

SPECIFICATIONS FOR INSTALLATION OF UV GRP CURED-IN-PLACE-PIPE (CIPP) (Reline America)

PART 1. GENERAL

1.01 INTENT

- A. It is the intent of this specification to provide for the reconstruction of pipelines and conduits by the installation of a resin-impregnated fiberglass material tube (“Liner”) which when cured shall extend the full length of the original pipe and provide a structurally sound, smooth, joint less and watertight pipe. The resin shall be cured using ultraviolet light within the tube. The Cured-In-Place Pipe (CIPP) will be continuous and tight fitting.

1.02 REFERENCED DOCUMENTS

- A. The following documents form a part of this specification to the extent stated herein:
 1. ASTM F2019 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic (GRP) Cured-in-Place Resin Pipe (CIPP)
 2. ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
 3. ASTM F1743 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Pull In and Inflate and Curing of a Resin-Impregnated Tube.
 4. ASTM D543 Test Method for Resistance of Plastics to Chemical Reagents
 5. ASTM D578 Standard Specification Glass Fiber Strands
 6. ASTM D638 Standard Test Method for Tensile Properties of Plastics
 7. ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
 8. ASTM D2122 Standard 1 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
 9. ASTM D3567 Standard Practice for Determining Dimensions of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings
 10. ASTM D5813 Standard Specification for Cured-in Place Thermosetting Resin Sewer Pipe

1.03 PRODUCT, MANUFACTURER/INSTALLER QUALIFICATION REQUIREMENTS

- A. Since sewer products are intended to have a 50-year design life, and in order to minimize the Owner’s risk, only proven products with substantial successful long-term track records will be approved. Products and Installers must meet all of the following criteria to be deemed Commercially Acceptable:
 1. The “Manufacturer” must have a minimum 500,000 linear feet of successfully installed liner in the United States of America with the same product being used on this project . The installing contractor must be trained and certified by the UV GRP manufacturer and have documented experience with a fiberglass UV cured liner.
 2. For each method of installation and curing used on this project, the Cured-In-Place-Pipe Lining (CIPPL) work shall be supervised by a foreman having previously supervised a minimum of 50,000 linear feet of CIPPL using a similar resin and

flexible tube and using the specific method of installation and curing method proposed.

3. The manufacturer of the glass reinforced tube, including wet out, of the CIPPL shall have been performing this same type of work with ultra violet cured glass reinforced pipe (UV GRP) for a minimum of five years and previously wet-out at least 500,000 linear feet of this same technology. If the Contractor does not have 50,000 linear feet of CIPPL experience with the UV curing system being used, then a manufacturer's onsite representative must be present during installations of the CIPP system until such time the owner is confident in the contractor's ability. The Contractor is to provide the Engineer with the manufacturer representative's work experience for approval. Work shall not begin prior to the Engineer's approval of the manufacturer's onsite representative.
4. The Contractor shall provide five (5) references of completed projects of similar installations.

PART 2. PRODUCTS

2.01 MATERIALS

- A. Fiberglass liner – At the time of manufacture, each lot of glass fiber tube liner shall be inspected for defects. At the time of delivery, the liner shall be homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters, and deleterious faults.
 1. The ENGINEER may at any time direct the manufacturer to obtain compound samples and prepare test specimens in accordance with the latest applicable ASTM standards.
- B. Cured-in Place Pipe – The glass fiber tubing shall include an exterior and interior film that protects and contains the polyester, vinylester or ortho based resin used in the liner. The exterior film shall be provided with a UV light blocker foil.
- C. Tube
 1. The wet out Tube shall have a uniform thickness that when compressed at installation pressures will meet or exceed the Design thickness.
 2. The Tube shall be sized such that when installed, will tightly fit the internal circumference and length of the original pipe.
 3. The glass fiber Tube shall be saturated with the appropriate resin using a resin bath system to allow for the lowest possible amount of air entrapment. An inner and outer material will be added that are both impervious to airborne styrene, with the outer material also having UV blocking characteristics. If required by the liner manufacturer, the inner membrane will be removed after the installation and curing processes are completed.
 4. The wall color of the interior pipe surface of CIPP after installation shall be a light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.
 5. The liner should be seamless in its cured state to ensure homogenous physical properties around the circumference of the cured liner.
- D. Resin
 1. The resin system shall be polyester, vinylester, or orthothalic (either ppg or npg grade) depending on the choice of the engineer, with a catalyst system that when properly cured within the tube composite meets the physical properties of:

- a. Flexural Modulus (minimum) 725,000 psi
 - b. Flexural Strength (minimum) 15,000 psi
 - c. Long term E-modulus 675,000 psi
 - d. Long term tensile bending strength 13,500 psi
2. The resin used with this product shall use UV light to cure the pipe. The liquid UV resin shall saturate the tube and produce a properly cured liner, which is resistant to abrasion due to solids, grit, and sand.
 3. Polyester, vinyl ester and catalyst system shall comply with the following requirements and when properly cured meet the requirements of ASTM F1216. Resins created from recycled materials are not allowed.
- E. Adheres to ASTM F 2019-11 (or latest edition)

2.02 GENERAL CORROSION REQUIREMENTS

- A. The UV GRP cured-in-place pipe system shall utilize resins which will withstand the corrosive effect of the existing residential, commercial, and industrial effluents, liquids and/or gases.

2.03 DELIVERY, STORAGE, AND HANDLING

- A. Care shall be taken in shipping, handling and storage to avoid damaging the liner. Any liner damaged in shipment shall be replaced as directed by the OWNER at no additional cost to OWNER.
- B. While stored, the CIPPL shall be adequately supported and protected. The UV Cure GRP CIPPL shall be stored in a manner as recommended by the manufacturer and as approved by the ENGINEER.

2.04 QUALITY CONTROL

- A. No change of material, design values, or procedures as developed before bidding the contract may be made during the course of the Work without the prior written approval of the ENGINEER.
- B. All liner to be installed under this Work may be inspected at the manufacturer's plant(s) and wet-out facility for compliance with these Specifications by OWNER or ENGINEER. The CONTRACTOR shall require the wet-out facility's cooperation in these inspections. The cost of inspection will be the responsibility of the OWNER.
- C. At the time of manufacture, inspect each lot of liner for defects. At the time of delivery, the liner shall be homogeneous throughout, uniform in color, free of cracks, holes, foreign materials, blisters, or deleterious faults.
- D. The liner manufacturer facility shall have a Quality Management System registered with the current ISO 9001 standard.
- E. The wet out of the liner must be done in an indoor environmentally controlled manufacturing setting. No onsite wet out will be allowed. OWNER or ENGINEER may inspect this facility at the manufacturer's plant(s) for compliance with these Specifications.

PART 3. EXECUTION

3.01 INSTALLATION OF GLASS FIBER TUBING

- A. The approved system must utilize an outer and inner film to ensure that the liner remains intact during the insertion process and to protect the resin at all times during the installation and curing process from water and debris contamination, and resin migration.
- B. A constant tension winch should be used, as specified by the liner manufacturer, to pull the glass fiber liner into position in the pipe. The liner shall have a longitudinal fiberglass reinforcement band which runs the entire length of the liner ensuring that the pulling force is transferred to the band and not the fiberglass liner. Once inserted, end plugs shall be used to cap each end of the glass fiber liner to prepare for pressurizing the liner. The end plugs shall be secured to prevent them from being expelled due to pressure. Liner restraints shall be used in manholes.
- C. A slip sheet shall be installed on the bottom one third to one half of the pipe prior to liner insertion (if it is not already part of the manufactured outer film of the liner), for the purpose of protecting the liner during insertion and reduce the drag, or as recommend by the liner manufacturer.
- D. The glass fiber liner shall be cured with UV light sources at a constant inner pressure. When inserting the curing equipment in the liner, care shall be taken to not damage the inner film material.
- E. The UV light sources shall be assembled according to the manufacturer's specifications for the liner diameter. For the liner to achieve the required water tightness and specified mechanical properties, the following parameters must be controlled during the entire curing process, giving the Engineer a record of the curing parameters over every segment of the entire length of the liner. This demonstrates that the entire liner is cured properly. The recording shall include:
 - 1. Curing speed
 - 2. Light source working & wattage
 - 3. Inner air pressure
 - 4. Curing temperatures
 - 5. Date and time
 - 6. Length of liner
- F. This shall be accomplished using a computer and database that are tamper proof. During the curing process, infrared sensors shall be used to record curing data that will be submitted to the Engineer with a post CCTV inspection.
- G. The optimal curing speed, or travel speed of the energized UV light sources, is determined for each length of liner based on liner diameter, liner thickness, and exothermic reaction temperature. Curing speed shall be as recommended by the manufacturer and determined by contractor based on various site specific field conditions.
- H. If the liner is manufactured with a removable inner film, the inner film material shall be removed and discarded after curing to provide optimal quality of the final product.

3.02 SUBMITTALS

- A. UV GRP Cured-In-Place Pipe - CONTRACTOR shall submit the following:
 - 1. Summary table of CIPP material properties, including short-term flexural modulus of elasticity, 50-year flexural modulus of elasticity, short-term flexural strength (bending stress), 50-year flexural strength (bending stress), and chemical resistance. Certified test reports shall be submitted verifying each value as described below.

2. Independent third party certified laboratory test reports demonstrating that the exact resin/liner combination to be used for this project meets the requirements for initial structural properties and chemical resistance (performed in accordance with ASTM F1216).
3. Independent third party certified laboratory test reports demonstrating that the exact resin and liner to be used for this project has been tested for long-term flexural modulus of elasticity and long-term flexural strength (i.e. 10,000 hour creep testing performed in accordance with ASTM 2990 or DIN 761 for design conditions applicable to this project). When filled resins are proposed, complementary data of the same data for unfilled resin shall also be provided. If the data submitted is not for the exact liner to be used on this project, submit a detailed description of the physical properties of both the liner used in the test and the liner to be used for this project to demonstrate that the two liners are comparable in terms of physical properties.
4. Test shall be performed for 10,000 hours under test conditions and loadings described below. The data points from 1,000 hours to 10,000 hours, or such other time period as determined by the ENGINEER based on the curve or slope of the plotted data, of the Long-term Flexural Modulus shall be extrapolated using a Microsoft Excel log-log scale linear regression analysis to determine the minimum service life performance of the resin-tube.
5. Testing shall be conducted at:
 - a. Temperature 21°C to 25°C
 - b. Relative humidity: 50% minimum
 - c. Load: Load shall be calculated at 0.25% of the short term E-modulus as tested per ASTM D790 or ISO 178, or as approved by ENGINEER.
6. The name of the liner and resin manufacturer, the location of the facility where each was manufactured, and a list of appurtenant materials and accessories to be furnished.
7. Structural design calculations and specification data sheets listing all parameters used in the liner design and thickness calculations based on Appendix X1 of ASTM F2019 for each pipe segment with less than 10% ovality. If the ovality is 10% or greater, use either the ASCE or the WRc Sewerage Rehabilitation Manual, Type II Design, Section 5.3.2.iii for non-round pipe.
8. The quality management system for the wet-out facility must be registered in accordance with and conform to the current ISO 9001 standard. It must ensure that proper materials and amounts are used in the resin saturation process and in liner shipping and storage. At a minimum, the quality control documentation shall include resin lot numbers, volumes of resin, catalyst, enhancers, date of wet-out, storage / transportation controls, and quality assurance procedures.
9. Installation quality control plan, including bypass pumping plans, mainline sewer cleaning plans, cleanliness requirements, liner shot plan and sequence, liner installation standard procedures (including, but not limited to, minimum / maximum allowable installation pressures and speeds certified by the liner manufacturer), intermediate manhole exposed liner restraining method, light train sizing, temperature monitoring plan, odor control procedure, and plan to manage flow to/from laterals during lining.
10. Curing schedule for each lining segment.
11. Available standard written warranty from the manufacturer.

12. The submittal of a Company's Health and Safety Program and all required documents to demonstrate and prove that all employees are Confined Space Entry trained and Rescue trained as well. A site specific Health and Safety Program will be created and submitted for review. All CONTRACTOR employees shall have all training documents submitted prior to work commencing for review.

3.03 WARRANTY

A. All lining work shall be fully guaranteed by the CONTRACTOR for a period of 1 year from the date of Final Acceptance unless otherwise stipulated in writing by the OWNER prior to the date of Conditional Acceptance. During this period, all serious defects discovered by the OWNER or ENGINEER shall be removed and replaced by the CONTRACTOR in a satisfactory manner at no cost to the OWNER. In addition, the OWNER may conduct independent television inspections, at its own expense, of the lining Work at any time prior to the completion of the guarantee period.

3.04 SAFETY

A. The Contractor shall carry out his operations in strict accordance with all applicable OSHA Standards. Particular attention is drawn to those safety requirements involving work on elevated platforms and entry into a confined space. It shall be the Contractor's responsibility to familiarize himself with OSHA Standards and Regulations pertaining to all aspects of this type of work. All equipment used on this project should be safe to operate and designed to eliminate manhole entry. If manhole entry is required, all OSHA guidelines for confined space entry shall be followed.

3.05 NOTIFICATION OF RESIDENTS

A. Prior to starting work, it is the responsibility of the Contractor to notify all residents that the lining process could affect. This notification shall consist of written information that outlines the CIPP process and timing of the project. This notification must be given a minimum of forty-eight (48) hours in advance of work in a given neighborhood.

3.06 BYPASS SEWAGE FLOW

A. Main lines shall be kept in service by bypassing sewage flow around the section or sections of sewer to be lined. The bypass shall be made by plugging the existing upstream manhole or adjacent sewer system. Pump and bypass lines shall be of adequate capacity and size to accommodate the flow without sewer backup. Sewer service connections within the section to be lined shall be temporarily taken out of service by the Contractor to permit relining. The operation of bypass pumping shall be considered incidental to the work. If sewage backup occurs and enters buildings, the Contractor shall be wholly responsible for cleanup, repair, and property damage costs and claims.

3.07 ACCESSIBILITY OF WATER FOR CLEANING

A. The Contractor is required to obtain a portable water meter from the local water department having jurisdiction in the area where lines are being cleaned/lined. All fresh water necessary for performance of work under this contract shall be obtained from approved fire hydrants and metered accordingly per the requirements of the local water department. Requirements of the local water department shall be strictly followed. The

water department may require an initial meter deposit. It is the responsibility of the Contractor to make these arrangements prior to start of this project.

3.08 CLEANING SEWERS

- A. Internal debris shall be removed from the existing pipeline. All roots, debris and protruding service connections shall be removed. Pipes shall be cleaned with hydraulically powered equipment, high-velocity jet cleaners, or mechanically powered equipment. This equipment shall be capable of sufficiently cleaning and clearing the existing pipe. During the sewer cleaning operations, satisfactory precautions shall be taken in the use of cleaning equipment to prevent additional damage to the existing pipe

3.09 TELEVISION INSPECTION

- A. After the sewer section to be lined is thoroughly cleaned, inspection shall be made with a color pan and tilt, 360° rotating head camera specifically designed and constructed for sewer inspection. Each sewer to be televised shall be field investigated to determine the need for plugging to eliminate flow from the line section. Lighting for the camera shall provide a clear picture of the entire periphery of the existing sewer. If the television inspection shows any areas where the sewer inside diameter may be deflected, decreased, or obstructed, the Engineer will coordinate a point repair. The Contractor shall carefully inspect the interior of the pipeline to determine the location of any conditions that may prevent proper installation of the impregnated tube. These conditions may include protruding service taps, collapsed or crushed pipe, and reductions in the cross-sectional area of more than 40%. The Contractor shall note these conditions so that they can be corrected. The original pipeline shall be cleared of these obstructions at the contracted unit price. Protruding taps or service connections which will obstruct or hinder the insertion of the liner, shall be removed to allow the liner to pass through. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then a point repair excavation shall be recommended to remove or repair the obstruction. The Engineer shall be notified immediately when the Contractor has determined the need for a point repair.
- B. Upon completion of the liner installation the CONTRACTOR shall perform a television inspection to document the as-built condition. The CONTRACTOR shall provide two copies of as-built inspection to the OWNER in digital format for review and acceptance by the OWNER.

3.10 SERVICE CONNECTIONS

- A. Existing sewer service connections shall be reinstated through the use of a closed-circuit television camera and a remote-controlled (robotic) cutting device: Inactive sewer service connections shall not be cut. The exact location and number of service connections shall be determined from TV tapes and/or in the field. It shall be the Contractor's responsibility to accurately field locate all existing service connections. The Contractor shall reconnect all service connections to the lined pipe. Experienced operators shall make connections so that no blind attempts or holes are made in the liner pipe. The Contractor shall be responsible for restoring/correcting without any delay, all missed or faulty reconnections, as well as for any damage caused to property owners for not reconnecting the services soon enough or for not giving notice to the owners. All existing

service connections shall be reconnected by remote TV controlled cutting device. All service connections shall be fully opened (95% to 100%) within 24 hours. No partial cuts shall be permitted over a weekend or overnight. When the service connection is reestablished, the invert of the service connection shall match the bottom of the reinstated service opening. The service shall be reinstated from a minimum of 95 percent to a maximum of 100 percent of internal diameter of the original service connection. The sewer service connection cuts shall be uniform and brushed to remove burrs and sharp edges. After all service laterals have been cut, the line section shall be flushed and all coupons from the re-established laterals retrieved. These retrieved coupons shall be properly disposed and not washed down the line. The contractor shall be held responsible for service back-ups caused by accumulated coupons and liner material left in the sewer.

3.11 FIT AND FINISH

- A. The finished liner shall be continuous over the entire length of the sewer section. The finished liner shall tightly conform to the walls of the existing (host) sewer main; therefore, it is the Contractor's responsibility to verify the section lengths and pipe dimensions. No gap or annular space between the finished liner and the existing (host) sewer main shall be visible at the manhole, sewer service connection, or other exposed points within the finished lined section. The finished liner shall be homogeneous throughout and free of any wrinkles, protrusions, holes, cracks, foreign material, blisters, or other deleterious faults or defects, which in the opinion of the Engineer, will affect the liner's structural integrity, hydraulic performance, future maintenance access, and overall line performance.

PART 4. MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

- A. Measurement of CIPP liner shall be by the number of feet, measured from center-to-center of small drainage structures or between open ends including the length of pipe bends and branches. Deductions in length shall not be made for manholes where the distance measured in the direction of flow, including bends, is 6 feet or less.

4.02 PAYMENT

- A. Payment for all inspections is included with the contract unit price of the corresponding pay item.
- B. Payment for accepted quantities shall be made at the contract prices and paid in monthly progress payments for all work performed in that month.