

## SPECIFICATIONS

### **PIPELINE SYSTEM REHABILITATION**

The intent of the work under this section involves the trenchless rehabilitation of existing sewer pipelines. This lining shall rebuild strength and substantially reduce possible infiltration, exfiltration, or root intrusion by providing a tight molded fit to the inside wall of the host pipe. The liner materials shall mold into the joints and over offsets to lock the liner into place and resist tracking of roots and water that could cause infiltration or exfiltration. The liner materials shall be chemical resistant to protect the host pipe against future deterioration of the pipeline and or joint materials due to the sewer environment.

The liner material shall be a seamless, jointless, solid wall material that will provide the maximum level of protection to the environment and against blockage by root intrusion. Pipe liners with joints will not be acceptable.

**SEWER REHABILITATION SHALL CONFORM TO SECTION 500 OF THE LATEST EDITION OF APWA STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION (“GREENBOOK”) AND ITS SUPPLEMENTS EXCEPT AS MODIFIED HEREIN.**

The Contractor shall select one of the following solid-wall, seamless, jointless, tight molded fitting liner systems listed below for the rehabilitation of existing sewer drain lines.

The criteria for selecting a liner system shall be based on the following, or as approved by the Engineer. Pipelines making bends or line size changes shall be CIPP, either type “A” or “B”. Other criteria such as severe grade, access limitations, and length may also dictate the type of liner to be used. In each case the Contractor shall select a liner type and provide justification to the Engineer and receive approval prior to installation.

- **Cured-in-Place Pipe Liner (CIPP Liner).** Shall comply with Subsection 500-1-4 Type “A” of the Standard Specifications for Public Works Construction.
- **Cured-in-Place Pipe Liner (CIPP Liner).** Shall comply with Subsection 500-1-4 Type “B” of the Standard Specifications for Public Works Construction.
- **Folded and Re-formed PVC Pipe Liner.** Shall conform to Subsection 500-1-10 Type “A” of the Standard Specifications for Public Works Construction.
- **Folded and Re-formed PVC Pipe Liner.** Shall conform to Subsection 500-1-10 Type “B” of the Standard Specifications for Public Works Construction.

**500-1.1.1 General.** (Add the following paragraphs):

The Contractor shall field verify the pipe diameter and lengths at the maintenance holes prior to ordering liner materials. The Contractor shall notify the Engineer of any discrepancies between existing plans and information obtained in the field.

A Contractor licensed or certified by the Manufacturer/Owner of the process or materials shall perform installation of the sewer lining. Bidders are required to submit copies of such

licenses or certifications with their bids. Failure to do so shall render the bid non-responsive.

Only manufacturing plants that have been inspected and evaluated by a GREENBOOK review team shall manufacture the flattened or folded plastic sewer lining material.

Contractors using Folded and Re-formed Plastic Pipe Liners shall submit the location of the inspected manufacturing location for the folded pipe extrusion plant.

Letters from the Manufacturer shall be submitted with the bid stating the location of the plant(s) inspected, the date of inspection and name of the review team members. Failure to do so shall render the bid non-responsive.

**Minimum pipe liner wall thickness:**

The minimum finished liner waterway thickness shall conform to Table 500-1.1.1. (A).

Table 500-1.1.1. (A)\*

Host Pipe Dia. (Inches)	6	8
Folded & Re-formed PVC:		
Dimension Ratio (DR)	35	35
Liner Thickness (inches)	.171	.229
CIPP:		
Dimension Ratio (DR)	46	50
Liner Thickness (inches)	.13	.16

\*Thickness based on 10' depth of cover over pipe; 5' groundwater; 1,000 psi soil modulus, 120 PCF soil weight; AASHTO Hwy loading; 2:1 safety factor; 50 year design life.

If the pipe liner process designed with a two to one (2:1) safety factor requires a thicker DR for the site, or existing pipeline condition, the Contractor shall provide the thicker pipe required.

CIPP designs shall use a minimum of seven percent (7%) extra resin to compensate for resin migration/seal factor to fill joints, cracked or deteriorated pipelines unless a higher percentage is required by the Manufacturer or host pipe condition to maintain the minimum wall thickness specified in table 500-1.1.1 (A).

**500-1.1.2 Submittals**

**500-1.1.3 Submittals Required with the Bid:**

**Working Knowledge of the Scope of the Project:** Name of person that inspected the job site and reviewed the closed circuit television (CCTV) log sheets and videos, if available.

**Manufacturers Material Certification:**

1. Copy of third party GREENBOOK chemical resistance test results (Pickle Jar Test) 210-2.3.3 or ASTM D 5813 (one year minimum test period) for each of the lining materials proposed.
2. Certification from Manufacturer that the formulation has not changed since the chemical resistance testing was completed.

**Product Trade Name:** Submit the trade name of the process, or processes proposed to complete this project.

**Product Manufacturer:** Copy of the Manufacturer's literature, material data sheets, and installation procedures.

Manufactured flattened or folded, plastic pipe liner supplier shall provide the pipe Manufacturer's company name, address, date of inspection and names of GREENBOOK committee review team members that reviewed the quality control procedures and inspected the manufacturing facilities.

Cured in Place Material: A copy of third party test results per ASTM D 2990 to verify long term creep reduction used to project 50-year physical property values.

**Submittals required before each installation of pipe****Factory Manufactured PVC pipe:**

1. Test results on each coil of pipe shall include all required testing results per the following GREENBOOK sections: Folded and Re-Formed plastic pipe liner 500-1.10.2 (c) or 500-1.10.3 (c)

**Cured-in-Place Pipe:**

1. Manufacturer's certification and test results that manufactured Cured-in-Place felt tubes meet the requirements of ASTM F1216 and meet the minimum strength requirements of ASTM D 5813.
2. Manufacturer's certification and test results that the polyester, vinyl ester or epoxy resin meet the physical requirements of ASTM F 1216, Table 1.
3. Calculations for the quantity of resin required for each wet out shall be submitted and approved by the Engineer prior to wetting out the liner.
4. A copy of the wet out log sheet, including the date, and the wet out supervisor's name. An Engineer registered in the State of California shall certify this wet out log, or the wet out shall be performed at a manufacturer's facility certified and operated under ISO 9000 or other internationally recognized quality control system. Manufacturer to submit a copy of ISO 9000 certification.

**Samples for testing required at the end of each installation**

1. A restrained test sample per specifications

## **Material Test Results required 30 days after installation**

1. Material test results from installation restrained test samples to verify compliance with the values specified.

### **500-1.1.4 Cleaning and Preliminary Inspection** (Add after the first paragraph.):

The Contractor shall assume that the pipes require heavy root cleaning unless it is noted in the Supplemental Conditions, TV log sheets, or video tapes made available to the Contractor before the bid opening. Heavy tuberculation may exist throughout the pipe and the Contractor shall anticipate the worst-case scenario for pipe cleaning. No additional costs for difficult cleaning or other problems will be accepted.

### **500-1.1.5 Television Inspection** (Third paragraph is replaced with the following):

CCTV inspection shall be preformed utilizing a rotating head video camera system.

(Add the following to the sixth paragraph):

Pre-lining and post-lining CCTV inspection shall be done while the flow in the line is bypassed.

The camera shall be stopped and the head rotated to look up every house lateral connection. A clear view shall be presented into each house connection for pre-rehabilitation, and a 360 degree panning view of the post-rehabilitation cut edge of the liner lateral connection.

### **500-1.1.7 Miscellaneous** (Modify by adding the following):

#### **(a) Service Connections** (Add the following paragraphs):

The Contractor shall pay the costs for all required point repairs or excavations made for service connections that are found plugged by the rehabilitation process.

Unless specifically directed by the Engineer in the Supplemental Conditions, all plugged service connections identified in the pre-lining videotape shall not be opened to prevent maintenance problems such as roots, infiltration, exfiltration or loss of backfill material into the newly lined pipe.

(Replace the fourth sentence in the second paragraph with the following):

The service opening shall be reinstated from a minimum of ninety percent (90%) to a maximum of one hundred five percent (105%) of the original service connection.

(Add to the end of the second paragraph):

The lateral opening cuts shall conform to the shape and size of the inside diameter of the existing service connection.

Service connections shall not be made until the liner pipe has stabilized. The use of mechanical restraining devices (such as red heads) that will restrict the pipe from completely stabilizing will not be allowed.

All final lateral cuts shall be finished with a wire brush to remove all chips, strings and curlicues to provide a smooth opening.

Lateral cut coupons shall be trapped and removed at the downstream manhole after the laterals have been opened. The Engineer will deduct up to fifty dollars for each lateral cut coupon two inches or larger left inside the sewer system.

Visible gaps one eighth of an inch (1/8") or larger between the outside liner waterway and the host pipe at the cut service connection will be sealed at the Contractor's expense using the following service connection sealing methods:

Method 1: Shore and excavate to expose the connection, use approved sealant to caulk the circumference of rehabilitation pipe to host pipe joint, seal the service connection to the host pipe with acid-resistant epoxy/resin mortar and backfill. The epoxy/resin material shall have proof of having passed the same chemical resistance test as the pipe liner materials.

Method 2: Robotic-access repair. Isolate the service connection to prevent unintended migration of grout. Pressure inject grout to seal the connection, annulus, broken joints, cracks, et cetera. A resin or grout mix: Portland cement, fly ash, water reducer and plasticizers to yield two thousand pounds per square inch (2,000 psi) compressive strength at twenty-eight days. Pressure inject grout until 0.25 cu. ft. is injected for pipe twelve inches (12") or less and a gage measured at the service connection is maintained for five minutes without grout take. If the grout isolation system fails or is ineffective, use Method 1 to seal all remaining connections. Remove errant grout that restricts full laminar flow from the service connection or pipe liner.

If the end of the liner pipe in the maintenance hole shrinks back inside the pipe during the warranty period the pipeline shall be re-televised by the Contractor. Any service lateral connections that have slipped or are offset shall be repaired by either method 1 or 2 specified above as approved by the Engineer. No extra compensation shall be paid for this.

**(Add these sections after the last paragraph above)**

**(b) Sanitation Facilities**

A clean portable unisex sanitation facility with a light shall be provided at each of the TV & cleaning, lining, and lateral cutting job sites for use by the Contractor's crews, City Inspector, and Engineer.

**(c) Bypass pumping**

Hoses and bypass pumps sized to adequately handle the flow shall be set up for every run. The bypass shall be set up and run prior to the pre-lining CCTV video and continued

throughout the entire lining process and lateral cutting. The bypass shall not be shut down until after the post-lining CCTV video is completed.

A spare pump of equal size and power to the one required to adequately handle the flow and sufficient extra fuel to operate eight hours shall be onsite as a backup for every bypass to prevent a sewer spill.

(d) Testing of the installed Liner.

1. Air pressure option: After the liner is installed and before the laterals are cut the installed liner pipe shall be air pressure tested per GREENBOOK section 306-1.4.4. The air pressure shall be stabilized at 5-psi gauge pressure and held for a time specified in table 306-1.4.4 (A) to the pipeline length with 0 ft house connections. The air pressure shall not drop too less than 4-psi gauge pressure after testing for the specified time.

If the time lapse is less than shown in the table, the Contractor shall make the necessary corrections to the liner pipe to reduce leakage to acceptable limits and retest.

2. Water leakage option: After the liner is installed and before the laterals are cut the installed liner pipe shall be tested with water for leakage in accordance with ASTM F 1216, paragraph 8.2 Gravity Pipe Leakage Testing.

#### **500-1.4 Cured-in-Place (CIPP Liner)**

**500-1.4.2 Material Composition and Testing** (Modify by adding the paragraph as follows):

The side of the liner exposed to the sewer flow after installation is completed shall have a layer of polyurethane bonded to it, with a minimum thickness of 0.01-inch and shall be pinhole free. All seams and patches in the polyurethane coating shall be inspected under a black light or thermal imaging device to assure a good bond. For pressure pipe the tube shall be put under a vacuum at the factory and submerged in a die bath to verify that it is pinhole free.

The factory test results for each length of felt tube to be installed shall be submitted to the Engineer before installation.

The felt tube shall be continuous and of sufficient length to extend the entire reach to be rehabilitated (from entry to end or exit point). No joints or laps will be permitted between maintenance holes.

The factory test results for each batch of resin shall be submitted to the Engineer before installation. Isophthalic polyester resins meeting the chemical resistance requirements of ASTM D 5813 (minimum one year exposure) shall be acceptable. The manufacturer shall certify that the resin used on this project is the same resin that was submitted and tested per ASTM D 5813 and D 2990.

(Replace the last paragraph with the following.):

Testing of the installed CIPP liner is required for this project.

1. One two-foot (2') long sample shall be cut from each section of the pipe liner that has been inserted through a same diameter pipe mold, at the upstream, downstream or any intermediate maintenance holes in accordance with ASTM D 5813 Section 7 Sampling. A minimum of one sample shall be taken for each installation of pipe liner. The samples shall be tagged with information including, but not limited to, the location of sample(s), date, pipe diameter and written verification by the onsite Inspector.
2. The Inspector shall check the sample using ASTM D 3567 to verify the minimum water way wall thickness specified in table 500-1 .1.1. (A)
3. The physical properties of the installed CIPP liner shall be verified through field sampling and independent laboratory testing as approved by the Engineer. The samples shall be submitted to an independent testing laboratory or factory testing laboratory and tested in accordance with ASTM 790 to confirm that the pipe liner conforms to the minimum flexural properties of ASTM F 1216, Table 1. Resin cure quality shall be tested per ASTM F1216.
4. All costs for the above testing shall be paid for by the Contractor and included in the bid price.
5. Test results are due within thirty (30) calendar days from the date samples are taken. The Contractor shall be responsible for repairing non-compliant pipe liner in accordance with section 500-1.4.8 of the SSPWC. The Engineer may grant a time extension for this repair.

**500-1.4.4 Chemical Resistance** (Modify last sentence of the paragraph as follows):

Proof of meeting these requirements shall be submitted with the Contractor's Bid.

**500-1.4.5 Installation** (Modify by adding the paragraphs as follows):

The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage, stretching during installation and loss of resin through cracks and irregularities in the host pipe. The calculations for the quantity of resin required shall be submitted and approved by the Engineer prior to wetting out the liner. A roller system shall be used to uniformly distribute the resin throughout the tube. The gap in the rollers shall be verified every 50 feet.

The Contractor shall use either an end-stop or holdback mechanism or other approved means to prevent the felt tube from extending into conduits, which are not to be rehabilitated.

**500-1.4.6 Curing** (Modify by adding these paragraphs as follows):

The heat source shall be fitted with monitors to gauge the temperature of the incoming and outgoing water or steam supply. Another such gauge shall be placed between the impregnated liner and the existing pipe invert at the remote maintenance hole to determine the temperature during cure.

The time required to cure is a function of the pipeline section diameter and length and shall be determined by the Contractor in accordance with the CIPP resin Manufacturer's instructions. The Contractor shall be responsible for determining when curing has been accomplished to meet the specified properties. Care shall be taken during the elevated curing temperatures so as not to over stress the fiber felt liner.

The cured liner shall have a smooth finish inside. Sanding or trimming the "fins" or folds shall remove any roughness over 5% of the id not to exceed 1/2 inch that may affect the hydraulic conditions. The Contractor may either apply a sealant compatible with the material to areas where sanding has taken place or re-line from maintenance hole to maintenance hole as approved by the Engineer.

(Add the following Subsections) **500-1.4.9 Handling**

The CONTRACTOR shall designate a location where the uncured resin in the original containers and the unimpregnated felt tube liner will be vacuum impregnated prior to installation. The Contractor shall allow the Engineer to inspect all materials and procedures. The Contractor shall pay all inspection costs including overtime and subsistence required for this wet out process and shall include this cost in the bid price.

#### **500-1.4.10 End Cuts**

The ends of the liner shall be cut off in the maintenance hole after installation. The cuts shall be smooth and parallel with the maintenance hole wall. The finished liner shall not protrude into the maintenance hole more than 2 inches.

If the maintenance hole has been lined through, the top half of the liner pipe may be cut off even with the top of the shelf leaving the channel lined.

The ends of the liner shall be sealed with an epoxy material that will bond with the materials of the pipe liner, host pipe and the maintenance hole.

#### **500-1.10 Folded and Re-formed PVC Pipe Liner Type "A" or "B"**

##### **500-1.10.2. (f) Installation and Field Inspection.**

**(2)** (Replace the paragraph with the following):

The use of a flexible heat containing or restraining tube is prohibited. The liner material shall mold directly against the host pipe to produce a tight molded fit to the host pipe.

**(7)** (Replace the last paragraph with the following.):

Testing of the installed PVC liner is required for this project.

1. The Engineer shall check the pipe coils before installation using ASTM D 2122-90 #7 to verify compliance with the minimum wall thickness in table 500-1.1.1. (A).



2. Before each installation the Contractor shall measure the OD of the liner pipe and the ID of the host pipe to verify that the liner will fit tightly and is not too small or too large.
3. One two-foot (2') long sample shall be cut from a section of the pipe liner that has been inserted through a same diameter pipe mold, at the upstream, downstream, intermediate, or above ground maintenance hole. One sample shall be taken for each installation. The Engineer shall designate the sampling location(s). The samples shall be tagged with information including, but not limited to, the location of sample(s), date, pipe diameter and written verification by the onsite Inspector.
4. The physical properties of the installed PVC liner shall be verified through field sampling and laboratory testing as approved by the Engineer. The samples shall be submitted to an independent or factory testing laboratory and tested in accordance with ASTM D 638 and ASTM 790 to confirm that the pipe liner conforms to the minimum requirements of the standard specifications section 500-1.10.2 (B) or 500-1.10.3. (B)
5. Pipe quality shall be verified through testing per ASTM F 1504 and F 1057 heat reversion test shall be performed on each test sample.
6. The costs for all testing shall be paid for by the Contractor and included in the bid price.
7. Test results are due within thirty (30) calendar days from the date the samples were taken. The Contractor shall be responsible for repairing non-compliant pipe liner in accordance with section 500-1.10.9 of the SSPWC. The Engineer may grant a time extension for this repair.

**500-1.10.4 End Seals** (Replace the paragraph with the following.):

After installation, the liner shall be cut off in the maintenance hole. The cut shall be smooth and parallel with the maintenance hole wall. The finished liner shall not protrude into the maintenance hole over two inches (2").

If the maintenance hole has been lined through, the top half of the liner pipe may be cut off even with the top of the shelf leaving the channel lined.

The ends of the liner shall be sealed with an epoxy material that will bond with the pipe liner material, host pipe material, and the maintenance hole materials.

**WORKING HOURS**

Normal working hours are 7:30 AM TO 4:30 PM. If the installation and preliminary cuts cannot be completed in the specified normal working hours the following shall apply. Lining will be allowed between only one maintenance hole to maintenance hole reach per day. No double runs.

All live laterals must be opened with a preliminary cut to relieve the flow the same day as the installation. The preliminary cuts shall be a minimum of a 3-inch smooth round cut. Final lateral cuts using the wire brush may be completed during normal working hours on a later day.