

# **CURED-IN-PLACE PIPE (CIPP) LATERAL PIPE LINING (Not at the Main to Lateral Connection)**

## **PERFORMANCE SPECIFICATION GUIDELINE (PSG)**

November 2017



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## **PART 1 - GENERAL**

### **1.1 Description of work and product delivery**

- 1.1 A. These Specifications include the minimum requirements for the rehabilitation of laterals as shown on the plans and included as part of these contract documents. These Specifications do NOT include details pertaining to the connection between the lateral pipe and the main line pipe (connection liner).
- 1.1 B. The rehabilitation of laterals shall be accomplished by the installation of Cured-In-Place-Pipe (CIPP). The CIPP liner will extend over the predetermined length of lateral pipeline and may be installed by use of several techniques, including but not limited to:
1. Inversion from the main and/or cleanout, or access pit or manhole
  2. Pull in from the main and/or cleanout, access pit or manhole
  3. Or other Owner approved methods not described within this document
- 1.1 C. The prices submitted by the Contractor shall include all costs for the various bid items necessary for furnishing and installing, complete and in place, the lateral liner in accordance with these specifications, except for those specified otherwise by the Owner.
- 1.1 D. At the discretion of the Owner, the lining system manufacturer will submit to the Owner, a minimum of 14 calendar days in advance of a bid date, all required product information to obtain pre-approval lining system status. Those lining systems that have been pre-approved will not need to be re-submitted as required in the submittal section of these specifications unless any of the lateral lining system components have changed from those pre-approved by the Owner. All other component products will be required to meet the submittal requirements as contained herein.
- 1.1 E. At the discretion of the Owner, the lining system installer will submit to the Owner, a minimum of 14 calendar days in advance of a bid date, all required qualifications information to obtain pre-approval lining system installer status. Those lateral lining system installers that have been pre-approved will be allowed to bid on the specified project scope.
- 1.1 F. The installed lateral lining system shall be free of all defects that will affect the design life, service life and performance of the lateral.
- 1.1 G. The installed lateral lining system shall eliminate water leakage into the lateral and prevent fluids from leaking out of the lateral. If leakage occurs through the lateral lining system or at the ends of the lateral lining system, and exceeds that allowed by ASTM F1216, the liner shall be repaired or removed and replaced as recommended by the manufacturer.
- 1.1 H. The lateral lining system shall be resistant against corrosion and typical chemicals found in domestic sewage, unless otherwise specified in the detailed section of the contract documents. The manufacturer of the lateral lining system shall provide testing data that supports the chemical resistance in accordance with ASTM F1216.

- 1.1 I. The lateral lining system may be designed to rehabilitate the existing lateral for partially or fully deteriorated design conditions (Owner/Engineer to determine which of the conditions is required for their project), as specified by the Owner, and in accordance with ASTM F1216. Partially deteriorated designs conditions assume the CIPP liner is designed to support groundwater loads only, while Fully Deteriorated design conditions assume the CIPP liner is designed to structurally replace the host pipe. Wall thickness design calculations stamped by a registered professional engineer will be submitted. All physical properties used in the design must be supported by third party testing and documentation for the exact product that is being submitted.
- 1.1 J. Flow entering the lateral shall be maintained or bypassed if the plugging of flow will adversely affect proper lateral lining system installation and/or the sewerage discharging entity. If there is no cleanout available for such bypass, then the discharging entity will be notified not to use their water for the period of time needed to clean, install, and cure the CIPP lateral lining system.
- 1.1 K. All lateral lining materials furnished as part of this contract shall be marked with detailed product information, stored in a manner specified by the manufacturer and tested to the requirements of this contract.

**1.2 Performance Work Statement (PWS) Submittal – Product/Contractor Prequalification (if opted by the Owner)**

- 1.2 A. The Contractor shall submit to the Owner a Performance Work Statement (PWS) and Contractor pre-qualifications package at a predetermined time set by the Owner, which clearly defines the proposed CIPP lateral lining system delivery in conformance with the requirements of the contract documents.
- 1.2 B. Clearly indicate that the lateral lining system will conform to the project requirements as outlined in the Description of Work, Scope of Work included and as further delineated in these contract documents.
- 1.2 C. Certify at the time of the bid that the designated items included in the contract documents were visited, inspected and evaluated by the Contractor or Contractor's Representative, prior to submitting a bid.
- 1.2 D. Where the scope of work is specifically delineated in the contract documents, a detailed installation plan describing all preparation work, cleaning operations, pre-inspections, sewage flow maintenance, traffic control, installation procedure, method of curing, quality control, testing to be performed, final inspection, warranties furnished and all else necessary and appropriate for a complete lateral lining system installation, shall be submitted.
- 1.2 E. A detailed installation schedule shall be prepared, submitted and conform to the requirements of these contract documents.
- 1.2 F. The Contractor's experience with the lateral lining system proposed for use in this contract. The name and experience of each lead individual performing work on this contract shall be submitted. If personnel are substituted after bid submittal the name

and experience of the individual shall be submitted to the Owner for approval before starting any work.

### **1.3 Submittals (after contract award)**

**1.3 A.** Product data submittals required for all lateral lining systems proposed for installation under this contract shall include:

1. LATERAL LINING SYSTEM material type and manufacturer to be used including: catalog data sheets, standard references, material composition, manufacturers recommended specifications, component physical properties and chemical resistance.
2. Manufacturer's detailed description of the recommended procedures for handling and storing materials
3. Manufacturers detailed description of the recommended lateral lining system installation process
4. Copies of independent testing performed on the CIPP liner composite verifying the product meets the requirements as specified in these contract documents and the manufacturers design.
5. By-Pass Pumping Plan if applicable to the lateral lining system being installed.
6. Traffic Control plan, if applicable for the lateral lining system being installed.
7. Certified statement, from the manufacturer, that the contractor/installer is an approved installer of the lateral lining system with certificates of completed training for each crew member involved in each rehabilitation component. This requirement shall comply with the specific lateral lining system requirements specified in the contract documents
8. Submittal of all quality assurance documentation and test reports for lateral lining system installed. (After Rehabilitation Completion)
9. CIPP wall thickness design calculations based upon ASTM F1216 assuming either Fully or Partially Deteriorated conditions,. The designs will be stamped by a Professional Engineer.
10. Wetout and cure logs per liner providing details pertaining to the resin type and quantity, catalyst type and quantity, tube type, installation pressures, temperatures and times (as applicable to the curing lateral lining system utilized), and pertinent Owner/User project specific data.
11. Third party testing to support the physical properties used in the design calculations for the liner wall thickness, chemical resistance and sealing data (when applicable).
12. Health and Safety plan detailing the site specific safety requirements.

13. Qualifications of the Contractor to install the lateral lining system.

14. Qualifications of the proposed lateral lining system to meet the requirements of the Contract.

#### **1.4 Quality Control Plan (QCP)**

1.4A. A detailed quality control plan (QCP) shall be submitted to the Owner in accordance with section 1.3

- i. Proposed procedures for quality control, frequency of sampling, product sampling and testing shall be defined.
- ii. Proposed methods and procedures for lateral lining system repair or replacement, (as defined in Section 1.5) in the event of product defects or failure.

#### **1.5 Lateral lining system repair/replacement**

1.5 A. Due to defects in preparation and/or installation, lateral lining systems will occasionally need to be repaired or partially replaced. The Manufacturer shall outline specific repair or replacement procedures for potential issues that may occur during the application of the lateral lining system. Repair/replacement procedures shall be as recommended by the lateral lining system manufacturer and shall be submitted as part of the PWS.

1.5 B. Issues, that may not affect the operation and long term life of the product, shall be identified and defined by the Manufacturer.

1.5 C. Repairable issues that may occur in the lateral lining system shall be specifically based on Manufacturer's recommendations, including a detailed step-by-step repair procedure, resulting in a finished product meeting the estimated performance and design life of the component and requirements of these contract specifications.

1.5 D. Un-repairable issues that may occur in the lateral lining system shall be clearly defined based on the Manufacturer's recommendations. The Contractor, together with the manufacturer, shall define the best recommended procedure for the total removal and replacement of the lateral lining system.

1.5 E. The Contractor shall receive no additional compensation for the repair or replacement of lateral lining system deemed non-conforming to the requirements of these contract documents and unacceptable by the Owner.

#### **1.6 Safety**

1.6 A. The Contractor shall conform to all work safety requirements of pertinent regulatory agencies, and shall secure the site for working conditions in compliance with the same. The Contractor shall erect such signs and other devices as are necessary for the safety of the work site.

1.6 B. The Contractor shall perform all of the Work in accordance with applicable OSHA safety standards. Emphasis shall be placed upon the requirements for entering confined spaces.

1.6 C. The Contractor shall have on the job site at all times at a minimum the following safety equipment:

1. Gas monitor capable of testing and detecting for combustible gas, oxygen deficiency and hydrogen sulfide.
2. Confined space access and retrieval winch system.
3. Ventilating fans with large diameter ventilating hose.
4. Safety harness and life lines.
5. Other equipment as may be required for a specific project
6. All equipment to be available for use, in sufficient quantity, by the Contractor, Engineer and Owner for the duration of the project.

1.6 D. All entries into or work within confined spaces shall be conducted in accordance with the U.S. Department of Health and Human Services/National Institute for Occupational Safety and Health [DHHS (NIOSH)] Publication No. 87-113, A Guide to Safety in Confined Spaces.

### **1.7 Warranty**

1.7 A. The materials used for the project shall be certified by the manufacturer for the specified purpose. The manufacturer shall warrant the lateral lining system to be free from defects in raw materials for one (1) year after installation or from the date of acceptance by the Owner, whichever is later. The Contractor shall warrant the installation of the lateral lining system for a period of one (1) year.

### **1.8 Warranty Inspections**

1.8 A. The Owner shall perform, at its own cost, any warranty CCTV inspections of the lateral lining system.

### **1.9 Measurement and payment**

1.9 A. Typical bid items consist of:

1. Clean and CCTV of specified lateral pipeline, per Each
2. CIPP Lining of specified lateral pipeline (referred to as setup or a lineal foot length equal to the shortest segment length specified for lining), per EA
3. CIPP Lining of specified lateral pipeline (after first 5'), per LF

1.9 B. Measurements for each item furnished and installed to the satisfaction of the Owner shall be at the units of measure contained in the Bid Proposal.

1.9 C. Payment for each item shall be in accordance with the contract documents at the unit or lump sum prices bid therefore in the Bid Proposal.

## **PART 2 - LATERAL LINING PRODUCTS**

## 2.1 Lateral - Cured In Place Pipe (CIPP)

### 2.1 A. General

1. The rehabilitation of pipelines shall be done by the installation of a resin-impregnated flexible liner which, when cured, shall be continuous and tight-fitting throughout the entire length of the original lateral pipe, or the portion of said pipe that has been specified for lining. The CIPP shall extend over the specified length of the lateral host pipe and provide a structurally sound, joint-less and water-tight new pipe within a pipe. The Contractor is responsible for proper, accurate and complete installation of the CIPP using the lateral lining system selected by the Contractor.
2. The CIPP shall be a felt, fiberglass or felt/fiberglass composite that after wet-out and installation provides a water-tight liner within the existing host pipe over the specified length of lateral pipeline.
3. Neither the CIPP lateral lining system, nor its installation, shall cause adverse effects to any of the Owner's processes or facilities.
4. The CIPP shall be continuous and joint-less from end to end and shall be free of all defects that will affect the long-term design life and performance of the pipe.
5. The CIPP shall be designed for 50 years or greater.
6. The CIPP may be designed for partially deteriorated (i.e., resistant to external groundwater pressures only) or fully deteriorated (i.e., fully structural stand alone pipe-within-a-pipe) in conformance with ASTM F1216.
7. The installed CIPP shall have corrosion resistance to the typical chemicals found in domestic sewage.
8. If there are any existing and confirmed active service connections connected to the lateral pipeline specified for lining, they shall be reinstated as directed by the Owner. The connections shall be re-opened, by any means, to not less than 90% of their original capacity. All over-cut service connections will be properly repaired to meet the requirements of these specifications. Any connections to a lateral pipeline must have clean outs within 50' of the lateral pipeline to allow external reinstatement.
9. The rehabilitation of lateral service lines may require the product to be capable of blind terminations within the service line and capable of navigating bends or other transitions in alignment as identified by the owner in the contract bid documents.
10. The liner will provide a water-tight seal at each end and throughout the liner. Data must be provided to support the product's ability to provide the watertight seal at each end. The product used in the sealing method shall be installed in accordance with manufacturer's recommendations.



11. Cleanouts will be installed at the discretion of the Owner, or the Contractor, if required for installation of the proposed lining system.

#### 2.1 B. References

1. ASTM F1216 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
2. ASTM F1743 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-In-Place Installation of Cured in Place Thermosetting Resin Pipe.
3. ASTM D543 – Practices for Evaluating the Resistance of Plastics to Chemical Reagents.
4. ASTM D790 – Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
5. ASTM D5813 – Specification for Cured in Place Thermosetting Resin Sewer Piping Lateral Lining Systems.
6. 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 Thermosetting Resin Pipe.
7. NASSCO Performance Specification Guideline for the installation of Cured in Place Pipe (CIPP) (June 2011).

#### 2.1 C. Materials

1. Non-woven fabric tube
  - (a) The fabric tube shall consist of one or more layers of absorbent non-woven felt fabric, felt/fiberglass or fiberglass and meet the applicable requirements of ASTM F 1216, ASTM F 1743, ASTM D 5813 or ASTM F2019. The fabric tube shall be capable of absorbing and carrying resins, constructed to withstand installation pressures and curing temperatures and have sufficient strength to bridge missing pipe segments and stretch to fit irregular pipe sections.
  - (b) The wet-out fabric tube shall have a uniform thickness and excess resin distribution that when compressed at installation pressures will meet or exceed the design thickness after cure.
  - (c) The fabric tube shall be manufactured to a size that when installed will tightly fit the internal circumference, meeting applicable ASTM standards of the original pipe. Allowance shall be made for circumferential stretching during installation. The tube shall be properly sized to the diameter of the existing pipe and the length to be rehabilitated and be able to stretch to fit irregular pipe sections and negotiate bends. The Contractor shall determine the minimum tube length necessary to effectively span the designated run. The Contractor

shall verify the lengths in the field prior to ordering or assembly and prior to impregnation of the tube with resin, to ensure that the tube will have sufficient length to extend the entire length required. The Contractor shall also measure the inside diameter of the existing pipelines in the field prior to ordering or assembling liner to ensure an installed tight-fitted condition.

- (d) The outside and/or inside layer of the fabric tube (before inversion/pull-in, as applicable) shall be coated with an impermeable, flexible membrane that will contain the resin and facilitate, vacuum impregnation and monitoring of the resin saturation during the resin impregnation (wetout) procedure.
- (e) No material shall be included in the fabric tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be acceptable upon visual inspection as evident by color contrast between the tube fabric and the activated resin containing a colorant.
- (f) 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. The hue of the color shall be dark enough to distinguish a contrast between the fully resin saturated felt fabric and dry or resin lean areas.
- (g) The final installed product shall be marked every 5 feet, or other approved interval, with the name of the manufacturer or CIPP lateral lining system, manufacturing lot and/or production footage on the inside of the cured liner.
- (h) The minimum length of the fabric tube shall be that deemed necessary by the installer to effectively span the distance from the starting point of access in the pipe to the terminating location, whether a blind termination in the pipe at the main, or at a manhole or access point, plus that amount required for installation purposes.
- (i) The liner coating shall be compatible with the proposed resin system.
- (j) The liner shall be constructed with transitions where applicable.

## 2. Resin

- (a) The resin shall be a corrosion resistant polyester, vinyl ester, silicate or epoxy resin and catalyst system and hardener system that, when properly cured within the tube composite, meets the requirements of ASTM F1216, ASTM F1743 or F2019, the physical properties herein, and those, which are to be utilized in the design of the CIPP for this project. The resin shall produce CIPP, which will comply with or exceed the structural and chemical resistance requirements of this specification.
- (b) The method of cure may either be from a manufacturer recommended heat source, light cure or by ambient temperature. Method of cure instructions, along with a cure log, shall be on-site at all times.

(c) The resin to tube ratio, by volume, shall be as recommended by the manufacturer.

3. Structural requirements

(a) The physical properties and characteristics of the finished liner will vary considerably, depending on the types of resin and tube used. It shall be the responsibility of the Contractor to provide a CIPP lateral lining system which meets or exceeds the minimum properties specified herein.

(b) The CIPP wall thickness shall be designed per ASTM F1216. The CIPP design shall assume no bonding to the original pipe wall.

(c) The CIPP shall be designed assuming the following minimum design data, unless otherwise modified by the Owner:

- (i) Factor of Safety = 2
- (ii) Soil Modulus = 1,000 psi
- (iii) Soil Density = 120 pcf
- (iv) Live Load = H20
- (v) Depth of Cover = as specified
- (vi) Groundwater = ½ depth of cover
- (vii) Ovality = 2%

(d) The design engineer shall set the long term (50 year extrapolated) Creep Retention Factor at 50% of the initial design flexural modulus as determined by ASTM D790 test method. This value shall be used unless the Contractor submits long term test data (ASTM D2990) to substantiate a different retention factor.

(e) The cured pipe material (CIPP) shall, at a minimum, meet or exceed the structural properties, as listed below.

- (i) Flexural modulus of elasticity: 250,000 psi
- (ii) Flexural strength: 4,500 psi

(f) The Owner must select and specify either Fully or Partially Deteriorated design requirements for the contract.

## **PART 3 - EXECUTION**

### **3.1 Lateral - Cured In Place Pipe (CIPP)**

### 3.1 A. General

1. Rehabilitation of lateral service lines is typically performed from either an excavated access pit or clean out between the structure and the mainline or from within the mainline.
2. Lateral CIPP installed from an access pit or cleanout is installed using a blind termination at the mainline connection therefore eliminating need to excavate the connection. In such case, the blind termination shall allow the CIPP to effectively terminate at or near the mainline without protruding by measuring the lateral length prior to install. The required distance and/or locations to be lined will be specified by the Owner.
3. Lateral CIPP installed from the mainline shall be pre-measured to line a specified distance identified within the bid documents. Commonly, this distance is the portion of the lateral owned by the utility owner – ending at the edge of the public right of way.
4. Excavated access pits shall be subject to the owner's specifications for trenching/excavation, backfill and surface remediation - including grading, paving, concrete and landscape restoration. The owner shall also specify the type of cleanout, if required.
5. When an agency has ownership or for other purposes is electing to rehabilitate laterals within the public right of way, the access pit shall be excavated within that right of way unless the owner has obtained legal access to private property via a temporary construction easement.

### 3.1 B. Preparation

1. Preparation, cleaning, inspection, sewage by-passing and public notification. The Contractor shall clean the interior of the existing host pipe prior to installation of the CIPP liner. All debris and obstructions, that will affect the installation and the final CIPP product, shall be removed and disposed of. All preparation shall be in accordance with the manufacturer's written installation procedures.
2. The CIPP liner shall be constructed of materials and methods, that when installed, shall provide a jointless and continuous CIPP designed in accordance with ASTM F1216 Appendix X1.1
3. The Contractor may, under the direction of the Owner, utilize any of the existing manholes in the project area as installation access points or excavate access points at predetermined locations.
4. Pre-Cleaning CCTV – The Contractor shall request utility locating (as required by the Owner or local Government) to identify potential crossbore utilities within the proximity of the service lateral to be cleaned for rehabilitation, if applicable. Prior to cleaning, the Contractor shall, to all extents possible, televise the service lateral to confirm that cleaning the lateral will not damage or breach a conflicting utility bored through the sewer lateral (such as natural gas or power) when the utility locate indicates a potential conflict.

5. Cleaning of Pipelines - The Contractor shall remove all internal debris from the pipeline that will interfere with the installation and the final product performance of the CIPP as required in these specifications. The Contractor shall make use of commercially available industry standard cleaning equipment to prepare the pipe for lining. Solid debris and deposits shall be removed from the lateral system, if possible, and disposed of properly by the Contractor. Precaution shall be taken, by the Contractor in the use of cleaning equipment to avoid damage to the existing pipe. If the pipe cannot be cleaned sufficiently using industry standard cleaning equipment, then additional cleaning will be considered changed conditions, as determined by the Owner.
6. Post-Cleaning CCTV – Upon completion of the cleaning, the Contractor shall then perform a Post-Cleaning CCTV Inspection, which typically acts as the Pre-Lining CCTV Inspection.
7. Existing Sewage Flows – The Contractor shall provide flow diversion, bypass pumping or stoppage requirements to the owner, including notifying upstream users to temporarily stop using their water/wastewater lateral, during the installation of the lining system.
8. Bypass Existing Sewage Flows - When circumstances require continuous service, for the flow of the service connection (such as medical facilities or laboratories), the Contractor will install a temporary sewage by-pass lateral lining system, if required by the Owner. Once the lining process has begun, existing sewage flows shall be maintained, until the resin/felt tube composite is fully cured, cooled down, fully televised and the installation is complete. The Contractor shall coordinate sewer bypass and flow interruptions with the Owner at least 7 days in advance and with the property owners and businesses at least 1 business day in advance. The pump and bypass lines shall be of adequate capacity and size to handle typical flows. .
9. Contractor shall perform post-cleaning video inspections of the pipelines. Only PACP certified personnel trained in locating breaks, obstacles and service connections by closed circuit television shall perform the inspection. The Contractor shall provide the Owner a copy of the pre-cleaning and post-cleaning video and suitable log, and/or in digital format, for review prior to installation of the CIPP and for later reference by the Owner, if specifically required by the Owner.
10. Line Obstructions - It shall be the responsibility of the Contractor to clear the line of obstructions that will interfere with the installation and long-term performance of the CIPP. If pre-installation inspection reveals an obstruction, misalignment, broken or collapsed section or sag that was not identified as part of the original scope of work and will prohibit proper installation of the CIPP, the Contractor may be directed by the Owner to correct the problem(s) prior to lining by utilizing open cut or other repair methods. This work will be considered changed conditions, or if there is an existing bid item for this work, the Contractor shall be compensated under the particular pay item designated for open cut point repairs.

11. The Contractor shall be responsible for confirming the locations of all branch service connections prior to installing and curing the CIPP. If required in the contract documents, each connection will be dye tested to determine whether or not the connection is live or abandoned. The cost for dye testing of existing service connections shall be compensated at the unit price bid. In the event the status of a service connection cannot be adequately defined, the Owner will make the final decision prior to installation and curing of the liner. Typically only service connections deemed "active" shall be reopened by the Contractor. Reinstatement in small diameter pipes typically requires external reinstatement through a cleanout.
12. The Contractor shall be allowed to use water from an owner-approved fire hydrant in the project vicinity. Use of an approved double check backflow assembly shall be required, unless an open gap exists in the Contractor's equipment. Contractor shall provide his own approved assembly. Contractor shall pay current market price for all water usage, unless otherwise specified by the Owner.

### 3.1 C. Install

1. The entire liner shall be wet-out using vacuum impregnation.
2. The CIPP Liner shall be installed and cured in the host pipe per the manufacturer's specifications as described and submitted
3. CIPP installation shall be in accordance with the applicable ASTM standards
4. The CIPP may be installed from a single access pit, manhole or via carrier transported through the mainline to enable the lateral CIPP to be inverted up the lateral.
5. The wet-out tube shall be positioned in the pipeline using the method specified by the manufacturer. Care should be exercised not to damage the tube as a result of installation. The tube should be pulled-in or inverted through an existing access pit, cleanout or placed within a manufacturer designated carrier for transport to the lateral via the mainline from a manhole or approved access point and fully extend up the lateral from the main to a termination point. Installing from a single point of access, typically being an excavated pit or a cleanout, is suitable if the Contractor follows manufacturer procedures for terminating the CIPP blind.
6. If required by the manufacturer, temperature gauges or sensors may be placed inside the host pipe to monitor the temperatures during the cure cycle. Liner and/or host pipe interface temperature shall be monitored and logged during curing of the liner.
7. Curing shall be accomplished by utilizing the appropriate medium in accordance with the manufacturer's recommended cure schedule. The curing source or in and output temperatures shall be monitored and logged during the cure cycles if applicable. The manufacturer's recommended cure method and schedule shall be used for each line segment installed, and the liner wall thickness and the existing ground conditions with regard to temperature, moisture level, and thermal conductivity of soil, per ASTM as applicable, shall be taken into account by the Contractor.

8. Thermoset resins shall have a cool down period in accordance with manufacturer's recommendations and noted as part of the cure log.
9. The manufacturer shall provide the method of sealing the CIPP ends and submit supporting documentation confirming the method will provide a long term seal.

#### 3.1 D. Finish

1. The installed CIPP shall be continuous over the specified length of the lateral section and be free from visual defects such as foreign inclusions, dry spots, pinholes, major wrinkles and de-lamination.
2. Any defect, which will or could affect the structural integrity or water-tightness, of the CIPP shall be repaired at the Contractor's expense,
3. The beginning and end of the CIPP shall be sealed to the existing host pipe. The sealing material shall be compatible with the pipe end and shall provide a watertight seal.
4. Branch lateral connections or any other pre-existing connection to the service lateral shall be reinstated by a remote controlled cutting device, either from within the pipeline or externally through a cleanout. The reinstated connection shall be brushed to allow for a smooth edge.
5. Cured samples of the CIPP may be required for testing to verify the flexural strength and modulus of the CIPP meet or exceed the specified values and those used in the design of the CIPP liner. Samples shall be acquired via manufacturer's recommendations or in accordance with ASTM F1216. The testing shall be performed by an independent 3<sup>rd</sup> party laboratory.