SECTION 02500

LINING WITH CURED-IN-PLACE PIPE (CIPP)

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The rehabilitation of a full length of an existing sewer main, from manhole to manhole, and partial/segmental/point repairs by the trenchless method known as Cured-In-Place Pipe (CIPP) lining.

1. CIPP consists of:

   a. Installing a resin-impregnated flexible tube, either inverted or pulled into the existing sewer main,

   b. Expanding the tube to fit tightly against the interior diameter of the main it was installed in by the use of water or air pressure.

   c. Curing/hardening the resin by elevating the temperature of the fluid (water/air) used for the inflation to a sufficient level for the initiators in the resin to effect a reaction.

   d. The resultant shall be a hard, impermeable pipe within a pipe.

2. Partial/segmental/point repair CIPP shall include lining a limited section of pipe of no less than three (3) linear feet in length or longer

1.02 SCOPE

A. Provide all material, labor, and equipment to rehabilitate the existing sanitary sewer as described herein and shown on the plans.

B. The CIPP process shall provide for the structural and hydraulic renewal of the existing sewer.

1. The CIPP liner shall be smooth, hard, strong and chemically inert.
2. The interior surface shall closely follow the contours of the host pipe.

C. When completed:

1. Re-establish access at manholes
   a. Seal at each manhole shall be watertight.
2. New CIPP liner shall extend from manhole to manhole
3. Re-establish service connections to the sewer. Produce a seal that eliminates

infiltration with an epoxy or resin mixture compatible with the liner resin system. Seal shall be water tight.

1.03 REFERENCES

A. ASTM

1. D543 – Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents
2. D638 - Standard Test Method for Tensile Properties of Plastics. D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
3. D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure.
4. D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
5. D2990 - Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics.
6. D2412 - Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
7. D2837 - Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
8. D5813 - Standard Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems.
9. F1216 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
10. F1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe.
11. 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.
12. F2599 – Standard Practice for the Sectional Repair of Damaged Pipe by Means of an Inverted Cured-In-Place Liner

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.

1.04 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 Section 02276 Site Restoration and Erosion Control.

3. Traffic Control Plan in accordance with MUTCD and 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

b. Include installation method statement for each lining including:

1) Repair details for potential sewer defects in conjunction with manholes, joints, laterals and infiltration.

2) Quality Control/Quality Assurances

c. 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.

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: number, location and sampling methods.

8. Proposed testing laboratory with qualifications, experience history and references.

9. Pre-installation CCTV inspection DVD.

10. 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 of CIPP systems.

      3) 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.

D. 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.

E. 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 materials and products.
    a. keep products safe from damage
    b. Promptly remove damaged products from the Work site at the Contractor's expense.
    c. Replace damaged products with undamaged products acceptable to the Manufacturer and Owner's Representative.
    d. Dispose of in accordance with current applicable regulations.
2. No materials or products shall be shipped to the Site of the Work without the agreement 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 water or steam cured resin-impregnated tubes in refrigerated truck trailers at a temperature below 45 degrees F to prevent premature curing.

D. No cuts, tears, or abrasions shall occur to liner tub.

E. No cuts, tears, or abrasions shall occur to liner tube during handling.

F. Materials shall be accompanied by test reports certifying that the material conforms to the ASTM standards listed herein.

G. The liner wet-out report must be provided for liner material and resin type.

1. The ratio of resin and fabric must be provided by the manufacturer.

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 - GENERAL

2.01 PRODUCTS

A. Liner pipe shall be cured-in-place pipe (CIPP) similar or equal to the following:

1. Insituform, St., Louis, MO.

2. Granite Inliner, Orleans, IN (formerly Layne Inliner).
3. IPR, The Woodlands, TX.
4. Other proposed liner products must be preapproved by the Owner's Representative.

B. Owner or Owner's Representative shall be entitled to witness the pipe manufacture.

2.02 MATERIALS

A. Flexible Liner Tube:

1. Consist of layers of flexible nonwoven and absorbent polyester felt:
   a. Designed in accordance with ASTM F1216, Appendix X.1.2.2 (Fully Deteriorated Gravity Pipe Condition).
   b. CIPP design shall assume no bonding to the original pipe wall.
   c. Fabricated from materials which when cured will be chemically resistant to reagents as defined in ASTM D543.
2. Manufacturer must have performed long-term testing for flexural creep of the CIP material installed by Subcontractors.
   a. Such testing results are to be used to determine the long-term, time dependent flexural modulus that will be used in product design.
      1) This constitutes a performance test of the tube and resin and general installation and curing workmanship.
   b. A percentage of the instantaneous used in design calculations for exterior buckling.
   c. A percentage of the instantaneous flexural modulus value will be used in design
      1) The percentage or the long-term creep retention value utilized will be verified by this testing.
      2) Retention values exceeding 50 percent of the short term test results will not be allowed.
   d. Materials used shall be of a quality equal to, or better than, the materials used in the long-term test with respect to the initial flexural modulus used in the CIPP design.
3. Layers of cured CIPP shall be uniformly bonded.
   a. Layers that separate cleanly using a probe or point of a knife blade are not acceptable.
   b. Probe or knife blade moving cleanly between layers is not acceptable.
   c. Occurrence of (a) or (b) above will require new samples to be obtained from the installed pipe.

d. Reoccurrence may cause rejection of the Work.

e. Overlapped layers of felt in longitudinal seams that cause lumps in the final product are not acceptable.

4. Capable of stretching to fit irregular pipe sections.

5. Fabricated and sized for each section to ensure snug and firm fit inside existing sewer

   a. Produce required thickness after resin is cured.

   b. After installation there shall be no wrinkles or permanent fins formed.

6. Inside layer of tube shall be coated with an impermeable material compatible with resin and felt.

7. Maximum Stretching Allowance: In accordance with ASTM F1216.

8. Fabricate in lengths such that liner occupies length of pipeline between launch and reception manholes.

9. Where several layers of felt are required, inner layer shall be stitched to form a tube.

   a. Each successive layer shall be individually wrapped around previous one and stitched together.

   b. Outer layer of felt shall have an installation tube pre-bonded to it, or a sheet of this material shall be wrapped around completed felt tube.

      1) Where a pre-bonded material is used, bond a covering strip over seam to form airtight joint.

B. Pre-liner:

1. Polypropylene compatible with resin system used for the CIPP:

   a. Shall not adversely affect adhesive properties of resin used in mainline or lateral liners.

   b. May be used (if required) to eliminate/control infiltration during CIPP installation.

C. Interior Pipe Wall Color: Shall not be a dark or non-reflective nature that could inhibit proper closed circuit television (CCTV) inspection.

D. Prior to design and manufacture of the liner,

1. Obtain all the information needed for to be provided for design including:

   a. condition of the host pipe,

   b. Host pipe:

      1) Diameter,

      2) Ovality,

      3) Deflection,

      4) Length

5) Bury conditions,
6) Soil type,
7) Soil loading factor
8) Hydrostatic load,

E. 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 Drawings
6. Flexural Strength: 4,500 psi
7. Short Term Flexural Modulus: 250,000 psi
8. Reduction Factor: 50%
9. Long Term Flexural Modules: 125,000 psi
10. k Enhancement Factor: 7.
11. Soil Modules: 1,000 psi
12. Soil Density: 125 pcf
13. Highway Live Load: AASHTO H-25
14. Safety Factor: 2 minimum
15. 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	6 mm
12”-15” Dia	7.5 mm
18” Dia.	9 mm
21” Dia	10.5 mm
24” Dia.	12 mm

a. If calculations require thicker wall, round to next higher multiple of 0.5 millimeters.

16. Poisson’s Ratio: 0.3
17. Minimum length Partial/Segmental/Point Repair liners to be 8 feet. Repair shall effectively span the distance from the adjacent pipe joint plus one (1) foot unless otherwise directed by the Owner’s Representative

a. Calculated lengths longer than 8 feet will govern.

18. Liner shall be watertight

19. Produce cured tube resistant to shrinkage, not corrode or oxidize, and resistant to abrasion from solids, grit, and sand in wastewater.

2.03 RESIN

A. Resin:

1. Corrosion-resistant polyester, vinyl ester or epoxy system including all required catalysts, initiators or hardeners.

    a. When cured within the tube create a composite that satisfies the requirements of ASTM F1216 and ASTM F1743.

    b. The physical properties specified herein and those which are to be utilized in the design of the CIPP for this Project.

2. Shall produce a CIPP that will comply with the structural and chemical resistance requirements of this Specification.

    a. Styrenated resins are allowed. General purpose, unsaturated, polyester, epoxy, isophtalic neopentyl glycol, or thermosetting vinyl ester resin, catalyst system, initiators, or hardeners that provide specified cured physical strengths and properties, and

3. Compatible with reconstruction inversion process.

4. Resin used for a partial/segmental/point repair:

    a. Epoxy resin providing the specified cured physical strengths and properties.

    b. Compatible with reconstruction inversion process

    c. Unless otherwise directed by the Owner's Representative.

5. Resistant to municipal wastewater environment including:

    a. Immersion in raw septic sewage at temperatures up to 75 degrees F.

6. Curing:

    a. Designed to cure properly within selected curing method.

    b. Initiation Temperature: 180 degrees F, maximum.

7. Resistant to ultra-violet light (sunlight) prior to installation.

8. Only neat resins are acceptable.

    a. PET resins, resin filters, resin additives, and resin enhancement

agents are prohibited.

b. Old resins and reworked resins are prohibited,

1) Regardless of whether or not they are mixed with new resin.

9. Chemical resistance of resin system shall have been tested by resin manufacturer in accordance with ASTM D543.

a. Exposure to chemical solutions listed below at temperatures of up to 75 degrees F shall be conducted for a minimum period of 1 month

1) Resulting in a loss of not more than 20 percent of initial structural properties.

b. Minimum Chemical Solution Concentration, ASTM F1216:

1) Tap Water, pH 6 to 9: 100 percent.

2) Nitric Acid: 5 percent.

3) Phosphoric Acid: 10 percent.

4) Sulfuric Acid: 10 percent.

5) Gasoline: 100 percent.

6) Vegetable Oil: 100 percent.

7) Detergent or Soap: 0.1 percent.

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.

10. CIPP Field Samples:

a. Submit test results from field installations of the same resin system and tub materials as propose for the actual installation.

b. Test results must verify that CIPP physical properties specified have been achieved in previous field applications.

B. Catalyst:

1. Primary: 1 percent maximum of resin by volume.

2. Secondary: 1/2 percent maximum of resin by volume.

C. Hydrophilic End Seals

1. Hydrotite, Greenstreak, Inc.

2. Ultra Seal, Adeka Corporation.

3. Insignia, LMK Technologies

2.04 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 setup.

1. Mark shall include manufacturer of liner, at regular intervals, not to exceed 5 feet, along full length.

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 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) and steam curing.
        1) Curing with pressurized steam creates additional safety concerns including:
            a) High temperatures,
            b) Quick burn times,
            c) Potential blow offs,
            d) Others.
        2) take additional precautions to secure the work area
            a) Insure the safety of everyone in or around the curing apparatus.
        3) Before utilizing this curing method:
            a) Submit a written copy of the Contractor's standard operating and safety procedures for this methodology to the Owner's Representative.
            b) Submittal to go to the Owner's Representative
            c) Address all safety concerns in the submittal
            d) Identify how/where OSHA requirements are addressed in the submitted procedures.
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. Bypass system shall include accommodating flow from mainlines and service laterals as required
    b. Service connection effluent (laterals) may be plugged only after proper

notification to the affected properties.

c. The Contractor is responsible for any overflows that occur due to his operations.

1) Damage/cleanup shall be completed by the Contractor at no additional expense to the project.

3. Do not install liner if ground water temperatures and/or ambient temperatures are excessive for the manufacturer's recommended installation procedures.

B. Where practicable, liners may be installed in continuous runs through manholes where there are two or more continuous sewer segments, especially to connect several short segments with a continuous lining.

1. Furnish a detailed traffic control plan and all labor and equipment necessary if required to complete installation.

2. No separate payment will be made for traffic control. It is an incidental part for CIPP installation.

3.02 PRE-INSTALLATION PROCEDURES

A. Locate and designate all existing manholes and new manhole access points as necessary for the Work.

1. Provide water from hydrants for cleaning, installation and other process related work items requiring water.

a. Comply with all connection and use requirements for water.

b. Use clean water for inversion and curing.

c. Water procurement shall be in accordance with purveyor's requirements.

2. Locate and mark all existing utilities in areas where excavation is to be performed prior to beginning any excavation.

B. Complete the following activities:

1. 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.

2. 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.

3. Pre-insertion CCTV Inspection:

a. In accordance with Section 01510 Sanitary Sewer Main Television and Sonar Inspection (CCTV)

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/repaired prior to initiating the lining.

c. Line Obstructions: If pre-insertion CCTV inspection reveals obstruction in existing pipe that cannot be removed by sewer cleaning equipment, with approval of Owner's Representative, perform point repair using flexible coupling.

4. Ensure proper sequence of work occurs between mainline and lateral lining activities.

5. 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.

b. When service connections protrude into existing pipe more than 1/2 inch, as measured from inside pipe wall, remove protruding portion of service connection to within 1/2 inch of inside pipe wall.

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. Quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for:
    a. Polymerization shrinkage
    b. Loss of resin during installation through cracks and irregularities in the original pipe wall.
2. Tube shall be vacuum impregnated with resin (wet-out) under controlled conditions.
    a. Designate vacuum-impregnated location prior to CIPP installation
    b. If requested, allow Owner's Representative to inspect materials and procedures used to vacuum impregnate tube.
    c. The point of vacuum shall be no further than 25 feet from the point of initial resin introduction.
        1) After vacuum in the tube is established, a vacuum point shall be no further than 75 feet from the leading edge of the resin.
        2) The leading edge of the resin slug shall be as near to perpendicular to the longitudinal axis of the tube as possible.
    d. If Contractor uses an alternative method of resin impregnation, method shall produce the equivalent results of a roller system.
        1) Proposed alternative shall be documented to Owner's Representative's and Program Manager's satisfaction that saturation of CIPP is sufficient.
    e. Handle resin impregnated tube to retard or prevent settling until it is ready for insertion.
3. Use roller system to uniformly distribute resin throughout tube.
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. Percent of filler, if any

k. Mixing ratios

l. Vacuum pressure of impregnation process

m. Wet-out start time and date

D. Insertion

1. Dewater existing host pipe for CIPP installation as required.

2. Insert wet-out tube through existing manhole or approved access point by means of an inversion process and application of hydrostatic head sufficient to extend tube to next designated manhole or termination point.

   a. Alternately, tube may be pulled into place and expanded with inflation bladder.

      1) Insertion method shall not result in abrasion or scuffing of the tube.

3. Once installation has begun, maintain pressure between minimum and maximum pressures until installation has been completed.

   a. Pressure shall be sufficient to hold tube tight against host sewer pipe.

4. Place temperature gauges between tube and host pipe's invert position to monitor temperature during cure cycle. VeriCure monitors are to be used when requested by Owner or Owner's Representative.

5. CIPP shall be continuous over entire length from manhole to manhole.

6. Complete installation process control sheet for every lining completed. Control sheet shall provide the following information:

   a. Liner length.

   b. Hydrostatic head at point of inversion.

   c. Hydrostatic head at termination point.

   d. Time inversion process started.

   e. Time cutting ends started.

   f. Time cutting laterals started.

   g. Number of laterals cut.

E. Inflation Bladder Removal: For pulled-in-place installation techniques where

inflation bladder is designed not to bond to CIPP, remove bladder material from CIPP

F. Curing:

1. Complete curing process control sheet for every lining completed.
2. Control sheets shall provide (as outlined in ASTM F1216):
    a. Include manufacture recommended temperatures and time for the different steps of curing process;
    b. Initial cure,
        1) Initial cure may be considered completed when exposed portions of flexible tube pipe take a hard set and temperature is adequate
    c. Post cure,
    d. Cooling
3. After installation, apply steam, or hot water as recommended by liner manufacturer.

    a. Steam:
        1) Provide safety system specifically structured for use of steam.
        2) Thermoset Resin: Designed to cure properly when using steam.
        3) CIPP Tube Thermoplastic Coating:
            a) Formulated from material designed specifically to withstand high temperature curing process utilizing steam.
            b) Polypropylene/polyethylene blend or equal.
        4) Equipment:
            a) Heat source shall be capable of delivering steam throughout section and uniformly raising steam temperature above temperature required to affect cure of resin.
            b) Install temperature gauges in the following areas:
                (1) Incoming steam supply.
                    (a) Outgoing steam supply.
                (2) Between impregnated tube and pipe invert at lining termination point.
                (3) VeriCure monitors are to be used when requested by Owner or Owner's Representative.
        5) Steam Temperature: 230 degrees F, minimum.
        6) Minimum Interface Temperature between Liner and Tube: 120 degrees F.

7) Pressure Required to Keep Tube Inflated: Per manufacturer's instructions.

8) Time: Per manufacturer's instructions.

9) Cool Down:

a) Send air through steam cured CIPP liner until liner cools down to 120 degrees F interface temperature.

b) Once 120 degrees F has been reached, water may be introduced to finish cooling line down to 90 degrees F.

c) During release of water, prevent vacuum that could damage newly installed CIPP.

b. Hot Water:

1) Provide safety system specifically structured for use of hot water.

2) Thermoset Resin: Designed to cure properly when using hot water.

3) CIPP Tube Thermoplastic Coating:

a) Formulated from material designed specifically to withstand high temperature curing process utilizing hot water.

b) Polypropylene/polyethylene blend or equal.

4) Equipment:

a) Heat source shall be capable of delivering hot water throughout section and uniformly raising water temperature above temperature required to affect cure of resin.

b) Install temperature gauges in the following areas:

(1) Incoming water supply.

(2) Outgoing water supply.

(3) Between impregnated tube and pipe invert at lining termination point.

5) VeriCure monitors are to be used when requested by Owner or Owner's Representative. Minimum Interface Temperature between Liner and Tube: 120 degrees F.

6) Time: 3 hours, minimum.

7) Cool Down:

a) Introduce cool water into CIPP to replace water being drained from small hole made in downstream end.

b) Cool liner to temperature below 90 degrees F before relieving hydrostatic head.

c) During release of water, prevent vacuum that could damage newly installed CIPP.

G. Manholes

1. CIPP terminating in manhole shall be cut in shape and manner approved by Owner's Representative.

2. Seal pipe opening and fill in annular space using products specified in Part 2 Products – Hydrophilic End Seals

   a. CIPP connections at manhole opening shall be watertight seal.

   b. Install seal per manufacturer's instructions.

   c. Recheck seal repair after 48 hours. If seal does not hold, continue to repair until there are no leaks.

   d. Channels: When CIPP is installed continuous through manhole create channel per Owner's Representative's Instructions. Do not beak or shear pipe.

H. Inverts:

1. Finish manhole inverts to provide smooth transition between connections.

2. Use CIPP liner material, an approved epoxy, or similar material to form smooth transition to eliminate sharp edges of CIPP, within host pipe, and in manholes at concrete bench and channel invert.

3. Invert rehabilitation shall be compatible with manhole rehabilitation activities.

I. Partial/Segmental/Point Repair CIPP Liners

1. Install partial CIPP liner in accordance with ASTM F2599 and same requirements for full liner.

2. Dimensions of liner shall be fabricated to size, that when installed, will neatly fit circumference of existing pipe.

3. Tube shall be vacuum impregnated with thermo-set resin.

   a. Remove air in tube by vacuum allowing resin to thoroughly impregnate tube.

   b. Retain a resin-impregnated sample of each installation to provide verification of curing process taking place in host pipe.

      1) Hang sample in entry manhole to simulate ambient conditions of host pipe.

4. Insert saturated tube and inversion bladder into carrying device and pull into host pipe.

   a. Pull shall be completed when end of launching device is aligned with

beginning of section to be repaired.

b. Protect resin and tube during pull to ensure no resin is lost by contact with manhole walls or pipe.

1) Resin that provides structural seal shall not contact pipe until positioned at point of repair.

c. Alternative methods of liner insertion and pressurization may be used for products and processes approved by the Georgia Department of Natural Resources and the Owner's Representative,

1) When the final cured-in-place product meets the intent of ASTM F1216.

2) Installation shall be in accordance with the manufacturer's recommendations and available for verification by the Owner's Representative.

5. Installer shall be capable of viewing the beginning of liner contacting host pipe;

a. Verify exact placement of liner.

6. No measuring from a CCTV counter or estimating will be allowed. Extract tube from carry device by controlled air or water pressure.

b. Hold tube in place against wall of host pipe by pressure until cure is complete

7. The CIPP point repair shall be an ambient cure system

c. Cure period shall be of a duration recommended by the resin manufacturer.

8. The finished pipe shall be continuous over the length of the internal point repair,

d. Overlap point repairs if necessary,

e. Be as free as commercially practicable from visual defects such as foreign inclusions, wrinkles, dry spots, pinholes, and delamination.

f. It shall also meet the leakage test requirements.

9. Alternate curing mediums may be used, including, but not limited to steam and ambient cure.

g. End product must meet or exceed the requirements of this section.

h. Alternate curing mediums and alternate installation methodologies must be submitted for approval to the Owner's Representative prior to the bid opening date as specified in the bid documents.

i. Notification of approval (or rejection) shall be made prior to bid opening.

j. When alternate curing mediums and/or alternate installation methodologies are approved for use,

2) Follow all of the manufacturer's recommendations for installation and curing,

3) No exceptions shall be permitted.

10. Should the Owner's Representative require a sample from the partial/segmental/point repair once sampling piece is cured and inflation bladder is deflated,

k. Remove bladder and launching device from host pipe.

l. Remove materials used in installation other than CIPP liner from host pipe.

m. Recover sample piece and label with upstream and downstream manhole numbers and footage from downstream manhole.

J. Service Lateral Re-Instatement:

1. Reconnect service connections using CCTV and a robotic cutter device to field locate laterals, reinstate, and determine number of service connections.

a. Service interruptions shall not exceed 8 hours.

b. Existing sewer service laterals will be internally reinstated to 100% of their pre-CIPP flow diameter.

c. The finished opening shall be smooth with no ragged edges and shall prevent clogging or blockages.

2. Do not reconnect services from abandoned or vacant lots

3. Unless otherwise directed by the Owner's Representative Show distance from nearest downstream manhole to reconnected service on record drawings

4. Recover coupons at downstream manhole and remove.

5. 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.

6. All service lateral reinstatements will be wire brushed to eliminate burrs and snags.

3.04 POST INSTALLATION

A. 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 Owner's Representative, be cause for rejection of entire liner.

a. Correct failed CIPP and defective CIPP from post installation television inspection or test reports for structural values or thickness as determined by the Owner's Representative.

b. Method of repair,

c. May require field or workshop demonstration,

d. Requires approval by the Owner's Representative prior to commencement of Work

2. Remove and replace pipe identified with defects or deformities at the Contractor's expense.

B. Both ends of the cured Liner shall be cut smoothly 2" from the inlet and outlet points in the manhole.

1. Sealed with an epoxy or resin mixture compatible with the Liner/resin system,
2. Providing a watertight seal.
3. Sealing material and installation method shall be submitted and approved by the Owner's Representative prior to start of construction.
4. Hydraulic cements and quick-set cement products are not acceptable.

C. Where liners of any type are installed in two or more continuous manhole to manhole segments,

1. Liner invert through the intermediate manholes shall be left intact.
2. Final finishing of the installation in intermediate manholes shall require removal of the top of the exposed liner
3. Neatly trimming of the liner edge where it touches the lip of the manhole bench.

D. Portions of any piece of liner material removed during installation shall be available for inspection and retention by the Owner's Representative.

1. All manhole drop connections shall be reviewed on an individual basis. Reinstate openings for all drop assemblies after relining mainline sewer.
2. 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 manholes are not required to be relined, unless directed by the Owner's Representative.

3.05 SAMPLE TESTING

A. The Contractor shall have an independent testing laboratory 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 sample from each liner segment installed to test in accordance with applicable 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 Owner's Representative.
      (2) Contractor bears all costs associated with additional testing.

Property	ASTM Test Method	Minimum Value
Flexural Strength	D790	4,500 psi
Flexural Modulus	D790	250,000 psi
Thickness	D5813	Contract requirement

4. Resin Sampling:
   a. 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
   b. Batch mix facilities, if any, shall provide sampling of mixed batch
   c. Submitted "wet-out" schedule cannot be modified without 24-hour notice to Program Manager
   d. Resin samples shall be drawn at times determined by Owner's Representative.
   e. Perform prior to conducting laboratory tests.
   f. Take a wall thickness measurement in accordance with ASTM D2122
   g. Make a minimum of four measurements, evenly spaced, on each test

specimen

h. Average thickness shall be equal or greater than required design thickness.

i. Failure of thickness shall be grounds for rejection for CIPP liner.

5. Field thickness testing:

1) Calculate average thickness using measured values.

6. If properties test do not meet the minimum physical and thickness requirements, the CIPP shall be repaired or replaced at the Contractor's expense.

7. 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 CIPP but after pre-lining 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.

C. No visible infiltration through the liner, at the joints, at the service connections or at the manholes

3.07 TESTING

A. 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.

B. Full Length CIPP testing shall be in accordance with Section 02650 – Testing for Acceptance of Sanitary Sewers.

C. Partial/Segmental/Point Repair CIPP testing shall be in accordance with Section 3.06 Television Inspection of this specification.

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 Owner's Representative 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 Owner's Representative, Contractor shall cut samples form liner along length of pipe.

1. The size and shape of the samples shall be determined by the Owner's Representative.
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: Owner's Representative 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 Associated certified test reports for each sewer main segment within 10 working days of the Liner installation.
2. 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 Owner's Representative, a defect in the CIPP liner requires removing a section of the CIPP liner, the Contractor shall make all repairs as directed by the Owner's Representative 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 shutdown

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 pumped 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 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.

G. No sewage from the services or main line shall be discharged on the ground or in waterways.

H. Holding pits or tanks are not allowed unless permitted by Federal, State, and local authorities having jurisdiction.

3.10 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.

3.11 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.

3.12 WARRANTY

A. Material Warranty: A written guarantee of 2 years shall be provided by manufacturer against breakdown of material effectiveness or 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. Deficiencies related to material and workmanship shall be repaired by contractor to the satisfaction of the Program Manager and at no additional cost.
2. 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