**SECTION 3.1**

**TECHNICAL SPECIFICATION FOR**

**REHABILITATION OF EXISTING WASTEWATER MAIN**

**BY CURED-IN-PLACE PIPE (CIPP)**

**PART 1: GENERAL**

**1.1 Scope of Work**

Furnish all materials, labor, equipment, tools, and required incidentals for providing and installing a flexible tube saturated with a thermosetting, sulfuric acid corrosion resistant, polyester, vinyl ester, or epoxy resin, either inverted or pulled into the existing wastewater main such that when properly cured, extends from one manhole to the next in a continuous, tight-fitting, corrosion resistant, watertight pipe.

* Inversion Method

Insertion of a resin impregnated tube into the existing wastewater main using an inversion standpipe under a hydrostatic head or air pressure.

* Pulling Method

This method consists of pulling a resin impregnated tube into the existing wastewater main and expand with a calibration hose through the center and under pressure.

**1.2 Related Works**

* Technical Specification for Wastewater Flow Control and Bypass Pumping
* Technical Specification for Wastewater Main Cleaning
* Technical Specification for Television Inspection of Wastewater Mains

**PART 2: QUALITY ASSURANCE**

**2.1 Reference Standards**

Unless otherwise stated, the latest editions of the following documents are applicable

for this specification:

ASTM F1216 Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin Impregnated Tube

ASTM D638 Standard Test Method for Tensile Properties of Plastics

ASTM D790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

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 D5813 Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems

ASTM D2990 Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

* 1. **Qualification Requirements**
		1. Manufacturer/Installer:

No work by other than the CIPP manufacturer that involves this rehabilitation process will be accepted, unless such installers or companies are certified and licensed by the CIPP manufacturer for such work and are approved by the Owner. In addition, Manufacturer/Installers must meet the following criteria to be deemed commercially acceptable:

* + - * Must satisfy all insurance, financial, and bonding requirements of the Owner, and must have had at least 5 (five) years active experience in the commercial installation.
			* Must successfully installed at least 100,000 feet of the cured-in-place product intended for use on this project in wastewater collection systems in the U.S. with at least 50,000 feet installed in the State of Texas.
			* Manufacturer/ Installer’s project manager must have a minimum of 3 years of CIPP installation experience, while under the employment of the Manufacturer/ Installer’s company.

2.2.2 Product:

* For a product to be considered commercially proven, a minimum of 20 successful wastewater collection system projects of a similar size and scope of work and 200,000 linear feet shall have been completed in the U.S. with the exact product intended for use on this project and documented to the satisfaction of the Owner to assure commercial viability.
* Both the rehabilitation manufacturing and installation processes shall operate under a quality management system which is third-party certified to ISO 9000 or

other recognized third-party certified organization standards. Proof of certification shall be required for approval.

* Sewer rehabilitation products submitted for approval must provide third party test results supporting the structural performance (short-term and long-term) of the product and such data shall be satisfactory to the Owner. No product will be approved without independent third party testing verification.
	1. **Warranty**
		+ A one-year warranty for the pipe shall be included from the Contractor, and shall cover the cost of replacement pipe and freight to project site, should the pipe have any defects in material or workmanship.
		+ In addition to the standard pipe warranty, the CIPP contractor shall provide in writing a warranty for a period of one year for all the CIPP work including material, installation, and pressure testing at no additional to the owner.
		+ Unless otherwise specified, the warranty periods shall begin after the Certificate of Acceptance is issued for the Contract.

**2.4 Submittal**

The Contractor shall furnish all necessary catalogs cut sheets, technical literature, shop drawings and engineering data to address the following documentations:

2.4.1 CIPP Questionnaire

The Contractor must fill out and submit with his product submittal the questionnaire at the end of this section. Upon approval by the Engineer all information filled out in the questionnaire becomes part of the Contract, therefore, binding the Contractor/manufacturer/installer to meet or exceed the values set forth in the questionnaire.

2.4.2 Material Data:

Type of resin tube material and its physical properties

2.4.3 Process Demonstration

* Submit detailed installation procedures including curing methods, curing temperatures, inversion methods, inversion or pull-in pressures, etc.
* Method of sealing liner at manholes.
	+ 1. Engineering Calculations:

Provide diameter, length, wall thickness and all structural design calculations for each wastewater main segment to be rehabilitated. All design calculations must be sealed by a State of Texas Registered Professional Engineer.

2.4.5 Testing/TV Inspection Report

* Copies of certified independent laboratory tests on the proposed resin impregnated tube showing values for short term Flexural Modulus of Elasticity, Flexural Strength, Tensile Strength as listed in the questionnaire. The testing laboratory must be a certified independent facility and not affiliated with the proposed CIPP manufacturer/installer. In addition, submit field test results from one previous CIPP project over the last three years using the same values shown on the questionnaire.
* Television inspection reports along with video made after new pipe installation.

2.4.6 References

* Provide three references of projects completed within last five years by the manufacturer in which a wastewater main was successfully rehabilitated using the proposed materials. Include contact names, addresses and phone numbers of agencies involved.

**PART 3: PRODUCTS**

**3.1 Resin**

The resin system shall be a corrosion resistant polyester, vinyl ester or epoxy including all required catalysts, initiators that when cured within the tube create a composite that satisfies the requirements of ASTM F1216, Section 5.1 or ASTM F1743, Section 5.2.1 or ASTM D 5813, Sections 5 and 6. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this specification.

**3.2 Lining Tube**

3.2.1 Inversion Flexible Felt Tube

* A sewn tube consisting of one or more layer of a non-woven felt material meeting the provisions of ASTM F1216, Section 5.1, can be used. The tube shall be lined on one side with a translucent waterproof coating such as polyurethane or polyvinylchloride (PVC) and fully impregnated with a sulfuric acid corrosion resistant liquid thermosetting polyester, vinyl ester, or epoxy resin and catalyst system compatible with the inversion process. The resin must meet ASTM F1216, Section 5.2. Any fiberglass stranded mattes are not acceptable.
* Size the tube to the existing wastewater pipe circumference and length between manholes as shown on drawings so it will stretch to fit irregular pipe sections; have sufficient strength to bridge missing pipe sections; and invert smoothly around bends. Allow for circumferential stretching during inversion.

3.2.2 Pulled-in Felt Fabrication

* + - * A lining tube impregnated with a sulfuric acid corrosion resistant liquid thermosetting polyester, vinyl ester, or epoxy resin and catalyst system meeting ASTM F1216, Section 5.2 and compatible with the process, can be used.
			* Size the tube to the existing wastewater pipe circumference and length between manholes shown on drawings so it will stretch to fit irregular pipe sections; have sufficient strength to bridge missing pipe sections; and invert smoothly around bends.

3.2.3 Thickness:

 Tubes must have a uniform thickness that when compressed at installation pressures will meet or exceed the design thicknesses noted in the Questionnaire.

3.2.4 Material Homogeneity:

 The tubes must be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric delamination or dry unsaturated layers.

3.2.5 Color:

CIPP wall coloring after installation must be a white color that can give a clear detail examination with the closed circuit television inspection equipment.

3.2.6 Seams:

 Seams in the tube must be stronger than the unseamed felt. Sewn joints must be spirally formed and sewn with no perpendicular joint to the long axis.

3.2.7 Markings:

The Tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 feet. Such markings shall include the manufacturers name or identifying symbol. The tubes must be manufactured in the USA.

**PART 4: STRUCTURAL REQUIREMENTS**

**4.1 Design Standards:**

The CIPP shall be designed as per ASTM F1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall.

**4.2 Roughness Coefficient:**

 Resin liner must be smooth and have an average “n” factor of 0.013 or lower.

* 1. **Design Parameters:**

The resin liner material and thickness must be designed by the manufacturer to meet the following minimum parameters:

* The existing pipe condition is classified as a Partially Deteriorated Gravity Flow Pipe Condition (ASTM F1216 X 1.2.1).
* Resin Impregnated Liner Design Properties:

Minimum Design Flexural Modulus of Elasticity 250,000 psi

Minimum Flexural Strength 4,500 psi

Design Creep Reduction Factor 50%

Design Life 50 years

* Design Factors

Enhancement Factor 7.0

Poisson's Ratio 0.3

Ovalness 5%

Minimum Safety Factor 1.5

* 1. **Special Considerations:**

The manufacturer may propose design figures different from those above but they must be included on the Questionnaire and supported with documentation from independent laboratory tests backing the reason for the deviation. The Owner must approve any changes.

**PART 5: EXECUTION**

**5.1 Preparatory Procedure**

Adhere to the following conditions, unless approved otherwise by the Owner. After reviewing all television inspection videos and reports, but prior to starting any liner inversion process, make a plan of all work activities. All point repairs must be satisfactorily completed, equipment and material mobilized, and the Owner furnished a copy of the impending work schedules for liner installations.

5.1.1 Safety

Carry out operations according to all OSHA and manufacturer's safety requirements, drawing particular attention to those safety requirements involving working with scaffolding and entering confined spaces.

5.1.2 Cleaning

It is the responsibility of the Contractor to clean the existing wastewater pipe, specified elsewhere in these Specifications, by removing all internal debris out of the wastewater main immediately before the television inspection.

5.1.3. Pre-Construction Television Inspection

A pre-construction television inspection of wastewater mains shall be performed to locate or /confirm the breaks, obstacles and service connections as per Technical Specification for "Television Inspection of Wastewater Mains". Carefully inspect the interior of the wastewater main to determine the location and extent of any structural failures. Note any locations of any conditions which may prevent proper installation so that such conditions can be corrected. The Owner must review and approve the television inspection video prior to proceed with any rehabilitation.

5.1.4 Flow Control

The Contractor is to provide wastewater flow diversion around the section or sections of pipe designated for effective TV inspection and CIPP rehabilitation, specified elsewhere in these Specifications, at a cost incidental to the CIPP rehabilitation. Submit a flow control implementation plan for the Owner's approval prior to starting work. DO NOT pump wastewater into the streets, alleys, storm drains, rivers, creeks, or drainage channels (man-made or natural). The pump and bypass lines must be of adequate capacity and size to handle the flow. Take all necessary steps to prevent flooding of any residence or business. Contractor is liable for any damages incurred by same.

5.1.5 Line Obstructions

Identify any point repairs required, such as dropped joints, intruding service connections, collapsed pipe, sags in main or any other obstructions which prevents completion of the inversion process and remove prior to the lining process. This work must be approved in writing by the Owner and is to be done by the Contractor. The Owner reserves the right to approve or disapprove of any point repairs identified. The Owner also can decide if the point repair identified is needed or not.

5.1.6 Water

 Water for the rehabilitation work is to be furnished by the City from the nearest fire hydrant. The Contractor must provide piping and connections for getting water to the site. Hauling, if required, is the Contractor's expense. Use a double-check valve assembly to prevent backflow in the event of a pressure failure. Backflow prevention must be approved by the Owner.

**5.2 Installation**

The manufacturer's written instructions and procedures for installing CIPP submitted as part of “Section 2.4 Submittal” above will be used as a basis of quality control by the Owner.

**5.3 Sealing Pipe in Manholes**

Cut the liner flush with the existing pipe at the manhole walls. Rework the invert (smoothed and built up) to match the flow line of the new liner pipe. If due to broken or misaligned wastewater pipe at the manhole, the installed pipe fails to make a tight seal, apply a sealant at that point. The sealant must be compatible with materials used in the lining process and approved, in writing, by the Owner.

* 1. **Service Connections**
* In providing re-connection of existing wastewater services, select (cut) service connection to match existing service diameter of minimum 6”. Any existing service smaller than 6” shall be upsize to minimum of 6”.
* It is the intent of these specifications that all service laterals be re-opened without excavation within 24 hours of beginning the inversion process, utilizing a remotely controlled cutting device, monitored by a CCTV.
* The Contractor shall certify a minimum of two complete functional cutters plus key spare components are on the job site before each installation or are in the immediate area of the jobsite and can be quickly obtained.
* Unless otherwise directed by the Owner or his authorized representative, all laterals will be reinstated with no less than 90% of their original capacity. No additional payment will be made for excavations for the purpose of reopening

connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

* 1. **Post-Rehabilitation Television Inspection**

Upon completion of CIPP operation and reconnection of the service laterals, the Contractor shall perform television inspection of the rehabilitated wastewater main as outlined in the technical section "Television Inspection of Wastewater Mains".

**5.6 Limitation and Constraints**

If wet-out is done at the site, confine the operations to one lane of traffic and provide adequate devices and facilities for containing any chemical spills.

**5.7 ACCEPTANCE**

5.7.1 Finish

* The finished pipe must be continuous over the entire length of an inversion run between two manholes and free from significant defects.
* Any defects which will affect, in the foreseeable future, or warranty period, the integrity or strength of the pipe in the opinion of the Owner must be repaired at the Contractor's expense, in a manner agreed upon by the Owner.

5.7.2 Testing of In-Place Material Properties

* Prepare flat plate samples according to ASTM F1216, Section 8.1 for each section of line between manholes. Samples should be taken in an area (at manholes) designated by the Owner. Prepare at least two samples per section between manholes.
* The Owner will collect the samples and have them tested by a laboratory at his own choosing and expense. Samples will be tested for compliance with the specified liner thickness, flexural strength and flexural modulus of elasticity stated in the approved Questionnaire.

5.7.3 Inspection

After the work is completed, the contractor will provide the Owner with a video showing the before and after condition, including the reinstated wastewater line and building lateral connections.

5.7.4 Failure to Meet Requirements

* The Owner will view the inspection video tape and determine if all required work is complete. Any deficiencies noted by the Owner must be corrected to his satisfaction.
* Any section failing the water tightness test must be corrected or modified by the Contractor until it passes.
* The Owner will evaluate in-place material tests for each section between manholes and if the test results show the liner does not meet the stated criteria in the approved Questionnaire, a penalty or deduction from the Contract will be assessed as follows:

 **C** =Bid Item Cost for CIPP per Linear Foot in the Bid Proposal

 **L** = Length of Line between Manholes where the deficiencies occurred.

 All adjustments are cumulative for Modulus, strength and thickness. These results will apply to all test values which fall between 95% and 100% of the stated Questionnaire value. If the results are below 95% for flexural Modulus and strength, the Contractor must submit a proposal to remedy the problem. The Owner may accept, at an adjusted price based on the formula above, thicknesses less than 95% of minimum stated in the attached Questionnaire only if the thickness provided exceeds the calculated modified design thickness (i.e. the thickness required with the actual flexural Modulus of elasticity and actual depth). No credit or extra pay will be given for any test results over the values listed in the Questionnaire.

**5.8 Cleanup**

Clean up the entire project area after the work is completed and all testing accepted. Remove and dispose of all excess material and debris not incorporated into the permanent installation.

**PART 6: METHOD OF MEASUREMENT AND PAYMENT**

Method of Measurement and Payment for the work included in this section will be in accordance with the payment schedule in the Bid Proposal.

**CIPP QUESTIONNAIRE**

**(To Be Filled by Contractor)**

Manufacturer/Installer \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Trademark Name for the Process \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Type and Brief Description of Installation Process (Inversion, Pull-in, or Other)

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Submit detailed installation procedures including curing methods, curing temperatures, inversion methods, inversion or pull-in pressures, etc.

Type and Description of the Liner: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Type and Brief Description of The Resin (polyester, vinyl ester, or epoxy resin):

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Submit laboratory analysis of the proposed resin(s) showing chemical makeup and concentrations. Samples will be taken in the field and tested to verify this chemical makeup.

**Engineering Properties of the Resin:**

Short Term Flexural Modulus of Elasticity \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Short Term Flexural Strength \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Short Term Tensile Strength \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**\*\*END OF SECTION\*\***