

**PREMIER-PIPE USA
TECHNICAL SPECIFICATION
CURED-IN-PLACE PIPE**

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PART 1 – GENERAL

1.01 THE REQUIREMENT

- A. This specification covers the work necessary to furnish and install complete, cured-in-place pipe (CIPP). The CONTRACTOR shall provide all materials, labor, equipment, and services necessary for bypass pumping and/or diversion of sewage flows, cleaning and television inspection of sewer to be lined, liner installation, reconnection of service connections, and final television inspection and testing of lined pipe system.

1.02 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

- A. The following references are part of this Specification, in case of conflict between the requirements of this Specification and those of the listed documents, the requirements of this Specification shall prevail. The latest edition of the following references shall be used:

- ASTM D543 Standard Test Methods of Resistance of Plastics and Chemical Reagents
- ASTM D790 Standard Test Methods of Unreinforced and Reinforced Insulating Materials Flexural Properties of Plastics and Electrical
- ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion of Curing of Resin-impregnated Tube

1.03 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall provide submittals on all lining materials and resins, and shall furnish manufacturer certification that the liner materials are in compliance with the specifications, codes, and standards referenced herein. The submittals shall include details of all component materials and construction details including complete manufacturers recommendations for storage procedures and temperature control, handling and inserting the liner, curing details, service connection methods, and trimming and finishing. The CONTRACTOR shall also provide manufacturers certification, field measurements, and pipe sizing calculations which demonstrate that the liner has been properly undersized to avoid the creation of wrinkles or folds.
- B. The CONTRACTOR shall submit bypass pumping and/or diversion plans for review by the ENGINEER at least 10 working days prior to the work. The CONTRACTOR shall notify the ENGINEER 24 hours prior to commencing with the bypass pumping operations. The CONTRACTOR'S plan for bypass pumping shall be satisfactory to the ENGINEER before the CONTRACTOR shall be allowed to commence bypass pumping.
- C. The CONTRACTOR shall submit shop drawings that identify the liner insertion and bypass pumping locations and methods with sufficient detail to assure that the work can be accomplished without sewage spill. The bypass pumping plan shall include an emergency response plan to be followed in the event of a failure of the bypass pumping system.
- D. The CONTRACTOR shall submit the resin manufacturer's heating requirements. Additionally, the CONTRACTOR shall conceptually discuss with the ENGINEER the general curing guidelines.
- E. The ENGINEER shall review all submittals and approve or reject.

1.04 QUALITY ASSURANCE

- A. The finished liner shall be continuous over the entire length of an insertion run between two manholes or access points and shall be free from visual defects such as foreign inclusions, dry spots, pinholes, and delamination.
- B. Wrinkles in the finished liner paper that cause a backwater of _____ inch or more or reduce the hydraulic capacity of the pipe are unacceptable and shall be removed and repaired by the CONTRACTOR at the CONTRACTOR'S expense. The CONTRACTOR shall remove a section of pipe, if so directed by the ENGINEER, to determine if a void between the wrinkle and pipe wall exists. If so proven that a void does exist, the CONTRACTOR shall repair and replace that section of pipe at the CONTRACTOR'S expense. If a void does not exist, the CONTRACTOR shall repair and replace that section of pipe at the OWNER'S expense. Methods of repair shall be proposed by the CONTRACTOR and submitted to the ENGINEER for review.

1.05 WARRANTY

- A. The CONTRACTOR shall provide a warranty to be in force and effect for a period of one year from the date of final acceptance. The warranty shall cause the CONTRACTOR to repair or replace the liner should failure result from faulty materials and installation.

PART 2 – PRODUCTS

2.01 MATERIALS

A. Liner Tube

- 1. The liner tube shall consist of one or more layers of flexible needed felt or an equivalent woven and/or non-woven material capable of carrying resin, withstanding installation pressure and curing temperatures, and is compatible with the resin system used. The liner shall be fabricated to a size that, when installed, will fit the internal circumference of the existing pipe without any annular space between the liner and existing pipe wall.
- 2. The resin used shall be compatible with the rehabilitation process, shall be able to cure in the presence or absence of water and the initiation temperature for cure shall be as recommended by the resin manufacturer and reviewed by the ENGINEER.
- 3. The liner shall be fabricated from materials which when cured, will be chemically resistant to withstand internal exposure to sewage gases containing quantities of hydrogen sulfide, carbon monoxide, methane, petroleum hydrocarbons, saturation with moisture, diluted sulfuric acid, and other chemical reagents determined by the ENGINEER.
- 4. The minimum tube length shall be that deemed necessary by the CONTRACTOR to effectively span the distance from the inlet to the outlet of the respective manholes, or access points, unless otherwise specified. The CONTRACTOR shall verify the lengths in the field before impregnation of the tube with resin. Individual insertion runs may be made over one or more manhole sections as determined in the field by the CONTRACTOR and reviewed by the ENGINEER.

Prior to insertion, the liner shall be free of all visible tears, holes, cuts, foreign materials, and other defects.

Prior to insertion, the CONTRACTOR shall provide data on the maximum allowable stresses and elongation of the tube. The exterior of the manufactured tube shall be marked along its length at regular intervals not to exceed five feet. These marks shall be used as a gauge to measure elongation during insertion. Should the overall elongation of a reach exceed five percent, the liner tube shall be rejected and replaced.

B. Resin

1. Unless otherwise specified, provide a general purpose, unsaturated, thermosetting, polyester, vinyl ester, or epoxy resin able to cure in the presence or absence of water, and a catalyst system compatible with the insertion process.
2. Resin shall not be subjected to ultraviolet light and shall form no excessive bubbling or wrinkling during lining.
3. The resin shall be shipped directly from the resin manufacturer’s facility to the CIPP wet-out facility. The resin shall not be sent to any intermediate mixing facility. Copies of the shipment documents from the resin manufacturer shall be submitted to the Engineer showing dates of shipment, the originating location and the receiving location; including with every shipment, the infrared spectrum analysis (IR Scan) from the manufacture source.
4. The resin shall be used to manufacture the CIPP as shipped. No filler or additives shall be added at the wet-out facility except for the required catalyst as recommended by the resin manufacturer. The Contractor shall submit a Certificate of Authenticity from the resin manufacturer for each shipment to the wet-out facility (to include the date of manufacture and the head distortion temperature). This information shall be submitted prior to manufacturing any CIPP.
5. The Contractor shall identify the wet-out facility where all CIPP under this Contract will be manufactured. All CIPP shall be manufactured from this designated wet-out facility throughout the entire Contract unless specifically approved otherwise by the Engineer in writing. Multiple wet-out facilities shall not be allowed.
6. The cured liner shall have the following minimum structural properties:
 Flexural Strength of 4,500 psi per ASTM D790
 Flexural Modulus of 250,000 psi per ASTM D790
 Tensile Strength of 3,000 psi per ASTM D638

2.02 PHYSICAL PROPERTIES

A. The CIPP system shall conform to and comply with the minimum standards listed below.

| Characteristic | Test Method | Polyester Resin Standard | Polyester Resin Enhanced | Vinyl Ester and Epoxy Resins |
|-------------------------------|-------------|--------------------------|--------------------------|------------------------------|
| Flexural Strength | ASTM D790 | 4,000 psi | 4,500 psi | 5,000 psi |
| Flexural Modulus (short term) | ASTM D790 | 250,000 psi | 400,000 psi | 300,000 psi |
| Flexural Modulus (long term) | ASTM D2990 | 125,000 psi | 200,000 psi | 150,000 psi |

B. The liner thicknesses are based on a pipe ovality of _____ percent and the resin’s physical properties shown in Section 2.02.A. If the CONTRACTOR uses resins having different physical properties, the CONTRACTOR shall submit detailed calculations of the proposed liner thickness for review and approval by the ENGINEER.

| Manhole Segment Upstream/ Downstream | Pipe Diameter (in.) | Pipe Depth (ft.) | Enhancement Factor K | Groundwater Resin Level (ft.) | Type | Minimum Required Thickness (mm) |
|--------------------------------------|---------------------|------------------|----------------------|-------------------------------|------|---------------------------------|
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(Project specific – to be completed by the ENGINEER)

Detailed design calculations for all external and internal loading conditions shall be submitted for review and approval. The CIPP shall be designed as per ASTM F1216, Appendix X1.3.2 of Fully Deteriorated Pressure Pipe condition. These detailed calculations shall provide the input data as well as the actual calculations for equations. X1.1, X1.3, X1.4, X1.7 of Appendix X1. of ASTM F1216.

PART 3 – EXECUTION

3.01 PREPARATION

A. Bypass Pumping

1. The CONTRACTOR shall provide bypass pumping and/or diversion when required for acceptable completion of the liner installation. Bypass pumping shall consist of furnishing, installing, and maintaining all power, primary and standby pumps, appurtenances and bypass piping required to maintain existing flows and services.
2. Bypass pumping shall be done in such a manner as not to damage private or public property, or create a nuisance or public menace. The pumped sewage shall be in an enclosed hose or pipe that is adequately protected from traffic, and shall be redirected into the sanitary sewer system. Dumping or free flow of sewage on private property, gutters, streets, sidewalks, or into storm sewers is prohibited.
3. The CONTRACTOR shall take all necessary precautions including constant monitoring of bypass pumping to insure that no private residences or properties are subjected to a sewage backup or spill. The CONTRATOR shall be liable for all cleanup, damages, and resultant fines in the event of a spill. After the work is completed, flow shall be restored to normal.

B. Cleaning and Inspection of Existing Sewer

1. The CONTRACTOR shall be responsible for cleaning, inspection, confirming the inside diameter and determining the condition of each manhole-to-manhole segment to be lined. The cleaning process shall include the removal of all roots. A television inspection shall be performed by the CONTRACTOR after the sewer cleaning operation, point repairs, and grouting is completed. The television inspection shall be completed in the same direction each time and shall be done with a CCTV color camera recorded in DIGITAL format. A pivot head camera shall be used for all pipelines that are 6 inches in diameter or greater to allow detailed lateral inspection. A copy of the television inspection disks from all televising operations shall be provided to the ENGINEER for review prior to the liner installation.

C. Point Repairs

1. It shall be the responsibility of the CONTRACTOR to clear the line of obstructions such as solids, offset joints, protruding service connections or collapsed pipe that will prevent liner insertion. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment or by remotely performed repair methods acceptable to the ENGINEER, then the CONTRACTOR shall make a point repair excavation to uncover and remove or repair the obstruction. Before any point repair excavation is pursued, the CONTRACTOR shall give the ENGINEER 3 working days notice. Point repair excavation shall proceed only with the ENGINEER'S written authorization. Protruding lateral shall be removed either internally with a hydro jet cutter or by external point repair. The type and location of the repairs are included with the project documents.

D. Grouting of Severe Defects

1. It shall be the responsibility of the CONTRACTOR to grout severe open joints and cracks in the pipeline. The CONTRACTOR shall be required to grout all open joints and cracks that in the CONTRACTOR'S opinion will impede the specified performance of the liner except that all open joints greater than 1 inch shall be grouted irrespective of the CONTRACTOR'S assessment. An estimate of the number of locations to be grouted is provided in the bid schedule. The locations shall be determined by the CONTRACTOR based on video tapes provided with the project document.

E. Manholes

1. The CONTRACTOR shall protect the manholes to withstand forces generated by equipment, water or air pressure used while inserting the tube.

3.02 INSTALLATION

A. Resin Impregnation

1. The uncured resin in the original containers and the unimpregnated fiber-felt tube shall be impregnated by vacuum or other means prior to installation. The materials and wet-out procedure shall be subject to inspection by the ENGINEER. A resin and catalyst system that is compatible with the requirements of the method shall be used.
2. The impregnated liner bag shall be transported to and stored at the site in such a manner that it will not be damaged, exposed to direct sunlight, or result in any public safety hazard. The impregnated liner bag shall be kept cool during shipment and storage. All materials shall be subject to inspection and review prior to installation.

B. Liner Installation

1. The impregnated tube shall be inserted through an existing manhole or other access approved by the ENGINEER by means of the installation process. The application of hydrostatic head, compressed air, or other means shall fully extend the liner to the next designated manhole or termination point and inflate and fit tightly to the host pipe wall.

C. Curing

1. After installation is completed, a suitable heat source and distribution equipment shall be provided. The equipment shall be capable of circulating hot water, air, and/or steam throughout the section by means of a pre-strung hose(water curing only) which has been perforated in accordance with the manufacturers' recommendations or other methods acceptable by the ENGINEER to raise the temperature uniformly above the temperature required to effect a resin cure. This temperature shall be determined by the manufacturer based on the resin/catalyst system employed.
2. The heat source piping shall be fitted with continuous monitoring thermocouples to gauge the temperature of the incoming and outgoing water, steam and/or air supply. Water, steam, or air temperature during the cure period shall meet the requirements of the resin manufacturer as measured at the heat source inflow and outflow return lines. At the direction of the ENGINEER, the CONTRACTOR shall provide standby equipment to maintain the heat source supply. An additional continuous monitoring thermocouple shall be placed between the impregnated felt tube and the pipe invert at the remote manhole and a point midway between the upstream and downstream manholes to determine the temperature during the cure. The temperature during the cure shall not be less than 130 degrees Fahrenheit at the boundary between the pipe wall and the liner unless otherwise directed by the ENGINEER because of the resin system used.
3. The initial cure shall be deemed to be completed when inspection of the exposed portions of the liner appear hard and sound and the remote temperature sensors indicate that an exotherm has occurred. The cure period shall be a duration recommended by the resin manufacturer during which time the recirculation of water, steam, and/or air and cycling of the heat exchanger continuously maintain the required temperature.
4. Temperature shall be maintained during the curing period as recommended by the resin manufacturer and shall follow the healing schedule supplied by the manufacturer and reviewed by the ENGINEER.

D. Cool Down

1. The hardened liner shall be cooled to a temperature below 100 degrees Fahrenheit before relieving the static head or pressure in the lined pipe and returning normal flow back into the system. The cool down may be accomplished by introducing cool water or air into the lined pipe. Care shall be taken in the release of the static head pressure so that a vacuum will not develop which could damage the newly installed liner.
2. If the liner fails to make a tight seal at the manhole walls, a seal consisting of a resin mixture compatible with the liner/resin system shall be applied in accordance with manufacturer specifications and approved by the ENGINEER.

3.03 SERVICE LINE RECONNECTION

- A. The CONTRACTOR shall be responsible for reconnecting service connections to the lined pipe. Reconnections of service connections shown on the plans shall be completed by one of the following methods:
1. Internally reconnected by using a pivot-head CCTV camera and a remote cutting tool to locate the service connections from inside the lined pipe, cutting a hole matching the service connection diameter, and grouting the area where the service connection enters the lined pipe to produce a water tight seal approved by the ENGINEER. CONTRACTOR shall provide nearly full-diameter hole, free from burrs or projections and with a smooth and crack-free edge. The hole shall be 95% minimum and 100% maximum of the original service connection diameter. The invert of the service connection shall match the bottom of the reinstated service opening.
 2. By excavating by hand and/or mechanical equipment to the location of the service connections tie-in, cutting the existing pipe and liner material, and installing a saddle acceptable to the ENGINEER. The excavation process shall be completed by mechanical means as defined in the project documents or by hand digging is required.
 3. Other remote methods as approved by the ENGINEER.
- B. An estimate of the number of service connections to be reconnected by the CONTRACTOR is provided in the bid schedule.

3.04 TESTING

A. Material Testing

1. All material testing shall be performed by a registered independent, third-party laboratory.
2. The CONTRACTOR shall provide certified test results of the short term physical properties of the cured lining material from the actual installed liner at a minimum of one location per each liner insertion setup. Either restrained sample testing or plate sample testing can be utilized depending upon the practicality of the conditions and diameter of the host pipe.
3. The cured liner shall be sampled and tested for flexural strength and flexural modulus (short term.) Flexural strength and modulus shall be tested in accordance with the requirements of ASTM D790. The liner shall be in compliance with the physical properties stated under Section 2.02 of this specification. A certificate of compliance shall be provided for long term flexural modulus in accordance with ASTM D 2990.
4. Corrosion resistance requirements shall be as stated in ASTM F1216, Section X2, Chemical Resistance Tests.
5. Delamination testing shall be in accordance with ASTM F1216, Section 8.4, if required by the ENGINEER.

B. Field Testing (Optional)

1. Test line for exfiltration in accordance with ASTM F1216, Section 8.2 prior to service line reconnections. Testing shall exclude maximum pressure limits (4.3 psi) at lowest end. Leakage testing shall be performed after all dry and non-bondable hoses and tubes are completely removed from the pipe.
2. After completion of all liner insertions, service reconnections, and finish work at the manholes, the sewer shall be televised with a color CCTV tilt-head camera recorded in digital format. The original disk shall be provided to the ENGINEER.

PART 4 – PAYMENT

4.01 CURED-IN-PLACE PIPE

- A. Payment will be made for the actual length of cured-in-place pipe installed. The length shall be measured from centerline of manhole to centerline of manhole. The unit price per linear foot installed shall include all materials, labor, equipment and supplies necessary for the complete liner installation, CCTV inspections and re-inspections, video tapes/disks, trimming of intruding laterals, flow diversion, sealing at manholes, testing, and cleaning and restorations.

4.02 GROUTING OF SEVER DEFECTS

- A. Payment will be made for the actual number of grout repairs completed. The unit price per grout repair shall include all materials, labor, equipment, and supplies necessary to complete the work as necessary.

4.03 SERVICE LINE RECONNECTIONS

- A. Internal cutting or other methods: Payment will be made for the actual number of needed service lines reconnected by internal cutting or other remote methods. The unit price per service line connected shall include all materials, labor, equipment, and supplies necessary to complete the work as specified.
- B. Point excavation: Payment will be made for the actual number of needed service lines reconnected by point excavation. The unit price per service connected shall include all materials, labor, equipment, and supplies necessary to complete the work as specified.