

SECTION 06010 – CURED-IN-PLACE PIPE (CIPP), CIPP POINT REPAIRS AND END SEALS

PART 1 - GENERAL

1.01 SUMMARY

This section covers work involved with the trenchless rehabilitation of sanitary sewers by the installation of a resin-impregnated flexible tube or liner which is inserted into the original conduit by use of hydrostatic head or air pressure. The resin is cured by circulation of hot water or steam within the tube. When cured and complete, the installed Cured-In-Place-Pipe (CIPP) liner shall extend from one manhole to the next in a continuous, tight-fitting, corrosion resistant, watertight, pipe within a pipe with a life expectancy of 50 plus years. Neither the CIPP system selected by the Contractor, nor its installation, shall cause adverse effects to any of the City's processes or facilities. This section also covers CIPP end seals, pipe end seals and CIPP sectional point repairs.

1.02 SPECIFICATION MODIFICATIONS

A. It is understood that throughout this section these Specifications may be modified by appropriate items in Section 01015 – Specific Project Requirements or as indicated in the Contract Drawings.

1.03 RELATED SECTIONS

- A. Section 01015 – Specific Project Requirements.
- B. Section 01270 – Adjustment Unit Prices and Measurement Procedures.
- C. Section 01300 – Submittals.
- D. Section 01566 – Cleanup Operations.
- E. Section 01700 – Traffic Control.
- F. Section 02676 – Sewer Line Cleaning.
- G. Section 02686 – Closed Circuit Television (CCTV) Inspection.
- H. Section 06012 – Rehabilitation of Sewer Laterals and Sewer Lateral Connections.

1.04 CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
 - ASTM D638 Standard Test Method for Tensile Properties of Plastics.
 - ASTM D790 Standard Test Method for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Material.
 - ASTM D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulation Materials.
 - ASTM D2990 Test Method for Tensile, Compressive and Flexural Creep and Creep-Rupture of Plastics.
 - ASTM D3567 Standard Practice for Determining Dimensions of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings.
 - ASTM D5813 Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems.

ASTM F1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.
ASTM F1743	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP).
ASTM F2561-20	Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner.
ASTM F2599	Standard Practice for the Section Repair of Damaged Pipe by Means of an Inverted Cured-In-Place Liner.
ASTM F3240-19	Standard Practice for Installation of Seamless Molded Hydrophilic Gaskets (SMHG) for Long-Term Water Tightness of Cured-in-Place Rehabilitation of Main and Lateral Pipelines.

1.05 DEFINITIONS

- A. Not used.

1.06 INFORMATION PROVIDED BY THE CITY

- A. As provided in the Contract Documents.

1.07 SUBMITTALS

- A. Submit as specified in Section 01300 – Submittals.
- B. Product Data:
 1. Design approach and formula(s).
 2. Diameter, length and wall thickness for each segment of sewer.
 3. Liner tube materials.
 4. Liner Resin.
 5. Fittings and adapters.
 6. Method and material of sealing liner at manholes.
 7. Manufacturer’s storage and handling requirements.
 8. Chemical and Physical Test Results conducted by a 3rd Party. Testing results shall be conducted within 18 months of submittal.
- C. Tests Reports:
 1. Certified reports and logs of all tests and inspections. Tests shall be completed in the past 2 years.
- D. Certificates, Affidavits and Qualifications.

1.08 CIPP INSTALLER QUALIFICATIONS

- A. The CIPP Installer and its key field installation personnel scheduled for the project shall have experience within the last five (5) years, from the date of submittal, with the installation of CIPP as specified herein:
 1. The Contractor shall provide a minimum of five (5) references for projects that the installer and key personnel have completed at least 20,000 linear feet of CIPP in diameters ranging from 8 to 42 inches in diameter. If CIPP of pipes larger than 42 inches in diameter is specified for the Work, the Installer’s references shall include experience with the installation of CIPP in pipe with like diameters. These project references shall include the name and telephone number of the contact person who has direct knowledge of the performance of the CIPP Installer. The reference

- must indicate an acceptable performance by the Installer.
- 2. Resumes of key field installation personnel (superintendent, foreman, cutter operator) shall be submitted to the City/Design Professional. All changes of key personnel during the execution of the Project requires submittal of the resumes for the personnel to be substituted.

1.09 **QUALITY ASSURANCE**

- A. The Contractor is responsible for the quality assurance and quality control of the Work.
- B. Furnish the following prior to shipment or installation as applicable:
 - 1. Affidavit of compliance with applicable standards for resins and liner tube materials.
 - 2. Certification sealed by an insured registered professional engineer that the liner design and thickness meet the minimum structural design criteria specified herein or as otherwise required by the project.
- C. Furnish the following after installation and testing:
 - 1. Affidavit of compliance for hydraulic leak test of lined pipe where water inversion was utilized.
 - 2. Affidavit of compliance for minimum liner thickness.

1.10 **PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Delivery and storage of lining and other materials shall conform to requirements of the manufacturer. Contractor shall submit manufacturer’s instructions for delivery and storage.
- B. Contractor shall furnish required storage facilities.
- C. Handle lining materials in compliance with the manufacturer's recommendations.
- D. Damaged material, as determined by the City/Design Professional, is unacceptable for installation.

PART 2 - PRODUCTS

2.01 **STRUCTURAL REQUIREMENTS**

- A. The liner tube shall be designed in accordance with ASTM F1216 Appendix - X1 Design Considerations. The design shall be based on a fully deteriorated pipe condition and shall be designed to withstand the structural requirements within this specification and designed for a minimum service life of not less than 50 years.
- B. The Manufacturer and Contractor shall certify and provide structural calculations that the product at the installed thickness will adequately support all loads.
- C. Minimum Structural Standards. The cured CIPP material shall conform to the following minimum structural standards per ASTM D5813 and F1216:

Flexural Strength (test method ASTM D790)	4,500 psi
Modulus of Elasticity (ASTM D790)	400,000 psi
- D. The CIPP design assumes no bonding to the original pipe. The required minimum design thickness of each liner wall shall be in accordance with ASTM F1216 Appendix - X1 Design Considerations with the minimum design parameters listed in Table 1 on the following page.

Table 1. CIPP Minimum Design Parameters

Parameter	Minimum
Mean diameter of original sewer	As measured
Depth of cover to top of pipe for Dead Load calculation	12.5 feet
Water table below surface	0 feet
Unit weight of soil	130 pcf
Soil Modulus (E')	700 psi
Ovality	2%
Live Load at 8 feet depth of cover	HS-25
Deteriorated Condition	Fully
Factor of Safety	2
Minimum design CIPP wall thickness unless approved by City	6 mm for 8-inch pipe, 7 mm for 10-inch pipe and 7.5 mm for 12-inch pipe

- E. The Contractor is required to field verify the mean diameter, minimum diameter and depth of cover of the existing pipeline, prior to ordering the liner material. All measurement information and the calculated liner thickness shall be provided to the City/Design Professional prior to ordering the liner. For diameters not listed in Table 1, based on field conditions, the Contractor may request a Live Load variance (from HS-25 to HS-20) to adjust the calculated liner thickness.

2.02 ADJUST THE DEPTH OF COVER FOR DEAD LOAD CALCULATION IF THE MEASURED DEPTH IS GREATER THAN THE MINIMUM VALUE IN THE TABLE 1. ADJUST LIVE LOAD CALCULATION FOR DEPTH OF COVER LESS THAN 8 FEET

A. Flexible Felt Liner Tube:

1. The CIPP shall meet the requirements of ASTM F1216.
2. The tube shall consist of one or more layers of flexible needled felt material or an equivalent nonwoven or woven material capable of carrying resin and withstanding installation pressures and curing temperatures.
3. The outside layer of the tube (before insertion) shall be translucent plastic coated with flexible material that allows visual inspection of the proper impregnation of the tube fabric with resin.
4. The tube shall be fabricated to a size that when installed will tightly fit the internal circumference and length of the original pipe. Allowance shall be made for longitudinal and circumferential stretching during the insertion process. The minimum length shall be that deemed necessary by the Contractor to effectively span the distance between respective access points without stretching the tube. The Contractor shall measure the lengths and diameters in the field before fabricating the tube. Individual insertion runs can be made over one or more manhole sections as determined in the field by the Contractor. The Contractor will be allowed to insert only the length of liner that it can install, cure and place back in service within the allowable working hours. Intermediate manholes shall be reopened, unless otherwise directed by the City/Design Professional.
5. The tube shall be homogenous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No materials shall be included

in the tube that is subject to delamination of the cured CIPP.

6. The tube shall have a uniform thickness when compressed at installation pressure.
7. The tube can be reinforced with carbon or glass fiber material for added strength as approved by the City.
8. The wall color of the interior pipe surface of the CIPP after installation shall be white, light blue or light green so that a clear and detailed examination with CCTV inspection equipment may be made.

B. Resin:

1. The resin system shall be specifically formulated for sewage service, shall have a documented history of use in similar applications and shall meet the minimum chemical resistance requirements of ASTM F1216. The resin's Spectroscopy wave length chart shall be submitted by the Contractor for the resin proposed for installation on the project. If required, the contractor shall provide a sample of the resin to the City for testing purposes. The resin shall be tinted so that adequate saturation can be readily observed.
2. The tube shall be impregnated with sufficient amount of resin to ensure that the resin is observed on the outer surface of the tube. After the tube is cured, it shall show satisfactory evidence of a fully impregnated tube or the existence of excess resin on the outer surface. The quantities of the liquid thermosetting material shall be sufficient to provide the thickness specified herein and to fill the volume of air voids in the liner tube with additional allowances for polymerization shrinkage and the loss of resin through cracks and irregularities in the original pipe wall.
3. The contractor shall submit to the City/Design Professional, resin saturation charts that indicate the manufacturer's recommended pounds of resin required to fully saturate each size and thickness of fabric tube.
4. The contractor shall submit, to the City/Design Professional, the factory wet-out report for each liner section proposed for installation on the project. The report shall accompany the delivery of each liner section and include, in addition to other project information, the specific resin product that was saturated into the tube and the amount of resin in pounds/foot that were saturated into the tube.

2.03 CIPP END SEAL (WATERSTOP)

- A. Waterstop shall be "Insignia End Seal Sleeve" by LMK, Inc. or City approved equivalent meeting the requirements of ASTM F3240-19.

2.04 PIPE END SEAL LINER

- A. The Pipe End Seal Liner is to be installed at the interface of the sewer pipe and the adjoining manhole. The intent of liner is to provide the rehabilitation of short lengths of pipe at the interface of the pipe and the adjoining manhole by the installation of a resin-impregnated flexible tube. The liner shall conform to the contours to form a hard, impermeable, corrosion resistant cured-in-place pipe end seal liner. The liner prevents water from migrating between the pipe and the manhole wall.
- B. The liner shall be fabricated from materials that will be chemically resistant and withstand internal exposure to domestic sewage having a pH range of 5 to 11 and a temperature up to 150 degrees Fahrenheit when cured. The liner shall be structurally designed for a minimum service life of 50 years.
- C. Resin – The resin used in the curing process shall have the following characteristics:
 1. The resin shall be a 100% solids, corrosion-resistant, two-part silicate or epoxy-

based resin system.

2. Resins may contain pigments, dyes or colorants which will not interfere with visual inspection of the cured liner.
- D. Tube – The liner that is installed shall have the following characteristics:
1. The tube shall consist of one or more layers of a flexible, absorbent, needled (non-woven) fleece/felt fabric meeting the requirements of ASTM F1216, ASTM F1743 and ASTM D5813. The tube shall be capable of being thermo-bonded along the prescribed circumference and length, completely compatible with the resin system used, and able to withstand the installation pressures and curing temperatures utilized. The tube material shall be able to stretch to fit irregular pipe/manhole interface sections, bridge missing pipe/mortar segments, and negotiate bends/contours. Any seams in the tube shall be stronger than the non-seamed felt material.
 2. The pipe end seal lining material shall be able to be fully impregnated with the resin system per the manufacturer's recommendations. The cured pipe end seal lining material shall conform to the minimum structural standards listed below:

	Standard	Results
Compressive	ASTM D-695	4,500 psi
Tensile Strength	ASTM D-638	3,000 psi

3. The installed liner shall be fabricated to a size that will tightly bond to the internal pipe diameter and adjoining manhole interface to be sealed and rehabilitated. Allowances shall be made for the longitudinal and circumferential stretching that occurs during placement of the tube, as well as the minimum extension beyond the pipe/manhole interface to be rehabilitated.
4. Contractor shall be responsible for measuring and determining actual pipe diameters and lengths in the field.
5. The tube shall be homogeneous across the entire wall thickness and contain no intermediate or encapsulated elastomeric layers. No material shall be included in the tubes that are subject to delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

2.05 CHEMICAL RESISTANCE

- A. The cured liner tube material shall meet the minimum chemical resistance requirements of ASTM F1216 Appendixes X2 Chemical-Resistance Tests.

2.06 QUALITY CONTROL

- A. The Contractor is responsible for the quality assurance and quality control of the Work.
- B. The Contractor shall submit samples to a laboratory for a report to be developed. Prior to shipping the samples to a laboratory, the Contractor shall obtain approval of the samples to be tested from the City/Design Professional.
- C. If the results of the tests do not meet the requirements listed in this specification and ASTM standards, the City may require the Contractor to perform further destructive tests on the liner segment in question; additionally, if the test results do not meet the requirements, the Contractor may be required to install a Type II liner per ASTM D5813. If the additional test results meet the requirements, a sectional point repair

shall be made in accordance with this Section, paragraph 2.07 and 3.16, at each location where destructive samples were obtained. All costs associated with additional testing, Type II liner installation and sectional point repairs shall be at the Contractor's sole expense.

D. Wet-Out Location:

1. To facilitate proper inspection, the wet-out location shall be identified so that the City may witness the wetting out procedures, if necessary. It will be at the City's discretion to witness this test and the wet-out of any or all the liners supplied for the project.

E. Inversion Installation:

1. The Contractor shall inform the City as to the maximum allowable inversion head (pressure) that can be used in inverting the tube into the pipe (as recommended by Manufacturer) without rupturing or diminishing the diameter and/or the thickness of the tube. Such installation pressure shall be monitored at all times during the insertion operation and the tube shall be rejected and removed prior to curing if the recommended inversion head force is exceeded. The Contractor shall submit the minimum and maximum inversion required to fully expand the liner against the host pipe.

F. Service Lateral Reinstatement:

1. The CIPP installer shall determine if a service connection is active prior to rehabilitation of the sewer. Dye testing, CCTV with a lateral launch camera and all other means shall be used to determine if a connection is active or not. Only active service connections and laterals shall be reinstated. Upon completion of all testing to determine active service connections, Contractor shall review results with the City's representative and obtain concurrence prior to reinstatement.
2. The CIPP installer shall install a sectional point repair in accordance with paragraph 2.07 and 3.16 for any reinstated non-active service connection. If the pipe diameter is greater than eighteen (18) inches, the Contractor shall submit to the City a method of repair for approval. All cost associated with repairs closing non-active service connections shall be at the Contractor's expense.
3. The City may direct the Contractor to complete point repairs of any misaligned active service connection that is opened after CIPP has been installed. Connections to CIPP lined pipe shall be made as shown in drawing 06010-1. This point repair shall be as directed and approved by the City and paid according to the appropriate Adjustment Unit Price.

2.07 CURED-IN-PLACE-PIPE (CIPP) POINT REPAIR LINER

A. All CIPP lining products shall comply with the latest edition of ASTM F1743 or ASTM F1216. The finished point repair pipe liner shall be fabricated from materials which when cured will be chemically resistant to and will withstand internal exposure to domestic sewage having a pH range of 5 to 11 and a temperature up to 150 degrees Fahrenheit. The point repair liner shall be structurally designed for a minimum service life of 50 years.

B. Resin – The resin used in the curing process shall have the following characteristics:

1. The resin shall be a corrosion-resistant, two-part silicate- or epoxy-based resin system that is ambient-cured or steam-cured and includes all required catalysts and initiators such that when properly cured, creates a composite that meets or exceeds the applicable requirements of ASTM F1216, ASTM F1743, and ASTM D5813, the physical properties stated in these specifications, and the properties claimed in the submitted and approved CIPP sectional point repair liner design for this project.

- The resin system shall allow for the CIPP sectional point repair liner to bond to the original (host) pipe.
2. Resins may contain pigments, dyes or colorants which will not interfere with visual inspection of the cured liner.
- C. Tube – The point repair tube installed into the host pipe and ultimately cured-in-place shall have the following characteristics:
1. The tube shall be fabricated from a two-side fiberglass mat, comprised of a chopped fiber mat on one side, bonded to a woven fiberglass mat on the other side. The fiber mat shall meet the requirements of ASTM F1216, ASTM F1743 and ASTM D5813. The tube shall be capable of being thermo-bonded along the prescribed circumference and length, completely compatible with the resin system used, and able to withstand the installation pressures and curing temperatures utilized. The tube material shall be able to stretch to fit irregular pipe sections, bridge missing pipe segments, and negotiate bends. Any seams in the tube shall be stronger than the non-seamed felt material.
 2. The point repair liner thickness design for each pipe size shall be in accordance with ASTM F1216, as well as the requirements listed in this specification. If Contractor encounters conditions that require or result in deviations from these assumptions, Contractor shall consult with Owner prior to installing liner. In the liner thickness calculations, the following requirements and assumptions shall apply:
 - a. The minimum acceptable cured-in-place liner thickness for CIPP sectional point repairs for fully-deteriorated pipe that is 15-inch diameter or less, shall be 3.0 millimeters (mm).
 - b. Sectional point repair liners shall bond to the original (host) pipe wall.
 - c. The height of groundwater above the pipe shall be a minimum of fifty percent (50%) of the pipe depth or 8 feet above top of pipe, whichever is greater.
 - d. Soil density of 120 pounds per cubic foot.
 - e. The enhancement factor (K) shall be no greater than seven point zero (7.0).
 - f. The minimum safety factor shall be two point zero (2.0).
 - g. The flexural modulus of elasticity shall be reduced to no more than 50% to account for long-term effects and used in the design equation E_L .
 - h. CIPP sectional point repair liners shall have a minimum service life of 50 years.
 3. The point repair lining material shall be able to be fully saturated with the liquid resin system, per the manufacturer's standards. The cured point repair lining material shall conform to the minimum structural standards listed below:

	Standard	Results
Flexural Stress	ASTM D-790	27,000 psi
Modulus of Elasticity	ASTM D-790	800,000 psi

4. The CIPP sectional point repair liner manufacturer shall have conducted long-term testing for flexural creep of the CIPP liner material installed. Such tests shall have measured the performance of the materials (tube and resin) and general workmanship of the installation and curing procedures. The performance test results shall be used to determine the long-term, time-dependent flexural modulus

to be utilized in the product design. A percentage of the instantaneous flexural modulus value is used in design calculations for external buckling. Retention values for the long-term flexural modulus shall be no more than 50% of the short-term test results. The materials utilized for this project shall be of a quality equal to, or better than, the materials used in the long-term performance tests with respect to the initial flexural modulus used in the CIPP design calculations.

5. The tube shall be fabricated to a size that, when installed, will bond to the internal circumference of the original conduit segment length to be rehabilitated. Allowances shall be made for the longitudinal and circumferential stretching that occurs during placement of the tube as well as the minimum one-foot extension beyond each side of the conduit segment to be rehabilitated in order to develop a firm adhesion to portions of the host pipe that have maintained structural integrity around the rehabilitated segment. The hydraulic cross-section of the pipe liner shall be maintained as large as possible.
6. The tube diameter shall be that deemed necessary by the Contractor to effectively carry out the packer inflation process and seal the point repair liner across the conduit segment to be rehabilitated. Wrinkles that exceed 1/2" in height or are between the 3 to 9 o'clock positions will not be allowed and must be removed prior to acceptance. Contractor shall be responsible for measuring and determining actual pipe diameters and lengths in the field.
7. The tube shall be homogeneous across the entire wall thickness and contain no intermediate or encapsulated elastomeric layers. No material shall be included in the tubes that are subject to delamination in the cured CIPP. No dry or unsaturated layers shall be evident.

PART 3 - EXECUTION

3.01 GENERAL

- A. The Contractor shall comply with the following procedures unless other procedures are approved by the City.
- B. Prior to the commencement of the actual liner tube inversion process, the Contractor shall plan its work after review of preliminary CCTV television inspection performed by the contractor. All point repairs shall be satisfactorily completed, equipment and material mobilized; and the City shall be informed on the impending work schedules (see paragraph C. below) for liner tube installations.
- C. General construction sequencing is as follows: cleaning of mainline, CCTV of mainline, all obstructions removed, mainline point repairs made where needed, bypass pumping established, mainline CIPP liner installed, laterals reinstated, LCR/MTH's installed (see Section 06012 – Rehabilitation of Sewer Laterals and Sewer Lateral Connections), manholes rehabbed and site restored.

3.02 SAFETY

- A. The Contractor shall carry out its operations in accordance with all OSHA and manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving working with scaffolding and entering confined spaces.
- B. The Contractor shall inform City of any hazardous material encountered during this project.
- C. Traffic control shall be performed in accordance with Section 01700 – Traffic Control.

3.03 CLEANING OF THE SEWER LINE

- A. The Contractor shall be required to remove all internal debris from the sewer lines, so the entire pipe can be thoroughly inspected and successfully reconstructed. Pipe to be lined shall be cleared of protruding service connections, debris or other obstructions that can hinder liner tube inversion. Cleaning shall be performed as specified in Section 02676 – Sewer Line Cleaning.

3.04 BYPASS PUMPING

- A. The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for rehabilitation and inspection and at a cost incidental to the insertion of the liner tube. The bypass shall be made by plugging the line at an existing upstream manhole or adjacent system. The pumping system shall be of adequate capacity and size to handle at least two times the max month flow rate. Contractor shall be responsible for verifying flow rates for each section of pipeline to be lined and determining the max month flow rate. The Contractor shall submit a flow control implementation plan for the City's acceptance prior to construction.
- B. Bypassing includes all mainline bypassing and service line bypassing, if required.
- C. Wastewater shall not be allowed to spill into storm drains, street gutters or open excavations. Any spills that occur must be taken care of properly and immediately. The City shall be immediately notified and the Contractor shall bear all costs associated with any spills from its bypass system.
- D. The Contractor shall take all necessary steps to prevent flooding of any residence or business and shall be liable for any damages incurred because of the Contractor's operation.
- E. Once liner is completely cured and service connections are reinstated:
 - 1. Place rehabilitated sewer sections back in service.
 - 2. All accumulated debris that is built up behind the bypass plug shall be removed in accordance with paragraph CLEANING OF THE SEWER LINE.

3.05 CCTV INSPECTIONS

- A. CCTV shall be as specified in Section 02686 – Closed Circuit Television (CCTV) Inspection.
- B. The CIPP installer shall provide inspection of wastewater mains by experienced personnel specially trained in locating breaks, obstacles and active service connections by CCTV, as specified in other sections. All inspections shall be in accordance with NASSCO PACP standards.
- C. The inspection of pipelines is also to aid in the determination of active service connections and the addresses which they serve.
- D. The interior of the wastewater main shall be carefully inspected to determine the location of all active lateral connections, the location and extent of any structural failures, pipe deflections, offset joints or other factors that will affect the installation or performance of the liner tube system.
- E. Contractor shall notify City when point repairs are required where existing sewer pipe sections must be removed or replaced to successfully install the CIPP liner.

3.06 LINE OBSTRUCTIONS

- A. It shall be the responsibility of the Contractor to clear the line of obstructions such as solids and roots that will prevent the insertion of the CIPP.

- B. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, excessively deformed section, mineral deposits or a collapse that will prevent the inversion process and it cannot be removed by conventional sewer cleaning equipment, then the Contractor will notify the City and Contractor shall make a point repair excavation to uncover and remove or repair the obstruction:
 - 1. Such excavation shall be approved in writing by the City prior to the commencement of the work and shall be considered as a separate pay item as provided in the Bid Schedule.
 - 2. Where sections of the existing sewer pipe must be removed (open cut point repair), a circular form or new pipe with couplings, shall be installed as approved by City.
 - 3. This work shall be performed by the Contractor as recommended by the CIPP manufacturer and directed by the City.

3.07 EXISTING VOIDS

- A. Field locate and record all voids and holes to be filled. Record shall include the following dimensions and measurements:
 - 1. Distance from both upstream and downstream manholes to each void or hole.
 - 2. Length, width and depth of each void or hole, such that approximate volume of fill material may be calculated.
 - 3. Location of each void or hole in the sewer crown stated in clock position as viewed from downstream.
- B. Prior to installation of the inversion liner, submit recommendations for filling voids, including those to be filled after installation of the liner. The City will issue a Request for Proposal and after acceptance of the Contractor's proposal, a Work Change Directive and Change Order will be issued for performance of the required Work.
- C. Fill all voids or holes recorded. All large voids or holes shall be filled with concrete, non-shrink grout or other material. Voids and holes below the centerline elevation of the existing sewer shall be filled prior to installation of the liner. Voids and holes above the centerline elevation of the existing sewer may be filled after installation of the liner. Perform in a manner to ensure that voids and holes are filled. Plug any holes in the liner wall with a manufacturer's approved method. Submit documentation of manufacturer's approved method of plugging holes.

3.08 PUBLIC COMMUNICATIONS

- A. Notification of affected property owners shall be in accordance with Section 01581 – Public Communications.
- B. Contact any home or business which cannot be reconnected within the time stated in the written notice.

3.09 TEMPORARY FACILITIES

- A. If so required by a served business, portable toilets for their use by their employees will be furnished and serviced by the Contractor. The costs of these items shall be included in the cost of CIPP. No additional payment will be made by the City.

3.10 CIPP INSTALLATION

- A. CIPP installation shall be in accordance with ASTM F1216, with the following additional requirements:
 - 1. Immediately prior to installing the liner, the contractor will completely flush and

- televise the pipeline for inspection by the City representative to ensure a clean, debris free pipeline.
2. Tube Impregnation (Wet Out):
 - (a) The Contractor shall designate a location where the uncured resin in original containers and the fiber felt liner tube shall be vacuum impregnated prior to installation.
 - (b) A resin/catalyst system compatible with the requirements of this method and applicable to the long-term service requirements of the pipeline, shall be used.
 - (c) After the felt liner tube has been fully impregnated with resin/catalyst the liner tube shall be fully installed within manufacturer's recommendations.
 3. All pulled-in-place methods of installation is prohibited.
 4. Curing:
 - (a) Once the curing process has started, the pressure shall be maintained between the manufacturer's minimum and maximum pressures until the operation has been completed. Should the pressure deviate substantially from within the range of minimum and maximum pressures, the installed tube may be tested to determine that it meets the contract requirements. If it fails to meet the contract requirements, the Contractor shall make repairs as described in paragraph QUALITY CONTROL.
 - (b) Contractor shall continuously monitor and record pressure during the curing process. A complete log of the pressures and temperatures shall be maintained on the site and shall be furnished to the City after each inversion.
 - (c) The City representative may also monitor the curing of the liner to verify general compliance with the recommended manufacturers cure schedule.
 - (d) Contractor shall use an odor neutralizer, during or after the lining operations, if odors are present near a home/business or inside the home/business. Contractor shall use Ecosorb by OMI Industries or City approved equal.

3.11 SEALING CIPP AT MANHOLES

- A. The liner tube shall extend a minimum of 2 to 3 inches into the manhole.
- B. Prior to CIPP installation, the Contractor shall install CIPP end seals (waterstops) to the interior circumference of the existing sewer at each end of the CIPP liner per manufacturer's recommendations. If a liner is "shot through" a manhole during installation, CIPP ends seals shall also be placed on both sides of the manhole. No separate payment for CIPP end seals shall be made.
- C. The invert of the manhole shall be reworked (smoothed and built up) to match the flow line of the new liner tube. Submit methods and materials for approval before installation.
- D. If the installed liner tube fails to make a tight seal, the Contractor shall apply a sealant at that point.
 1. The sealant shall be compatible with materials used in the lining process and shall be as recommended by the manufacturer of the pipe liner.
 2. Seal shall be composed of a resin mixture compatible with the liner tube as recommended by the liner tube manufacturer.

3.12 SERVICE CONNECTIONS

- A. After curing of the CIPP has been completed and after the pressure test specified herein, the Contractor shall reinstate only the existing active service connections and branch connections.
- B. It is the intent of these specifications that active service connections and branch connections be reopened without excavation and in the case of non-man entry pipes, from the interior of the pipeline utilizing a remotely controlled cutting device, monitored by a closed-circuit television camera, which fully opens the service connections. Reinstatement of sewer service shall provide a full diameter hole, free from burrs or projections and finished with a smooth edge.
- C. The Contractor shall certify he has a minimum of two (2) complete working lateral cutter systems, plus spare key components on the site before each insertion.
- D. If the lateral cutter systems are not functional, no additional payment will be made for excavations for reinstating service connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration.
- E. All active service laterals shall be reinstated within 8 hours of beginning the inversion process unless a written plan is submitted by the contractor and approved by City prior to the inversion process.
 - 1. Contractor shall provide temporary facilities or hotel accommodations for the residents if sewer service is not restored within 8 hours.

3.13 INSPECTION

- A. Water tightness:
 - 1. For CIPP liners installed under hydrostatic head, leakage testing the CIPP shall be accomplished during cure while under a positive head.
- B. Visual Inspection:
 - 1. Visual inspection of the CIPP liner shall be in accordance with ASTM F1216.
 - 2. All defects discovered during the post CIPP CCTV inspection shall be corrected by the Contractor at the Contractor's expense before the work will be considered complete by the City. Defects include any wrinkles in the finished liner greater than one-half (1/2) inch or the results in reduction of pipeline hydraulic capacity. If directed by the City, Contractor shall remove the wrinkle and install a sectional point repair in accordance with this Section, paragraph 2.07 and 3.16, at no additional cost to the City. Any wrinkling in a glass or carbon fiber layer of Composite CIPP tube can reduce the structural capacity. Wrinkling in glass or carbon fiber reinforcement is not allowed. Contractor shall remove the wrinkle and install a sectional point repair in accordance with this Section, paragraph 2.07 and 3.16, at no additional cost to the City.
 - 3. Pinholes in the CIPP liner are not allowed and the cured CIPP liner shall be rejected. All observed pinholes shall be addressed and repaired by the Contractor at no additional cost to the City.
 - 4. The post-construction CCTV data shall be conducted once all work in a line segment is complete (main line, point repairs, laterals and manhole rehabilitation).
 - 5. Direct flow around sections being televised using the same method required for installation.

3.14 PIPE END SEAL LINER

- A. Contractor shall apply the approved resin onto the pipe end seal liner onsite prior to installation and provide all equipment required to install the liner into the pipe and cure it once in place.
- B. The Pipe End Seal Liner shall be installed in accordance with the latest practices given in ASTM F1743 for resin-impregnated, pulled-in-place installations.
- C. Resin-Impregnation and Wet-Out – Each liner to be installed shall be infused or impregnated with a thermo-setting bonding resin. This process shall include the following procedures:
 - 1. The Contractor shall designate the location where the liner will be impregnated with resin prior to installation. The resin shall be hand-applied and troweled onto the liner to achieve a uniform distribution of the resin throughout the material. Installer or Contractor shall allow Owner to inspect the materials and the "wet-out" procedure.
 - 2. Only 100% solids resin systems which are approved by the liner manufacturer shall be utilized.
 - 3. The quantity of resin used for the liner's impregnation shall be sufficient to fill the volume of air voids in the liner with additional allowances made for any shrinkage or anticipated loss of resin through cracks and irregularities in the host pipe and manhole walls.
- D. Insertion and Installation of Liner – The insertion and installation of the liner into the defective pipe/interface segments shall conform to the following procedures:
 - 1. Contractor shall wrap the impregnated liner material onto the installation packer and insert the packer with liner through the adjoining pipe/manhole interface to be lined.
 - 2. While in the host pipe, the packer with liner shall be placed at a position to fully reline the defective area to be rehabilitated. Contractor shall use cameras, push rods, and positioning ropes/cables as necessary to ensure proper placement.
 - 3. Contractor shall slowly inflate the packer to a safe and appropriate working pressure, as recommended by the liner manufacturer.
 - 4. Upon proper positioning and inflation, Contractor shall allow liner to cure per the manufacturer's recommendations.
- E. Curing Liner – Curing of the liner shall conform to the following procedures:
 - 1. The curing period shall be for the duration recommended by the resin manufacturer based on the installation process used. The installation packer shall not lose air pressure during the curing process.
 - 2. The finished liner may overlap at least two inches along the interior manhole wall along the entire interface circumference in order to develop a firm adhesion/seal to portions of the host pipe and manhole wall. The liner shall be as free of visual defects such as foreign inclusions, dry spots, pinholes, and delamination.

3.15 FIELD QUALITY CONTROL

- A. Finish:
 - 1. The finished CIPP liner shall be continuous over the entire length of an insertion run between two manholes and be free, as commercially practicable, from visual defects such as foreign inclusions, dry spots, pinholes and delamination. It shall also meet the leakage/pressure test requirements specified herein.
 - 2. Any defects which will affect the integrity or strength of the liner tube shall be repaired at the Contractor's expense, in a manner recommended by the manufacturer and mutually agreed upon by the City and the Contractor.

B. Sampling:

1. Samples should be obtained from every liner section installed in accordance with ASTM F1216.
2. The sample form pipe shall be PVC pipe (SDR-26, AWWA C900) of the minimum lengths indicated in the table below. Internal preparation shall be made to the PVC sample form pipe using a release agent such as PVA (polyvinyl alcohol solution) so that the liner sample can be removed without damage. Restrained samples shall be for pipe sizes up to 18-inch in diameter. For pipe sizes larger than 18-inch diameter, provide samples as described in ASTM F1216 8.1.2.

Table 2. Sample Requirements

Liner Thickness	Minimum Sample Form Pipe Length
6 - 7.5 mm	12 inches
8 mm and greater	20 inches

3. An identification number shall be marked on the outside of the sample form pipe. This number will be assigned by the City/Design Professional.
4. The liner shall be cured and cooled down within both the host pipe and the sample form pipe in accordance with the Construction Contract requirements.
5. The sample shall then be removed and trimmed to proper size, labeled with the correct identification number and submitted for testing at the Contractor's expense.
6. Failure to meet or exceed any of the requirements of this specification based on the design parameters outlined in the Construction Contract Documents shall be cause for rejection.
7. The Contractor shall retain all samples not selected for testing until completion and acceptance of all Work. Samples shall then be turned over to the City, unless otherwise directed.

C. Material Testing:

1. CIPP samples shall be tested in accordance with ASTM F1216. The following tests shall be performed by a 3rd Party Certified Independent laboratory, approved by the City at the Contractor's sole expense:
 - (a) Short-Term Flexural (Bending) Properties in accordance with ASTM F790.
 - (b) Tensile Properties Tests shall be performed in accordance with ASTM D638.
 - (c) CIPP Wall Thickness Tests shall be performed in accordance with ASTM D3567 and ASTM D5813. The average thickness of the installed CIPP shall meet or exceed the minimum design thickness. The minimum installed/cured wall thickness at any point shall not be less than 99% of the specified design thickness.
 - (d) The City may witness inspection and testing of the materials, when requested prior to testing.
2. Frequency:
 - (a) Twenty percent (20%) of the CIPP samples, to be selected by the City, shall be tested by the independent laboratory. Additional samples shall be tested, if there are any failures within the first 20%.
3. Reports:
 - (a) Three copies of all certified reports and logs of all tests and inspections conducted shall be submitted directly to the City.

3.16 CURED-IN-PLACE-PIPE (CIPP) POINT REPAIR LINER

- A. The Contractor shall use equipment and methods adequate to protect the pipe, joint elements, and prevent shock contact of adjacent units during moving, storage, or installation. Damaged sections that cause reasonable doubt as to their structural strength or water-tightness shall be repaired by Contractor.
- B. Resin-Impregnation and Wet-Out – Contractor shall apply the approved resin onto the sectional point repair liner on-site just prior to installation and provide all equipment required to install the point repair liner into the conduit and cure it once in place. Each point repair liner to be installed on the project shall be infused or impregnated with a thermo-bonding resin. This process shall include the following procedures:
 - 1. The Contractor shall designate the location where the point repair liner will be impregnated with resin prior to installation. The resin shall be hand-applied and troweled onto the liner to achieve a uniform distribution of the resin throughout the material. This is considered the “wet-out” process. Installer or Contractor shall allow Owner to inspect the materials and the "wet-out" procedure.
 - 2. Only resin systems which are approved by the point repair liner manufacturer shall be utilized.
 - 3. The quantity of resin used for the liner’s impregnation shall be sufficient to fill the volume of air voids in the liner with additional allowances made for any shrinkage or anticipated loss of resin through cracks and irregularities in the host pipe wall.
- C. Insertion and Installation – The CIPP liner shall be installed in accordance with the latest practices given in ASTM F1743 for resin-impregnated, pulled-in-place installations. The insertion and installation of the point repair liner shall conform to the following procedures:
 - 1. Contractor shall wrap the impregnated liner material onto the installation packer and insert the packer with liner through an existing manhole or other access point.
 - 2. While in the host pipe, the packer with liner shall be placed at the center of the defective area to be rehabilitated. Contractor shall use cameras, push rods, and positioning ropes/cables as necessary to ensure proper placement.
 - 3. Contractor shall slowly inflate the packer to a safe and appropriate working pressure to pop the binding wire and initiate any audible device that signifies sufficient inflation.
 - 4. Upon proper positioning and inflation, Contractor shall allow point repair liner to cure per manufacturer’s recommendations.
 - 5. Curing – Curing of the liner shall conform to the following procedures: the curing period shall be for the duration recommended by the resin manufacturer based on the lining process used. The packer shall not lose air pressure during the curing process. Care shall be taken in the release of packer pressure so as not to damage the liner, host pipe, or any adjacent connections.
 - 6. The point repair lining shall be as free as commercially practical from visual defects such as foreign inclusions, dry spots, pinholes, and delamination. The lining shall be impervious and free of any leakage from the pipe to the surrounding ground or from the ground to the inside of the lined pipe.

3.17 WARRANTY

- A. The Contractor shall warrant the CIPP installation for a period of three (3) years. During the Contractor warranty period, any defects which affect the integrity or strength of the pipe, as identified by the City during routine inspections, shall be repaired at the Contractor's expense in a manner recommended by the manufacturer and mutually agreed by the City and the Contractor.
- B. This shall include but not be limited to all material, excavation, backfilling, cutting, concrete, pipe, shoring, temporary pavement, permanent pavement, permits, bypass pumping, surface restoration and other incidental work required to remove the liner from the existing pipe.
- C. If removal is not feasible or if removal will cause more harm than acceptable to the host pipeline, alternatives may be proposed by the Contractor to the City for review and approval.
- D. The integrity of the existing pipe where the liner was removed shall be rehabilitated by installing another liner or if this procedure is not feasible by installing a new pipe section.
- E. There shall be no direct payment, to the Contractor, for this work.

3.18 PROTECTION OF EXISTING WORK

- A. CIPP installations associated with this work may be along or through existing structures, manholes or pipe segments that have previously been rehabilitated.
- B. Damage to existing linings (manhole coatings, existing CIPP installations, lateral linings, LCRs, etc...) due to the installation of the new CIPP liners or any work associated construction shall be repaired at no additional cost to the City. Requirements include, but is not limited to, the following:
 - 1. Manhole wall corrosion protection top coats that are damaged or removed due to the installation or the curing of the new CIPP liner.
 - 2. The previously rehabilitated manhole structure shall be repaired with a similar, compatible product as recommended by the manhole coating material manufacturer.
 - 3. If repair of the existing structure coating is impossible, the existing manhole corrosion prevention product should be removed and the entire structure recoated.

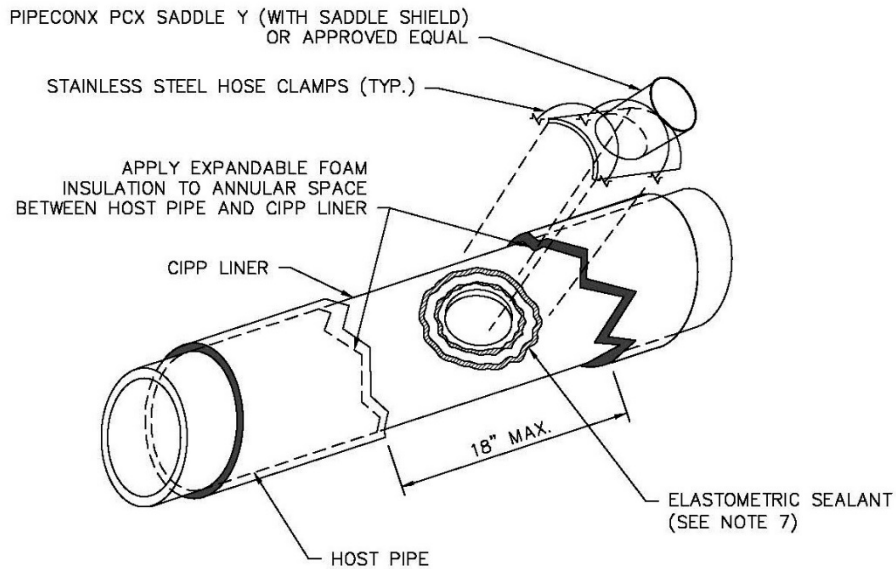
3.19 REJECTION

- A. Materials and installation may be rejected for failure to meet the requirements of this Section.

3.20 CLEANUP

- A. After installation and testing, the Contractor shall clean up the entire project area. All excess material and debris shall be disposed of by the Contractor.
- B. Cleanup shall be in accordance with Section 01566 – Cleanup Operations.

Drawing 06010-1 on the following page.



NOTES:

1. EXCAVATE BELOW THE EXISTING SEWER TO COMPLETE THE WORK.
2. CHIP AWAY HOST PIPE ONCE CIPP LINER HAS BEEN INSTALLED AND CURED.
3. CORE CIPP LINED PIPE TO SIZE OF SADDLE OPENING, SAVE COUPON FOR CITY.
4. CONTRACTOR SHALL GRIND DOWN THE CIPP LINER TO MAKE A SMOOTH CONNECTION PRIOR TO APPLYING THE SEALANT.
5. TAKE A PICTURE OF HOLE BEFORE INSTALLING SADDLE.
6. THE CONTRACTOR SHALL CONTACT THE CITY IF THE SADDLE IS UNABLE TO MAKE A GOOD CONNECTION OR IF A TEE SADDLE MUST BE INSTALLED INSTEAD.
7. APPLY TWO BEADS OF CONSEAL CS-1500 SEALANT OR APPROVAL EQUAL AROUND CORE HOLE.
8. ATTACH SADDLE ACCORDING TO MANUFACTURER'S RECOMMENDATIONS,
9. BACKFILL SEWER USING GRANULAR BEDDING AS SPECIFIED IN SECTION 02250 TRENCHING, PIPE EMBEDMENT AND BACKFILL.

**SADDLE CONNECTION
ON SEWER WITH CIPP**

WATER SERVICES
CITY OF KANSAS CITY, MISSOURI

DRAWING NO. **06010-1**

DEVELOPED BY: _____
TECHNICAL ADVISORY COMMITTEE

APPROVED BY: _____
DATE: 2/17/2021

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OF
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END OF SECTION