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

PART 1 - GENERAL

1.1 SECTION INCLUDES

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

1.2 PROCESS DESCRIPTION

A. The CIPP process is defined as the reconstruction of gravity sewer pipe by the installation of a 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 or steam 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.

1.3 CONTRACTOR EXPERIENCE

A. CONTRACTOR performing the CIPP process shall be required to provide a list of all projects of similar size and scope performed within the last three (3) years. The list shall include contact names and telephone numbers, as well as the CIPP process/system utilized, length, diameter, and monetary value of the work performed.

1.4 RELATED SECTIONS

A. Section 02547 - Manhole Rehabilitation.
B. Section 02540 - Sewer Cleaning.
C. Section 02541 - Sewer Television Inspection.
D. Section 02542 - Sewer Flow Control.
1.5 REFERENCES

A. Codes, Specifications and Standards
   1. Codes, specifications and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply unless otherwise shown or specified.

   ASTM D-543 Test methods for resistance of plastics to chemical reagents.
   ASTM D-790 Test methods for flexible properties of reinforced and unreinforced plastic and electrical insulating materials.
   ASTM D-3839 Practical for underground installation of flexible reinforced thermosetting resin pipe and reinforced plastic mortar pipe.
   ASTM F-1216 Rehabilitation of existing pipelines and conduits by inversion and curing of a resin impregnated tube.


1.6 SUBMITTALS

A. CONTRACTOR shall submit the following:
   1. Manufacturer's Certificate of Compliance certifying compliance with the applicable specifications and standards.
   2. Certified copies of test reports of factory tests required by the applicable standards and this Section.
   3. Manufacturer's installation instructions and procedures.
1.7 DELIVERY, STORAGE, AND HANDLING

A. CONTRACTOR shall be responsible for the delivery, storage, and handling of products. No products shall be shipped to the job site without the approval of OWNER or OWNER’S Resident Project Representative.

B. CONTRACTOR shall keep products safe from damage. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

1.8 DESIGN CRITERIA

A. The Cured-In-Place Liner thickness shall be calculated and designed based on the following physical condition of the existing pipe to be rehabilitated.

1. All pipes shall be considered fully deteriorated.

2. All pipes shall be subjected to full soil load with applicable Live Load, and water table 6-inch below the top of the ground.

3. All pipes should be considered to have a minimum of 2% deviation in the circumference.

4. Conditions (1) and (3) may change (after TV report), for later case-by-case design approved by DESIGN ENGINEER. DESIGN ENGINEER may also add, and/or modify the conditions, based on field information and other considerations.

B. Based on above criteria the following table has been prepared for the structural values specified in 2.1A. Thickness is rounded to the next higher multiple of 1.5 mm, after adding an allowance of 5% to the design thickness for resin migration. CONTRACTOR shall verify the thickness table for correctness, and have it changed by OWNER, through an addendum before the bid date, if necessary. After bid, the thicknesses given in the table shall govern, unless approved otherwise by OWNER in writing. Thickness, however, may not be reduced without due credit to OWNER, if approved by DESIGN ENGINEER.

C. DESIGN ENGINEER shall have the right to modify/change the required liner thickness, depending upon field condition evident from the video CD(s). An analysis of design criteria and calculations for the liner thickness, if different, shall be provided to DESIGN ENGINEER for approval, whose decision shall be final. DESIGN ENGINEER may vary the liner thickness for the same size sewer depending upon field condition of the pipes, and/or depths.
D. Correction of failed liner or liner deemed unacceptable, as a result of the post video inspection, and/or test reports for structural values, thickness, chemical resistance, etc., shall always be the responsibility of CONTRACTOR, at no extra cost to OWNER. DESIGN ENGINEER shall approve Method of correction/repair with prior field demonstration, if required. It shall be understood that minimum criteria of the specification shall not be lowered to compromise with lower than the required test values, unless approved by OWNER in writing.

**LINER THICKNESS**

<table>
<thead>
<tr>
<th>Sewer Diameter</th>
<th>Pipe Invert Depth up to 10' (also the min.)</th>
<th>Pipe Invert Depth 10'-15'</th>
<th>Pipe Invert Depth over 15'</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot;</td>
<td>4.5mm</td>
<td>4.5mm</td>
<td>4.5mm</td>
</tr>
<tr>
<td>8&quot;</td>
<td>6.0mm</td>
<td>6.0mm</td>
<td>6.0mm</td>
</tr>
<tr>
<td>10&quot;</td>
<td>6.0mm</td>
<td>6.0mm</td>
<td>7.5mm</td>
</tr>
<tr>
<td>12&quot;</td>
<td>6.0mm</td>
<td>7.5mm</td>
<td>9.0mm</td>
</tr>
<tr>
<td>15&quot;</td>
<td>7.5mm</td>
<td>9.0mm</td>
<td>10.0mm</td>
</tr>
<tr>
<td>18&quot;</td>
<td>9.0mm</td>
<td>12.0mm</td>
<td>13.5mm</td>
</tr>
<tr>
<td>21&quot;</td>
<td>10.5mm</td>
<td>13.5mm</td>
<td>15.0mm</td>
</tr>
<tr>
<td>24&quot;</td>
<td>12.0mm</td>
<td>15.0mm</td>
<td>16.5mm</td>
</tr>
<tr>
<td>30&quot;</td>
<td>15.0mm</td>
<td>18.0mm</td>
<td>21.0mm</td>
</tr>
<tr>
<td>36&quot;</td>
<td>16.5mm</td>
<td>21.0mm</td>
<td>24.0mm</td>
</tr>
<tr>
<td>42&quot;</td>
<td>19.5mm</td>
<td>24.5mm</td>
<td>28.5mm</td>
</tr>
<tr>
<td>48&quot;</td>
<td>22.5mm</td>
<td>28.5mm</td>
<td>33.0mm</td>
</tr>
</tbody>
</table>

PART 2. PRODUCTS

2.1 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>4500 psi</td>
<td>ASTM D 790 mod.</td>
</tr>
<tr>
<td>Modulus of Elasticity</td>
<td>250,000 psi</td>
<td>ASTM D 790 mod.</td>
</tr>
<tr>
<td>Chemical Resistance</td>
<td>loss not to exceed the above values</td>
<td>ASTM D 453</td>
</tr>
</tbody>
</table>
Certified copies of all test reports on the properties of the selected resin, and later, on the field liner coupons performed by the independent testing laboratory shall be submitted by CONTRACTOR to DESIGN ENGINEER. A minimum of two structural tests shall be necessary from each installation run and one test per run for chemical resistance quality. All testing costs are incidental and to be included in the unit price bid for CIPP.

B. Tube: Shall be supplied by the system licensor to CONTRACTOR in accordance with Section 5.1 of ASTM F 1216-89 and/or the latest revision thereof.

PART 3. EXECUTION

3.1 PRE-INSTALLATION PREPARATIONS

A. The following preparation/steps shall be completed, unless approved otherwise by DESIGN ENGINEER. Prior to the commencement of the actual liner inversion with approved liner thickness, CONTRACTOR must receive specific work order(s) and instructions based on earlier television inspections. All point repairs must be completed to OWNER’S satisfaction; equipment and material mobilized; and the DESIGN ENGINEER and OWNER’S Resident Project Representative shall be informed of the impending work schedules for liner installations.

1. Safety: CONTRACTOR shall carry out his or her operations in strict accordance with all applicable OSHA Standards. Particular attention shall be paid to those safety requirements involving work on an elevated platform and entry into a confined space. It shall be CONTRACTOR’S responsibility to be familiar with OSHA Standards and Regulations pertaining to all aspects of the Work.

2. Pre-Insertion Cleaning: It shall be at the discretion of CONTRACTOR to rewash, re-clean and ready the existing sewer pipe immediately before the pre-insertion television (TV) inspection, at a cost incidental to the insertion of liners.

3. Pre-Insertion Television (TV) Inspection: CONTRACTOR shall provide a CD of the video (TV) inspection. It shall be the responsibility of CONTRACTOR, to video (TV) inspect the sewer pipe immediately before the insertion of the resin impregnated tube, to assure that the pipe is clean and existing pipe conditions are acceptable for lining. This inspection as well as the video (TV) inspection after the inversion, shall be incidental to the insertion of the liner and no extra payment shall be made.
4. Dye Testing: Several sewer line segments may contain an excessive number of services for the dwellings served. CONTRACTOR shall determine through dye testing, or other OWNER-acceptable methods, the services that are live and require reinstatement prior to commencing lining of the sewer main. Services that are inactive, but reinstated, shall be plugged at CONTRACTOR’S expense. Dye testing is incidental to the work, and no extra payment shall be made for dye testing.

5. Bypassing Sewage: Reference Section 02542 Sewer Flow Control

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

B. All pre-installation preparations and procedures set forth by the process manufacturer shall be the responsibility of CONTRACTOR, at no extra cost to OWNER. It shall always be CONTRACTOR’S responsibility to make sure that the final Cured-In-Place Pipe (CIPP) shall be acceptable to OWNER and meet all the specified requirements of a finished pipe.

3.2 INSTALLATION PROCEDURES

A. Installation procedures may vary with the method of rehabilitation techniques/process approved for the project.

B. CONTRACTOR submittals shall 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. All such instructions and procedures submitted shall be carefully followed unless prior approval from OWNER is obtained for any necessary changes.

1. Wet Out
2. Insertion
3. Curing
4. Cool Down
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 DESIGN 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 OWNER-approved manner described later. It shall also meet the leakage requirements of pressure test as specified in Section 02532.

All liner installation will be warranted to be free from defects in materials and workmanship for a period of one (1) year from the date of Substantial Completion. Should a defect occur during this one (1) year period that is attributable to the liner installation or materials, and then this defect shall be repaired at no additional cost to the Owner.

Process Limitations: Though the installation process may be licensed or proprietary in nature, CONTRACTOR shall not change any material, thickness, design values, or procedural matters stated or approved in the submittals, without DESIGN ENGINEER'S prior knowledge and re-approval. CONTRACTOR shall submit in writing full details about component materials, their properties and installation procedures and abide by them fully during the entire course of the project.

C. The minimum required performance criteria and/or standards, physical/structural properties, chemical resistance tests, and the liner thicknesses as given in this Specification shall be strictly complied with. It shall be the responsibility of CONTRACTOR to comply with the specifications in full without any request for any deviation after the award of the Contract. OWNER reserves the rights to accept, reject, or modify any later requests for deviation to the Specifications, at no additional cost to OWNER or even to the extent of claiming a credit to the Contract Price. OWNER reserves the right to reject any Submittal and CIPP process not complying with these Specifications and to waive any informalities or minor defects therein. CONTRACTOR shall agree that such rejection shall be without liability on the part of OWNER for any damage or claim, including but not limited to loss of profits, savings or income, or any indirect, consequential, incidental, exemplary, punitive or special damages brought by CONTRACTOR because of such rejections, nor shall CONTRACTOR seek any recourse of any kind against OWNER because of such rejections. The filing of a Bid in response to this invitation shall constitute an agreement by CONTRACTOR to these conditions.

D. OWNER requires a continuous, uniform liner for a pipeline section. OWNER may not allow intermediate excavation for new manhole for whatever reason, even at no cost to OWNER.

3.3 SEALING AND BENCHES IN MANHOLE

A. The CIPP shall make a tight fitting seal with the existing pipe(s) in the manhole. The top half of the pipe shall be neatly cut off and not broken or sheared off, at least four
(4) inches away from the walls. 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. Channel cross-section shall be U-shaped with a minimum height of 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 inch vertical for every 12 inches horizontal pitch towards the channel.

B. The rubber joint seal shall be an extended hydrophilic rubber compounded from chloropene (Neoprene) rubber and a hydrophilic resin, which expands upon contact with water. The rubber joint shall be bonded with adhesive on one face to hold it in place during assembly. On contact with water, the rubber shall swell by up to 10 times its original volume if necessary, and mold itself to completely fill any gaps and exert pressure evenly to ensure the seal. High compression or bolt up forces shall not be necessary to affect a complete and watertight seal.

C. CIPP and the existing pipe in the manhole must 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.

3.4 SERVICE REINSTALLMENTS

A. The exact location and number of service connections shall be determined from TV CDs and/or in the field. It shall be CONTRACTOR’S responsibility to accurately field locate all existing service connections. The contractor shall reconnect all active service connections to the liner pipe. All initial internal service cut outs shall be made to the lesser of a 6-inch diameter opening or 90% of the original diameter of the connection. If the service cannot be relined or replaced through excavation, internally reinstate the service to 100 percent of the original opening, and provide a smooth opening with no ragged edges. Services shall not be reconnected from unoccupied, abandoned or vacant lots, unless directed otherwise by OWNER or OWNER’S Resident Project Representative. 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.

3.5 SERVICE CONNECTION BY EXCAVATION

A. All existing active service connections shall be excavated at the exact location as exposed. They shall be disconnected at the joints and 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 6-inch diameter hole is drilled out. The cut out hole in the liner shall be coated with approved resin/epoxy that will cure at the ambient temperature.

B. A pre-fabricated polyethylene saddle or approved equal fitting shall be installed over the cut out by CONTRACTOR. 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 service shall be replaced to the property or easement line or to the distance shown on the plans, and terminated with a cleanout. The new 6-inch stub-out, or lateral, shall be connected to the existing service line with a flexible PVC coupling, "Fernco" or OWNER-approved equal.

C. At all points where the liner pipe or service line has been exposed (e.g., in access shafts, service connections, outside of manholes, etc.), CONTRACTOR shall prepare for the placement of a crushed stone backfill by removing all debris and creating a void below and around the pipe. The width of this void shall not exceed 4/3 of the liner's outside diameter plus 15 inches. Use a minimum of 6 inches of 1/2" to 3/4" crushed stone to provide bedding for the liner and service line. Provide the rest of the backfill from 6 inches above the pipe to grade as specified in Section 02321. Replace pavement removed during excavation in accordance with the requirements of Section 02740 as applicable.

3.6 TESTING FOR ACCEPTANCE

A. Television (TV) CDs shall be required after the liner has been installed in the existing sewer pipe. The televising shall be done after all service connections have been made, unless required earlier by DESIGN ENGINEER or OWNER’S Resident Project Representative.

B. Low-pressure air test as specified in Section 02532 shall be required after the liner has been installed in the existing sewer pipe and connections made.

C. At the manhole connections no visible leak around the liner shall be allowed.

3.7 CLEAN UP

A. After the installation work has been completed and all testing acceptable, CONTRACTOR shall clean up the entire project area and return the ground cover to grade. CONTRACTOR shall properly dispose of all excess material and debris not
incorporated into the permanent installation in accordance with all applicable laws and regulations and with Section 02321, paragraph 3.4. Sidewalks, driveways, and street surfaces shall be restored as specified.

3.8 PATENTS

A. CONTRACTOR shall warrant and save harmless OWNER and DESIGN ENGINEER against all claims for patent infringement and any loss resulting therefrom.

3.9 PRIVATE SERVICE LINE SHUTDOWN

A. When it is necessary to shutdown a private service line while work is in progress and before the service lines are reconnected, the Resident Project Representative shall to be notified by CONTRACTOR at least one week prior to the shutdown. All resident notifications are to be handled by OWNER’S Customer Support Representative. CONTRACTOR shall not contact residences during the course of the work unless specifically instructed to do so by OWNER or OWNER’S Resident Project Representative. No service is to remain shutdown for more than a period of eight (8) hours unless CONTRACTOR provides substitute services for the residents. If the service is to be shutdown for more than eight (8) hours and CONTRACTOR cannot provide substitute services, then CONTRACTOR shall be required to provide temporary living quarters (i.e. hotel) for the resident at no additional cost to OWNER or the resident. Temporary living quarters must be approved by OWNER and coordinated through OWNER’S Customer Support Representative.

B. Commercial sewer services shall be maintained at all times 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.

3.10 WARRANTY

A. All liner installation shall be warranted to be free from defects in materials and workmanship for a period of one (1) year from the date of Substantial Completion. Should a defect occur during this one (1) year period that is attributable to the liner installation or materials, this defect shall be repaired at no additional cost to OWNER.

END OF SECTION