

*[Brackets and italics indicate a decision point or note to the specifier/engineer and should be deleted once the decision is made]*

## **SECTION 02800**

### **CURED IN PLACE (CIP) SEWER LINING**

#### **PART 1 - GENERAL**

##### **1.1 SUMMARY**

- A. Section Includes:
  - 1. Cured In Place Sewer Lining
  - 2. Service Lateral Reinstallments
  
- B. Related Sections:
  - 1. Division 1 – General Requirements
  - 2. Division 2 – Submittals

##### **1.2 QUALITY ASSURANCE**

- A. Referenced Standards:
  - 1. American Society for Testing and Materials (ASTM)
    - a. C581, Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used In Glass Fiber Reinforced Structures, Intended for Liquid Service.
    - b. D543, Test Method for Resistance of Plastics to Chemical Reagents.
    - c. D790, Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
    - d. D1600, Standard Terminology for Abbreviated Terms Relating to Plastics.
    - e. F1216, Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
    - f. F1743-96, Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP).
  
- B. Qualifications
  - 1. Manufacturer:
    - a. Manufacturer shall have a minimum of five years experience in the manufacture of the proposed CIP lining system.
    - b. Manufacturer shall be licenser of the CIP lining system.
  - 2. Contractor:

- a. Contractor's on-site superintendent shall be certified by the manufacturer that they have completed a training program for installation of the lining system.
- b. Contractor's on-site superintendent shall have installed a minimum of 10,000 ft of the proposed lining system.

### **1.3 SUBMITTALS**

- A. Quality Control
  1. Manufacturer's Quality Control Program
  2. Name of Manufacturer's Quality Control Manager.
  3. Factory test reports
- B. Shop Drawings:
  1. See Section ##### – Shop Drawings, Product Data and Samples and Miscellaneous Submittals.
  2. Product technical data including:
    - a. Manufacturer's installation instructions.
    - b. Physical properties datasheet.
  3. Wall Thickness Design Calculations
- C. Certifications:
  1. Manufacturer certification of Contractor's on-site superintendent.
  2. Manufacturer certification that products submitted meet requirements of standards referenced.
- D. Video Inspections
  1. Pre-installation inspection video and computer reports.
  2. Post-installation inspection video and computer reports.
- E. Phasing Plan including:
  1. Bypass pumping procedure
  2. Order of construction
  3. Traffic control plan
- F. Installation Reports

## **PART 2 - PRODUCTS**

### **2.1 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  1. Mississippi Textile Corp.
  2. Masterliner

3. Liner Products
  4. Pre-approved equal.
- B. Submit request for substitutions in accordance with Section #### – Product Substitutions.

## 2.2 MATERIALS

- A. Fabric Tube:
1. Tube material shall consist of one or more layers of absorbent non-woven felt or woven fiberglass.
  2. The tube material shall meet the requirements of ASTM F1216, Section 5.1.
  3. The tube shall have uniform thickness that when compressed at installation pressures will meet or exceed the design thickness.
  4. The outside layer of tube (before wetout) shall be plastic coated with a translucent flexible material that clearly allows inspection of the resin impregnation (wetout) procedure. This plastic coating shall not delaminate after curing of the CIP liner.
  5. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers.
  6. The wall color of the interior surface of the tube shall be light reflective to facilitate closed circuit video inspection.
  7. Dimensions:
    - a. Length: Sufficient to span the distance between entry and exit manholes. Distances to be field-verified by Contractor prior to manufacturing.
    - b. Outside Diameter: Fabricated to a size that will tightly fit the internal circumference of the original pipe. Allowance should be made for circumferential stretching during inversion.
- B. Resin:
1. The resin system shall be a corrosion resistant polyester, vinylester or epoxy system including all necessary catalysts, initiators and hardeners.
  2. The resin system shall meet the requirements of ASTM F1216 and F1763 including the physical properties herein.
  3. PET/Isophthalic polyester resins are not allowed. Polyester may be either all isophthalic acid or all terephthalic acid but not a combination of both.
- C. Structural Requirements:
1. The CIP liner thickness shall be designed in accordance with ASTM F1216, Appendix X1. The design parameters shall be as follows:  
*[Specifier should put the design parameters for pipe condition, depth, groundwater height and live load in a table in the drawings or specifications if they are significantly different for each run of sewer]*

- a. Pipe Condition: *Fully Deteriorated / Partially Deteriorated*  
*[Specifier must decide which pipe condition to use and delete the other]*
  - b. Depth of Existing Pipe Invert: ###
  - c. Soil Modulus: *500 psi*
  - d. Height of Groundwater Above Top of Pipe: ###
  - e. Ovality of Existing Pipe: *2%*
  - f. Soil Load: *120 lbs/ft3*
  - g. Live Load: *Highway H20 / Railroad/ None* *[Specifier must decide which Live Load to use and delete the other]*
  - h. Long Term Flexural: 50% of ASTM D-790 value
  - i. Maximum Deflection: 5%
  - j. Minimum Safety Factor: 2.0
  - k. Resin Migration: 5%
2. The cured CIP liner shall have the following minimum structural properties:

	<b>Test Method</b>	<b>Minimum Value</b>
Modulus of Elasticity	ASTM D-790	400,000 psi
Flexural Stress	ASTM D-790	4,500 psi

- 3. Contractor shall provide wall thickness design calculations for Engineer's approval prior to resin impregnation of the liner.
- 4. The finished CIP liner shall yield the minimum wall thickness as calculated by ASTM F1216.

**PART 3 - EXECUTION**

**3.1 INSTALLATION PREPARATION**

- A. The Owner shall be responsible for the following:
  - 1. Locating and opening all manhole access points for the work.
  - 2. Providing right-of-way to access the manhole locations.
  - 3. Providing free water from nearby sources, such as fire hydrants, for process of the work. Contractor shall make every effort to conserve water.
- B. Cleaning of Sewer Line – Debris which would interfere with the installation of the liner shall be removed. The Contractor shall dispose of debris in a location approved by the Owner and in accordance with all Federal, State and Local regulations.
- C. Line Obstructions – The line shall be cleared of obstructions such as solids, dropped joints, protruding service connections or collapsed pipe that may prevent pipe installation. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment,

then a point repair excavation shall be made to uncover and remove or repair the obstruction. Such point repair shall be approved in writing by the Owner's representative prior to commencement of the work and shall be considered as a separate pay item.

- D. Service Locations - The Contractor shall be responsible for confirming the locations of all active branch connections prior to installing liner.
- E. The Contractor shall verify that the diameter of the pipeline to be rehabilitated is the same as that specified on the drawings.

### **3.2 TELEVISION INSPECTION**

#### **A. General**

1. Pre-Lining TV Inspection: Prior to liner installation, Contractor shall visually inspect pipe sections by means of closed circuit television camera to identify any unknown defects or obstructions and to accurately locate active sewer services.
2. Post-Liner TV Inspection: Contractor shall re-inspect lined pipe sections after the completion of lining to verify the integrity of the liner and restored service connections.

#### **B. Equipment:**

1. The television camera shall be specifically designed and constructed to perform sewer inspections. The camera shall have a minimum sensitivity of 3 lux, with remote focus, iris, and light intensity control. The camera shall be operative in 100 percent humidity conditions and have a head that will rotate 180 degrees on axis and 360 degrees on arc to give full view of laterals, joints and any defects.
2. Lighting for the camera shall minimize reflective glare.
3. A remote reading footage counter, accurate to two-tenths of a foot, shall be used.
4. The camera shall be mounted on skids or a tractor with wheels suitably sized for each pipe diameter.

#### **C. Procedure:**

1. The camera shall be moved through the line at a speed no greater than 30 feet per minute.
2. The camera shall pan and tilt at all sewer defects and lateral connections to provide a video of each location. This is required for pre- and post-liner inspections.
3. If during the inspection the television camera will not pass through the entire sewer section, the Contractor shall perform the inspection from the opposite manhole. If again the camera fails to pass

through the entire sewer section, the inspection shall be considered complete.

4. Footage measurements shall begin at the centerline of the upstream manhole, unless otherwise specified by the Owner or Engineer. Footage shall be shown on the streaming video view at all times and manually checked by use of a walking meter, roll-a-tape, or other suitable device.
5. Provide video showing full circumference of pipe inlet, pipe outlet, and every lateral.

D. Documentation:

1. Color video recordings in VHS, MPEG, or .avi format shall be made of the television inspections and two copies each shall be supplied to the Owner.
2. Computer generated inspection reports shall include the following
  - a. Fault Report showing a picture of each fault or service connection along with the footage to their location.
  - b. Log Report showing a schematic drawing of the sewer run. This report shall indicate the severity of the fault and its footage location. The severity of the faults shall be indicated by a color coding system.

### **3.3 SEWAGE BY-PASSING**

- A. The Contractor shall provide for the flow of wastewater around the section or sections of pipe designated for rehabilitation. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or into an adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. The Contractor shall take all necessary precautions to prevent flooding on any private property. The Contractor will be liable for any damages incurred should flooding occur. Raw sewage must be pumped into the sanitary system or disposed of in some manner as approved by the Department of Environmental Quality.
- B. The Contractor shall maintain sanitary sewer usage throughout the duration of the project. In the event that service is temporarily disrupted, the Contractor shall be required to notify the Owner and all affected properties whose service lateral will be shut down and to advise against water usage until the lateral is back in service. Such notification shall be provided to the affected residents at least one week prior to service disconnection. The Contractor will be liable for any damages incurred should flooding or water damage occur.

### **3.4 PUBLIC NOTIFICATION**

- A. 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 sanitary sewer and informing them of the work to be conducted, and if the sewer service will be off-line.
- B. The Contractor shall also provide the following:
  - 1. Written notice to be delivered to each home or business describing the work, how it affects them, and a local telephone number of the Contractor they can call to discuss the project or any problems which could arise.
  - 2. Written notice the day prior to the beginning of work being conducted on the section relative to the residents affected.
  - 3. Personal contact with any home or business which cannot be reconnected within the time stated in the written notice.

### **3.5 PIPE LINER INSTALLATION**

- A. CIP liner installation shall be in accordance with ASTM F1216, Section 7, or ASTM F1743 and the manufacturer's recommendations. Either the inversion or pull-in method is acceptable.
- B. Liner Insertion:
  - 1. Make all point repairs and clear all obstructions, as identified during initial video inspection, prior to pipe lining.
  - 2. Inversion Method:
    - a. Wetout tube shall be inverted into the existing sewer line through an existing manhole using hydrostatic water pressure or air pressure.
    - b. Inversion pressures shall be kept below the maximum values recommended by the liner manufacturer. Contractor shall take care to use the minimum pressure that causes the inversion to progress to prevent stretching of the liner.
  - 3. Pull-In Method:
    - a. Use a power winch and steel cable connected to a pulling head as recommended by the manufacturer to advance the pipe liner.
    - b. Insert pipe liner into entry manhole and slowly feed from the supply reel, while simultaneously pulling pipe liner at the exit manhole. Maintain two-way communication between personnel at entry and exit manholes to coordinate the rate of pipe liner supply and pulling operations.
    - c. Contractor shall inform the Engineer of the maximum allowable pulling force that can be used to insert the liner. This maximum force shall be provided by the liner manufacturer and shall prevent stretching or rupturing of the liner. The pulling force

shall be measured and monitored at all times during the insertion process.

C. Liner Curing and Processing:

1. Curing shall be accomplished by utilizing hot water under hydrostatic pressure or pressurized saturated steam.
2. The heat source for the curing process shall be fitted with suitable monitors to gauge the incoming and outgoing heating fluid.
3. Install temperature and pressure gauges at entry and exit manholes to monitor internal conditions during pipe liner curing.
4. Introduce hot water or pressurized steam to develop and maintain conditions inside pipe liner in strict accordance with manufacturer's recommendations. Curing equipment shall allow Contractor to introduce cold water or air to control the temperature of the curing process.
5. Contractor shall maintain constant pressure on the liner during the curing process to keep the liner in tight contact with the existing pipe.
6. Once the exothermic process begins to take place, the Contractor shall control the temperature of the curing process to prevent overheating of the liner.
7. The curing process shall continue until the exothermic reaction is completed and the liner is cooled to below 100 degrees.

D. Installation Documentation - Contractor shall complete an Installation Report for each section of lining that includes the following information:

1. Owner Name
2. Project Location
3. Installation Date
4. Superintendent's Name
5. Weather Conditions
6. Section Length
7. Pipe Diameter
8. Pipe Composition
9. Street Name
10. Liner Number and Length
11. Up and Downstream Manhole Numbers
12. Time to Insert in Liner
13. Pull Force
14. Curing Time
15. Time of Exothermic Reaction
16. Time, Temperature and Pressure during Liner Processing
17. Cool Down Time
18. Description of any problems during installation



- E. Service Lateral Reinstatement:
  - 1. Reinstall existing service connections using remote controlled methods as approved by the manufacturer or otherwise approved by the Engineer.
  - 2. After creating a hole in the liner, polish the edges of the hole to remove sharp edges and improve flow conditions. The clear opening in the liner for the service lateral shall provide a minimum of 90 percent of the capacity of the lateral pipe.
- F. Manhole Sealing and Benches:
  - 1. Provide a watertight seal at the insertion and termination points in the manholes, in accordance with the liner manufacturer's recommendations.

### **3.6 TESTING AND INSPECTION**

- A. CIP Liner Field Samples – When requested by the Engineer, the Contractor shall submit test results from other field installations of the same resin system and tube materials as proposed for this project. These test results must verify that the CIP liner physical properties are as previously specified.
- B. Post-Installation video per Section 3.2 shall be provided by the contractor.

### **3.7 SAFETY**

- A. The Contractor shall carry out his operation in strict accordance with all applicable OSHA standards. Particular attention is drawn to those safety requirements involving entering and working in confined spaces.
- B. All trenches shall be sloped and/or shored in accordance with applicable OSHA standards.

### **3.8 CLEAN UP**

- A. After the installation has been completed, the project area affected by the Contractor's operation shall be reinstated to its original condition.
- B. Any sidewalk, driveways, street surfacing disrupted shall be restored to original condition.
- C. No separate payment will be made for restoration but shall be considered incidental to the items of the Bid.

### **3.9 PAYMENT**

- A. Payment for the work included in this section will be in accordance with the unit prices set forth in the Bid for the quantity of work performed. Work performed such as street patching, by-pass pumping, temporary encasement pipes, dewatering, and other activities not listed on the Bid Form shall not be paid for directly but shall be considered subsidiary to the items of the Bid.