consist of one or more layers of 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 flexible felt fiber tube shall be fabricated to a size that when installed it will neatly fit the internal circumference of the existing pipe specified by the Engineer. An allowance shall be made for some circumferential stretching during inversion. The minimum length shall effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise specified. The Contractor shall verify the circumference of the host pipe and the lengths in the field before impregnation of the tube with the resin. Individual insertion runs

can be made over one or more manhole sections as determined in the field by the Contractor and approved by the qualified factory field service representative and Construction Engineer.

- 4.1 Tube: The tube shall consist of one or more layers of flexible needled felt or an equivalent nonwoven or woven material or a combination of nonwoven and woven materials that are compatible with the resin system used and are capable of supporting and carrying resin. The tube shall be capable of withstanding installation procedures and curing temperatures. Longitudinal and circumferential joints between multiple layers of a tube should be staggered to not overlap. The tube shall be fabricated to fit its final in-place position in the existing pipe, with allowance for stretch as recommended by the tube manufacturer. The elongation or expansion of the flexible tube during installation, both longitudinally and circumferentially should be limited to 5-10% to minimize reduction of the finished wall thickness.
- 4.2 Tube Coating: The inside or outside surface, or both, of the tube shall be coated with a plastic flexible material that is compatible with the tube and the resin system used. The coating shall allow visual inspection of the proper impregnation of the tube fabric with resin. The final inside flexible plastic coating will form the inner layer of the finished pipe and is required to contain the impregnated resin in the tube.
- 4.3 CIPP Wall: The layers which constitute the pipe wall must be such that when the thermosetting resin cures the Cured-In-Place-Pipe has no delamination, dry spots or lifts.

The minimum allowable wall thickness for CIPP shall be per Table 1 and as directed by the Engineer after review of TV inspection. (Table 1)

Table 1 - Wall Thickness For CIPP			
H (Ft)	DR		T (in.)
	Sound Host Pipe	Deteriorated Host Pipe	
<10	60	50	$T = \frac{D}{DR}$
10-15	50	40	
15-20	45	35	
20-25	40	30	
>25	40	25	
H, Height of cover over pipe (ft) T = Wall Thickness of CIPP (in)			
DR, Dimension Ratio, D/T D= Nominal Diameter (in)			

When cured, the CIPP must form a mechanical bond with the conduit and the wall color of the interior pipe surface of the CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made. Unless otherwise specified, the Contractor shall furnish a general purpose, unsaturated, polyester resin, and catalyst system compatible with the inversion or pull-in process that provides cured physical strengths specified herein. The existing sewers, where designated or required shall be lined using material and workmanship which can be adapted to the restrictions of the work site.

The Contractor shall not begin this phase of the work until there is sufficient material on hand to complete the job and required submittals as per 4.4 are submitted to the qualified factory field service representative and Construction Engineer, prior to use of the lining material.

4.4 Submittal: The following items shall have submittals and shall be in conformance with the requirements of Special Provisions.

4.4.1 RESIN:

- a. Submit technical data sheet showing physical and chemical properties for the proposed resin to be used in the project.
- b. Submit test results to show compliance with ASTM C581 - Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures Intended for Liquid Services.

4.4.2 TUBE:

- a. Submit technical data sheet showing physical properties.

4.4.3 CIPP:

- a. Prepare and submit curing schedule.
- b. Submit copies of curing log sheets with temperature reading prior to curing, during curing and during cool down for each installation section. Must be submitted at least weekly.
- c. Submit, copies of all test results performed by the Contractor's Independent Testing Laboratory for test listed in Section 9, testing.
- d. Submit Contractor's Quality Control Plan and/or Procedures showing control conditions used during impregnation of the resin to ensure proper materials and proper dispersion is achieved in the wet out process.
- e. Submit pre-installation TV inspection video after cleaning, and Acceptance TV inspection video after rehabilitation as per City Standard Specification Section 027611.

5. CONSTRUCTION METHODS

5.1 Pre-Installation Procedures: The following installation procedures shall be adhered to unless otherwise approved by the City's Engineer.

5.1.1 Safety: The Contractor shall carry out his operations in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving work on an elevated platform and entry into a confined space or the use of steam.

5.1.2 Access: It shall be the responsibility of the Contractor to locate and designate all manhole access points open and accessible for the work, and provide rights of access to these points. Traffic routing shall be per traffic control plan approved by the City Traffic Engineer. If a street must be closed to traffic because of the orientation of the sewer, the Contractor shall submit a proposed traffic control and detour plan for approval to the City Traffic Engineer.

- 5.1.3 Pre-Installation Cleaning: It shall be the responsibility of the Contractor to remove all debris that is located within the wastewater pipe. The Contractor is responsible for the disposal of all debris removed from the sewers during the cleaning operation per City Standard Specification Section 027604.
- 5.1.4 Pre-Installation Inspection: Inspection of wastewater pipe shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television inspection. The interior of the pipe shall be carefully inspected to determine that the line is free any conditions which may prevent proper installation of the CIPP. A videotape and log per Section City Standard Specification Section 027611 shall be submitted to the Engineer prior to installation.
- 5.1.5 Bypassing Wastewater: The Contractor shall provide for continuous sewage flow as necessary. Bypass pumping shall be made by plugging the line upstream 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. Discharge into storm sewer shall not be allowed. All bypass pumping must be per City Standard Specification Section 027200 Control of Wastewater Flows.
- 5.1.6 Point Repairs & Line Obstructions: It shall be the responsibility of the Contractor to clear the line of obstructions such as solids, roots protruding service or other obstruction that would impede flow thru the CIPP. Displaced joints, missing portions of pipe or other occurrences that may not be rectified by thru-the-pipe methods shall be repaired as a point repair, when directed by the Engineer. The Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. PVC pipe, in accordance with City Standard Specification Section 027602 Gravity Wastewater Lines, shall be used as a host replacement pipe for the CIPP.
- 5.1.7 Service: The Contractor shall maintain continuous wastewater service without disruptions.
- 5.1.8 Public Notification: A public notification program shall be implemented and shall, as a minimum, require the Contractor to be responsible for contacting each home or business connected to the wastewater line and informing them of the work to be conducted, and when their wastewater service will be affected. The Contractor shall provide the following:
- 5.1.8.1 Written notice to be delivered to each home or business describing the work, schedules, how it affects them, and a local telephone of the Contractor they can call to discuss the project or any problems which could arise.
- 5.1.8.2 Personal contact and attempted written notice the day prior to the beginning of work being conducted on the section relative to the residents affected.
- 5.1.8.3 Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

6. INSTALLATION PROCEDURES

- 6.1 Wet-Out: The Contractor shall identify the location where the tube will be impregnated (“wet-out”) with resin using distribution rollers and vacuum to saturate the tube felt fiber thoroughly prior to installation. The Contractor shall allow the qualified factory field service engineer and Construction Engineer to inspect the materials and wet-out procedure at the designated location. A catalyst system or additive compatible with the resin and the tube shall be used. The amount 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 through cracks and irregularities in the original pipe wall. Handling of the resin-impregnated flexible tube to prevent resin setting until it is ready for insertion and during installation shall be the responsibility of the Contractor.

A vacuum impregnation process shall be used. To insure a thorough wet-out, the point of vacuum shall be as recommended by the manufacturer and per ASTM F1216.

- 6.2 Insertion: The wetted tube shall be inserted through an existing manhole or other approved access by means of an inversion or pull-in process and the application of a water column sufficient to fully extend it to the next designated manhole or termination point. The tube end shall initially be turned inside out and attached to a platform ring or standpipe. The inversion water column will be adjusted to be of sufficient height to cause the impregnated tube to invert from manhole-to-manhole and hold the tube tight against the existing pipe wall, to produce dimples at side connections, and flared ends at the manholes.

If the pull-in method is used, the impregnated primary liner is towed into the host pipe through the existing manhole with a cable winch. The primary liner shall be floated into place virtually eliminating stresses on the material. Proper lubrication may be needed for longer and thicker liners. The secondary liner should then be inverted with the column of water to inflate the primary liner. This may extrude small amount of resin through the perforations of the outer coating of the primary liner. For the pull-in method, insertion of the new liner shall in no case exceed 800 linear feet.

- 6.3 Curing: After the insertion is completed, the Contractor shall supply a suitable heat source and water recirculation system capable of delivering hot water uniformly throughout the section to effect a consistent cure of the resin. The curing temperature shall be that recommended by the resin/catalyst system manufacturer and shall be maintained at such temperature. The Contractor shall follow a schedule to cure the liner and submit the schedule to the Engineer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another such gauge shall be placed between the impregnated tube and the invert of the original pipe at the manhole(s) to determine the temperature during the resin curing process. The Contractor shall continue uninterrupted heating until the desired temperature is achieved, shall accurately measure temperatures at both ends of the pipe and maintain a curing log of CIPP temperatures at the upstream and downstream manholes during curing to document that proper temperatures and cure times have been achieved.

Initial cure shall be considered completed when the exposed portions of the CIPP appear to be hard and the remote temperature sensing device indicates the cure period to be of adequate duration as recommended by the resin/catalyst system manufacturer and modified for the inversion process.

- 6.4 Cool-Down: The Contractor shall cool the hardened CIPP 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 CIPP. Do not discharge water in excess of 100 degree Fahrenheit into the wastewater system.
- 6.5 Warranty: The finished CIPP shall be continuous over the entire length of an inversion run and be free from visual defects such as foreign inclusions, dry spots, pinholes, lifts and delamination. It shall also meet the leakage requirements or pressure test specified below. The finished CIPP shall be warranted for one year after the acceptance of the Project. During the warranty period any defects which will affect the integrity or strength of the CIPP shall be repaired at the Contractor's expense in a manner mutually agreed to by the City and the Contractor.

7. SEALING OF MANHOLES

If the CIPP fails to make a tight seal at a manhole, the Contractor shall apply a seal at that point. The seal shall be of a material compatible with the CIPP material. Do not leave any annular gaps. Seal the annular space with a 1/2 inch diameter activated oakum band soaked in chemical sealant. Seal any annular spaces greater than 1/2 inch with manhole wall repair material. Finish off the seal with a non-shrink all solids epoxy placed around the pipe opening from inside the manhole in a band at least 4 inches wide. Complete the sealing procedure for each liner segment immediately after the liner is cured.

8. SERVICE CONNECTIONS

After the CIPP has been cured in place, the Contractor shall reopen the existing active service connections as designated by the Engineer. This shall generally be done without excavation, and in the case of non-man entry pipe, from the interior of the pipeline by means of a television camera and a robotic cutting device that reestablishes the service connection to not less than 100% capacity. Cutting devices that use high pressure water shall not be used since they may cause damage to the service. When fiberglass or other reinforcing fibers are used, that may cause wicking at service openings, the service opening edges must be sealed with a resin mixture compatible with the tube resin. The Contractor shall certify he has a minimum of two complete working cutter units plus spare key components on the site before each insertion.

9. TESTING

- 9.1 Chemical Resistance: The CIPP shall meet the chemical resistance requirements of ASTM F 1216, Appendix X2. The test specimens shall be capable of exposure for a minimum of one month at a temperature of 73.4°F. During this period the CIPP test specimens should lose no more than 20% of their initial flexural strength and flexural modulus when tested in accordance with Section 8 of ASTM F1216. In Appendix X2, Table X2.1 presents a list of chemical solutions that serve as a recommended minimum requirement for the chemical-resistant

properties of CIPP in standard domestic wastewater applications. 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.

- 9.2 Leakage Testing: The water leakage testing of the CIPP shall be tested using an exfiltration test method, when directed by the Engineer. This test shall be in accordance with ASTM F 1216, 8.2.
- 9.3 Wall Thickness Test: This thickness shall be measured in accordance with ASTM D 2122.
- 9.4 Samples: Per ASTM F 1216, 8.1, the preparation of two CIPP samples is required for each insertion segment. One sample from each of the following two methods:
 - 9.4.1 The sample should be cut from a section of cured CIPP at an intermediate manhole or at the termination point that has been inverted or pull-in through a like diameter pipe which has been held in place by a suitable heat sink, such as sandbags.
 - 9.4.2 The sample should be fabricated from material taken from the tube and the resin/catalyst system used and cured in a clamped mold placed in the down tube when circulating heated water is used and in the silencer when steam is used.
 - 9.4.3 The samples for each of these cases should be large enough to provide a minimum of three specimens and a recommended five specimens for flexural testing and also for tensile testing, if applicable. The Short-term Flexural (Bending) Properties testing should be in accordance with Test Methods ASTM D 790 and shall have a minimum flexural modulus of 250 ksi and a minimum tensile strength of 2500 psi.
 - 9.4.4 The samples taken for the measurement of the liner thickness shall be as described in this Specification, section 9.3.

10. POST INSPECTION

Post CCN of the CIPP rehabilitated line is required for acceptance inspection.

11. CLEAN-UP

Prior to acceptance, the Contractor shall clean and restore the project area affected by these operations.

12. PATENTS

The insertion process is patented and is installed by licensed Contractors. The Contractor shall warrant to the City and his Engineer that the methods, materials and equipment used herein, where covered by license is furnished in accordance with such license and the prices included

on the Bid Form include applicable royalties and fees in accordance with such license. The Contractor shall warrant and save harmless the City and his Engineer against all claims for patent infringement and any loss thereof.

13. MEASUREMENT AND PAYMENT

Unless otherwise specified on the Bid Form, Cured-In-Place Pipe for rehabilitation shall be measured and paid for by the linear foot, for each size (Nominal Diameter, DR, and Height of cover over host pipe) specified, complete in place. The liner will be measured and paid for based on the distance between centers of upstream and downstream manholes.

Point repairs for CIPP shall not be measured for pay but will be considered subsidiary to any CIPP bid item.