

SECTION 33 01 30.7 CURED IN PLACE PIPE LINING FOR REHABILITATION OF SANITARY SEWERAGE MAINS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Minimum requirements for the rehabilitation of sanitary sewer pipelines by the installation of Cured-In-Place Pipe (CIPP) within the existing, deteriorated pipe as shown on approved drawings. The work for rehabilitation of sanitary sewer pipelines shall include the cleaning and flushing of existing sanitary sewers prior to installation of CIPP.
- B. The rehabilitation of sanitary sewer pipelines shall be done by the installation of a resin-impregnated flexible tube which, when cured, shall be continuous and tight-fitting throughout the entire length of the original pipe. The CIPP shall extend the full length of the original pipe and provide a structurally sound, jointless and water-tight new pipe within a pipe. The Contractor is responsible for proper, accurate and complete installation of the CIPP using the system selected by the Contractor. Ground water will be present in the existing sanitary sewer. Service connections shall be reestablished after the CIPP is cured.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. D256 – Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
 - 2. D638 – Standard Test Method for Tensile Properties of Plastics
 - 3. D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 - 4. D1248 – Standard Specification of Polyethylene Plastics Molding and Extrusion Materials
 - 5. D1693 – Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
 - 6. D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
 - 7. D2122 – Determining Dimensions of Thermoplastic Pipe and Fittings
 - 8. D2657 – Standard Practice for Heat-Joining Polyolefin Pipe and Fittings
 - 9. D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
 - 10. D2990 – Tensile, Compressive, and Flexural Creep and Creep Rupture of Plastics
 - 11. D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
 - 12. D5260 - Standard Classification for Chemical Resistance of Poly(Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - 13. D5813 - Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems
 - 14. F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
 - 15. F1533 - Standard Specification for Deformed Polyethylene (PE) Liner

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16. F1606 - Standard Practice for Rehabilitation of Existing Sewers and Conduits with Deformed Polyethylene (PE) Liner
17. F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
18. F1867 - Standard Practice for Installation of Folded/Formed Poly(Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer and Conduit Rehabilitation
19. F1871 - Standard Specification for Folded/Formed Poly(Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation
20. F2019 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Thermosetting Resin Pipe (CIPP)

1.3 SUBMITTALS

- A. Shop Drawings and Product Data
 1. Manufacturer
 2. Sufficient data to verify compliance with the specifications and to illustrate construction and assembly of the products.
 3. Detailed specifications and data describing materials used.
 4. Indicate liner dimensions for each pipe size to be relined.
 5. Complete description of proposed wet-out procedures.
- B. Manufacturer's Installation Instructions
 1. Submit detailed description of liner placement and curing procedures for piping.
 2. Include description of procedures for sealing liner material at manholes and reestablishing service connections.
 3. Submit manufacturer's requirements for receiving, handling, and storage of materials.
- C. Manufacturer's Field Start-up Report
 1. Indicate personnel present and actual test procedures that were performed by manufacturer's representative.
 2. Manufacturer to submit field verification of proper assembly.
- D. Contractor's procedures and materials for service renewal
- E. Digital Video Discs (DVDs):
 1. Submit video recordings of piping sections
 2. Show cured liner and reestablished service connections after relining Work is complete.

1.4 COORDINATION

- A. Coordinate Work of this Section with users connected to the system.
- B. Notify home owners and businesses at least 48 hours in advance of expected disruption of sanitary service.
- C. Limit disruption of service to individual properties to one-time occurrence for maximum of eight hours.
- D. Do not disrupt customer service between hours of 5:00 P.M. and 8:00 A.M.
- E. Provide and maintain temporary facilities, including piping and pumps, to meet Town requirements.

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1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of piping mains and services that include CIPP liner. Indicate pipe inverts and top of pipe elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' documented experience.
- B. Installer: Company specializing in performing Work of this Section with minimum five years' documented experience in installation of liner materials and licensed or certified by manufacturer.

1.7 DELIVERY STORAGE AND HANDLING

- A. The 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 the Town Engineer.
- B. Keep products safe from damage. Promptly remove damaged products from the job site. Replace damaged products with undamaged products. Protect material from moisture.
- C. Store hydrophilic end seal gaskets inside, in a dry, humidity controlled environment. The end seal will swell when exposed to moisture, either direct or indirect.

1.8 EXISTING CONDITIONS

- A. Verify field measurements prior to fabrications.
- B. Indicate field measurements on Shop Drawings.

1.9 WARRANTY

- A. Material Warranty
 - 1. All CIPP liners shall be certified by the manufacturer for specified material properties for the repair. The manufacturer shall warranty the liner to be free from defects in raw materials for ten years from the date of installation. During the warranty period, any defects which affect the integrity, strength or water tightness of the installed pipe shall be repaired at the contractor's expense.
- B. Installation Warranty
 - 1. The Installer shall guarantee the CIPP liner against defects in installation and workmanship for the period of two (2) years commencing with the date of substantial completion of the CIPP system.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. CIPP Liner
- B. Layne, Inc
- C. Insituform Technologies, Inc.
- D. LMK Technologies, LLC
- E. Or accepted substitution approved by Town Engineer

2.2 DESIGN CONSIDERATIONS

- A. CIPP shall be designed in accordance with ASTM F1216 and D5813.
- B. CIPP design for the main sheet shall assume no bonding to the original pipe.

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- C. The resin saturated main sheet must place the resin in full contact with the host pipe. The cured liner must provide coating on the interior of the lateral piping for an improved flow rate.
- D. The liner must be smooth and have an average roughness coefficient “n” factor of 0.013 or lower.

2.3 GENERAL

- A. The CIPP liner shall be constructed of materials and methods that provide a jointless and continuous structurally sound liner able to withstand all imposed static, and dynamic loads on a long-term basis.
- B. Design lining material to have sufficient structural strength to support dead loads, live loads, and groundwater load imposed, assuming existing pipe cannot share loading or contribute to structural integrity of liner.
- C. Field measurements of the existing pipe diameters, ovality and length shall be taken.
- D. Pipe liner shall be capable of installation with water in the carrier pipe and surrounding groundwater.
- E. The flexible tube shall be fabricated to a size that when installed will neatly fit (minimum 99.75%) the internal circumference of the existing sanitary sewer lines (including services). Allowance shall be made for circumferential stretching during insertion so that the final cured product is snug against the wall of the host pipe.
- F. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise shown or specified. The Contractor shall verify the lengths in the field before impregnation.

2.4 CURED-IN-PLACE-LINER (CIPP)

- A. Unless otherwise specified, the Contractor shall furnish a general purpose, unsaturated, polyester or thermosetting vinyl ester resin and catalyst system compatible with the reconstruction inversion process that provides cured physical strengths specified herein, and complies with ASTM D5813, F1216, F1743, and F2019.
- B. Liner material shall be manufactured with resins pre-impregnated within the liner to eliminate the possibility of air bubbles and voids. Resin shall be a corrosion-resistant polyester or vinyl ester resin and catalyst system that, when properly cured within tube composite, meets requirements of ASTM F1216, F1743, and F2019.
- C. The liner thickness shall be sized for a minimum hydrostatic load of 8.0 feet and maximum depth of earth cover as measured in the field. The hydrostatic load shall be increased to the manhole depth plus 1.0 foot for bury depths in excess of 8.0 feet.
- D. The finished pipe liner in place shall be fabricated from materials which when complete is chemically resistant to and will withstand internal exposure to domestic sewage having a pH range of 5 to 11 and temperature of 150°F.
- E. Minimum Design Criteria:
 - 1. Minimum flexural strength: 4,500 PSI
 - 2. Initial Modulus of Elasticity: 250,000 PSI
 - 3. Nominal CIPP Thickness: Per ASTM F1216, Minimum of 6mm

2.5 MAINLINE CONNECTION

- A. The main tube and lateral tube shall form a one-piece assembly by stitching the lateral tube to the mainsheet aperture.
- B. The connecting end of the lateral tube shall be shaped to match the aperture and curvature of the main tube.

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- C. The lateral tube and main tube shall be sealed by use of a flexible UV cured adhesive/sealant applied in a factory controlled setting.
- D. The main/lateral tube assembly shall take the shape of a tee or wye with corresponding dimensions such as a curved circle or a curved elliptical opening in the pipefitting.

2.6 HYDROPHILIC GASKET SEAL

- A. The rubber joint seal shall be an extended hydrophilic rubber compounded from chloroprene (Neoprene) rubber and a hydrophilic resin, which expands on contact with water.
- B. The rubber joint seal shall be bonded with adhesive on one face to hold it in place during assembly.
- C. 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 effect a complete and watertight seal.
- D. Hydrophilic rubber joint seals shall be installed at all manhole walls for all lining products.
- E. The mainline tube shall include a seamless molded flange shaped gasket attached to the main liner tube at the connection or four molded hydrophilic O-rings at the mainline termination ends.
- F. The gaskets must be a minimum of 2.5mm thick and must retain this consistent thickness under installation pressures.
- G. The hydrophilic gasket seals must be manufactured in a controlled factory environment with strict quality control and quality assurance protocols.
- H. A liquid sealant, adhesives or other fluid like materials having paste like consistency will not be accepted.

2.7 SOURCE QUALITY CONTROL

- A. Inspect extruded material for defects and physical properties according to ASTM D1785. Verify liner material is homogeneous and free of defects, cracks, holes, blisters, protrusions, foreign materials, or other deleterious faults.
- B. Marking:
 - 1. For testing purposes, mark each production lot with identical marking number.
 - 2. Mark each reel of folded PVC pipe at intervals not to exceed 5 feet with coded number identifying manufacturer, size, cell class, machine, shift, and date when liner was extruded.
- C. Chemical and Physical Testing: Test cured samples according to ASTM D5260.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cleaning: Clean existing sewer pipes of debris, sedimentation, and mineral deposits with high-velocity cleaner, bucket and scraper, root saws, rolling or balling units, or other appropriate means.
- B. Bypassing Sewage:
 - 1. Set up bypassing pump system to isolate each section of piping for relining.
 - 2. Maintain bypass pumping until lining is totally formed and service connections are reestablished.
- C. The interior of the pipeline shall be carefully inspected to determine the location of any condition that shall prevent proper installation, such as roots, severe offsets, and collapsed or crushed pipe sections. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection of pipelines.

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3.2 ACCESS SAFETY

- A. Prior to entering access areas such as manholes, an excavation pit, performing inspection or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen shall be undertaken in accordance with local, state, or federal safety regulations.

3.3 SANITARY SEWER REHABILITATION PROCEDURES

- A. Pipe Rehabilitation (CIPP) for limits between manholes, or as shown.
- B. Sewer lines with no indication for either pipe rehabilitation (CIPP) or full replacement are to have no work performed on them.
- C. Where practicable, liners should be installed in continuous runs where there are two or more continuous manhole segments. This is especially desirable to connect several short manhole segments with a continuous lining.
- D. Pipe rehabilitation with cured in place thermosetting resin pipe (CIPP) methods must adhere to ASTM F1216 and F2019 for pulled in place installation.
 1. Work includes installation of continuous lengths of homogeneous resin impregnated flexible tube cured tight to existing pipe wall with UV curing, pressurized steam, or in accordance with the manufacturer's recommendations.
 2. Work includes:
 - a. Field air testing
 - b. Point repair prior to lining where necessary
- E. Contractor Responsibilities Include:
 1. Contractor to install the specified system must be responsible for complete performances of such, including, but not limited to:
 - a. Materials
 - b. Application
 - c. Quality Control
 2. Contractor will supply Town Engineer with documentation showing past installation experience and licensing prior to construction.
 3. Contractor prequalification may be required by individual product manufacturers.
 4. Contractor shall inspect all surfaces and sewers prior to construction and notify Town Engineer of any discrepancies or disparities that may interfere with proper preparation or installation.
 5. Contractor must comply with all requirements of the manufacturer.
 6. Contractor is responsible for all quality assurance testing of systems after construction.
 7. Contractor is responsible for all sewage bypass equipment and traffic control.
 8. Contractor is to verify all existing utilities prior to digging for replacement.
 9. After the liner has been installed, as directed by Town Engineer, existing services shall be temporarily reinstated to 95% of the original opening.
 - a. This shall be done without excavation in pavement areas, and in the case of non-man-entry pipes, from the interior of the pipeline by means of a 360-degree television camera and a cutting device that reestablishes the service connection.
 - b. When a remote cutting device is used and a cleanout is available, then a mini-camera down the service shall also be used to assist the operator in cutting or trimming.

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- c. Restored openings should be neatly and smoothly cut and without rough edges. Care must be exercised not to damage the CIPP or the existing main or lateral pipes.
- d. Connections should not be over-cut as this could damage the pipe, break the CIPP watertight seal and/or interfere with future lining of the lateral. Any damage to the liner or lateral while reinstating services will be repaired by a hat or injection sealing method. No grouting will be allowed and no separate payment shall be made for such repair.

3.4 FINISHED CIPP

- A. It shall be a homogenous CIPP liner assembly from manhole to manhole.
- B. The CIPP shall be smooth with minimal wrinkling and shall increase flow rate.
- C. The profile of the hydrophilic molded gaskets should be visible and verifiable during post-video inspection on liners 6mm or thinner thickness.
- D. The CIPP shall be free of dry spots, lifts, and delamination.
- E. The CIPP shall include a textile taper at each end providing a smooth transition to the host mainline liner for accommodating video equipment and maintaining proper flow in the mainline.

3.5 TESTING

- A. The wall thickness shall be measured in accordance with the applicable sections of ASTM Test Method D5813 and D3567. One test shall be taken for every 500 LF of lining completed.
- B. Flexural strength and flexural modulus of elasticity shall be determined in accordance with ASTM D-790. One test shall be taken for every 500 LF of lining completed.
- C. After installation or during the curing/installation process, Contractor shall conduct a mainline integrity pressure test. The test must demonstrate CIPP mainline is watertight.
 - 1. The Contractor shall furnish all necessary equipment to conduct the test. An acceptable method is a low pressure air test, conducted as follows:
 - 2. Pressurize the test section to 4.0 psi and hold above 3.5 psi for not less than 2 minutes. Add air if necessary to keep the pressure above 3.5 psi. At the end of this 2 minute stabilization period, note the pressure (must be 3.5 psi minimum) and begin the timed period. If the pressure drops 0.5 psi in less than the time given in the table below, the section of pipe shall have failed the test.
 - 3. When the prevailing groundwater is above the sewer being tested, test pressure shall be increased 0.43 psi for each foot that the water table is above the invert of the sewer.

Sewer Diameter (Inches)	Minimum Test Time per 100 ft. (seconds)
8	72
10	90
12	108
18	144

- 4. If the time for the pressure to drop 0.5 psi is 125 percent or less of the time given in the table, the line shall immediately be re-pressurized to 3.5 psi and the test repeated.
- 5. The pressure gage used shall be supplied by the Contractor and have minimum divisions of 0.10 psi and be oil filled.

3.6 PROSECUTION OF WORK

- A. All sewer services connected to the main shall be reinstated after the sewer main has been lined or replaced due to defects. The Contractor shall note that not all sewer lines segments have been televised in their entirety due to obstructions blocking further entry, etc. These obstructions shall be cleared to allow TV viewing of the entire segment length before lining is commenced. Existing sanitary sewer segments may be broken and contribute considerable

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ground water to the sewer main or contain considerable amounts of grease, roots or other debris.

3.7 FINAL ACCEPTANCE

- A. All CIPP sample testing and repairs to the installed CIPP as applicable shall be completed, before final acceptance, meeting the requirements of these specifications and documented in written form.
- B. The Contractor shall perform a detailed closed-circuit television inspection in accordance with ASTM standards, after installation of the CIPP liner and reconnection of the side sewers. The finished liner shall be continuous over the entire length of the installation and shall be free of significant visual defects, damage, deflection, holes, leaks and other defects. Unedited digital recordings of the inspection shall be provided to the Town within ten (10) working days of the liner installation.
- C. The data shall note the inspection date, manhole depths from rim to inverts, location of all reconnected side sewers, debris, defects in the liner, including but not limited to gouges, cracks, bulges, or bumps. Immediately prior to conducting the video inspection, the Contractor shall thoroughly clean the newly installed liner removing all debris and build-up that may have accumulated, at no additional cost to the Town.
- D. Bypass pumping or plugging from the upstream manhole shall be utilized to minimize sewage from entering the line during the inspection. In the case of bellies in the line, the pipe shall be cleared of any standing water to provide continuous visibility during the inspection.

END OF SECTION 33 01 30.7