

SECTION 33 11 00.21**CURED-IN-PLACE PIPE****PART 1: GENERAL****1.01 SECTION INCLUDES**

This Section provides specifications for the reconstruction of pipelines and conduits by the installation of a resin-impregnated flexible tube which is tightly formed to the original conduit.

1.02 RELATED WORK

Piping - General Provisions - Specification Section 33 11 00.

1.03 SUBMITTALS

Submit shop drawings and manufacturer's literature for all Contractor supplied materials promptly to the AW Project manager for approval in accordance with Specification Section 01 33 00.

1.04 REFERENCES

This Section references the following American Society for Testing and Materials standards. In the case of conflicting requirements between this specification and these referenced documents, this specification will govern.

- A. ASTM F1216 – Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube
- B. ASTM F1743 - Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)
- C. ASTM D5813 - Cured-in-Place Thermosetting Resin Sewer Pipe
- D. ASTM D790 - Test Methods for Flexural Properties of Un-reinforced and Reinforced Plastics and Electrical Insulating Materials
- E. ASTM D2990 - Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

1.05 PRODUCT, MANUFACTURER, AND INSTALLER QUALIFICATION REQUIREMENTS

- A. Since sewer products are intended to have a 50-year design life, and in order to minimize AW's risk, only proven products with substantial successful long-term track records will be approved. All trenchless rehabilitation products and installers must be pre-approved prior to the formal opening of proposals.
- B. For a product to be considered Commercially Proven, a minimum of 1,000,000 linear feet or 4,000 manhole-to-manhole line sections of successful wastewater

collection system installations in the U.S. must be documented to the satisfaction of AW to assure commercial viability.

- C. For an Installer to be considered as Commercially Proven, the Installer must satisfy all insurance, financial, and bonding requirements of AW, and must have had at least 5 (five) years active experience in the commercial installation. In addition, the Installer must have successfully installed at least 50,000 feet of the product bid in wastewater collection systems. Acceptable documentation of these minimum installations must be submitted to AW.
- D. 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 AW. Test samples shall be prepared so as to simulate installation methods and trauma of the product. No product will be approved without independent third party testing verification.
- E. 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 organization standards. Proof of certification shall be required for approval.
- F. Documentation for products and installers seeking pre-approved status must be submitted no less than two weeks prior to proposal due date to allow time for adequate consideration. AW will advise of acceptance or rejection a minimum of three days prior to the due date. All required submittals must be satisfactory to AW.

PART 2: PRODUCTS

2.01 MATERIALS

- A. Tube - The sewn tube shall consist of one or more layers of absorbent non-woven felt fabric and meet the requirements of ASTM F1216, Section 5.1 or ASTM F1743, Section 5.2.1. The tube shall be constructed to withstand installation pressures, have sufficient strength to bridge missing pipe, and stretch to fit irregular pipe sections.
- B. The wet out tube shall have a relatively uniform thickness that when compressed at installation pressures will equal or exceed the calculated minimum design thickness.
- C. The tube shall be manufactured to a size that, when installed, will tightly fit the internal circumference and length of the original pipe. Allowance should be made for circumferential stretching during inversion. Overlapped layers of felt in longitudinal seams that cause lumps in the final product shall not be utilized.

- D. The outside layer of the tube shall be coated with an impermeable, flexible membrane that will contain the resin and all the resin impregnation (wet out) procedure to be monitored.
- E. The Tube shall be homogeneous across the entire wall thickness containing no intermediate or encapsulated elastomeric layers. No material shall be included in the Tube that may cause delamination in the cured CIPP. No dry or unsaturated layers shall be evident.
- F. The wall color of the interior pipe surface of CIPP after installation shall be a relatively light reflective color so that a clear detailed examination with closed circuit television inspection equipment may be made.
- G. Seams in the Tube shall be stronger than the non-seamed felt material.
- H. The tube shall be marked for distance at regular intervals along its entire length, not to exceed 5 ft. Such markings shall include the manufacturer's name or identifying symbol. The tubes must be manufactured in the USA.
- I. Resin - The resin system shall be a corrosion resistant polyester, vinyl ester, or epoxy system including all required catalysts, initiators or hardeners that when cured within the tube create a composite that satisfies the requirements of ASTM F1216 and ASTM F1743, the physical properties herein, and those which are to be utilized in the design of the CIPP for this Project. The resin shall produce a CIPP that will comply with the structural and chemical resistance requirements of this Specification.

2.02 STRUCTURAL REQUIREMENTS

- A. The CIPP shall be designed as per ASTM F1216, Appendix X.1. The CIPP design shall assume no bonding to the original pipe wall.
- B. The Contractor must have performed long-term testing for flexural creep of the CIPP pipe material installed by his Company. Such testing results are to be used to determine the long-term, time dependent flexural modulus to be utilized in the product design. This is a performance test of the materials (Tube and Resin) and general workmanship of the installation and curing. A percentage of the instantaneous flexural modulus value (as measured by ASTM D790 testing) will be used in design calculations for external buckling. The percentage, or the long-term creep retention value utilized, will be verified by this testing. Retention values exceeding 50% of the short-term test results shall not be applied unless substantiated by qualified third party test data to AW's satisfaction. The materials utilized for the contracted project shall be of a quality equal to or better than the materials used in the long-term test with respect to the initial flexural modulus used in the CIPP design.
- C. The Enhancement Factor 'K' to be used in 'Partially Deteriorated' Design conditions shall be assigned a value of 7. Application of Enhancement (K)

Factors in excess of 7 shall be substantiated through independent test data to the satisfaction of AW.

- D. The layers of the cured CIPP shall be uniformly bonded. It shall not be possible to separate any two layers with a probe or point of a knife blade so that the layers separate cleanly or the probe or knife blade moves freely between the layers. If the layers separate during field sample testing, new samples will be required to be obtained from the installed pipe. Any reoccurrence may cause rejection of the work.
- E. The cured pipe material (CIPP) shall conform to the structural properties, as listed below.

MINIMUM CIPP PHYSICAL PROPERTIES

		Cured Polyester Composite	
Property	Test Method	Min. Standards per ASTM F1216	Min. standards for Enhanced Resin
Modulus of Elasticity	ASTM D790	250,000 psi	400,000 psi
Flexural Stress	ASTM D790	4,500 psi	4,500 psi

- F. The required structural CIPP wall thickness shall be based as a minimum, on the physical properties in Section 2.02E and in accordance with the design equations in the Appendix X1, Design Considerations, of ASTM F1216, and the following design parameters:

Design Safety Factor (typically used value)	= <u>2.0</u>
Retention Factor for Long-Term Flexural Modulus to be used in Design (As determined by long-term tests described in section 2.02B and approved by AW)	= <u>1% - 60%</u>
Ovality* (calculated from (X1.1 of ASTM F1216)	= <u>%</u>
Enhancement Factor, K	= <u>See 2.02C</u>
Groundwater Depth (above invert of existing pipe)*	= <u>ft.</u>
Soil Depth (above crown of existing pipe)*	= <u>ft.</u>

* Denotes information, which can be provided here or in inspection videotapes or project construction plans. Multiple line segments may require a table of values.

- G. Any layers of the tube that are not saturated with resin prior to insertion into the existing pipe shall not be included in the structural CIPP wall thickness computation.

2.03 TESTING REQUIREMENTS

- A. **Chemical Resistance** - The CIPP shall meet the chemical resistance requirements of ASTM F1216, Appendix X2. CIPP samples for testing shall be of tube and resin system similar to that proposed for actual construction. It is required that CIPP samples with and without plastic coating meet these chemical-testing requirements.
- B. **Hydraulic Capacity** - Overall, the hydraulic cross-section shall be maintained as large as possible. The CIPP shall have a minimum of the full flow capacity of the original pipe before rehabilitation. Calculated capacities may be derived using a commonly accepted roughness coefficient for the existing pipe material taking into consideration its age and condition.
- C. **CIPP Field Samples** - When requested by AW, the Contractor shall submit test results from field installations in the USA of the same resin system and tube materials as proposed for the actual installation. These test results must verify that the CIPP physical properties specified in Section 2.02E have been achieved in previous field applications. Samples for this project shall be made and tested as described in Section 3.2.

PART 3: EXECUTION

3.01 INSTALLATION – INCIDENTAL ITEMS

- A. It shall be the responsibility of the Contractor to locate and designate all manhole access points open and accessible for the work, and provide rights-of-access to these locations. If a street must be closed to traffic because of the orientation of the sewer, the Contractor shall institute the actions necessary to provide access during this for the mutually agreed time period. AW shall provide free access to water hydrants for cleaning, installation and other process related work items requiring water.
- B. **Cleaning of Sewer Lines** - The Contractor, when required, shall remove all internal debris out of the sewer line that will interfere with the installation of CIPP. The Contractor shall provide a dumpsite for all debris removed from the sewers during the cleaning operation. Unless stated otherwise, it is assumed this site will be at or near the sewage treatment facility to which the debris would have arrived in absence of the cleaning operation. Any hazardous waste material encountered during this project will be considered as a changed condition.
- C. **Bypassing Sewage** - The Contractor shall provide for the flow of sewage around the section or sections of pipe designated for repair. Plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or

adjacent system shall make the bypass. The pump(s) and bypass line(s) shall be of adequate capacity to accommodate the sewage flow. AW may require a detail of the bypass plan to be submitted.

- D. Inspection of Pipelines - Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections using close circuit television (CCTV) inspection techniques. The pipeline interior shall be carefully inspected to determine the location of any conditions that may prevent proper installation of CIPP. These shall be noted and corrected. A videotape and suitable written log for each line section shall be produced for later reference by AW.
- E. Line Obstructions - 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 CIPP. If pre-installation inspection reveals an obstruction such as a protruding service connection, dropped joint, or a collapse that will prevent the installation process, that was not evident on the pre-bid video and it cannot be removed by conventional sewer cleaning equipment, then the Contractor shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by AW prior to the commencement of the work and shall be considered as a separate pay item.
- F. Public Notification - The Contractor shall make every effort to maintain sewer service usage throughout the duration of the project. In the event that a connection will be out of service, the longest period of no service shall be 8 hours. A public notification program shall be implemented, and shall as a minimum, require the Contractor to be responsible for contacting each home or business connected to the sanitary sewer and informing them of the work to be conducted, and when the sewer will be off-line. The Contractor shall also provide the following:
 - 1. Written notice to be delivered to each home or business the day prior to the beginning of work being conducted on the section, and a local telephone number of the Contractor they can call to discuss the project or any potential problems.
 - 2. Personal contact with any home or business, which cannot be reconnected within the time stated in the written notice.
- G. The Contractor shall be responsible for confirming the locations of all branch service connections prior to installing the CIPP.

3.02 INSTALLATION

- A. CIPP installation shall be in accordance with ASTM F1216, Section 7, or ASTM F1743, Section 6, with the following modifications:

1. Resin Impregnation - The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the loss of resin during installation through cracks and irregularities in the original pipe wall. If a vacuum impregnation process is used, the point of vacuum shall be no further than 25-feet from the point of initial resin introduction. After vacuum in the tube is established, a vacuum point shall be no further than 75-feet from the leading edge of the resin. The leading edge of the resin slug shall be as near to perpendicular to the longitudinal axis of the tube as possible. A roller system shall be used to uniformly distribute the resin throughout the tube. If the Installer uses an alternate method of resin impregnation, the method must produce the equivalent results. Any alternate resin impregnation method must be documented to the AW's satisfaction that the saturation of the CIPP is sufficient.
2. Tube Insertion – The wet out tube shall be positioned in the pipeline using either inversion or a pull-in method. If pulled into place, a power winch should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.
3. Temperature gauges shall be placed between the tube and the host pipe's invert position to monitor the temperatures during the cure cycle.
4. Curing shall be accomplished by utilizing hot water under hydrostatic pressure or steam pressure in accordance with the manufacturer's recommended cure schedule.

3.03 REINSTATEMENT OF BRANCH CONNECTIONS

- A. It is the intent of these specifications that branch connections to buildings be re-opened without excavation, utilizing a remotely controlled cutting device, monitored by 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 AW Project Manager or his authorized representative, all laterals will be reinstated. 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.

3.04 INSPECTION

- A. CIPP samples shall be prepared and physical properties tested in accordance with ASTM F1216 or ASTM F1743, Section 8, using either method proposed. The flexural properties must meet or exceed the values listed in Table 1 of the applicable ASTM.

- B. Wall thickness of samples shall be determined as described in paragraph 8.1.6 of ASTM F1743. The minimum wall thickness at any point shall not be less than 87½% of the minimum design wall thickness as calculated in paragraph 2.02F of this document.
- C. Visual inspection of the CIPP shall be in accordance with ASTM F1743, Section 8.6.

3.05 INSPECTION

- A. Upon acceptance of the installation work and testing, the Contractor shall restore the project area affected by the operations to a condition at least equal to that existing prior to the work.

END OF SECTION 33 11 00.21