

**SECTION 02548**  
**CURED-IN-PLACE PIPE LATERAL LINER**

**PART 1. GENERAL**

**1.01 SCOPE**

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

**1.02 DESIGN CRITERIA**

- A. Design liner thickness in accordance with ASTM F1216, F1743, or F2019 (as appropriate for the proposed liner product) using the following criteria:
  - 1. Pipe Diameters: Per Project Drawings.
  - 2. Ovality: 3 percent, or as shown on plans.
  - 3. Pipe Condition: Fully deteriorated.
  - 4. External Water: Ground Surface.
  - 5. Short-Term Tensile Strength (ASTM D638): 3,000 psi.
  - 6. Tensile Strength Reduction Factor: 50 percent.
  - 7. Long-Term Tensile Strength: 1,500 psi.
  - 8. Flexural Strength (ASTM D790): Unreinforced: 4,500 psi.
  - 9. Short-Term Flexural Modulus (ASTM D790): 250,000 psi, or as shown on plans.
  - 10. Flexural Modulus and Flexural Strength Reduction Factor: 50 percent.
  - 11. Long Term Flexural Strength: Unreinforced: 2,250 psi.
  - 12. Long-Term Flexural Modulus: 125,000 psi, or as shown on plans.
  - 13. k Enhancement Factor: 7.
  - 14. Soil Modulus: 1,000 psi, or as shown on plans.
  - 15. Soil Density: 120 pcf, or as shown on plans.
  - 16. Highway Live Load: AASHTO HS20-44.
  - 17. Safety Factor: 2 minimum.
  - 18. Minimum Thickness: 3 millimeters.
  - 19. Poisson's Ratio: 0.3.
  - 20. Liner shall be watertight.

**1.03 SUBMITTALS**

- A. Action Submittals:
  - 1. Manufacturer's technical literature on proposed lining system.
  - 2. Resin:
    - a. Specifications.
    - b. Characteristics.
    - c. Properties.

- d. Itemize exceptions and deviations to Specification.
  3. Annular space sealant.
  4. Service connection seals.
- B. Informational Submittals:
1. Design calculations:
    - a. Liner thickness design calculations signed and sealed by Professional Engineer in the State of TN.
    - b. Manufacture certification of material to values utilized in calculations.
    - c. If reinforced liners are proposed, submit long-term ASTM D790 and ASTM D2990 test data supporting reduction factor used in design.
  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" and curing schedule.
  4. Installer's and accredited testing laboratory statement of qualifications.
  5. Manufacturer's Certificate of Compliance certifying compliance with the applicable specifications and standards.
  6. Warranty and/or Special Guarantee.
  7. Manufacturer's instructions for material shipping, storage, and handling requirements.
  8. Certified copies of test reports of factory tests required by the applicable standards and this Section.
  9. Dye testing results
  10. DVD or external hard drive of both pre- and post CCTV inspections.

#### 1.04 QUALITY ASSURANCE

- A. Installer shall be trained and approved by manufacturer of lateral liner system and method of curing. Installer shall provide documentation, including references, of projects completed within the past 3 years and having a minimum of 1,000 lateral installations with the selected lateral lining system.
- B. Superintendent shall have minimum of 3 years of onsite experience with the selected lateral lining system.

## 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products as recommended by the manufacture to prevent damages. Materials shall be made safe from theft, vandalism, and damage.
- B. All products and materials specified herein shall be inspected at the request of OWNER or RESIDENT PROJECT REPRESENTATIVE. All materials that fail to conform to these Specifications shall be rejected. After delivery to the Site, any materials that have been damaged in transit or are otherwise unsuitable for use in the Work shall be rejected and removed from the Site by the CONTRACTOR at no cost to the OWNER
- C. Ship resin directly to wet-out facility from manufacturer.
- D. 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, due to material or workmanship failure, 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. A warranty inspection can be completed by the OWNER up to 5 years after final acceptance.

## **PART 2. PRODUCTS**

### 2.01 MATERIALS

- A. Resin:
  - 1. Unless otherwise specified, CONTRACTOR shall furnish a general purpose, unsaturated, polyester, epoxy, isophthalic neopentyl glycol, or thermosetting vinyl ester resin, catalyst system, initiators, or hardeners that provide specified cured physical strengths and properties, and compatible with reconstruction inversion process.
  - 2. Resistant to municipal wastewater environment; immersion in septic sewage at temperatures up to 75 degrees F.

3. Curing:
    - a. Designed to cure properly within selected curing method.
    - b. Initiation Temperature: 180 degrees F, maximum for water cure.
  4. Resins shall be chemical resistant and tested and manufactured in accordance with ASTM F1216 and ASTM D543.
  5. PET fibers, resins, resin fillers, resin additives, and resin enhancement agents are prohibited. Only neat resins are acceptable.
  6. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.
  7. Produce a cured tube resistant to shrinkage that will not corrode or oxidize and is resistant to abrasion from solids, grit, and sand in wastewater.
  8. Bond between tube layers shall be strong and uniform. Layers, after cure, shall be saturated with resin.
  9. Resin system shall be manufactured by a company selected by CIPP lateral liner supplier.
  10. Manufacturers and Products:
    - a. Reichhold.
    - b. Interplastic Corporation.
    - c. Ashland Specialty Chemical Company.
    - d. AOC.
- B. 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 Products, or as required to meet the performance requirements of the liner.
    - b. Secondary Catalyst: Akzo Products or Puritan Products, or as required to meet the performance requirements of the liner.
- C. Lateral Lining Tube:
1. Consist of layers of flexible nonwoven and absorbent polyester felt manufactured under quality controlled conditions set by manufacturer and applicable requirements set forth in ASTM F1216 and ASTM F1743 that, when cured, will be chemically resistant to reagents as defined in ASTM D543.
  2. Lining shall be correct diameter; after installation there shall be no wrinkles or form permanent fins. Tube shall be capable of stretching to fit irregular pipe sections and fabricated and sized for each section to ensure snug and firm fit inside existing sewer; produce required thickness after resin is cured.
  3. Wastewater-contact inside layer of tube shall be coated with an impermeable material compatible with resin and felt and shall not be a dark or non-reflective nature that inhibits proper closed circuit television inspection.

4. Capable of conforming to offset joints, bells, 45-degree bends, 90-degree bends, and disfigured pipe sections.
  5. Manufacturers and Products:
    - a. Performance Liner and T-Liner, LMK Technologies.
    - b. Top Seal, Amerik Supplies, Inc.
    - c. Service Connection Seal + Lateral, BLD Services, LLC.
- D. Interface Seal:
1. Structural properties in accordance with ASTM F1216 and as referenced in the design criteria and compatible with the main line liner and proposed lateral liner.
  2. Meet the 50-year design life of the CIPP lateral liner.
  3. Designed to be installed via remote device without excavation or installation of cleanout.
  4. One piece construction and designed such that when expanded shall tightly fit both T and Y connections at interface between mainline and lateral pipe.
  5. Provide a watertight connection between service connection and mainline.
  6. Conform to one of the following two methods:
    - a. Method A Sectional Type Seals: A full-circle 16-inch long CIPP mainline liner integrally manufactured to lateral liner providing a seamless connection between mainline liner and lateral liner. Required if mainline does not have a CIPP lining.
    - b. Method B Brim Type Seals: Provide 3-inch minimum overlap inside of mainline. One-piece construction designed such that when expanded shall tightly fit both "T" and "Y" connections at interface between mainline and lateral pipe. Permissible only if mainline has a CIPP lining.
  7. Shall extend inside the lateral pipe past the first lateral joint up to 3 feet.
- E. Cleanouts and Boxes: As specified in Section 02532, Sanitary Sewers (Gravity).

### **PART 3. EXECUTION**

#### **3.01 WORKER SAFETY**

- A. Contractor shall implement all current recommendations, guidelines, and regulations of the National Institute for Occupational Safety and Health (NIOSH), and the Occupational Health and Safety Administration (OSHA) for the safety of workers and the public affected by the CIPP installation.
- B. Records of any complaints or incidents shall be provided to the OWNER.

### 3.02 PRE-INSTALLATION PREPARATIONS

- A. Complete the following activities, unless approved otherwise by OWNER:
1. Confirm mainline CIPP liner has been installed and approved by OWNER, if applicable. Lateral liner shall not be installed prior to acceptance of mainline CIPP liner by OWNER.
  2. Pre-Insertion Cleaning: Rewash, re-clean 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 shall be responsible for performing dye testing to determine if the services are live and require re-instatement.
  5. Bypassing Wastewater: Reference Section 02542, Sewer Flow Control.
  6. Establish appropriate Traffic Control in accordance with 01550, Work Zone Traffic Control.
  7. 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 is not identified on the Project Drawings and cannot be removed by sewer cleaning equipment, then CONTRACTOR notify the OWNER.

### 3.03 INSTALLATION

- A. Wet Out
1. Verify lateral diameter and length in field before fabricating lateral liner system.
  2. Wet out shall be vacuum impregnated with resin under controlled conditions.
  3. Use roller system to uniformly distribute resin throughout tube.
  4. Resin shall fill all voids in tube material with no air spaces or pockets.
  5. Handle resin impregnated tube to retard or prevent settling until it is read for insertion.
  6. Use of alternative methods of resin impregnation shall be approved by the OWNER prior to implementation.
- B. Insertion:
1. Install CIPP in accordance with practices outlined in ASTM F1216 for direct inversion installations and ASTM F1743 for pull in installations.
  2. Dewater existing host pipe for CIPP installation that does not use inversion method to expand tube against pipe wall.
  3. Use lubricant as recommended by manufacturer; no resin shall be lost by contact with pipe during pull-in process.

4. Insert wet-out lining system remotely from main by means of inversion process or pulled-in method, and application of hydrostatic head sufficient to extend tube fully to lateral termination point.
  5. Utilize a hydrophilic sealant (or equivalent) to enhance a watertight seal.
  6. Once installation has begun, maintain pressure sufficient to hold tube tight against host lateral pipe.
  7. Complete installation process control sheet for every lateral lining completed. Control sheet shall provide the following information:
    - a. Type of connection seal.
    - b. Lateral liner length.
    - c. Hydrostatic head at point of inversion.
    - d. Hydrostatic head at termination point.
    - e. Time inversion process started.
  8. Trim back cured liner/resin composite pipe left protruding from main line or service connection using hydraulic-powered robotic cutting device specifically designed for cutting cured-in-place pipe.
  9. Remove materials from sewer system and prevent from floating downstream. CONTRACTOR will be held responsible for cost of repairs or maintenance resulting from materials accumulating in downstream pump stations.
- C. Interface Seal:
1. Install from mainline sewer and extend inside lateral for a distance specified on the project drawings; or a minimum of 3 feet.
  2. No clean out is required for installation of connection seal to lateral liner system.
  3. Do not install in presence of active infiltration. To control infiltration at lateral interface seal use materials compatible with both mainline liner and lateral line.
- D. Curing: After installation ambient cure or, apply steam, hot water, or ultraviolet (UV) light as recommended by liner manufacturer.
1. General:
    - a. Complete curing process control sheet for every lateral liner completed.
    - b. Control sheets shall provide required temperatures and time for the different steps of curing process; initial cure, post cure, and cooling as outlined in ASTM F1216.
    - c. Initial cure may be considered complete when exposed portions of flexible tube pipe take a hard set and temperature is adequate, as recommended by manufacturer.
  2. Ambient Cure:
    - a. The wet-out liner shall be loaded inside a pressure apparatus above ground and winched into place using a robot and camera system.
    - b. Pressure Required to Keep Tube Inflated: Per manufacturer's instructions.

- c. Time: Per manufacturer's instructions.
- d. Cool Down:
  - 1) The Installer shall cool the hardened CIPP to a temperature to approximately 90 degrees F before relieving the pressure in the pressure apparatus.
- 3. Steam:
  - a. Provide safety system specifically structured for use of steam.
  - b. Equipment:
    - 1) Heat source shall be capable of delivering steam throughout section and uniformly raising steam temperature above temperature required to affect cure of resin.
    - 2) Install temperature gauges in the following areas:
      - a) Incoming steam supply.
      - b) Outgoing steam supply.
      - c) Between impregnated tube and pipe invert at lining termination point.
  - c. Steam Temperature: 230 degrees F, minimum.
  - d. Interface Temperature between Liner and Tube: 120 degrees F, minimum.
  - e. Pressure Required to Keep Tube Inflated: Per manufacturer's instructions.
  - f. Time: Per manufacturer's instructions.
  - g. Cool Down:
    - 1) Send air through steam cured CIPP liner until liner cools down to 120 degrees F interface temperature.
    - 2) Once 120 degrees F has been reached, water may be introduced to finish cooling line down to 90 degrees F.
    - 3) During release of water, prevent vacuum that could damage newly installed CIPP.
- 4. Hot Water:
  - a. Equipment:
    - 1) Heat source shall be capable of delivering hot water throughout section and uniformly raising water temperature above temperature required to affect cure of resin.
    - 2) Install temperature gauges in the following areas:
      - a) Incoming water supply.
      - b) Outgoing water supply.
      - c) Between impregnated tube and pipe invert at lining termination point.
  - b. Interface Temperature between Liner and Tube: 120 degrees F, minimum.
  - c. Time: 3 hours, minimum.



- d. Cool Down:
  - 1) Introduce cool water into CIPP to replace water being drained from small hole made in downstream end.
  - 2) Cool liner to temperature below 90 degrees F before relieving hydrostatic head.
  - 3) During release of water, prevent vacuum that could damage newly installed CIPP.
- 5. UV:
  - a. Curing parameters, such as curing speed, inner air pressure, and wattage, per manufacturer recommendations.
  - b. Optimal curing speed or travel speed of energized UV light sources is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature.
  - c. Invert liner into pipe with standard pressure drum.
  - d. After completion of inversion process introduce light chain in liner and close ends with couplings.
  - e. Remove and discard inner film material after curing to provide optimal quality of final product.
  - f. Control panel operating UV curing unit light chain may be pulled on a trailer attached to UV unit.
  - g. Flushing of UV cured CIPP liner to reduce styrene residual is not required.

#### 3.04 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. Notify building occupants with a KUB approved door hanger not less than 36 hours prior to shutdown.
- B. When a service lateral will be disconnected the flow shall be controlled in accordance with Specification 02542, Sewer Flow Control.
- C. No service is to remain shut down without sewer flow control or a leak free temporary connection. Otherwise, CONTRACTOR shall then 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. Commercial sewer services shall be maintained when businesses are open.

### 3.05 FIELD QUALITY CONTROL

- A. The finished CIPP shall be continuous over entire length and shall be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities.
  - 1. Defects and deformities may, at the discretion of the OWNER, be cause for rejection of entire liner. CONTRACTOR shall correct deficiencies at not additional cost to the OWNER.
  - 2. Method of repair, which may require field or workshop demonstration, shall be approved by OWNER prior to commencement of work.
  - 3. Where repair of the liner is not achievable or acceptable to the OWNER, CONTRACTOR shall replace the service line using conventional methods.
  
- B. 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 or external hard drive within two weeks after permanent lateral reinstatements have been completed.
  
- C. Low Pressure Air Test Procedure:
  - 1. Test each lateral in accordance with the procedure described herein.
  - 2. Place test balls no more than 5 inches inside CIPP lateral liner at upper point of repair.
  - 3. Place test balls in mainline a minimum of 12 inches from and centered on lateral opening.
  - 4. Introduce air into sealed line until internal pressure of 4.0 psig is achieved.
  - 5. Allow pressure to stabilize for 2 minutes, but in no case let pressure drop to less than 3.5 psig.
  - 6. Failed Test:
    - a. If pressure drops 0.5 psig in less than 4 minutes, test will be considered to have failed.
    - b. If lined lateral fails air test, locate leak and perform corrective measures including:
      - 1) Re-inspection of lateral by CCTV.
      - 2) Repair using materials and methods specified.
      - 3) Repeat air test.
  
- D. Laboratory Testing:
  - 1. Samples: For every 10 laterals lined, two flat plate samples shall be processed and tested. Samples removed for testing shall be individually labeled and logged to record the following:
    - a. OWNER's project number and title.
    - b. Sample number.
    - c. Segment number of line as noted on supplements.
    - d. Date and time of sample.
    - e. Name of CONTRACTOR.

- f. Location and by whom tested.
  - g. Street name and address.
  - h. Test results.
2. CONTRACTOR shall prepare the flat plate samples onsite using the actual CIPP liner being installed. Once the liner is applied to the clamped mold, the Sample shall be placed in either the upstream or downstream manhole, to simulate the environmental conditions that the lateral liner being installed will experience during the curing process. After the curing process has being completed, the sample shall be removed, labeled, and sent to the laboratory facility for physical properties testing.
  3. Field Thickness testing shall be in accordance with ASTM D2122. The average thickness, calculated from four measurements on each specimen, shall be equal to or greater than the required design thickness. Failure of the thickness test shall be grounds for rejection of all CIPP liners installed since the last successful test.
  4. Samples shall be tested for modulus of elasticity and flexural strength in accordance with ASTM D790. Preparation and testing samples shall be performed in accordance with the approved submittals. Failure of either the modulus or flexural strength tests on either sample shall be grounds for the rejection of all CIPP liners installed since the last successful test.
  5. Testing shall be completed by an accredited laboratory at the CONTRACTOR's expense. Testing results shall be provided to the OWNER within 7 days of receipt.

**E. CIPP Correction:**

1. Correct failed liner or liner deemed unacceptable by Engineer as result of CCTV inspection, leakage test results, laboratory testing, or thickness test.
2. Remedy for failed laboratory and thickness test shall be as shown in the following table:

Pipe Correction			
Test	Required Value	Test Result	Remedy
Flexural Strength	4,500 psi	4,300 to 4,490 psi	10% unit price reduction
	4,500 psi	4,100 to 4,290 psi	30% unit price reduction
	4,500 psi	Less than 4,100 psi	Pipe replacement
Flexural Modulus	250,000 psi	238,000 to 249,000 psi	10% unit price reduction
	250,000 psi	225,000 to 237,900 psi	30% unit price reduction
	250,000 psi	Less than	Pipe replacement

Pipe Correction			
Test	Required Value	Test Result	Remedy
		225,000 psi	
Thickness	Minimum or design, whichever is greater	$\geq 90\%$ to 100%	No unit price reduction
	Minimum or design, whichever is greater	$\geq 80\%$ , but less than 90%	15% unit price reduction
	Minimum or design, whichever is greater	$< 80\%$	Pipe replacement

### 3.06 CLEANING

- A. After liner installation has been completed and accepted, the CONTRACTOR shall clean up the entire project area and restore Site to its original condition prior to the commencement of work. Excess material and debris not incorporated into the permanent installation shall be disposed of by the CONTRACTOR.

**END OF SECTION**