

## SECTION 02501

### LINING WITH ULTRA-VIOLET LIGHT FIBERGLASS CURED-IN-PLACE PIPE

#### PART 1 — GENERAL

##### 1.01 SECTION INCLUDES

- A. Work under this section shall include rehabilitating a full length of an existing sewer main, from manhole to manhole, by the trenchless method known as ultra violet cured-in-place-pipe (UV-CIPP) in accordance with these Specifications. CIPP consists of installing a resin-impregnated fiberglass material tube (Liner) that when cured extends the full length of the original pipe and shall provide a structurally sound, smooth, joint-less and watertight pipe.

##### 1.02 REFERENCES

A. ASTM

1. C581 – Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures Intended for Liquid Service.
2. D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
3. D578/D578M - Standard Specification for Glass Fiber Strands.
4. D618 - Standard Practice for Conditioning Plastics for Testing.
5. D638 - Standard Test Method for Tensile Properties of Plastics.
6. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
7. D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.
8. D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
9. D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
10. D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
11. D2990 - Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.

12. D3567 - Standard Practice for Determining Dimensions of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings.
  13. D 3681 – Standard Test Method for Chemical Resistance of Fiberglass (Glass-Fiber-Reinforced Thermosetting Resin) Pipe in a Deflected Condition.
  14. D5813 – Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe.
  15. F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
  16. F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).
  17. 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).
- B.** National Association of Sewer Service Companies (NASSCO): Guideline for the use and handling of styrenated resins in cured-in-place-pipe, September, 2008
- C.** Potable Water Main, Gravity Sanitary Sewer, and Sanitary Sewer and Force Main Design Standards, DeKalb County Department of Watershed Management.

### **1.03 DEFINITIONS**

- A.** UV-CIPP - Ultra Violet Cured-in-Place-Pipe is defined as a hollow cylinder consisting of a glass reinforced fabric tube impregnated with an ultra violet light sensitive resin. The impregnated tube is cured by the application of ultra violet light. The UV-CIPP is formed within an existing pipe and takes the shape of and fits tightly to the pipe, all as defined in ASTM Standard F1743. The definitions in ASTM Standard F1216, and ASTM F2019 shall also apply.

### **1.04 QUALIFICATION REQUIREMENTS**

- A.** Product manufacturer shall have:
1. Minimum 10 years’ experience in CIPP manufacturing including:
    - a. Manufacture of a minimum of 100,000 linear feet of CIPP
    - b. References for 10 projects for CIPP with pipe diameters of similar size or greater to those found on the contract drawings
    - c. Personal experience of the manufacturing manager with other manufacturing companies may be substituted in lieu of the current company experience
    - d. Product is designed for a minimum 50-year design life.
- B.** Installing Contractor shall have:

1. Minimum of 5 years' experience in sewer rehabilitation including:
  - a. Minimum 30,000 linear feet of sewer rehabilitation
    1. In pipe diameter of similar size to those found on the contract drawings or greater utilizing CIPP trenchless technology.
  - b. Personal experience of the Contractor's construction manager with other construction companies may be substituted in lieu of the current company experience
    1. Substitution after award requires approval of Owner's Representative.
  - c. Contractor's Installing Personnel (Superintendent and foreman) must have:
    1. Minimum 3 years active experience in commercial installation of CIPP liner
    2. Key personnel shall each have completed minimum 30,000 linear feet and 100 line sections of CIPP in gravity sewers.
    3. Certified training on installing manufacturer's product approved by the manufacturer.
2. Demonstrate they have a manufacturer approved quality assurance program to standardize the materials, manufacture, wet out and installation of the specific CIPP product in place.

## 1.05 SUBMITTALS

- A. Action Submittals (submit for review and approval):
  1. Comprehensive Construction Sequencing Plan including:
    - a. Work Site Plan including:
      - 1) Proposed access routes
      - 2) Set up locations for lining installation
      - 3) Wet out area (if required) including:
        - a) Typical insertion and curing schedule/plan
          - (1) Submit wet out, insertion and curing plan for each and every lining proposed
            - (a) Submit minimum 48 hours (2 working days) prior to each installation
    - b. Site Health and Safety Plan
    - c. Required Construction Permits

- d. Sewer Flow Control Plan in accordance with Section 01520 including:
    - 1) Spill Containment Plan
    - 2) Emergency contingent plan
  - e. Work schedule
  - 2. Erosion Control Plan in accordance with the DeKalb County Department of Watershed Management Protocol for Providing Erosion and Sedimentation Controls on Construction Projects.
  - 3. Traffic Control Plan in accordance with GDOT requirements (where applicable).
  - 4. Analysis of design criteria and calculations for CIPP thickness per ASTM F1216 full deteriorated condition.
    - a. Submit complete data and design calculations for each lining
      - 1) Include installation method statement for each lining including:
        - a) Repair details for potential sewer defects in conjunction with manholes, joints, laterals and infiltration.
        - b) Quality Control/Quality Assurances
      - b. Calculations shall be prepared and stamped by a Professional Engineer in the State of Georgia.
        - 1) Approval of the calculations shall not relieve the Contractor of any contractual obligations.
      - c. Minimum thickness shall be 3 mm.
  - 5. Curing temperature/monitoring system shop drawings
  - 6. Shop Drawings for hydrophilic end seals and pre-liners to be used and method of installation.
  - 7. Proposed testing procedure including:
  - 8. Number, location and sampling methods
  - 9. Proposed testing laboratory with qualifications, experience history and references.
  - 10. Pre-installation CCTV inspection DVD.
  - 11. Qualification requirements for the Contractor, Installer and personnel (See Item 1.04 Qualifications, this specification)
- B. Informational Submittals:**
- 1. Manufacturer's technical literature and certificate demonstrating the materials to be used meet the referenced standards and the requirements of these specifications.
  - 2. Proposed equipment and procedures for accomplishing the cured-in-place pipe lining work.

3. Manufacturer's printed installation instructions including:
  - a. Installation method statement including:
    - 1) Details concerning curing methods,
    - 2) Inversion pressures necessary for proper installation,
    - 3) Minimum pressure required to hold tube tight against existing host pipe,
    - 4) Maximum allowable pressure that will not damage tube,
    - 5) Type of insertion,
    - 6) Defect repair:
      - a) Methods of repairing in conjunction with manholes,
      - b) Joints,
      - c) Laterals,
      - d) Active infiltration,
      - e) Quality control/quality assurance plan,
      - f) Repair material test results.
4. Product data and Manufacturer's installation procedures for resin and catalyst system including but not limited to specifications, characteristics, properties, and itemized exceptions and deviations to Specification.
5. Certified test reports on physical properties and chemical resistance of proposed resin
6. Material Safety Data Sheets for all resins, and other additives such as accelerants, colorants, and lubricants utilized in the pipe liner/lining process.
7. Manufacturer's Certificate of Compliance that resin material is appropriate for intended application and in conformance with specifications
8. Certified test reports on physical properties and chemical resistance of proposed resin
9. Annular space sealant
10. Service connection fittings

**C. Project Submittals**

1. The Contractor shall submit the following information during the project for the use of CIPP at a particular location:
  - a. Field measurements.
  - b. Design wall thickness calculations,
    - 1) signed and sealed by a professional engineer registered in the state of Georgia and proficient in the design of CIPP systems
    - 2) Manufacturer certification of material to values used in calculations.

2. “Wet-out” Plan: for each proposed lining section,
    - a. method for “wet-out” or flexible tube
    - b. specific insertion and curing schedule
  3. Contractor’s procedures and materials for installing the liner and renewing sewer services including time and duration of sewer service unavailability.
  4. Sampling procedures and locations for obtaining representative samples of the finished liner.
- B.** The Contractor shall submit a daily written record as specified in Section 01320 Progress Reports & Videos
1. The Owner’s Representative shall certify receipt of the daily record (in email format) noting any items and adding any observations with reference to claims for payment to the Contractor.
  2. The Owner’s Representative may request a weekly submission in the form of progress report.
    - a. Owner’s Representative shall provide the Contractor a written request for a weekly progress report.
- C.** Record drawings, including the identification of the work completed by the Contractor, and the post-installation CCTV shall be submitted within 2 weeks after the project is completed.

## **1.06 DELIVERY, STORAGE, AND HANDLING**

- A.** Packaging, handling and shipping shall be done in accordance with the manufacturer’s instructions.
1. The Contractor shall be responsible for the delivery, storage, and handling of products.
    - a. Keep products safe from damage
    - b. Promptly remove damaged products from the work site at the Contractor’s expense.
      - 1) Dispose of in accordance with current applicable regulations.
    - c. Replace damaged products with undamaged products acceptable to the Manufacturer and Owner’s Representative.
  2. No products shall be shipped to the job site without the approval of the Owner's Representative.
- B.** Resin to be shipped directly to wet-out facility from resin manufacturer unless otherwise approved by the Owner’s Representative.
- C.** Store UV light cured liners in a light proof, cool environment to prevent premature

curing

- D. No cuts, tears, or abrasions shall occur to liner tube during handling.
- E. All materials shall be accompanied by test reports certifying the material conforms to the ASTM standards listed herein.
  - 1. Materials shall be shipped, stored, and handled in a manner consistent with written recommendations of the manufacturer.
  - 2. The liner wet-out report must be provided for liner material and resin type.
    - a. The ratio of resin and fiberglass must be provided by the manufacturer.
- F. All damaged materials rejected by the Owner's Representative shall be promptly removed from the project site at the Contractor's expense and disposed of in accordance with current applicable regulations.

## 1.07 SAFETY

- A. Perform work in accordance with OSHA standards and State and Federal safety regulations.
- B. No confined space entry will be permitted without the development and implementation of a confined space entry plan.
  - 1. Plan shall be in accordance with OSHA standards
  - 2. Personnel involved shall have current training certificates
  - 3. Entry permit is required prior to entry.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. Glass Fibers:
  - 1. The glass fibers shall be corrosion resistant E-CR
  - 2. Each lot of glass fibers liner shall be inspected for defects and tested in accordance with applicable sections of ASTM F2019.
- B. Tube (Liner):
  - 1. Any materials not approved by the Program Manager prior to installation into the piping shall be rejected and shall be removed and replaced with approved materials at the Contractor's expense
  - 2. The liner shall have an impervious internal and external coating material to protect the resin from ultra violet light exposure and from contamination during shipping and installation.
  - 3. The fiber glass liner shall be saturated with the appropriate resin using the

resin bath or vacuum suction impregnation methods and prevent the least amount of air entrapment.

4. Manufacture/construct the UV-CIPP using materials and methods that when installed:
  - a. Provides a jointless and continuous structurally sound liner
  - b. Able to withstand all imposed static, and dynamic loads on a long-term basis.
5. The impregnation of the resin into the glass fiber tube must be performed at the manufacturer's factory.
  - a. No on-site wet-out of the tube will be allowed.
  - b. The liner shall be designed to meet the contract requirements.
6. The liner shall be sized such that when installed it will tightly fit the internal circumference of the host pipe.
7. The manufacturer shall test raw materials and liner material at various stages of manufacturing.
8. Every finished liner shall be sampled and tested for modulus of elasticity, and wall thickness.
  - a. The results will be provided to the Program Manager.
9. The liner shall be seamless so that homogeneous properties are attained throughout the length and circumference.
10. The inner and outer membranes shall be certified styrene gas barriers.
11. All liners shall be packaged in special shipping containers and UV protection foil,
  - a. Allowing storage of the resin impregnated liner for up to 6 months, with no need for refrigeration.

**C.** Design liner thickness using the following criteria:

1. Design Life: 50 Years
2. Pipe Diameters: Per Contract Drawings
3. Ovality 2%
4. Pipe Condition: Fully deteriorated
5. External Water: Ground surface if not specified on the Contract Documents
6. Tensile Strength: 20,000 psi
7. Flexural Strength: 20,000 psi
8. Short Term Flexural Modules: 1,000,000 psi
9. Long Term Flexural Modules: 600,000 psi
10. Reduction Factor: 50%

11. k Enhancement Factor: 7
12. Soil Modules: 1,000 psi
13. Soil Density: 125 pcf
14. Highway Live Load: AASHTO H-25
15. Safety Factor: 2 minimum
16. Minimum Thickness: The liner thickness of each pipe segment shall be determined by the Contractor and submitted per Paragraph 1.05 of this Section. The minimum CIPPL design thicknesses are listed below.

6" - 10" Dia	3 mm
12" – 15" Dia	6 mm
18" - 24" Dia	7 mm

- a. The nominal liner wall thickness shall be constructed to the nearest 0.5 mm increment.

17. Poisson’s ratio: 0.3
18. Liner shall be watertight

**D. Resin:**

1. General purpose, unsaturated, polyester, epoxy, isophtalic neopentyl glycol, or thermosetting vinyl ester resin including:
  - c. Catalyst system, initiators, or hardeners providing specified cured physical strengths and properties,
  - d. Compatible with reconstruction inversion process.
2. Resistant to municipal wastewater environment including:
  - e. Immersion in septic sewage at temperatures up to 75 degrees F.
3. PET resins, resin fillers, resin additives, and resin enhancement agents are prohibited.
  - f. Only neat resins are acceptable.
  - g. Old resins and reworked resins are prohibited, regardless of whether or not they are mixed with new resin.
4. Chemical resistance of resin system shall have been tested by resin manufacturer in accordance with ASTM D543.
  - h. Exposure to chemical solutions listed below at temperatures of up to 75 degrees F shall be conducted for a minimum period of 1 month and shall result in a loss of not more than 20 percent of initial structural properties.
    - 1) Minimum Chemical Solution Concentration, ASTM F1216:

- a) Tap Water, pH 6 to 9: 100 percent.
  - b) Nitric Acid: 5 percent.
  - c) Phosphoric Acid: 10 percent.
  - d) Sulfuric Acid: 10 percent.
  - e) Gasoline: 100 percent.
  - f) Vegetable Oil: 100 percent.
  - g) Detergent or Soap: 0.1 percent.
5. Produce cured tube resistant to shrinkage, not corrode or oxidize, and resistant to abrasion from solids, grit, and sand in wastewater.
  6. Bond between tube layers shall be strong and uniform.
  7. Layers, after cure, shall be saturated with resin.
  8. The resin color will not interfere with visual inspection of cured liner.

## 2.02 SOURCE QUALITY CONTROL

- A. At time of manufacture, each lot of liner shall be inspected and certified to be free of defects.
- B. Mark inside of tube in at least one location per set up.
  1. Mark shall include manufacturer of liner, at regular intervals, not to exceed 5 feet, along full length.
- C. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction.
  1. CIPP samples with and without plastic coating shall meet these chemical testing requirements.
  2. CIPP Field Samples:
    - a. Submit test results from field installations of the same resin system and tub materials as proposed for the actual installation.
    - b. Test results must verify that CIPP physical properties specified have been achieved in previous field applications.

## PART 3 – EXECUTION

### 3.01 PREPARATION

- A. The following installation procedures shall be adhered to unless otherwise approved by the Owner's Representative.
  1. Carry out all operations in accordance with all Federal, State, and local safety laws, regulations, standards, policies, and procedures including those

promulgated by OSHA and those recommended by the manufacturer.

- a. Particular attention is drawn to those safety requirements involving entering confined spaces (follow OSHA requirements).
  - 1) The Contractor shall take additional precautions to secure the work area and insure the safety of everyone in or around the curing apparatus.
  - 2) Before utilizing this method, the Contractor shall submit a copy of the Contractor's standard operating procedures addressing safety issues for this methodology to the Program Manager.
2. The Contractor shall bypass wastewater around the sewer segment or sewer segments designated for lining as specified in Section 01520 –Sewer Flow Control.
  - a. Service connection effluent may be plugged only after proper notification to the affected properties.
  - b. Individual's sewer service shall not be interrupted for more than 8 hours.
    - 1) If proposal is to interrupt service for more than 8 hours alternative means of providing service during construction will be required.
3. Do not install liner if ground water temperatures and/or ambient temperatures are excessive for the manufacturer's recommended installation procedures.
4. Where practicable, liners can be installed in continuous runs through manholes:
  - a. Where there are two or more continuous sewer segments,
  - b. Or to connect several short segments with a continuous lining.
  - c. If a road/lane must be closed to traffic, the Contractor shall furnish a detailed traffic control plan and all labor and equipment necessary.
    - 1) No separate payment will be made for traffic control.
    - 2) It is an incidental part for CIPP installation.

### 3.02 PRE-INSTALLATION PROCEDURES

- A. Complete the following activities, unless otherwise approved by the Program Manager.
  1. Perform operations in accordance with OSHA Standards.
  2. Before Work commences:
    - a. Required pre-installation submittals shall be approved by

## Owner's Representative, including:

- 1) Traffic management plan/measures,
  - 2) Safe pedestrian passage,
  - 3) Provision of vehicular access to property,
  - 4) Bypass/diversion pumping,
  - 5) Emergency measures/contingent plans.
- b. Submit an Installation Access Plan including:
- 1) Access manhole location(s)
  - 2) Site plan sketch showing dimensions of access within work limits and utilities
  - 3) Approximate installation rate (ft/day)
  - 4) Appropriate excavation/backfill/resurfacing procedures including permits according to Georgia Dept. of Transportation and governing agency standards.
3. Pre-insertion Cleaning:
- a. Clean sewer pipe before pre-insertion television inspection.
- 1) Immediately before installation of the lining complete a high pressure flush and vacuum in sewer sections to be rehabilitated and repaired including pertinent manholes.
  - 2) Remove any root, grease buildup and any other obstruction that may interfere with the lining operation.
- b. Debris removed from sewer during cleaning shall be transported in watertight containers and disposed of in accordance with local, State, and Federal Regulations.
4. Pre-insertion CCTV Inspection:
- a. In accordance with Section 01510 – Sanitary Sewer Main Television & Sonar Inspection.
- b. Inspect sewer pipe before insertion of resin impregnated tube to ensure pipe is clean and existing pipe conditions are acceptable for lining.
- 1) Any notable condition that could affect the lining operation will be removed/repared prior to initiating the lining.
5. Line Obstructions: If pre-installation video CCTV inspection reveals obstruction in existing pipe that cannot be removed by sewer cleaning equipment, with approval of Program Manager, perform point repair using flexible coupling.

6. Ensure proper sequence of work occurs between mainline and lateral lining activities.
7. Confirm accurate location and serviceability of existing lateral or service connection (tap). Serviceability shall be confirmed by flowing water, dye testing, or visually with CCTV inspection.
  - a. Dye Testing: Where sewer line segments may contain abandoned services, Contractor may be directed by Program Manager to perform dye testing to determine if services are live and require reinstatement.
    - 1) The Contractor shall be responsible for the identification and verification of all branch service connections prior to installing the UV-CIPP.
  - b. Line Obstructions: If pre-installation video CCTV inspection reveals obstruction in existing pipe that cannot be removed by sewer cleaning equipment, with approval of Program Manager, perform point repair using flexible coupling.
    - 1) When service connections protrude into existing pipe more than ½ inch, as measured from inside pipe wall, remove protruding portion of service connection to within ½ inch of inside pipe wall.
8. The contractor shall remove, grind or take other precautions necessary to address sharp edges or protrusions that could tear the liner or the protective sheets or films.
9. For pipes where sags exist in the pipe segment:
  - a. Water in the sag is to be removed to avoid trapping water between the liner and the host pipe.

### 3.03 INSTALLATION

- A. Verify diameters and lengths in field before manufacturing and cutting liner to length.
- B. Install in accordance with ASTM F1216, Section 7 or ASTM F1743, Section 6.
  1. Active infiltration must be removed prior to insertion of the liner.
- C. Resin Impregnation (Wet-Out)
  1. Tube shall be either impregnated with resin either by the resin bath or vacuum suction methods under controlled conditions.
    - a. Resin bath impregnation must be performed at the manufacturer's factory.
    - b. Vacuum suction impregnation – location must be designated prior to CIPP installation.

- c. No onsite wet-out of the tube will be allowed.
  - d. If requested, allow Program Manager to inspect materials and procedures used to impregnate the tube.
  - e. If Contractor uses an alternative method of resin impregnation, method shall produce the equivalent results.
    - 1) An alternative resin impregnation method shall be documented to Program Manager and Owner's satisfaction that saturation of CIPP is sufficient.
  - f. Handle resin impregnated tube to retard or prevent settling until it is ready for insertion.
2. Resin must be uniformly distributed throughout the tube.
- a. Use roller system to uniformly distribute resin throughout tube.
3. Volume:
- a. Resin shall fill voids in tube material at nominal thickness and diameter; no air spaces or pockets allowed.
  - b. Adjust by adding excess resin to change resin volume because of polymerization and to allow for migration of resin into crack and joints in original pipe.
4. Complete wet-out process control sheet for every lining completed. Control sheet shall provide the following information:
- a. Liner manufacturer
  - b. Liner diameter
  - c. Number of layers
  - d. Resin manufacturer
  - e. Resin amount
  - f. Resin type
  - g. Batch number
  - h. Catalyst and accelerator name/type
  - i. Hardener name/type
  - j. Mixing ratios
  - k. If vacuum suction method use: pressure of impregnation process
  - l. Wet-out start time and date

#### D. Insertion

- 1. CIPP installation shall be in accordance with applicable ASTM F2019 and manufacturer's specifications.

2. The Contractor and Manufacturer shall provide all appropriate transport, handling and protection equipment to transport the impregnated tube to the project site.
  - a. All materials should be protected from the weather and exposure to UV light during the manufacture, storage, transport, and installation.
3. All fabricating and Contractor testing shall be carried out under cover and no materials shall be exposed to the weather until they are ready to be inserted.
4. Each liner shall be accompanied by suitable documentation indicating:
  - a. Time and date of manufacture,
  - b. Fiberglass thickness,
  - c. Length of liner,
  - d. Resin types,
  - e. Resin content,
  - f. Catalyst,
  - g. Relevant batch numbers,
  - h. etc.
5. Liner protection – Prior to inserting the Liner, a plastic slip/rub sheet 10 mil thick will be pulled and laid flat into the host pipe such that it protects the Liner from damage as the Liner is pulled in.
6. Liner Insertion –
  - a. Insert the liner through an existing manhole or approved access point
  - b. Fully extend to the next designated manhole or termination point.
  - c. Pulling speed shall not exceed 15 ft/min.
  - d. Exercise care that no axial stretching occurs so that there is no damage to the tube during the pulling phase.
7. The tube shall be positioned in the pipeline using the method specified by the manufacturer.
  - a. Exercise care not to damage the tube as a result of installation.
8. Liner Inflation –
  - a. Pressurize the tube to achieve and maintain a tight fit (no gap) against the host pipe throughout the curing process.
    - 1) End plugs or packers shall be used to cap each end

of the liner to prepare for pressurizing.

- 2) The end caps shall be secured with straps or by other means to prevent them from being expelled.
  - b. The curing light train and CCTV camera shall be installed and directed through the entire length of the tube during which a detailed CCTV inspection is performed of the uncured tube.
  - c. Any defects, such as water bubbles, shall be addressed before the curing begins.
  - d. The light train is the activated and moved back along the length of the tube to affect the curing of the tube into a UV-CIPP.
9. The liner ends shall be the full size of the host pipe and shall be tight fitting to the end of the host pipe.
  - a. No wrinkles are acceptable at the termination of the liner.
  - b. No leaking from the liner/host pipe interface will be accepted.
10. The light cure train shall be fitted with suitable monitors to gauge the cure achieved throughout the length of the liner.
  - a. The speed of cure shall be as per the manufacturer's requirements.
11. The inner tube protective membrane shall be removed after the liner has been cured.
12. Complete installation process control sheets for every lining completed. Control sheet shall provide the following information:
  - a. Date and time
  - b. Liner length
  - c. Pressure required to inflate tube and hold tight until curing process complete
  - d. Time curing process started
  - e. Curing time
  - f. Time curing process ended
  - g. Light source and wattage
  - h. Exothermic (curing) Temperatures
  - i. Time cutting ends started
  - j. Time cutting laterals started
  - k. Number of laterals cut

#### E. Curing

1. The Contractor shall be responsible for the thorough curing of the liner to achieve the specified results.

- a. The curing process shall be performed in accordance with the manufacturer's recommendations.
2. Contractor shall extend, at their expense, curing time to achieve a hard, sound liner demonstrating the specified mechanical and chemical properties, if required.
3. Service Lateral Re-Instatement:
  - a. After liner has been cured in place:
    - 1) Use CCTV and a robotic cutter device to field locate existing service connections,
    - 2) Confirm the number of service connections to be reinstated and complete work to bring them back on line.
      - a) Recover coupons at downstream manhole and remove.
      - b) All service lateral reinstatements will be wire brushed to eliminate burrs and snags.
    - 3) Service interruptions shall not exceed 8 hours.
    - 4) Existing sewer service laterals will be internally reinstated to 100% of their pre-CIPP flow diameter.
      - a) The finished opening shall be smooth with no ragged edges and shall prevent clogging or blockages.
  - b. Do not reconnect services from abandoned or vacant lots, unless otherwise directed by the Program Manager.
  - c. Show distance from nearest downstream manhole to reconnected service on record drawings.
  - d. When a remote cutting device is used and a cleanout is available, then a mini-camera down the service may also be used to assist the operator in cutting or trimming.

### 3.04 POST INSTALLATION

- A. UV-CIPP installation shall be free from visual defects such as foreign inclusions, dry spots, keel, boat hull, pinholes, wrinkles, and other deformities.
  1. Defects and deformities may, at discretion of the Program Manager, be cause for rejection of entire liner.
  2. Contractor shall correct failed UV-CIPP and defective UV-CIPP,
    - a. identified from post installation television inspection,
    - b. test reports for structural values

- c. thickness
  3. Method of repair, which may require field or workshop demonstration, shall be approved by the Program Manager prior to commencement of work.
  4. Remove and replace pipe identified with defects or deformities that cannot be repaired to the satisfaction of the Program Manager and/or the Manufacturer.
- B. Both ends of the cured Liner shall be cut smoothly 2” from the inlet and outlet points in the manhole
  1. Seal with an epoxy or resin mixture compatible with the Liner/resin system, providing a watertight seal.
  2. Sealing material and installation method shall be submitted and approved by the Owner’s Representative prior to start of construction.
    - a. Tube manufacturer shall also be consulted for appropriate sealing material and installation method.
  3. Hydraulic cements and quick-set cement products are not acceptable.
- C. Where liners of any type are installed in two or more continuous manhole segments, the liner invert through the intermediate manholes shall be left intact.
  1. Final finishing of the installation in those intermediate manholes shall require removal of the top of the exposed liner
  2. Neat trimming of the liner edge where it touches the lip of the manhole bench.
  3. Sealing between the new liner and pre-existing manhole channel.
- D. Portions of any piece of liner material removed during installation shall be available for inspection and retention by the Owner’s Representative.
- E. All manhole drop connections will be reviewed on an individual basis.
  1. Reinstate openings for all drop assemblies after relining mainline sewer.
  2. Everywhere possible, outside drop assemblies shall be lined with a cured-in- place liner compatible with the mainline liner, for the full length of the drop assembly and bend.
  3. Drop assemblies inside of manholes are not required to be relined, unless directed by the Owner’s Representative.
- F. Each line segment lined shall be CCTV inspected as soon as practical after processing to assure complete curing.

1. Segments not fully conforming to these Specifications must be immediately brought to the Owner’s Representative attention with a proposed method of correction without cost to the Owner.

**3.05 SAMPLE TESTING**

- A. The Contractor shall have an independent testing lab analyze finished liner samples taken from manhole cutoffs, service coupons, etc.
  1. A minimum of one (1) 12-inch long restrained sample shall be taken from each liner segment installed, or as directed by the Owner’s Representative.
  2. Physical samples removed for testing shall be individually labeled and logged to record the following:
    - a. Owner’s Project number and title
    - b. Sample number
    - c. Segment number of line as noted on plans
    - d. Date and time of sample
    - e. Name of Contractor
    - f. Location and by whom tested
    - g. Results of test
    - h. Street name and address
  3. Send one (1) sample from each liner segment installed to test in accordance with ASTM standards for:
    - a. Flexural Modulus,
    - b. Flexural Strength
    - c. Wall thickness shall be conducted, a minimum of three samples per project will be tested.
    - d. If tests do not meet the minimum values:
      - 1) Additional samples originally not sent for testing may be required to be tested, as directed by the Program Manager.
      - 2) Contractor bears all costs associated with additional testing.

Property	ASTM Test	Minimum
Flexural Strength	D790	20,000 psi
Flexural Modulus	D790	1,000,000 psi

Thickness	D2122 (per F2019)	Contract requirement

- B. Resin Sampling:
  - 1. Wet-out facility resin mixing equipment shall have a valve downstream of the mixing function and immediately upstream of application of mixed resin of tube where resin samples may be drawn.
  - 2. Batch mix facilities, if any, shall provide sampling of mixed batch.
  - 3. Submitted “wet-out” schedule cannot be modified without 24-hour notice to Owner’s Representative.
  - 4. Resin samples shall be drawn at times determined by Owner’s Representative.
- C. Field thickness testing:
  - 1. Perform prior to conducting laboratory tests.
  - 2. Take a wall thickness measurement in accordance with ASTM D2122
  - 3. Make a minimum of four measurements, evenly spaced, on each test specimen.
    - a. Calculate average thickness using measured values.
  - 4. Average thickness shall be equal or greater than required design thickness.
  - 5. Failure of thickness test shall be grounds for rejection for CIPP liner
- D. If properties tests do not meet the minimum physical and thickness requirements, the CIPP shall be repaired or replaced at the Contractor’s expense.
- E. All curing, cutting, and identification of samples will be witnessed by the Owner’s Representative.

**3.06 TELEVISION INSPECTION**

- A. Perform television survey in accordance with the requirements of Section 01510 – Sanitary Sewer Main Television and Sonar Inspection (CCTV).
  - 1. CCTV shall be performed:
    - a. Prior to installation of the UV-CIPP but after cleaning.
    - b. After installation of CIPP line and the reconnection of all active sewer laterals.
- B. Conduct finished inspections continuous over entire length of sewer

between manholes within 48 hours of installation.

1. Liner shall be free from visual defects, damage, and deflection.
  - a. No visible infiltration through the liner, at the joints, at the service connections or at the manholes
2. Base acceptance of liner on videotaped CCTV inspection and that defects described in 1, above, do not exist.
  - a. Corrections of defects or failures identified in post-installation CCTV shall be repaired at no cost to Owner
  - b. Method of repair shall be approved by Owner's Representative prior to completion of work.

### 3.07 TESTING

- A. Test full Length CIPP testing shall be in accordance with Section 02650 – Testing for Acceptance of Sanitary Sewers.

### 3.08 ACCEPTANCE

- A. Laboratory Testing: one sample shall be sent to an independent laboratory and tested.
  1. Preparation and testing standards shall be performed in accordance with the approved submittals.
  2. Failure of any test can be grounds for rejection of the CIPP liner.
  3. At the direction of the Program Manager a second sample shall be tested.
- B. Destructive Testing: Where test results of samples from the 12-inch long pipe section are lower than required values, at the direction of the Program Manager, Contractor shall cut samples form liner along length of pipe.
  1. The size and shape of the samples shall be determined by Program Manager.
  2. The Contractor shall repair the CIPP liner and host pipe at no additional cost to the Owner.
  3. Failure of test shall be grounds for rejection for the CIPP liner.
- C. Resin Sampling: Program Manager drawing the samples will arrive unannounced and shall be afforded immediate access to the equipment.
  1. Resin sample shall be sent to the independent laboratory and tested.
  2. Testing standards shall be performed in accordance with approved submittals.

3. Failure of any test can be grounds for rejection for the CIPP liner.
- D. Low-pressure air testing or hydrostatic exfiltration test: acceptance based on successful completion of this test as specified herein.
- E. The Contractor shall submit to the Owner's Representative, for acceptance and approval,
  1. Two (2) copies of unedited post-installation CD/DVDs
  2. Associated certified test reports for each sewer main segment within 10 working days of the Liner installation.
  3. No more than one sewer main segment shall be included on a post- installation Inspection CD/DVD or curing report.
- F. It is the intent of these specifications the completed liner, with all appurtenances, to be essentially equivalent in final quality and appearance to new sewer pipe installation.
  1. The conditions of the existing host pipe will be taken into consideration.
- G. Where, in the opinion of the Program Manager, a defect in the CIPP liner requires removing a section of the CIPP liner, the Contractor shall make all repairs as directed by the Program Manager and shall install a segmental liner, compatible with the CIPP liner, to accomplish a continuous finished liner.
  1. No separate measurement and payment will be made for such defect repair or for the post-repair segmental liner.

### 3.09 PRIVATE SERVICE LINE SHUTDOWN

- A. Notify Owner's Representative at least 1 week prior to shut down.
- B. When it is necessary to shut down a private sewer service line notify building occupants regarding service lateral disconnection by placing a door hanger approved by the Owner's Representative.
  1. Place door hangers 48 hours prior to shut down.
- C. When service lateral will be disconnected from main for more than 8 hours, lateral shall be positively drained or pump down.
  1. Monitor status of flow and storage.
  2. Pump lateral more frequently where flows exceed storage capacity of lateral or Contractor provided temporary storage.
- D. If service lateral cannot be positively drained or pumped down or disconnection of service is anticipated being 8 hours or longer,
  1. Contractor shall provide temporary living accommodations for

- resident at no additional cost to Owner or resident.
2. Temporary living quarters accommodations shall be approved by Program Manager and coordinated through resident and Owner's Customer Support Representative.
  3. Alternatively, Contractor may supply a temporary bypass pumping system to keep the lateral operational.
- E. Notify building occupants when work is complete and uninterrupted service restored.
- F. Commercial sewer services shall be maintained at all times while the business is open.
1. No sewage from the services or main line shall be discharged on the ground or in waterways.
  2. Holding pits or tanks are not allowed unless permitted by Federal, State, and local authorities having jurisdiction.

### 3.010 CLEANUP

- A. After the CIPP liner installation work has been completed and all testing acceptable, the Contractor shall clean up the work area.
1. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor.
    - a. The debris and liquids are to be disposed of properly in accordance with all applicable laws.
    - b. The local municipality can furnish a letter to the landfill stating the Contractor is authorized to dispose of the non-hazardous materials.
    - c. Debris and liquids type and quantities are to be tracked in the daily Contractor diary.
    - d. Hauling and disposal costs will be borne by the Contractor.
  2. The work area shall be left in a condition equal to or better than prior condition.
    - a. Disturbed grassed areas shall be seeded or sod placed as directed by the Owner's Representative at no additional cost to the Owner.
    - b. The work site restoration work shall be completed in accordance with the requirements of Section 02480 – Site Restoration and Erosion Control.
    - c.

### 3.011 DOCUMENTATION

- A. The Contractor shall complete work on each asset as assigned via the Owner's Computerized Work Order Management system.
  - 1. Upon start of work, the Contractor shall receive work orders as assigned by the Owner's Representative.
  - 2. The Contractor shall maintain and synchronize the status of each rehabilitation work order issued.

### 3.012 **WARRANTY**

- A. **Material Warranty:** A written guarantee of 2 years shall be provided by manufacturer against breakdown of material effectiveness of structural repair elements.
  
- B. **Workmanship Warranty:** The Contractor shall guarantee his work for a warranty period of two (2) years from the date of final acceptance against any leakage, cracking, loss of bond, or other discontinuity as identified.
  - 1. Contractor and liner manufacturer representative shall participate in inspection.
  - 2. Deficiencies related to material and workmanship shall be repaired by contractor to the satisfaction of the Program Manager at no additional cost.
  - 3. If repairs are made, then the Contractor shall warrant the work for one (1) year in addition to the original warranty period required by the Contract.

**END OF SECTION**