SECTION 02548
CURED-IN-PLACE PIPE LATERAL LINER

PART 1. GENERAL

1.01 SCOPE

A. The Work of this Section includes providing a cured-in-place pipe (CIPP) liner to stabilize structural defects and constructional inadequacies in sanitary sewer lateral pipelines. The liner shall be smooth, hard, strong, and chemically inert.

B. CONTRACTOR to provide materials, labor, equipment, and services necessary for: bypass pumping or diversion of sewage flows, pre-installation procedures, rehabilitation of existing sanitary sewer services by lining existing pipe, re-establishing connections to existing sewer main, initial and final CCTV inspection, and final testing of the CIPP system.

1.02 SUBMITTALS

A. Action Submittals:
   1. Manufacturer's technical literature on proposed lining system conforming to this Specification and the standards referenced herein.
   2. Information from resin manufacturer, including specifications, physical and chemical properties.

B. Informational Submittals:
   1. Design Calculations:
      a. For the liner thickness per ASTM F1216. Design shall be signed and sealed by a professional Engineer registered in the State of Tennessee and certified by the manufacturer as to the compliance of its material to the values used in the calculations.
      b. Data and design calculations for each lining segment, together with an installation method statement.
   2. CIPP sampling, preparation/curing and testing procedures.
   3. CIPP repair methods.
   4. Proposed testing laboratory with qualifications and experience history and references.
   5. Certificates:
      a. Affidavit attesting to the previous successful use of the material for lining sanitary sewer laterals and references for projects completed within the past 5 years that total a minimum of 500 lateral liners installed.

b. Written certification from manufacturer that installer is an approved applicator of lining materials, with a minimum of 3 years' experience in sewer rehabilitation.
c. Written certification that the resin material is appropriate for the intended application.

6. Test Reports:
   a. Certified copies of test reports on physical properties and chemical resistance of the proposed resin.
   b. Sample liner coupons.
7. Installation and wet out process control sheets.
8. Pre and Post CCTV inspection DVDs.
9. CIPP manufacturer certification of proper installation.

1.03 QUALITY ASSURANCE

A. Qualifications: Installer shall be licensed by the lining system manufacturer.

1.04 RESPONSIBILITY FOR OVERFLOWS OR SPILLS

A. It shall be the responsibility of the CONTRACTOR to schedule and perform its work in a manner that does not cause or contribute to incidence of overflows or spills of sewage from the sewer system.

B. In the event CONTRACTOR's work activities contribute to overflows or spills, the CONTRACTOR shall immediately take appropriate action to contain and stop the overflow, clean up the spillage, disinfect the area affected by the spill, and notify the OWNER in a timely manner.

1.05 DELIVERY, STORAGE, AND HANDLING

A. If the flexible tube is impregnated with resin at the factory, it shall be transported, installed, and cured before expiration of the shelf life.

B. Impregnated tube shall be stored and transported under refrigerated, ultraviolet light-free conditions.

C. Each liner shall be accompanied with the appropriate documentation indicating time and date of liner manufacturing, felt thickness, number of layers, length of liner, resin type and name, hardener type and name, batch numbers, and mixing ratios.

D. No cuts, tears, or abrasions shall occur during handling. CONTRACTOR shall not place the tube into the host pipe before the OWNER inspects the tube.

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 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:
   1. LMK Enterprises, Inc.; T Liner.
   2. AMerik Supplies, Inc.; TOP HAT System.
   3. Insituform Technologies, Inc.; Service Lateral Rehabilitation System.

2.02 MATERIALS

A. Resin:
   1. The resin used to impregnate the tube shall produce a cured tube that shall be resistant to shrinkage, shall not corrode or oxidize, and shall be resistant to abrasion from solids, grit, and sand.
   2. Proven resistance to the municipal wastewater environment that may comprise, as a minimum, all of the following factors:
      a. Immersion in septic sewage at temperatures up to 75 degrees F.
      b. Exposure in hydrogen sulfide gas from septic sewage at temperatures up to 75 degrees F.
   3. Proven resistance to ultra-violet light (sunlight) at any stage prior to installation.
   4. Solvent free epoxy resin. Polyester and vinylester resins are not acceptable.
   5. Shall not contain silicones, stereates, or natural waxes that would adversely affect the adhesives properties or any other chemical or physical properties of the CIPP liner.
   6. The internal wall color of the cured liner shall be a light reflective color so that a clear detailed CCTV inspection can be accomplished.
   7. Chemical resistance of resin system shall have been tested by resin manufacturer in accordance with ASTM D543. Exposure to the chemical solutions listed in Table 1 shall be conducted at temperatures of up to 75 degrees F. This test shall be conducted for a 1-month minimum period and shall result in a loss of not more than 20 percent of the initial structural properties.

Table 1 Minimum Chemical Resistance Requirements for Typical Municipal Sewer Applications (ASTM D543)	
Chemical Solution	**Concentration (%)**
Tap Water (pH 6-9)	100
Nitric Acid	5
Phosphoric Acid	10
Sulfuric Acid	10
Gasoline	100
Vegetable Oil	100
Detergent or Soap	0.1

8. Resin system shall be manufactured by a company selected by the CIPP supplier. Use epoxy resins complying with requirements in Table 2.

B. CIPP Lateral Lining Tube:
   1. General:
      a. One or more layers of flexible needled felt or an equivalent nonwoven material.
      b. Tube shall be continuous in length and wall thickness shall be uniform. Overlapping sections are not allowed in the circumference or the length of the lateral liner.
      c. Capable of conforming to offset joints, bells, 45-degree bends, 90-degree bends, and disfigured pipe sections.
   2. CIPP Properties: After curing shall meet the minimum structural properties listed below:

Table 2 CIPP Initial Structural Properties (ASTM F1216)		
Property	**ASTM Method**	**Minimum Value**
Tensile Strength	D638	3,000 psi
Flexural Strength	D790	4,500 psi
Short Term Flexural		
Modulus of Elasticity	D790	250,000 psi

3. CIPP Thickness:
   a. Calculate minimum thickness after curing based on the following design conditions in accordance with ASTM F1216:
      1) Fully deteriorated pipe condition.
      2) Subjected to a full soil load of 120 pounds per cubic foot.
      3) Soil reaction modulus for pipe zone backfill material is 1,000 psi.
      4) Subject to a groundwater elevation at ground surface.
      5) Long-term flexural strength and long-term flexural modulus of elasticity shall be equivalent to 50 percent of the initial flexural strength and initial flexural modulus of elasticity, respectively, as measured in accordance with ASTM D790.
      6) Safety: Minimum factor of 2.0.
      7) Design life of CIPP repair shall be 50 years.

C. Interface Seal:
   1. Structural properties in accordance with ASTM F1216 and as referenced in Table 2.
   2. Meet the 50-year design life of the CIPP lateral liner.
   3. Conform to one of the following two methods:
      a. Method A: A full-circle 16-inch long CIPP mainline liner integrally manufactured to lateral liner providing a seamless connection between mainline liner and lateral liner.
      b. Method B: One-piece construction designed such that when expanded shall tightly fit both “T” and “Y” connections at interface between mainline and lateral pipe.
   4. Shall provide a minimum of a 3-inch overlap inside the mainline and shall extend inside the lateral pipe past the first lateral joint up to 3 feet.
      1. Designed for either “T” or “Y” fittings and able to accommodate either condition without wrinkles or folds when installed.
      2. Provide a watertight connection between service connection and mainline.

D. Cleanouts and Boxes: As specified in Section 02532, Sanitary Sewers (Gravity).

PART 3. EXECUTION

3.01 TEMPORARY FLOW BYPASS AND DIVERSION PUMPING

A. CONTRACTOR shall provide for the transfer of flow, through or around section or sections of pipe that are to be repaired. The proposed bypassing system shall be approved in advance by OWNER. The acceptance of the bypassing system in advance by OWNER shall in no way relieve CONTRACTOR of responsibility or public liability. Temporary flow bypass and diversion pumping shall be carried out in accordance with Section 02542, Sewer Flow Control.

3.02 PRIVATE LATERAL SHUTDOWN

A. Prior to shutdown of private service lines provide notifications and comply with the requirements as specified in Section 02546, Cured-in-Place Pipe (Liner Process).

3.03 TRAFFIC CONTROL

A. CONTRACTOR shall provide traffic control in accordance with Section 01550, Work Zone Traffic Control.

3.04 PRE-INSTALLATION PROCEDURES

A. Submittals shall be approved, including traffic management measures, safe pedestrian passage, provisions of vehicular access to property, bypass/diversion pumping, and emergency measures prior to the commencement of the Work.

B. Lateral lining shall only occur after the corresponding mainline sewer has been lined, tested and approved by OWNER. It is the responsibility of the CONTRACTOR to ensure the proper sequence of work between the mainline and lateral lining activities. Lining of laterals before planned mainline lining activities have been completed and accepted by OWNER, will require CONTRACTOR to completely re-line laterals that were previously lined along the corresponding mainline pipe segment at no cost to the OWNER.

C. CONTRACTOR shall notify property owners or tenants affected by this construction at least 24 hours prior to any service disruption affecting their service connection. The mainline sewer shall be kept in operation at all times during the rehabilitation of the lateral lines.

D. CONTRACTOR shall CCTV inspect the lateral line immediately prior to reconstruction and determine the overall structural condition of the lateral.

E. Preconditioning shall be carried out in accordance Section 02540, Sewer Cleaning, and Section 02543, Sewer Line Chemical Root Treatment. In addition, CONTRACTOR shall prior to installation of the lining high pressure flush and vacuum the lateral and remove grease buildup or other obstruction that may interfere with lining operations.

F. If lateral liner installation requires the use of a cleanout, the rehabilitation work shall be accomplished utilizing existing cleanouts. No cleanouts shall be installed without the express written authorization from the OWNER.

G. CONTRACTOR shall obtain approval from OWNER before connection seal can be installed.

3.05 INSTALLATION

A. General:
   1. Install CIPP in accordance with practices outlined in ASTM F1216 for direct inversion installations.
   2. CIPP lateral liner installation shall be accomplished remotely using air or water for inversion and curing. The cured-in-place pipe shall provide be smooth conforming to existing pipe and shall eliminate groundwater infiltration or connection to the outside of the host pipe/service.

B. Wet Out:
   1. Thoroughly saturate flexible tube prior to installation. Catalyst system or additives compatible with the resin and flexible tube shall be as recommended by the manufacturer.
   2. Resin impregnated flexible tube shall be handled to retard or prevent resin setting until it is ready for insertion.
   3. CONTRACTOR shall complete a wet-out process control sheet for every lining completed. The control sheets shall provide the following information:
      a. Liner manufacturer.
      b. Liner diameter.
      c. Number of layers.
      d. Resin amount.
      e. Resin type.
      f. Resin manufacturer.
      g. Batch number.
      h. Hardener name.
      i. Batch number.
      j. Mixing ratios.
      k. Vacuum pressure of impregnation process.
      l. Wet-out start time and date.

C. Insertion:
   1. Install CIPP short lateral liner/interface seal from mainline sewer and extend up to 3 feet inside the lateral. No cleanout is required for the installation of the connection seal and the short lateral liner system.
   2. The CIPP lateral liner in excess of 3 feet shall be installed utilizing existing 4-inch or 6-inch diameter cleanout installed at the property line. It is the intent of these Contract Documents that lateral lining work be accomplished utilizing existing cleanouts. If a lateral has been identified to be repaired by means of a lateral liner installation and no cleanout exists at the property line, the CONTRACTOR shall obtain authorization from the OWNER to install a new cleanout.

3. The CONTRACTOR shall document the placement of the CIPP lateral liner by internal video inspection with the camera being inserted from the lateral cleanout down to mainline pipe. Installer shall be capable of viewing the lateral liner contacting the lateral pipe from the beginning to the end of the repair.
4. Use lubricant to reduce friction between the host pipe and the liner during the inversion and pull-in process. The lubricant used shall be a nontoxic product with no detrimental effects on the liner and shall be compatible with the wastewater treatment plant operations.
5. The addition of water pressure shall be adjusted to cause the impregnated flexible tube to invert from the mainline to lateral cleanout, holding the tube tight against the host sewer pipe.
6. If water is used to accomplish the inversion process, the CONTRACTOR shall complete an installation process control sheet for every lining completed. The control sheets shall provide the following information:
   a. Liner length.
   b. Hydrostatic head at point of inversion.
   c. Hydrostatic head at termination point.
   d. Time when inversion process starts.
   e. Time start cutting ends.
7. If air is used in the inversion process, liner manufacturer shall provide the minimum pressure required to hold the tube tight against host pipe and maximum pressure allowable to not damage the tube. Once the inversion has started, the pressure shall be maintained between the recommended pressure ranges until the inversion has been completed. Should the pressure deviate from within this range, the installed liner shall be removed. The CONTRACTOR shall complete an installation process control sheet for every lining completed. The control sheets shall provide the following information:
   a. Liner length.
   b. Minimum pressure.
   c. Maximum pressure.
   d. Time and pressure when inversion process started and every ten minutes until inversion process completes.
   e. Time start cutting ends.
8. Trim cured tube/resin composite pipe left protruding from the service connection back using a hydraulic-powered robotic cutting device specifically designed for cutting cure-in-place pipe.

D. Interface Seal Installation:

   3. Install interface seal and lateral liners according to the following two instances:

   a. On main line sewers that have been lined under this Contract, each reinstated lateral that has not been identified to be rehabilitated by means of a CIPP lateral lining shall have a connection seal installed in accordance with Method B of this Specification. The connection seal shall extend at least past

the first lateral joint, past the connection to the mainline pipe, and up to 3 feet into the lateral.

b. Each reinstated lateral that has been identified to be rehabilitated by means of a CIPP lateral lining shall have an interface seal installed in accordance with Method A or Method B of this Specification. The interface seal and lateral liner shall extend at least 15 feet into the lateral.

2. If the interface seal requires insertion, the seal shall be completely installed via remote device without excavation. The interface seal between the lateral liner and the mainline sewer pipe shall be compatible with the mainline liner and the lateral liner/pipe.
3. The interface seal shall be properly expanded to tightly fit the lateral interface. A full protocol for time and temperature shall be completed and documented for the proper curing of the seal.
4. The CONTRACTOR shall complete a curing process control sheet for every lining completed. The control sheets shall provide the following information:
   a. Temperatures and time for the different steps of the curing process such initial cure, post-cure, and cooling as outlined in ASTM F1216.
5. The curing process shall be conducted in accordance with the practices outlined in ASTM F1216.
6. Fit heat source with suitable monitors in accordance with ASTM F1216. The temperature of the incoming and outgoing heat source shall be recorded in order to determine when uniform temperature is achieved throughout the length of the liner. Thermocouples shall be installed at the top and bottom of the liner between the liner and the host pipe to appropriately control the resin curing process.
7. If air is used in the curing process, the liner manufacturer shall provide the minimum pressure required to hold the tube tight against the host pipe and maximum pressure allowable to not damage the tube. Once the inversion has started, the pressure shall be maintained between the recommended pressure ranges until the inversion has been completed. Should the pressure deviate more than 2.3 feet of water from within this range, the installed liner shall be removed.
8. If the curing process occurs at ambient temperature, the CONTRACTOR shall record the time when the curing process starts, time for initial hardness, and time when full cure is accomplished.

E. Transport debris removed from the sewer during cleaning in watertight containers and disposed of in accordance with all local, State, and Federal regulations.

3.06 FIELD QUALITY CONTROL

A. Inspection:
   1. The finished CIPP shall be continuous and free from visual defects such as foreign inclusions, dry spots, pinholes, delamination, and wrinkles greater in length than 1 percent of the pipe ID.

2. Section of lining with such defects shall either be removed and replaced at no additional cost to the OWNER or the CONTRACTOR will not receive payment for any work associated with rehabilitating the lateral in question (including connection seal).

B. Post-Televising of Completed Work:
   1. Following completion of CIPP liner installation, a CCTV inspection shall be completed in accordance with Section 02541, Sewer Television Inspection.
   2. NASSCO Pipeline Assessment and Certification (PACP) codes are not required for this inspection.
   3. Correction of failed CIPP or CIPP deemed defective from post-installation television inspection or test reports for structural values, thickness, etc., shall be repaired as determined by OWNER at no extra cost to the OWNER. Method of repair, which may require field or workshop demonstration, shall be approved by OWNER.

3.07 TESTING

A. 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. 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.
   4. Samples shall be numbered as follows:
      a. Sample No. 1: Flat plate sample.

5. Testing shall be completed by an accredited 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 7 days of receipt.

3.08 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