

**5. ENGINEERING DESIGN (Continued)**

The design for the lining shall be provided to the Owner prior to installation. Engineering properties used in the design shall be the appropriate long-term material properties. The design calculations shall show technical assumptions, identify the design formulas used and show the wall thickness and finished inside diameter. The ovality condition used in the calculations shall be identified. The Engineering design shall graphically illustrate the installation (depth of the sewer, water table, invert and crown) and shall provide full details of the parameters used.

**6. MANUFACTURING AND QUALITY CONTROL**

Detailed information describing the method of manufacturing and the final composition of the rehabilitation materials shall be provided. This information must also include descriptions of any major components not directly provided by the Manufacturer.

Documentation shall be submitted as to all components used to produce the final installed product. Detailed quality control procedures for rehabilitation materials, manufacturing and installation shall be submitted. This shall include inspection requirements, testing procedures, and allowable manufacturing tolerance levels. All related ASTM standards, or any nationally recognized standards, for product manufacturing must be submitted.

**7. INSTALLATION PROCEDURES**

**A. General**

The installation and all related work shall comply with the requirements of Federal, State, and Municipal regulations as applicable. Installer shall submit evidence of being trained to install the Product. All related ASTM standards, or any nationally recognized standards, for installation of the product shall be submitted. An itemized list detailing the installation procedures shall be submitted including the estimated time for each task, and any other items unique to each process.

**B. Preparation of Existing Sewer**

The sewer to be rehabilitated shall be prepared in accordance with the requirements for CIPP installation. Debris, grease, roots, calcite, and other deposits shall be removed without damaging the existing sewer walls. Any and all detritus produced thereby shall be removed from the sanitary sewer system.

The Contractor is responsible for all aspects of removal and proper disposal of material from the sanitary sewer system. The Owner does not have a designated disposal facility. The Contractor shall independently verify a disposal location prior to mobilizing to the site.

Where service laterals protrude into the sewer, these protrusions shall be removed without damage to the lateral or sewer pipe wall. Flail type equipment will not be permitted for the removal of protruding laterals. Lateral protrusions greater than ¼" will not be permitted.

If significant groundwater infiltration is present in the existing sewer, such as PACP infiltration gusher or multiple runners, the Contractor shall install a pre-liner tube or perform chemical grouting to control resin loss and contamination, maintain CIPP thickness, prevent physical property reduction and prevent inadequate curing of the CIPP resulting from water or other contamination of the resin during installation.

it to the next designated manhole or termination point.

Tube installation forces or pressures shall be limited so as not to stretch the tube longitudinally by more than 5% of the original length. The maximum inversion rate shall be 32 feet-per-minute, with a maximum hoop tension in the felt liner of 8,000 psi.

## **7. INSTALLATION PROCEDURES**

### **E. Insertion & Curing (Continued)**

#### **2. Curing**

Curing shall be accomplished utilizing hot water under hydrostatic pressure. A suitable heat source and water recirculation equipment shall be required to circulate heated water throughout the pipe. The equipment shall be capable of delivering hot water throughout the liner at the temperature required to properly cure the resin. Water temperature in the line during the cure period shall be as recommended by the resin manufacturer. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply. Another gauge shall be placed between the impregnated tube and the pipe invert at the termination to determine the temperature during cure. Readings shall be taken every 15 minutes. A record of the readings shall be provided to the Engineer.

Initial cure will occur during temperature heat-up and is complete when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize a cure in the resin. After initial cure is reached, the temperature shall be raised to the post-cure temperature recommended by the resin manufacturer. The post-cure temperature shall be held for a period as recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the boiler to maintain the temperature shall continue. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

The CIPP shall be cooled to a temperature below 100°F (38°C) before relieving the hydrostatic head. Cool-down may be accomplished by the introduction of cool water into the CIPP to replace water being drained from a small hole made in the downstream end. Care shall be taken in the release of the static head so that a vacuum will not be created that could damage the newly installed pipe.

The curing process shall be monitored by qualified personnel and written records (including boiler monitor graph) shall be maintained throughout the curing process. Records shall be kept on file and made available to the Engineer upon request.

Alternatively, steam curing and air inversion will be allowed if they are performed under current ASTM and NASSCO standards with corresponding documentation from the liner's manufacturer regarding their recommended installation and curing methods. Those documents should include their procedures for installation speed and pressure, and for maintaining a curing temperature log on their cure schedule. Provided that the manufacturer's specifications are followed, those methods will be acceptable.

### **F. Lateral Reinstatement**

Where service lateral flow has been interrupted, reinstatement of the lateral shall proceed immediately. Laterals may be partially reinstated sufficient to restore flow, with a full reinstatement within 12 hours. Lateral reinstatement shall be made internally with the