

ADDENDUM TWO
HIGHLAND PARK SEWER REHABILITATION
W-12-030-201
CITY OF CHATTANOOGA, TENNESSEE

The following changes shall be made to the Contract Documents, Specifications, and Drawings:

I. Clarifications

- a) Spec section 33 38 01 Cured-In-Place Pipe, paragraph 1.03B CIPP System Manufacturer. This section states that the CIPP System Manufacturer must have a proven record of “a **minimum of 20,000 linear feet in diameters 24-inch or larger over the last five years. In addition, a minimum of 10,000 linear feet of 36-inch diameter or larger, of the exact name brand product must have been installed in the United States.**” The 24-inch requirement is very restrictive and since there is no 24-inch on this project, can this requirement be deleted as a requirement?
 - i) **No. The requirement cannot be deleted, but the following revisions have been made to the specification.**
 - ii) Paragraph 1.03B will be modified to say the following: “a minimum of **25,000** linear feet in diameters **8-inch** or larger over the last five years. In addition, a minimum of **10,000** linear feet of **12-inch** diameter or larger, of the exact name brand product must have been installed in the United States.
 - iii) Paragraph 1.03C will be modified to say the following: “**25,000 linear feet of 12-inch**”
 - iv) Paragraph 1.03D will be modified to say the following: “**5,000 feet of 12-inch**”
 - v) **Specification section 33 01 30.73 Cured-In-Place Pipe (CIPP) has been updated to reflect these changes and is attached to this addendum. Please replace the current section with this attachment.**



May 18, 2016

/s/ Justin C Holland, Administrator
City of Chattanooga,
Department of Public Works

Part 1 General

1.01 Scope

- A. Furnish all labor, material and equipment to provide for the reconstruction of existing sewer pipes using an approved Cured-In-Place Pipe (CIPP) method by forming a new pipe within an existing pipe.
- B. The sewer reconstruction shall be accomplished by the installation of a thermosetting resin-impregnated flexible felt-fiber tube coated on one side with an impermeable plastic which is installed into the existing sewer utilizing hydrostatic head. Curing is accomplished by circulating hot water throughout the length of the inverted tube to cure the resin into a hard, impermeable pipe with the plastic coating on the interior surface of the newly formed pipe. The CIPP shall extend the full length of the original pipe segment and shall provide a structurally sound, joint-less, close fitting and corrosion resistant cured-in-place pipe.
- C. The work performed under this Section of the Specifications is deemed to be Specialty Contractor Work and is subject to the provisions of Section 00 72 00 General Conditions, Article 6.06, Paragraph (I).
- D. The deterioration of sewers is an on-going process. In the event pre-construction inspections reveal the sewers to be in substantially different conditions than those in the design requirements specified herein, the Contractor shall submit a changed site condition notice and request such changes in liner thickness, supporting such requests with the appropriate design data satisfactory to the Engineer.

1.02 Reference Standards

Supply all products and perform all work in accordance with applicable American Society for Testing and Material (ASTM), American Water Works Association (AWWA), American National Standards Institute (ANSI), or other recognized standards. The latest revisions of all standards in effect on the date of advertisement are applicable. Where differences exist, or any latitude is either inferred or interpreted between this Specification and referenced product/process standards, this Specification shall govern.

1.03 Quality Assurance

- A. In order to establish minimum product quality and Installer capability, the following minimum requirements shall be met. The purpose for these submittals is to allow the Owner/Engineer the opportunity to conduct a complete, thorough and objective evaluation of proposed CIPP products and the Installing Contractor and to determine if the submitted products and Installer meet all experience, quality and utility standards required by the Specifications.
- B. CIPP System Manufacturer: The CIPP system must have a minimum proven performance record of 1,000,000 linear feet installed of the exact name-brand product

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bid in the United States, with a minimum of **25,000** linear feet in diameters **8-inch** or larger over the last five years. In addition, a minimum of **10,000** linear feet of **12-inch** diameter or larger, of the exact name brand product must have been installed in the United States. Documentation shall be submitted with the Bid in accordance with the Instructions to Bidders.

- C. Contractor/Installer Experience: The Installing Contractor for the cured-in-place reconstruction of sewers must have a minimum of five years of experience using the exact named product proposed and, have installed at least 300,000 linear feet of the exact named proposed product including at least **25,000** feet of **12-inch** diameter or larger cured-in-place product. Documentation along with contact names and telephone numbers from the last ten projects shall be submitted with the Bid in accordance with the Instructions to Bidders.
- D. On Site Field Superintendent: The Qualifying Superintendent must have a minimum of five years of experience with cured-in-place pipe products. In addition, the Qualifying Superintendent must have supervised jobs in which at least 20,000 feet of pipe has been reconstructed using the exact named product proposed including a minimum of 5,000 feet of **12-inch** diameter or larger cured-in-place product. The Contractor shall submit information to document this with the Bid in accordance with the Instructions to Bidders. The superintendent for the Project shall be on-site during all phases of the work involving any pre and post-installation video inspection, sewer cleaning or insertion and processing of the CIPP.
- E. Resin Class
 - 1. The Contractor shall designate a wet-out facility and shall provide wet-out liner tubes from this designated facility only. Multiple facilities to supply wet-out liner tubes for the duration of this Contract may not be used without prior approval of the Engineer.
 - 2. The Contractor shall place a sampling valve in-line at a point in the resin/catalyst mixing stage so that a sample of non-catalyzed resin may be taken. A second sampling valve shall be placed in-line at a point after the resin/catalyst mixing stage, but prior to catalyzed resin injection into the liner so that a resin sample may be taken. Both sampling valves shall be left in place for the duration of the Contract.
 - 3. The Engineer shall have the right to inspect the designated wet-out facility and draw samples from one or both sampling valves without prior notice to the Contractor for the duration of the Contract.
 - 4. Infrared Analysis
 - a. The Engineer reserves the right to subject resin samples to an infrared analysis (IR) Scan. This standard analytical test involves shining a beam of light in the infrared frequency region through a thin sample of subject resin. The frequency of light is then varied across the infrared spectrum. Chemical functional groups present in the resin being analyzed will absorb infrared light at specific frequencies and with characteristic absorption intensities.

- b. A spectrum created from the measurement of light transmitted through the sample across the range of infrared frequencies shall be used to determine the resin's chemical fingerprint. For Standard Polyester, an overlaid IR spectrum of Reichhold PolyLite® 33420 shall be used as a baseline comparison for the purpose of a test under this contract. For Enhanced Polyester resin, an overlaid IR spectrum of Reichhold PolyLite® 33420-E shall be used as a baseline comparison for the purpose of a test under this contract.
- c. The Engineer may perform random Infrared Scans (IR Scans) and/or Composite Burn-offs to ensure resin quality and consistency throughout the duration of the Contract and shall be responsible for the cost of IR testing.

1.04 Submittals

- A. Submit shop drawings in accordance with the requirements of Section 01 33 23 of these Specifications. Specific submittal information shall include the following:
 - 1. The Contractor shall furnish submittal data establishing the structural capabilities, chemical composition, and other mechanical properties of the liner system proposed.
 - 2. The Contractor shall furnish the proposed liner thickness for each pipe size and depth categories, along with a certification, signed and sealed by an engineer registered in the state that the Project is located, to the effect that the proposed liner thicknesses were calculated based on the parameters specified in Article 2.04 of this section of the Specifications and the site specific external loads. In no case will the proposed liner thicknesses be less than those specified in Article 2.04 of this section of the Specifications. The Standard Dimension Ratio (SDR) is the ratio of the outside diameter (OD) of the pipe to its minimum wall thickness. All CIPP wall thicknesses, SDRs by diameters, and depth ranges corresponding to the requirements of the Contract Documents, must be submitted to the Engineer for approval prior to installation.
 - 3. The Contractor shall furnish copies of the manufacturer's brochures giving a complete description of the product proposed, its physical and chemical composition, the same for the thermosetting resin or epoxy hardener.
 - 4. Pre- and post-installation videos and logs per Article 3.03 shall be submitted during the course of work.
 - 5. Catalyst system and resin/catalyst ratio.
 - 6. The proposed curing schedules and process shall be approved by the resin manufacturer in writing. Cure schedules shall include specific information on curing procedures, "post exothermic cooking times" duration and "cool down" procedures – all to be approved by the resin manufacturer in writing.

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7. The Contractor shall submit a Certificate of Authenticity from the resin manufacturer for each shipment to the wet-out facility to include the date of manufacture and Heat Distortion Temperature. This information shall be submitted before the manufacture or installation of any CIPP.
- B. The manufacturer shall submit written certification that the lining system complies with all applicable requirements of these Specifications.
- C. The Contractor shall submit its proposed plan for ensuring that the finished and installed CIPP meets the minimum thickness requirements. The plan shall include detailed inversion procedures to reduce stretching and resin loss and to minimize shrinkage.

1.05 Warranty

The Contractor shall warrant all work and materials installed under this Contract for five years from the date of final acceptance. All CIPP liners shall have a minimum design and service life of 50 years. The date of final acceptance shall be the date final payment is made to the Contractor.

Part 2 Products

2.01 Resins

- A. The resin for CIPP installed under this Contract shall be a Standard Polyester Resin or Enhanced Polyester Resin unless otherwise directed by the Engineer due to site-specific field conditions and/or design requirements.
- B. Standard Polyester Resins
 1. The resin used shall be a corrosion resistant isophthalic polyester specifically designed for the CIPP being installed. Only premium, virgin, non-recycled resin shall be used. The resin shall be manufactured under ISO 9001 certified procedures.
 2. The resin shall have been tested according to ASTM D2990, D5813, and F1216 by accredited, third-party testing facilities. Results of these tests shall be made available to Engineer upon request.
 3. The resin vendor must be able to reference the corrosion scale with the resin itself having a heat deflection temperature greater than 212 degrees Fahrenheit.
- C. Enhanced Polyester Resins
 1. The resin used shall be a corrosion resistant enhanced thixotropic, medium reactivity, high viscosity, and rigid, chemical resistant isophthalic resin. These resins contain a mineral filler to enhance mechanical properties and are specifically formulated for use in the cured-in-place pipe (CIPP) industry.

2. The resin shall have physical and chemical properties equal to those of Reichhold PolyLite® 33420-E and shall have been tested according to ASTM D 2990, D 5813 and F 1216 by accredited third party testing facilities. Results of these tests shall be made available to the Engineer upon request.
 3. The resin must be manufactured under ISO 9001 certified procedures. The resin vendor must be able to reference the corrosion scale with the resin itself having a heat deflection temperature greater than 224 degrees Fahrenheit. Only premium, non-recycled resins will be accepted.
- D. Resins shall be shipped directly from the resin manufacturer's facility to the CIPP wet-out facility. Resins shall not be sent to any intermediate mixing facility. Copies of the shipping documents from the resin manufacturer shall be submitted to the Engineer indicating dates of shipment, originating and receiving locations.

2.02 Catalyst Systems

- A. The catalyst system shall be made up of a primary catalyst and a secondary catalyst. The primary catalyst shall be added at a maximum of 1% of the resin volume by weight unless otherwise approved by the Engineer. The secondary catalyst shall be added at a maximum of 0.50% of the resin volume by weight unless otherwise approved by the Engineer.
- B. Resins, catalysts and resin/catalyst mix ratios shall not be changed or altered during this Contract unless specifically approved by the Engineer in writing.

2.03 Liner Tube

- A. The tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216.
- B. The acceptable liner tube shall be constructed under ISO 9001 certified procedures. Proper certification shall be provided prior to the manufacture or installation of any CIPP.
- C. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular shaped pipe sections.
- D. The wet-out tube shall have a uniform thickness that when compressed at installation pressures shall meet or exceed design thickness.
- E. The tube shall be manufactured to a size that when installed shall tightly fit the internal circumference and length of the original pipe. In the event that under-sized pipe is present, liner tube shall be manufactured so that overlap folds or wrinkles do not occur. Allowances shall be made for circumferential stretching during inversion.
- F. The outside layer of the tube, before installation, shall have an impermeable polyurethane or polyethylene plastic coating. This coating shall be an impermeable, flexible membrane that shall contain the resin and facilitate monitoring of resin saturation during resin impregnation. This coating shall form the inner layer of the

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finished pipe and is required for enhancement of corrosion resistance, flow and abrasion properties.

- G. The tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated layers. No material may be included in the tube that may cause de-lamination in the cured liner, and no dry or unsaturated areas or layer shall be evident.
- H. The wall color of the interior liner surface after installation shall be such that a clear, detailed inspection with closed-circuit television equipment may be conducted.
- I. The outside of the tube shall be marked for distance at regular intervals not to exceed 10 feet. The tube shall be stamped with the manufacturer's name or identifying symbol in regular intervals not to exceed 20 feet.
- J. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance between manhole sections of the segment to be lined unless otherwise specified. The line lengths shall be verified in the field before impregnation of the tube with resin.

2.04 CIPP Design

A. Liner Thickness

- 1. The CIPP thickness shall be designed in accordance with the applicable provisions of ASTM F 1216 and D 2412 for "fully deteriorated gravity pipe conditions" and the following design conditions:
 - a. AASHTO HS20-44 Live Load, whether under streets or not. The live load will vary based on depth of pipe.
 - b. A dead load based on the depth of pipe shown on the Drawings and a soil modulus of elasticity of 1,000 psi, soil weight of 120 pounds per cubic foot and a coefficient of friction of $Ku'=0.130r$.
 - c. Short-term flexural modulus and long-term modulus when tested in accordance with ASTM D790.
 - i. Standard Polyester: 250,000 psi and 125,000 psi, respectively
 - ii. Enhanced Polyester: 400,000 psi and 200,000 psi, respectively
 - d. Minimum Flexural Stress of 4,500 psi, when tested in accordance with ASTM D790.
 - e. Safety factor of 2.0.
 - f. Groundwater height at the ground surface.
 - g. Maximum pipe ovality of 2%.

- h. Poisson ratio of 0.3.
- i. Enhancement factor (K) of 7.
- j. Service temperature range shall be 40 to 140 degrees F.
- k. Maximum long-term deflection shall be 5%.
- l. Any and all other site specific external loads. It is the Contractor's responsibility to determine the site specific external loads.

2. Minimum Acceptable Pipe Thickness

Pipe Diameter (Inches)	Depth to Invert (Feet)	Minimum Thickness (mm)
8	0-17	6.0
10	0-9	6.0
10	9.1-16	7.5

- 3. The liner thickness shall be the greater of the calculated thickness to meet the design requirements of Paragraph 1 above or the minimum acceptable pipe thickness from Paragraph 2 above. If calculations require a thicker wall, round to the next higher multiple of 1.5 mm currently in manufacture.
- 4. All references to liner thickness shall be defined as total thickness after installation and after curing is complete.

- B. The finished CIPP shall provide a uniform smooth interior wall surface with a Manning "n" coefficient of 0.011.

Part 3 Execution

3.01 General

- A. All reconstruction of existing gravity sewers using an approved CIPP product and installer shall be performed in strict accordance with this Specification and ASTM F1216.
- B. Pull-in and inflate methods of CIPP installations (reference ASTM F1743) will not be acceptable without written approval by the Engineer.
- C. 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 an elevated platform and entry into a confined space and the operation of high-pressure air/steam equipment.
- D. The Contractor shall be responsible for obtaining water necessary for cleaning, inversion and other work items requiring water. The Contractor shall be responsible for

obtaining a hydrant use permit from Tennessee American Water.

- E. The Contractor shall be responsible for locating and access to all manholes.
- F. All surfaces, which have been damaged by the Contractor's operations, shall be restored to a condition at least equal to that in which they were found immediately prior to the beginning of the Contractor's operations. Suitable materials and methods, acceptable to the Engineer, shall be used for such restoration. The restoration of existing property or structures shall be performed as promptly as practicable and shall not be left until the end of the construction period. The cost for correcting damages resulting from the Contractor's actions shall be the responsibility of the Contractor.
- G. The tube shall be fabricated to a size that, when installed, will neatly fit the internal circumference of the conduit(s) designated for CIPP. Allowance shall be made for the circumferential stretching during insertion of the tube.
- H. The Contractor shall be responsible for determining the minimum length to effectively span the distance from the manhole to manhole and shall verify the length of the fabric tube in the field before the tube is either cut to length or wet-out with resin. The tube may run through one or more manholes with the approval of the Engineer.
- I. Protruding Service Connections: When service connections protrude into the existing pipe, the Contractor shall remove the protruding portion of the service connection to be flush with the inside pipe wall or to the satisfaction of the Engineer. Removal of the protruding portion of the service connection shall be accomplished using a television camera and internal cutting device, which shall not damage the collection line or the portion of the service line to remain in place. This work shall be accomplished prior to the installation of the CIPP.
- J. Traffic Control: The Contractor shall be responsible for traffic control during the course of each phase of the Work. Prior to beginning Work, Contractor shall submit a traffic control plan for each section of Work for the review and approval. It is the intent that this Work is to be accomplished with as little disturbance to traffic, private property, and the public as is reasonably possible, consistent with timely completion thereof. The traffic control plan shall reflect such requirements where applicable. Signs, signals, and detours shall conform to the local and state requirements for streets and highways. The Contractor shall have and maintain on site a sufficient supply of traffic cones and other traffic signaling devices, including trained and properly equipped flagmen, to safely control all traffic through the work zone(s). Road closures and / or detours will require advance scheduling and prior approval by the Engineer.

3.02 Daily Work Schedule

Insofar as is possible, Work shall be so scheduled that the lining of the pipe, curing of the tube, and the reinstatement of service connections can be accomplished in a single working day or shift. Prior approval must be obtained from the Engineer if work is to be performed at night or on weekends to minimize traffic disturbance. At the end of each working day, temporary tie connections shall be made between the relined section of pipe and the existing system and the plug in the upstream manhole removed, but not

before the section being lined has been properly cured in accordance with the manufacturer's instructions and all service connections are reinstated. In some instances, it may be necessary to bypass effluent from service connections.

3.03 By-Pass Pumping

- A. The installation methodology contemplated requires the temporary blocking and back-ups of sewers and sewage. Contractor shall be responsible to limit the extent and duration of such blockages and back-ups so that overflows and spillage onto public or private property and into storm sewers, waterways, and streets does not occur. In the event that such spillage or overflows do occur during the course of or as a result of the Work, the Contractor performing the Work shall immediately eliminate the spillage or overflow and, as necessary, remove the blockage and eliminate the back-up. On elimination of the spillage or overflow, the Contractor is to clean up and disinfect the area. Work to stop or contain such events is to be deemed emergency in nature and sufficient justification for total mobilization of resources, the use of overtime or double time, and any other reasonable measures to assure correction of the problem without delay. Damages arising from blockages, back-ups, spillage, or overflows of sewage during the course of the Work or because of the Work shall be the sole responsibility of the Contractor.
- B. Sewage flow shall be pumped around segments during the installation and testing of cured-in-place pipe, the televising of sewers and lateral service reinstatement.
- C. Pumping equipment shall have the capacity to convey 100% of peak flows around the construction area. The flow shall be intercepted at the upstream end of the construction area and shall be pumped through temporary piping of adequate size. The flow shall be discharged into a manhole on the downstream side of the construction area, thus by-passing the sewer segment(s) under construction. The Contractor shall be required to contact all residential and commercial customers whose service lines connect to the sewer main being bypassed and inform them that they will be temporarily out of service. The Contractor shall also advise those customers against water usage until the mainline is back in service. After completing the necessary work on the main line to allow its reuse, the Contractor shall advise those customers that the sewer main is back in service. The Contractor shall maintain a high degree of professionalism, both in workmanship and appearance, at all times. Should a condition arise that the Contractor cannot restore service within 12 hours of service interruption; the Contractor shall make provisions for pumping all flows within the service interruption area at no cost to the Owner.
- D. Open channels or trenches shall not be used to convey flow.
- E. A standby pump of the same capacity shall be required on site.
- F. The Contractor is responsible for paying all fines imposed for overflows or spills during construction.

3.04 Preliminary Installation Requirements

- A. Contractor shall notify the Engineer prior to beginning cleaning activities and pre-

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construction closed-circuit televising (CCTV) inspection. Contractor shall plan cleaning and pre-construction CCTV inspection activities far enough in advance of CIPP lining activities to allow Engineer time to review any critical damage reports that may develop from the CCTV inspection results.

- B. Prior to CIPP installation, the pipe shall be cleaned to the satisfaction of the Engineer in accordance with Section 33 01 30.14 of these Specifications.
- C. Debris Disposal: All debris cleaned from the pipe shall be removed and disposed of at the Owner's Wastewater Treatment Plant. Debris shall not be allowed to wash into any other pipe segment either upstream or downstream from the pipe segment being cleaned. All waste disposal at the Owner's Wastewater Treatment Plant shall meet the requirements set forth by the Owner including dewatering of waste prior to disposal.
- D. Pre-Installation CCTV Video Inspection: The section of sewer designated for CIPP shall to be televised its full length using a remote television camera in accordance with Section 33 01 30.16 of these Specifications and shall be submitted to the Engineer for review.

3.05 Resin Impregnation of the CIPP Tube (Wet-Out)

The Contractor shall designate a location where the tube shall be impregnated or "wet out" with resin, using distribution rollers and a vacuum impregnation system to thoroughly saturate the tube's felt fiber prior to installation in the field. The impregnated tube shall be free of pinholes, resin voids and other defects. If the cured-in-place pipe is impregnated at the manufacturing plant, it shall be delivered to the job site in a refrigerated truck, and remain refrigerated (below 45° Fahrenheit or as specified by the resin manufacturer) prior to installation to prevent premature curing. The flexible tube shall be vacuum impregnated with resin under controlled conditions or by such other means provided such means can assure thorough resin impregnation to the full satisfaction of the Engineer. The volume of resin used shall be sufficient to fill all voids in the tube material at normal or required thickness and diameter. The volume of resin shall be adjusted by adding seven to ten percent excess resin for the change in resin volume due to polymerization and allow for any migration of resin into the cracks and joints in the original pipe.

3.06 Inversion of CIPP

- A. The preferred method of installation and cure for CIPP shall be inversion using hydrostatic head (water column) pressure and curing with heated, circulated water. The use of pressurized air inversion/steam cure will be considered on a case-by-case basis only. The Contractor shall submit a written request for the use of pressurized air/steam in sewer segments where the Contractor feels that the utilization of pressurized air/steam will be beneficial to the Owner. The Contractor shall not assume in any case that the use of pressurized air/steam is acceptable to the Owner without prior written authorization from the Owner. The impregnated tube shall be inverted through an existing manhole or other approved access point utilizing a hydrostatic water column until it has fully traversed the designated line length and the inversion face breaches the destination manhole or termination point.

Contractor must have written approval from the Engineer prior to using pressurized air for inversion. The fluid column shall have been adjusted and maintained to be sufficient to cause the impregnated tube to hold tight against the existing pipe wall, produce dimples at side connections, and flared ends at the manholes. Lubricant during inversion shall be used as necessary in accordance with the CIPP manufacturer's recommendations. The lubricant used should be a nontoxic, oil-based product that has no detrimental effects on the tube, heating source and pump system, will not support the growth of bacteria, and will not adversely affect the fluid to be transported. Lubricant shall be used in processes with permeable coatings. Thermocouples shall be placed at the top and bottom interface of termination manhole which is furthest from the heat source for monitoring temperature during the cure cycle. Care should be taken during tube installation not to over-stress the fabric fiber and to minimize longitudinal stretch, resin loss and thinning of the liner wall.

- B. Before the inversion begins, the tube manufacturer shall submit to the Contractor, and the Contractor to the Engineer, the minimum pressure required to hold the tube tight against the host pipe and the maximum allowable pressure so as not to damage the tube.
- C. When using pressurized air, particular attention should be given to the maintenance of the minimum required "finished and installed" thickness of the CIPP.
- D. Once the inversion has started, pressure shall be maintained between the minimum and maximum pressures until the inversion has been accomplished.

3.07 Curing

A. Using Circulated Water

- 1. A suitable source of heat and water recirculation equipment is required to circulate heated water throughout the pipe. The equipment shall be capable of delivering hot water throughout the inverted tube to uniformly raise the temperature required to affect a cure of the resin.
- 2. Initial cure will occur during temperature heat-up and is completed when exposed portions of the new pipe appear to be hard and sound and the thermocouples indicate that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature should be raised to the post-cure temperature recommended by the resin manufacturer. Post-cure temperature should be held for a period as recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the heat source to maintain the temperature continues.
- 3. Prior to any inversion, the Contractor shall provide a Post-Cure Hold Time and Temperature Table. This table shall indicate the minimum time and temperature the inverted tube will be held at in order to achieve desired physical properties. The resin manufacturer shall certify both the time and temperatures presented in the table.

4. Curing must take into account the existing pipe material, the resin system, and the ground conditions (temperature, moisture level, and thermal conductivity of the soil).

3.09 Cool-Down

Cool-down of the cured pipe liner shall be in accordance with the manufacturer's recommendations. Care should be taken during the cool-down process so as to minimize shrinkage of the CIPP.

3.10 Termination and Sealing at Manhole Outlets

- A. Termination of the cured-in-place pipe at the manhole shall be completed by trimming the inverted pipe end back in accordance with the CIPP manufacturer's recommendations and to the satisfaction of the Engineer
- B. No annular space shall be visible between the CIPP and manhole wall. If, in the judgment of the Engineer the CIPP does not fit tightly against the sewer main at its termination point(s), the void between the host pipe and the CIPP shall be sealed by filling it with a resin/epoxy mixture compatible with the CIPP approved by the Engineer or by utilizing manhole end seals or hydro-tite gaskets, all at no additional cost to the Owner.

3.11 Testing of CIPP

- A. The Contractor shall prepare CIPP Acceptance Tests for each CIPP line segment during the duration of this Contract. The samples shall be for laboratory determination of flexural strength, flexural modulus and wall thickness for each test sample. These three individual analyses shall comprise one completed test. All samples shall be collected per the sampling protocols set forth in ASTM F1216.
- B. For each line segment, from the point most distant from the heat source, the Contractor shall remove one restrained sample of the installed liner at least 12 inches in length for testing. For sewers 15 inches and larger, plate samples may be taken and cured in the same water as the installed CIPP. For each sample taken, the Contractor shall cut and deliver a 12 inch in length representative sample (taken at least 2 inches from the end of the specimen) to the Engineer. The sample delivered to the Engineer shall be clearly labeled with the date of installation and sewer segment and removed from any restraining mold. The samples shall be taken in the presence of the Engineer. The Engineer may return such samples to the Contractor for disposal.
- C. The tests shall be used to verify that the installed CIPP meets these Specifications. CIPP thickness shall be measured in accordance with ASTM D5813. Flexural properties shall be determined per ASTM D790. The Contractor shall label and date all samples and deliver the samples directly to the Engineer. All testing shall be performed by an independent, ASTM-certified testing laboratory of Engineer's

designation. Payment to the Contractor shall be withheld pending the Engineer's acceptance of the CIPP test results. The Laboratory costs will be paid in accordance with the terms and conditions of Cash Allowances specified elsewhere.

- D. Any liner that does not meet the specified strength and/or thickness requirements, regardless of the amount below the specified requirements, shall be corrected by the Contractor in a manner approved by the Engineer at no additional cost to the Owner. The Engineer's decision on how to correct deficient CIPP installations shall be final. Options for correcting deficient liners that may be considered by the Engineer include removing the liner and re-lining the sewer, excavating and replacing the sewer from manhole to manhole, or providing the Owner with a credit. The primary option that will be considered will be to re-line the sewer. Credits will only be authorized for CIPP that does not meet required thickness. If a credit is acceptable to the Owner, the credit shall be calculated by multiplying the bid price by the percent that the liner thickness is below the required installed thickness as follows:

$$\text{Credit} = (1 - \text{Installed CIPP thickness/required CIPP thickness}) \times \text{bid price}$$

- E. The Contractor shall not assume a credit will be acceptable to the Owner in any case.

3.12 Lateral Service Reconnection - Internal

- A. After the CIPP has been cured, the existing service connections and laterals shall be reinstated. In general, reinstatement of service connections and laterals shall be accomplished internally, without surface excavation, using a remote control cutting device equipped with a television monitor. Reopened services shall be wire brushed to the satisfaction of the Engineer. In some cases, remote reinstatement may not be possible. In these instances, reconnection by excavation as specified below is acceptable. All connections must be reinstated by at least 95-percent of the original opening. Holes cut outside the lateral opening or oversized cutting (more than 100%) must be repaired at the Contractor's expense. Particular attention shall be given to the lower quadrant of the opening to ensure that no accumulation of solids or debris will occur at the service tie-in.
- B. All capped or factory plugged service connections shall not be opened unless otherwise directed by the Engineer.

3.13 Lateral Service Reconnection By Excavation

- A. General: Sewer lateral house connections accomplished by excavation shall be connected to the pipe by dual-strapped saddles. The Contractor shall connect existing sewer house lateral service pipe to the saddle using a flexible coupling. After connection to the saddle, the sewer house connection pipe shall have a slope toward the newly lined sewer equal to the pre-existing on the lateral pipe or a minimum of two percent.
- B. Execution

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1. The Contractor shall excavate the area of the lateral connection so that the host pipe and existing connection is exposed. The host pipe shall be broken back or removed in such a manner that the new CIPP liner is exposed without causing damage to the liner.
2. An appropriately sized hole acceptable to the Engineer shall be cut into the CIPP using a circular hole cutter. Hanging or loose cuttings shall be removed so that the newly opened hole is smoothed around its edges.
3. A sealant compatible with CIPP and acceptable to the Engineer shall be liberally applied around the newly cut hole to form a watertight seal between the CIPP liner and PVC pipe saddle used to make the connection.
4. A dual-strap PVC pipe saddle acceptable to the Engineer shall be secured to the CIPP in accordance with the manufacturer's recommendations.
5. Before the service lateral pipe is connected to the saddle, the Contractor shall hand wipe a hydrogen sulfide resistant composite epoxy resin mixture inside the saddle where the saddle and CIPP surfaces meet to ensure a watertight seal.
6. The Contractor shall connect the lateral service pipe to the saddle according to the manufacturer's recommendations and in a manner acceptable to the Engineer.

3.14 Final Acceptance

- A. Post-installation videos shall be conducted and submitted to the Engineer in accordance with Section 33 01 30.16 of these Specifications. The finished CIPP shall be continuous over the length of pipe between two manholes and shall be an impermeable, joint-less conduit, free from visual defects such as foreign inclusions, dry spots, pin holes, lifts, or delamination.
- B. Wrinkles in the CIPP (other than minor, longitudinal pressure wrinkles) will not be acceptable. The Engineer shall determine as to the acceptability of pressure wrinkling with that decision being final.
- C. After curing of the resin is completed, the hardened CIPP shall extend from manhole to manhole of the section designated providing a structurally sound, corrosion-resistant, watertight conduit that excludes exfiltration and infiltration, is tight-fitting within the existing pipe, and is free of voids or annular spaces between the CIPP and the existing pipe walls. K-Factor for tightness shall equal 7.0 or greater. All terminations into manhole walls shall be watertight at the time of final inspection. No annular space shall be visible between the CIPP and manhole wall.
- D. The finished pipe must be such that when the thermosetting resin cures, the total wall thickness will be a homogeneous, monolithic felt and resin composite matrix that will be chemically resistant to withstand internal exposure to domestic sewage. When cured, the CIPP must form a mechanical bond with the host pipe.

3.15 Customer Notifications

- A. The Contractor shall contact all residential and commercial customers whose service is to be interrupted by rehabilitation work or who may be affected by upstream or downstream rehabilitations. The customer shall be informed that they will be temporarily out of service. This notification shall be made a minimum of 24 hours prior to beginning rehabilitation work.
- B. For all residences the Contractor shall leave a door hanger detailing the service outage and providing contact information. Door hanger samples shall be submitted to the Engineer for review and approval. The Contractor shall also advise those customers against water usage until the mainline and lateral are back in service. After completing the necessary work on the main line and lateral to allow their reuse, the Contractor shall advise those customers that the sewer is back in service. Should a condition arise that the Contractor cannot restore service within 12 hours of service interruption; the Contractor shall make provisions for pumping all flows within the service interruption area at no cost to the Owner.
- C. All customer notification documentation and procedures shall meet the requirements of the Owner.

END OF SECTION