SECTION 02546
CURED-IN-PLACE PIPE (LINER PROCESS)

PART 1. GENERAL

1.01 SCOPE

A. Rehabilitation of existing gravity sanitary sewer lines by the Cured-in-Place Pipe (CIPP) process.

B. The CIPP process is defined as the reconstruction of gravity sewer pipe by the installation of polyester or an epoxy vinylester, thermosetting resin, vacuum impregnated flexible polyester felt fiber tube, having an impermeable inner surface. The resin-impregnated tube is formed to the host pipe by means of a water column. Curing is 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, and close fitting pipe that when cured is mechanically bonded to the host pipe.

1.02 REFERENCES

A. The following is a list of standards that may be referenced in this Section:

1. ASTM International (ASTM):
   d. F1216, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.


1.03 DESIGN CRITERIA

A. Design liner thickness upon the following criteria:

1. Pipes considered to be fully deteriorated.
2. Pipes subjected to full soil load with applicable live load and with water table at the top of the ground. Under pavement, live load shall include AASHTO HS20-44 Truck Loading in each pavement lane.
3. Minimum Ovality of Pipe: 3 percent of circumference.
4. Design calculations shall be based upon Appendix X1 of ASTM F1216 with a Factor of Safety of 2.
5. Pipe Thickness:
   a. Pipe 10 inches in Diameter or Less: Rounded to the next higher multiple of 0.5 mm, with a minimum thickness of 6 mm.
   b. Pipe Greater than 10 inches in Diameter: Rounded to the next higher multiple of 0.5 mm, with a minimum thickness of 7.5 mm.
6. Creep Retention: Not less than 50 percent.
7. Poisson’s Ratio: 0.3.
9. Liner shall be watertight.

B. Provide analysis of design criteria and calculations for liner thickness to OWNER for approval. OWNER may vary liner thickness for same size sewer depending upon field condition of pipes or depths.

1.04 SUBMITTALS

A. Action Submittals: Product data.

B. Informational Submittals:
   1. Design calculations.
   2. Manufacturer’s installation instructions and procedures. Furnish information, essentially in the same format as below, or give details of the procedure and the steps to be followed for the installation of the CIPP, even if the process is named in the Specification.
      a. Wet Out.
      b. Insertion.
      c. Curing.
      d. Cool Down.
      e. Finished Pipe.
   3. “Wet out” schedule.
   4. Installer’s statement of qualifications.
   5. Manufacturer’s Certificate of Compliance certifying compliance with the applicable specifications and standards.
   6. Certified copies of test reports of factory tests required by the applicable standards and this Section.
   7. DVD of CCTV inspection.
1.05 DELIVERY, STORAGE, AND HANDLING

A. Keep products safe from damage. Promptly remove damaged products from Site. Replace damaged products with undamaged products.

B. Maintain resin-impregnated tubes in refrigerated truck trailers at a temperature below 45 degrees F to prevent premature curing. Prior to beginning inversion, no portion of the resin-impregnated liner shall be subjected to sunlight or ultraviolet radiation. Resin-impregnated tubes with signs of premature curing shall not be installed and shall be removed from the Project Site.

1.06 SPECIAL GUARANTEE

A. Provide manufacturer’s extended guarantee or warranty, with Owner named as beneficiary, in writing, as special guarantee. Special guarantee shall provide for correction, or at the option of the Owner, removal and replacement of Work specified in this Specification section found defective during a period of 5 years after the date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in the General Conditions.

PART 2. PRODUCTS

2.01 MATERIALS

A. Resin: Unless otherwise specified, CONTRACTOR shall furnish a general purpose, unsaturated, polyester or thermosetting vinylester resin and catalyst system compatible with the reconstruction inversion process that provides the cured physical strengths and properties specified herein.

<table>
<thead>
<tr>
<th>Physical Characteristic</th>
<th>Minimum Values</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexural Strength</td>
<td>4,500 psi</td>
<td>ASTM D790 mod.</td>
</tr>
<tr>
<td>Modulus of Elasticity</td>
<td>250,000 psi</td>
<td>ASTM D790 mod.</td>
</tr>
</tbody>
</table>

B. Resins shall be shipped directly to the wet-out facility from the resin manufacturer and shall be one of the following:

1. Reichhold; Polylite #33420 or DION 9800-20.
2. Interplastic Corporation; #COR72-AA-455HV or #CORVE8190.
3. Ashland Specialty Chemical Company; #AROPOL MR12018 or HETRON Q6405.
4. AOC; 701, Vipel; L704NET-11, or Vipel; L704AAP-12.
C. PET resins, resin fillers, resin additives, and resin enhancement agents are prohibited. Only neat resins are acceptable. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.

D. Tube:
   1. In accordance with ASTM F1216.
   2. Liner tube shall consist of layers of flexible nonwoven polyester felt.
   3. Sewage-contact inside layer of tube shall be coated with an impermeable material compatible with resin and felt.
   4. Manufacturers:
      a. Applied Felt.
      b. Insituform Technologies.
      c. Liner Products.

E. Catalysts:
   1. Primary catalyst shall not exceed 1 percent of the resin by volume.
   2. Secondary catalyst shall not exceed 1/2 percent of the resin by volume.
   3. Catalysts shall be:
      a. Primary Catalyst: Akzo; Perkadox 16 or Norox 600.
      b. Secondary Catalyst: Akzo; Trigonox C or Norox TBPB.

2.02 ACCESSORIES

A. Hydrophilic Rubber Joint Seal: Greenstreak, Inc.; Hydrotite.

B. PVC Saddle Tees: Solvent welded type for 8-inch CIPP sewer main connection. Tee shall fit the existing pipe and have an integral 6-inch branch connection with gasket. The saddle shall include two stainless steel straps. Saddle tees shall meet the requirements of ASTM D3034 and ASTM F477.

C. Coupling: Flexible PVC coupler, 3/8-inch thick, with multiple sealing ribs and stainless steel T-bolt clamps as manufactured by Fernco, Inc.

PART 3. EXECUTION

3.01 PRE-INSTALLATION PREPARATIONS

A. Complete the following activities, unless approved otherwise by OWNER:
   1. Safety: Perform operations in accordance with applicable OSHA Standards. Particular attention shall be paid to those safety requirements involving work on an elevated platform and entry into a confined space.
2. Pre-Insertion Cleaning: Rewash, reclean and ready existing sewer pipe immediately before the pre-insertion television inspection.

3. Pre-Insertion CCTV Inspection: Inspect sewer pipe before insertion of resin impregnated tube to ensure pipe is clean and existing pipe conditions are acceptable for lining. Provide a DVD of the CCTV inspection.

4. Dye Testing: Where sewer line segments may contain abandoned services, CONTRACTOR may be directed to perform dye testing to determine if the services are live and require re-instatement.

5. Bypassing Sewage: Reference Section 02542, Sewer Flow Control.

6. Line Obstructions: If pre-insertion video CCTV inspection reveals an obstruction in the existing pipe (such as heavy solids, dropped joints, protruding service taps or collapsed pipe which may prevent completion of the inversion process), that cannot be removed by sewer cleaning equipment, then a point repair using flexible coupling may be made with the approval of OWNER.

3.02 PRIVATE SERVICE LATERAL SHUTDOWN

A. Notify OWNER at least 1 week prior to the shutdown when it is necessary to shutdown a private service line while Work is in progress and before the service lines are reconnected.

B. Notify building occupants regarding service lateral disconnection by placing a door hanger approved by the OWNER. Place door hangers between 1 and 3 days prior to disconnection.

C. When a service lateral will be disconnected from the main for more than 1 day, lateral shall be positively drained or pumped a minimum of once every 24 hours. Monitor status of flow and storage. Pump lateral more frequently where flows exceed the storage capacity of the lateral or temporary storage as may be provided by CONTRACTOR.

D. Temporarily restore services in uncompleted sections during nonwork hours.

E. Notify building occupants when Work is complete and full uninterrupted service restored.

F. No service is to remain shutdown for more than a period of 8 hours, unless CONTRACTOR provides substitute services for the residents. If the service is to be shutdown for more than 8 hours and CONTRACTOR cannot provide substitute services, then CONTRACTOR shall provide temporary living quarters (i.e., hotel) for the resident at no additional cost to OWNER or the resident. Temporary living quarters shall be approved by OWNER and coordinated through OWNER’s Customer Support Representative.
G. Maintain commercial sewer services while businesses are open. No sewage from the services or main line shall be allowed to be discharged on the ground or in waterways. Holding pits or tanks are not allowed unless permitted by TDEC.

3.03 INSTALLATION PROCEDURES

A. Liner shall be water cured only. Steam curing is prohibited.
   1. Curing Time: 3 hours minimum.
   2. Minimum interface temperature between liner and tube shall be 120 degrees F.

B. The finished CIPP shall:
   1. Be continuous over 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.
   2. When passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by OWNER.
   3. Annular space between existing pipe and the CIPP shall be sealed.
   4. Meet leakage requirements of pressure test as specified in Section 02532, Sanitary Sewers.

C. OWNER requires a continuous, uniform liner for a pipeline section. OWNER will not allow intermediate excavation for new manhole.

3.04 SEALING AND BENCHES IN MANHOLE

A. CIPP shall make a tight fitting seal with existing pipe(s) in manhole. For CIPP that is installed continuous through manhole, the top half of the pipe shall be neatly cut off and not broken or sheared off at least 2 inches away from wall. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other pipes or channels, if any. Channel cross-section shall be U-shaped.

B. At each pipe opening into manhole, hydrophilic rubber joint seal shall be bonded with adhesive to the host sewer pipe or to the opening in the manhole barrel to hold it in place during inversion.

C. Seal CIPP and existing pipe in manhole as stated above before proceeding on to next manhole section. Manholes shall be individually inspected for liner cut-offs, benches, and sealing of liner annular space.
3.05 SERVICE REINSTATEMENTS

A. The exact location and number of service connections shall be determined from CCTV. Field locate existing service connections. Perform service cut outs at active service connections immediately after liner has cured. Initial internal service cut outs shall be made to the lesser of a 6-inch diameter opening or 90 percent of the original diameter of the connection. If the service cannot be replaced through excavation, internally reinstate the service to 100 percent of original opening, and provide a smooth opening with no ragged edges. Services shall not be reconnected from abandoned or vacant lots, unless directed otherwise by OWNER. Restore and correct missed or faulty reconnections as well as damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners. Services which are reconnected to rehabilitated liner shall be shown on “as-built drawings” with the distance from the nearest downstream manhole.

3.06 SERVICE CONNECTION BY EXCAVATION

A. Excavate existing active service connections. Disconnect at joints and existing sewer (now the carrier pipe for the liner) and remove to expose the liner to the extent necessary. Do not damage liner pipe or allow to normalize to ambient temperature and cool down before 6-inch diameter hole is drilled out. Coat cut out hole in liner with approved resin/epoxy that will cure at the ambient temperature.

B. Install PVC saddle tee with gasketed PVC connection for the new sewer service lateral over the cut out. Saddle shall be a one-piece saddle attached to the liner with epoxy and equipped with a neoprene gasket so that a complete seal is accomplished when the strap-on saddle is tightened with two stainless steel bands; one on each side. The stub-out attached to the saddle shall protrude into liner a distance equal to the wall thickness of liner.

C. Replace sewer service laterals per Section 02532, Sanitary Sewers (Gravity).

3.07 TESTING FOR ACCEPTANCE

A. Sampling and Measuring: One minimum 12-inch long restrained pipe section shall be cut from the cured liner installation. Measurements of sample thickness will be taken by OWNER from four locations on each section. The average thickness of the measurements shall be equal to or greater than the required design thickness.
B. Laboratory Testing: One sample from each CIPP liner installation, or as otherwise specified by the OWNER, shall be sent to an independent laboratory and tested for modulus of elasticity and flexural strength. Preparation and testing standards shall be performed in accordance with the approved submittals. Failure of any test can be grounds for rejection of the CIPP liner. At the direction of OWNER, a second sample shall be tested.

C. Destructive Testing: In cases where test results of samples from the 12-inch long pipe section are lower than required values, at the direction of OWNER, CONTRACTOR shall cut samples from liner along length of pipe. The size and shape of the samples shall be determined by OWNER. The CONTRACTOR shall repair the CIPP liner and host pipe at no additional cost to OWNER. Failure of the thickness test shall be grounds for rejection for the CIPP liner.

D. Resin Sampling: “Wet-out” facility resin mixing equipment shall have a valve downstream of the mixing functions and immediately upstream of the application of the mixed resin to the tube where OWNER can draw resin samples. CONTRACTOR’s batch mix facilities, if any, shall provide for sampling of the mixed batch. Submitted “wet-out” schedule cannot be modified without 24-hour notice to OWNER. Resin samples shall be drawn at times determined by OWNER. The OWNER drawing the samples will arrive unannounced and shall be afforded immediate access to the equipment.

E. CCTV shall be as specified in Section 02541, Sewer Television Inspection. Televising shall be done after service connections have been made, unless required earlier by OWNER. Provide CCTV DVD’s after liner has been installed in existing sewer pipe.

F. Low-pressure air test as specified in Section 02532, Sanitary Sewers, shall be required after liner has been installed in existing sewer pipe and service lateral connections have been completed.

G. No visible leak around liner at manhole connections will be allowed.

H. Correct failed liner or liner deemed unacceptable by OWNER as a result of the post-video inspection or test reports for structural values and thickness.
   1. Remedy shall be defined as shown in the following table and shall be based upon lowest test in each test category. Where pipe replacement is required, payment shall be made in full for the cured-in-place pipe. No payment will be made to construct a new sewer segment.
## PIPE CORRECTION

<table>
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<th>TEST</th>
<th>REQ’D VALUE</th>
<th>TEST RESULT</th>
<th>REMEDY</th>
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<td>10% Unit Price Reduction</td>
</tr>
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<td></td>
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<td>30% Unit Price Reduction</td>
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<td>4,500 psi</td>
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<td>Pipe Replacement</td>
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<td>250,000 psi</td>
<td>225,000 to 237,900 psi</td>
<td>30% Unit Price Reduction</td>
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<td></td>
<td>250,000 psi</td>
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END OF SECTION