
02780 – LINER FOR SEWER REHABILITATION

(Revised 11/06/09)

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PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the contract, including General Requirements and Supplementary Conditions applicable to this specification.
- B. Section 01000 – GENERAL REQUIREMENTS.
- C. Section 02750 - SEWER LINE CLEANING.
- D. Section 02760 – TELEVISION INSPECTION OF SEWER LINES.
- E. Section 02770 – SEWER FLOW CONTROL.

1.2 SUMMARY

This section includes sewer line rehabilitation by installation of a flexible liner system. This section includes equipment, labor, and materials necessary to perform all work for sewer line rehabilitation by cured-in-place pipe (CIPP) process or fold and form (FF) process and reinstatement of service lateral connections.

1.3 SUBMITTALS

- A. The contractor shall submit to the engineer for review complete design calculations for the liner thickness per ASTM F1216. The design shall be signed and sealed by a professional engineer registered in the State of Virginia and certified by the manufacturer as to the compliance of his material to the values used in the calculations.
- B. Submit written description of shipping, storage, and handling procedures for all components of the lining system; equipment; and products to be used, and certified copies of test reports that indicate the applicable standards have been met.
- C. Submit field information and calculations demonstrating any variance in the minimal required thickness of the liner.

- D. Submit manufacturer's certificate of compliance for all high density polyethylene material furnished in accordance with this specification section.
- E. For CIPP installations, submit the following:
 - 1) Fabric tube information, including, at a minimum, specific gravity and nominal void volume content.
 - 2) Flexible membrane material, including nominal thickness, specific gravity and recommended repair procedure.
 - 3) Raw resin data and cured resin properties including specific gravity both liquid and cured, resin catalyst ratios, a list of resin admixtures and normal resin polymerization shrinkage to be expected.
 - 4) Resin/felt composite including specific gravity with all felt voids filled with resin, the estimated resin required to the felt voids and the additional resin to be added.
 - 5) Certification from the Manufacturer that the resin/catalyst and tube material complies with the required application, meets the intended service condition and the physical requirements set forth in this specification.
 - 6) Tube Wet-out and Cure Schedule, including:
 - a) Calculations for each diameter CIPP liner to be installed including design thickness, flexible membrane perimeter, additional resin target amount and the specified quantity of resin as submitted herein. A complete description of the proposed wet-out procedure for the proposed technology shall be submitted.
 - b) Manufacturer's recommended cure schedule for each diameter and thickness of CIPP liner to be installed. Contractor shall provide a detailed cure schedule for the curing medium, the method of application and the documentation to verify that the installed product meets the requirements of these specifications. A detailed cool-down schedule shall be submitted for the curing medium proposed.
- F. For fold and form installations, submit design liner thicknesses to be installed and supporting design assumptions for each sewer reach to be lined.
- G. Literature and background information on the independent third party testing laboratory proposed for testing physical properties of the installed pipe.
- H. A bypass pumping plan in accordance with Section 02770- *Sewer Flow Control*.
- I. A written description of procedures and equipment to be used.
- J. Product and manufacturer's recommended handling and installation procedures for sealing the annular space between the liner and host pipe.

1.4 QUALITY ASSURANCE

- A. Comply with all codes, laws, ordinances, and regulations of governmental authorities having jurisdiction over this part of the work.
- B. The Contractor shall comply with the latest revision of the Virginia Occupational Safety and Health Standards for the Construction Industry as adopted by the Safety and Health Codes Commission of Virginia.

- C. The Contractor shall comply with Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation, “Virginia Erosion and Sedimentation Control Handbook,” latest revision.
- D. The liner shall be fabricated to a size and length that, when installed, shall neatly fit the internal circumference of the sewer line section to be lined as shown on the drawings or as determined by the televised inspection. Allowance shall be given for excess pipe (rib) when the cross-sectional areas have been reduced due to offset joints, partial collapse, out of round sections, and the like.
- E. Materials and operations shall comply with the latest revision of the Codes and Standards listed below:

American Society for Testing and Materials

- ASTM F 1216** Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
- ASTM D 790** Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- ASTM D 1248** Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable
- ASTM D 2837** Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- ASTM D 1693** Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
- ASTM D 1784** Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
- ASTM D 256** Impact Resistance of Plastic and Electrical Insulation Materials
- ASTM D 2122** Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- ASTM D 638** Standard Test Method for Tensile Properties of Plastics
- ASTM F 1533** Standard Specification for Deformed Polyethylene (PE) Liner
- ASTM F 1743** Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

1.5 STANDARD ABBREVIATIONS

| | |
|---------------|--|
| ASTM | American Society For Testing and Materials |
| AASHTO | American Association of State Highway and Transportation Officials |

1.6 COORDINATION

- A. The contractor shall completely remove and dispose of all dirt, debris, rubbish and surplus, and unsuitable materials at the end of each work day at no additional cost to the owner.
- B. Whenever the contractor desires to use a hydrant for water supply, the contractor shall obtain the permission of the owner. All costs associated with the use of water supplied from hydrants shall not be paid for separately but shall be deemed to be included in the bid. Operation of hydrant shall be in accordance with the City Of Lynchburg Backflow Prevention Program. Use of an RPZ device or air gap is required.

PART 2- PRODUCTS

2.1 CURED-IN-PLACE LINER

- A. The cured-in-place liner process shall consist of a flexible tube or liner that has been impregnated with a thermosetting or ultraviolet setting (UV) resin, which is resistant to attack by normal components of domestic sewage. The resin shall be thermally or UV cured to form a hard impermeable pipe, which conforms to the following minimum values when tested in accordance with ASTM F 1216.

| | | |
|--------------------------------|---|----------------|
| Wall Thickness | As calculated and submitted by contractor | ASTM F 1216 |
| Impact Strength | 1.9 ft-lbs/in | ASTM D 256 |
| Flexural Strength | 4,500 PSI | ASTM D 790 MOD |
| Flexural Modulus Of Elasticity | 250,000 PSI | ASTM D 790 MOD |

- B. The liner thickness shall be based on the following physical conditions of the existing sanitary sewer pipe.
 - 1) Pipes shall be fully deteriorated.
 - 2) Pipes shall be subject to a minimum full soil load of 120 pounds/cf, live loads as calculated by AASHTO HS-20-44 Highway Loading, and water table at the ground surface.
 - 3) Pipes shall be considered to have a minimum of 2 percent ovality in the circumference.

- C. Acceptable cured-in-place process shall be “Insituform”, “National liner”, “Masterliner”, or approved equal, and shall be furnished and installed by a licensed contractor for the respective process.

2.2 FOLD AND FORM LINER

- A. The sewer liner pipe and fittings shall be manufactured from the following:

- 1) High density polyethylene pipe compound that conforms to ASTM D 1248 and meets the requirements for type PE34, CLASS C product. Pipe made from this compound shall have a long-term hydrostatic strength rating of 1,600 PSI or more, in accordance with ASTM D 2837. When the environmental stress crack resistance (ESCR) of the compound is measured in accordance with ASTM D 1693, Condition C, the compound shall withstand not less than 192 hours in 100 percent solution IGEPAL CO-630 at 100 degrees F before reaching a 20 percent failure point (F20).
- 2) Polyvinyl chloride alloy pipe compound that conforms to ASTM D 1784 cell classification 12111-C, 12344-B, OR 12334-B. Pipe made from this compound shall have a long-term hydrostatic strength rating of 1,600 PSI or more, in accordance with ASTM D 2837.

- B. Physical strength: The liner pipe shall conform to the minimum structural standards, as listed below:

| | | |
|--------------------------------|---|------------|
| Wall thickness | As calculated and submitted by contractor | ASTM D2122 |
| Flexural Strength (Yield) | 3,300 PSI | ASTM D 638 |
| Flexural Strength (Break) | 4,500 PSI | ASTM D 638 |
| Flexural Modulus Of Elasticity | 250,000 PSI | ASTM D 790 |

- C. High density polyethylene liner material tests: Tests for compliance with this specification shall be made according to ASTM F 1533. A certificate of compliance with this specification shall be provided by the manufacturer for all high density polyethylene material furnished according to this section.
- D. The liner thickness shall be based on the following physical conditions of the existing sanitary sewer pipe.
- 1) Pipes shall be considered fully deteriorated.
 - 2) Pipes shall be subject to a minimum full soil load of 120 pounds/cf, live loads as calculated by AASHTO HS-20-44 Highway Loading, and water table at the ground surface.
 - 3) Pipes shall be considered to have a minimum of 2 percent ovality in the circumference.
- E. Acceptable fold and form processes shall be “U-Liner Pipe”, “Nupipe”, “Ultraliner”, or approved equal, and shall be furnished and installed by a licensed contractor of the respective process.

2.3 ANNULAR SPACE SEALING

Seals between liner and host pipe shall be made at each connection to a manhole using a hydrophilic water sealing material that is compatible with the liner system to form a water-tight connection. The seal shall be made with “Hydrotite” by Greenstreak, or approved equal. Hydraulic cements and quick-set cement products are not acceptable.

PART 3- EXECUTION

3.1 GENERAL REQUIREMENTS APPLYING TO ALL REHABILITATION WORK

- A. The rehabilitation of the sewer main shall be performed without the need for excavation or demolition of existing structures, and be able to re-establish user lateral services without excavation and minimize the disruptions to neighboring homes and traffic. Excavation for point repairs or emergencies shall be permitted, but only as required and directed by the City Engineer.
- B. The finished lining shall be joint-less and continuous over the entire length of an insertion run between the starting and terminating manholes and be as free as commercially practicable from visual defects such as foreign inclusions, dry spots, pinholes, and delaminations. If the proposed method of inserting the liner requires the modification of a manhole, the cost to modify and repair the manhole shall be performed on a force account basis and pre-approved by the City Engineer.
- C. **Pre-insertion Cleaning:** Clean the existing sewer pipe designated for rehabilitation using high-velocity water jet equipment in accordance with Section 02750- *Sewer Line Cleaning* immediately before the pre-insertion television inspection.
- D. **Pre-insertion Television Inspection:** Perform a television inspection of the designated sewer lines immediately before the rehabilitation process in accordance with Section 02760- *Television Inspection of Sewer Lines* to assure that the pipe is clean and existing pipe conditions are acceptable for lining.
- E. **Bypassing Sewage:** Provide for continuous sewage flow around the section(s) of pipe designated for the insertion of liners and service laterals connecting to these sections of pipe in accordance with Section 02770- *Sewer Flow Control*.
- F. **Line Obstructions:** If pre-insertion television inspection reveals an obstruction in the existing pipe (such as heavy solids, dropped joints, protruding service taps, or collapsed pipe which will prevent completion of the lining process) that cannot be removed by conventional sewer cleaning equipment, then a point repair shall be made by the contractor at the direction of the City Engineer. Point repairs shall be performed on a force account basis and pre-approved by the City Engineer.

3.2 CURED-IN-PLACE PROCESS

- A. **Wet Out:** The contractor shall designate a location where the liner shall be impregnated (“wetted out”) with resin to thoroughly saturate the liner prior to installation. The contractor shall inform the City Construction Coordinator in advance of this operation.

- B. **Insertion:** The wetted out tube shall be transported and kept in a stable state until it is inserted through an existing manhole by approved techniques/process of the contractor. The insertion area, equipment platform, etc. shall be securely protected, and all damaged yards, driveways, walks, etc. shall be repaired, at no cost to the owner.
- C. **Heat Curing:** After the insertion is completed, the contractor shall use a heat source to uniformly heat the liner to cure the resin in the liner. The curing temperatures shall be as recommended by the resin/catalyst system of the resin manufacturer. The heat source shall be fitted with suitable monitors to gage the temperature of the incoming and outgoing heat source. Initial cure may be considered completed when the exposed portions of the liner appear to be hard, and the remote sensing device indicates the temperature to be adequate, as recommended by the resin/catalyst system manufacturer. Curing temperatures and duration shall comply with previously submitted data and information.
- D. **UV Curing:** After the insertion is completed, the liner shall be visually inspected before curing is to begin. The contractor shall then use an Ultraviolet light source to cure the resin in accordance with manufactures recommendations. The light source should be fitted with closed circuit television and infrared sensors to monitor the liner wall temperatures to ensure proper cure. Initial cure may be considered completed when the infrared data indicates adequate reaction temperatures throughout the entire length of liner. Contractor shall provide documentation of curing equipment calibration, lamp intensity, number of lit lamps, inner air pressure of the liner in psi, curing speed in feet per minute, and resin reaction temperature.
- E. **Finished Pipe:** The finished CIPP shall be continuous over the entire length from manhole to manhole and be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities. The liner passing through or terminating in a manhole shall be carefully cut out in a shape and manner approved by the City Engineer. The invert and benches shall be streamlined and improved for smooth flow. The area/annular space between existing and the CIPP shall be sealed.
- F. **Sealing and Benches in Manhole:** The CIPP shall make a tight fitting seal with the existing pipe(s) in the manhole and shall be sealed as specified in Part 2 of this specification section, paragraph – Annual Space Sealing. Top half of the pipe shall be neatly cut off and not broken or sheared off, at least 4 inches away from the walls. The channel in the manhole shall be a smooth continuation of the pipe(s) and shall be merged with other lines or channels, if any. Channel cross-section shall be u-shaped with a minimum height of half pipe diameter, to three-fourths of the pipe diameter for 15 inches and larger. The side of the channels shall be built up with mortar/concrete to provide benches at a maximum of 1 in 12 pitch towards the channel.

3.3 FOLD AND FORM PROCESS

- A. The liner shall be inserted into the existing sewer line with a power winch and steel cable connected to the end of the liner by use of an appropriate pulling head. A second pulling head may be attached to the other end of the liner for attachment of a tag line to pull the liner back out of the sewer line, if necessary. Length of the liner pipe to be inserted at any one time shall be governed by the winch drum capacity and winching power available and consideration of the size

and condition of the sewer. During insertion, precautions should be taken to protect the liner pipe to prevent scoring the outside of the liner as it is being pulled into the sewer.

- B. **Reforming:** After insertion is completed, the contractor shall supply a suitable heat/pressure source and water recirculation equipment. The equipment shall be capable of delivering hot water/pressure throughout the section to uniformly raise the water temperature above the temperature required to reform the liner.
- C. The heat source shall be fitted with suitable monitors to gage the temperature of the incoming and outgoing water supply.
- D. The contractor shall cool the liner to a temperature below 100 degrees F before relieving the reforming pressure. Cool-down may be accomplished by the introduction of cool water or other approved method into the recirculation network.
- E. **Finish:** The finished liner shall be continuous over the entire length of the insertion and be as free as commercially practicable from visual defects such as foreign inclusions.
- F. **Sealing Liner at Manholes:** Seals between folded and formed liner and host pipe shall be made using materials specified in Part 2 of this specification section, paragraph- Annual Space Sealing.

3.4 REINSTATEMENT OF SERVICE LATERALS

- A. **Location of Existing Service Laterals:** The exact location and number of service laterals shall be determined from television tapes and/or in the field. It shall be the contractor's responsibility to accurately field locate all existing service laterals. The contractor shall reconnect all service laterals to the liner pipe. The contractor shall restore/correct without any delay, all missed or faulty reconnections, as well as for any damage caused for not reconnecting the services soon enough. All services which are reconnected to rehabilitated liner shall be shown on the record drawings with the exact distance from the nearest upstream/downstream manhole. All existing service laterals shall be reconnected by remote television controlled cutting device method. Active laterals shall not be disconnected nor service interrupted between the hours of 5 p.m. ad 9 a.m. If the contractor cannot install the pipe liner and reconnect the active services between 9 a.m. and 5 p.m. bypass pumping of the service connection to the sanitary sewer system shall be required. The method of bypassing shall be submitted by the contractor and shall be in accordance with Section 02770-*Sewer Flow Control*.
- B. **Service Connection by Remote Cut:**
 - 1) Service connections shall be performed by a TV controlled remote cutting device using experienced operators. Blind attempts and/or holes in the liner are not acceptable. Location shall be re-verified carefully with earlier tapes for accuracy especially where dimples are not defined or clearly ascertained. The engineer reserves the right to require service laterals by excavation at certain locations, if the quality, workmanship, and approval rating for remote cut is poor and not satisfactory and shall be at no cost to the Owner. Excess, wrong holes or trial cuts shall not be made and shall be repaired at no cost to

the owner. Defective connections shall be repaired to the owner's satisfaction at no extra cost. If a remote cut connection is to be rectified or replaced with connection by excavation, it shall be done at no additional cost to the owner.

- 2) The remote cut shall be smooth and circular in nature as seen by a 360-degree television camera. Reinstated service connection holes for laterals at wye connections shall be elliptical; holes at tee connections shall be circular. The hole shall be a maximum of 100 percent and a minimum of 90 percent of the service pipe diameter. It shall be properly aligned and be concentric to the existing connection.

3.5 TESTING FOR ACCEPTANCE

- A. Television inspection in accordance with Section 02760 – *Television Inspection of Sewer Lines* shall be provided after the liner has been installed in the existing sewer pipe. The televising shall be done after all service connections have been reinstated. Payment for lining of sewer lines will not be made until the owner has reviewed the post-lining video tape and accepted the lining. Wrinkles or other discontinuities in the finished liner that cause a deformity of 5 percent or more of the pipe diameter, and any other defects, which may, in the opinion of the engineer, affect the integrity or strength of the liner, are unacceptable and shall be removed and repaired at the contractor's expense in a manner satisfactory to the engineer. The finished liner shall also be continuous over the entire length of an installation run.
- B. For each installation of liner 18-inch and less, the contractor shall obtain two samples from the cured liner, at an intermediate manhole or at the termination manhole, that has been installed through a like diameter pipe that has been held in place by a suitable heat sink, such as sandbags. Clamped or vacuum bagged samples taken from the downtube or suspended inside the pipe are not acceptable.

For each installation of liner above 18-inch, the contractor shall obtain samples of cured liner fabricated from material taken from the tube resin system in accordance with ASTM F 1216. The clamped mold should be placed within the downtube when circulating heated water is used and in the silencer when steam is used.

Samples of cured liner shall be given to the Engineer immediately after sampling occurs. The Engineer shall identify the sample location, package the sample, and ship the sample to the independent third party testing agency. The contractor shall be responsible for all costs associated with shipping and testing of the liner samples.

- C. Manhole locations for samples shall be as designated by the engineer in the field. The physical properties of the installed liner shall be verified through field sampling and laboratory testing. All materials testing shall be performed, at the contractor's expense, by an independent third party laboratory recommended by the manufacturer and approved by the engineer.
- D. The testing shall be in accordance with applicable ASTM test methods listed in Part 2 of this specification section to confirm compliance with the physical properties listed herein.

- E. The contractor shall provide certified copies of all test results. If properties tested do not meet all minimum requirements specified, the liner shall be removed and replaced, at no additional cost to the owner, and re-tested.
- F. Payment for the liner will not be made until the installed liner samples meet the required physical properties. Wall thickness determination shall be per the process described in ASTM F1743, paragraph 8.1.6 for CIPP liners and ASTM D2122 for fold and form liners.

3.6 FAILURE OF STRUCTURAL REHABILITATION LINER

If a liner fails to reform/cure, the contractor shall be required to remove the failed liner at no additional cost. The work shall include all material, excavation, backfilling, cutting concrete, pipe shoring, temporary pavement, permanent pavement, and other incidental work required to remove the liner from the existing pipe. The City Engineer shall approve all methods to be used prior to starting work on this item.

End of Section 02780

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