SECTION 813

PIPE REHABILITATION BY CURED-IN-PLACE PIPE METHOD

I. GENERAL

1.1. DESCRIPTION OF WORK

A. All applicable requirements of other portions of the Contract Documents apply to the Work of this Section.

B. Related Documents.

1. ASTM F 1216 – Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

2. ASTM D 543 –Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents

3. ASTM D 618-61 – Standard Practice for Conditioning Plastics for Testing

4. ASTM F 1743 - Standard Practice for Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP)

5. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics

6. ASTM D 790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

7. ASTM D 792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

8. ASTM D 2990 - Standard Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

9. ASTM D 5813 - Standard Specification for Cured-in-Place Thermosetting Resin Sewer Piping Systems

C. Products shall conform to Section 200.

D. The Contractor shall perform all required permanent landscape restoration of disturbed areas on private property and within the locality or VDOT right-of-way upon completion of the Work to the satisfaction of the Owner.

E. These specifications include requirements for all design, materials, transportation, equipment and labor necessary to rehabilitate deteriorated sections of sewer listed in the contract

documents by means of cured-in-place pipe (CIPP) liner. This specification is intended to identify the minimum requirements of the Owner.

F. General Requirements:

1. The Contractor shall furnish all material, labor and special equipment required to accomplish the Work in accordance with these specifications. The installation shall affect the complete interior relining of the existing sanitary sewer piping and shall result in a smooth, hard, strong and chemically inert interior finish, and closely following the contours of the existing piping. The Contractor shall provide a watertight completed system with mainline sewer and all lateral connections in operational condition.

2. The Contractor shall comply with erosion and sediment control and other applicable requirements to protect drainage structures, systems, and waters of the Commonwealth.

3. Potable water usage shall be in accordance with Section 810 - Sewer Line Cleaning.

4. Lining Contractor Experience.

a. The Contractor for the cured-in-place rehabilitation of sewers must have a minimum of 3 years experience using the proposed product and have installed at least 50,000 linear feet of the proposed product for collection system. All contractor employees and/or subcontractors performing Work on the cured-in-place rehabilitation of sewer must be certified by the cured-in-place rehabilitation system manufacturer/supplier as qualified to perform Work with the proposed product.

b. The superintendent for the job must have supervised jobs in which at least 50,000 linear feet of collection system pipe has been rehabilitated using the product proposed in the bid. The superintendent for the job shall be on-site during all phases of the Work involving the insertion and processing of the liner pipe. The superintendent must be an employee of the lining contractor.

c. The Contractor shall be licensed by the liner process manufacturer/supplier.

1.2. SUBMITTALS

Submittals shall be made by the Contractor in accordance with the procedures set forth in Section 105 - Control of Work, and as described below.

A. After notification of award of a specific project, the Contractor shall provide the following information for review and approval.

1. A comprehensive construction sequencing plan. At minimum the plan shall include the following:

a. A proposed schedule.

b. Identification of all proposed access routes.

c. Identification of set-up locations for lining installation.

d. Lining procedures.

e. Bypass Pumping Plan in accordance with Section 812 – Bypass Pumping.

f. Traffic Control Plan in accordance with VDOT or locality requirements.

2. Letter identifying the crew members performing the lining. If any of the crew members are not identified on the original certification letter received during the pre-qualification process, then a new certification letter listing the crew member(s) must be received from the rehabilitated system manufacturer/supplier prior to initiation of the specific project.

3. Calculations supporting recommended liner thicknesses. The data shall include both the sealed calculated thicknesses and the thicknesses proposed to be installed. A registered Professional Engineer shall seal the calculations and provide an executed copy of the following form:

Professional Engineer Certification Form

The undersigned hereby certifies that he/she is a Professional Engineer registered in the State of Virginia and that he/she is employed by:
_____(Name of Contractor)
to design cured in place liner segments. The undersigned further certifies that he/she has performed the design of the specified liner diameters and thicknesses and that the design is in conformance with all applicable local, state, and federal codes, rules, and regulations. It is further certified that the signature and Professional Engineer stamp will be affixed to all calculations and drawings used in, and resulting from the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the Owner within seven (7) Days following the Owner's request.

Professional Engineer Stamp _____

*By*_____

4. Minimum liner thickness:

a. Minimum liner thickness for nominal pipe diameters of 6 inches shall be 4.5 mm. Minimum liner thickness for nominal pipe diameters of 8 to 12 inches shall be 4.5 mm. Minimum liner thickness for nominal pipe diameters of 14

to 16 inches shall be 8 mm. Minimum liner thickness for nominal pipe diameters of 18 inches shall be 9 mm.

b. Liner thicknesses may be modified with the Owner's approval of supporting calculations by the Contractor's Professional Engineer. .

B. Prior to initiation of the Work the Contractor shall submit the following information for review and approval. These items may be submitted prior to the notice to proceed for review and approval.

1. Shop drawings and product data for the rehabilitation method including a report outlining the process to be used in the rehabilitation of the sewer line. The report shall also include information specific to the job, such as coordination issues, access, timing, manufacturer's installation instructions and bypass pumping.

2. Infrared spectrum analysis for proposed resin and confirmation of the resins meeting ASTM D 5813.

3. Detailed description of lubricant proposed for inversion process. Lubricant shall be compatible with the Hampton Roads Sanitation District's wastewater treatment plant operations and pretreatment program.

4. Certification of resin volume and required 5% to 10% addition.

5. Certification from resin manufacturer regarding approval of resin dye quantity and type.

6. Information on the maximum allowable tensile stress for the tube from the felt manufacturer.

7. One complete set of CDs/DVDs from each of the television inspections performed (Pre-Installation TV Inspection), as specified in Section 811 - Television Inspection. The Owner shall specify the storage media

C. At least 7 working days prior to initiation of construction, the following information shall be provided for Owner review and approval:

1. All measurements made by the Contractor to verify length, ovality, and diameter of pipe prior to ordering of material. .

2. Quality assurance and quality control information from product manufacturer including recommended heating and cooling procedures (including temperatures) from the rehabilitation system supplier.

3. Procedure for disposal of superheated water.

D. The following information shall be submitted after the Work has been performed and along with the next application for payment:

1. A specification sheet for each liner delivered. The sheet shall include, at minimum, the liner length, thickness, diameter, batch number, and resin volume.

2. The curing log of temperatures at the upstream and downstream manholes during the curing process.

3. Results of testing for materials provided for this job, as specified in this Specification.

4. One complete set of CDs/DVDs from each of the television inspections performed Post-Installation TV Inspection), as specified in Section 811 - Television Inspection. The Owner shall specify the storage media.

II. EXECUTION

2.1. GENERAL

A. Inspections:

1. Prior to beginning insertion of the liner bag, the Contractor shall inspect the cleaned line by use of closed-circuit T.V. cameras (in accordance with Section 811 - Television Inspection), and shall confirm to his own satisfaction that the lines are adequately cleaned. Insertion of the bag by the Contractor shall serve as evidence of his acceptance of the condition of the piping and the suitability of the liner insertion within the host pipe. Failure of the liner system due to inadequately cleaned host pipes shall be repaired by the Contractor at no cost to the Owner.

2. During the process of manufacture and impregnation, the Owner shall have the reasonable opportunity to examine all operations where the manufacture and impregnation (when applicable) of the liner is being carried out. The Contractor shall give appropriate prior notice in order that the Owner's inspector may be on hand to observe the various processes.

3. No Work shall be performed by the Contractor except in the presence of the Owner's inspection personnel, unless otherwise approved. The Contractor shall coordinate his work schedule and give 48 hours (2 working days) prior notice regarding his intentions to perform any and/or all parts of the Work, in order that the Owner's inspector may be on hand. Any Work performed in the absence of the Owner’s inspector is subject to removal and replacement at the Contractor's expense.

4. The Contractor shall, in the presence of the Owner's inspector, inspect the line using closed-circuit television equipment.

5. The video thus produced shall be accompanied by a simultaneously produced, narrated sound CD/DVD. The sound narration shall draw attention to all recognizable defects, imperfections, etc., and the location along the length of the piping shall be accurately noted. Also, the locations and all pertinent details regarding the entrance of service laterals into the main trunk sewer shall be accurately noted on the sound CD/DVD. One copy of the sound and video

CDs/DVDs shall become the property of the Owner. Televising shall be performed as specified in Section 811 - Television Inspection.

B. Preparatory Procedures:

1. Prior to initiation of a specific project, it is the responsibility of the Contractor to notify all residents that could be affected by the lining process. This notification shall consist of written information and verbal communication that outlines the CIPP process and timing of the project. The written information shall be delivered to each home or business at least 48 hours prior to the start of insertion, and at minimum shall describe the Work, schedule, how it affects the home/business, the project manager's name, crew foreman's name, emergency contact number, and details how to identify crew members/vehicle. .

2. The Contractor shall provide water and sewer to affected property owners in the event of service interruption, at no additional cost to the Owner.

3. The Contractor shall be responsible for the construction layout at the beginning of the project. The Contractor shall take all precautions to protect all stakes, hubs, control points, etc. If the stakes, hubs, control points, etc. are disturbed during construction, the Contractor shall re-stake at his expense. The Contractor is responsible for the accuracy of the re-staking in accordance with Section 105 - Control of Work.

4. All utilities must be marked by "Miss Utility" prior to construction layout.

5. The actual sizes, lengths and materials of the pipes to be lined shall be indicated on the Contract Documents, but shall be verified by the Contractor prior to commencing with the Work.

6. Cleaning of sewer lines and manholes shall be performed as specified in Section 810 – Sewer Line Cleaning.

7. When required for acceptable completion of an insertion process, the Contractor shall provide for adequate flow control including but not limited to required pumping and bypassing as stipulated in Section 812 – Bypass Pumping.

8. The line shall be cleared of obstructions such as solids, or intruding service connections that may prevent liner installation. If the inspection reveals an obstruction that cannot be removed by conventional remote sewer equipment, then a point repair excavation shall be made to remove or repair the obstruction. NOTE: Point repairs shall be made only after cleaning methods were performed and shall be approved in advance by the Owner. Such point repairs shall be reimbursed per agreed upon unit prices.

9. Roots shall be removed in the designated sections where root intrusion is a problem. Special attention should be used during the cleaning operation to assure almost complete removal of roots from the joints. Procedures may include the use of mechanical equipment such as rodding machines, bucket machines and winches

using root cutters and porcupines, and equipment such as high-velocity jet cleaners in accordance with Section 810 - Sewer Line Cleaning.

10. The Contractor shall seal all leaks and infiltration identified in the Bid Documents that will prevent the liner from curing properly. Infiltration control is considered incidental and shall be included in the cost of the project.

2.2. LINER INSTALLATION

A. Procedures:

1. The liner shall be installed in accordance with ASTM F 1216 or ASTM F 1743.

2. Conduct operations in accordance with applicable OSHA standards, including those safety requirements involving Work on an elevated platform and entry into a confined space. Make suitable precautions to eliminate hazards to personnel near construction activities when pressurized air is being used.

3. In the event of insertion being delayed after impregnation by unexpected site conditions but prior to the start of the insertion process, the Contractor shall store, at his own cost, the liner, at a temperature of less than 30° F for use when conditions allow.

4. The liner shall be installed via an inversion process or other process that has been approved by the Owner. The free open end of the liner bag shall be firmly secured to the platform and the folded liner passed down a suitably reinforced column to a chute or bend leading to the opening of the pipe to be lined. Potable water at ambient temperature shall be supplied to the platform at a rate sufficient to cause controlled installation of the liner into the pipeline. Use of non-potable water shall be used only upon approval from the Owner. Contractor shall assume potable water usage when developing unit pricing.

5. Liner inversion rate for water inversion installations shall not exceed 32 feet per minute and the tail of the liner or the tail tag rope shall be suitably restrained to prevent liner run away, if applicable.

6. The Contractor shall supply a suitable heat source and recirculation equipment capable of delivering required curing temperature to the far end of the liner to quickly and uniformly raise the water temperature in the entire liner, once inverted in the pipeline, above the temperature required to commence the exothermic reaction of the resin as determined by the catalyst system employed.

7. The heat source shall be fitted with suitable monitors to gauge the temperature of the incoming and outgoing water supply to determine when uniform temperature is achieved throughout the length of the liner. Another such gauge shall be placed between the impregnated tube and the pipe invert at the termination to determine the temperatures during cure. Install thermocouples at the top and bottom (12- and 6-O'Clock positions) of the liner between the liner and host pipe. If the liner is installed through manhole structures, thermocouples shall also be placed at each structure.

8. Initial cure will occur during temperature heat-up and shall be completed when exposed portions of the new pipe appear to be hard and sound and the remote temperature sensor indicates that the temperature is of a magnitude to realize an exotherm or cure in the resin. After initial cure is reached, the temperature shall be raised to the post-cure temperature recommended by the resin manufacturer. The post-cure temperature shall be held for a period as recommended by the resin manufacturer, during which time the recirculation of the water and cycling of the boiler to maintain the temperature shall continue. The curing of the CIPP must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of soil).

9. The curing period shall be carried out under an inversion head to maintain a minimum hoop tension in the liner felt of 1 lb/in^2.

10. Maintain a curing log of CIPP temperatures at the upstream and downstream manholes during the curing process to document that proper temperatures and cure times have been achieved.

11. Invert through Manholes. The invert shall be continuous and smooth through all manholes. If a liner is installed through a manhole, the bottom portion of the liner shall remain and the bench of the manhole shall be grouted and shaped as necessary to support the liner. If the liner terminates on either side of a manhole, the invert shall be built up to remove any flow restrictions and to form a continuous invert through the manhole. The cost of this Work shall be included in the price bid.

12. The finished pipelining shall be continuous over the entire length of an insertion run between two manholes or structures and be as free as commercially practicable from visual defects such as fins, foreign inclusions, dry spots, air bubbles, pinholes, dimples 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. Defects that will impede flow or maintenance equipment will not be permissible.

13. The inner surface shall be free of cracks and crazing with smooth finish and with an average of not over two pits per 12 inch square, providing the pits are less than 0.12 inch in diameter and not over 0.04 inch deep and are covered with sufficient resin to avoid exposure of the inner fabric.

14. Some minor waviness, that in the Owner's opinion will not appreciably decrease the flow characteristics or be the cause of a possible blockage, shall be permissible.

2.3. SEALING AT MANHOLES

A. Form a tight seal between the CIPP and the manhole wall at the pipe penetration. Do not leave any annular gaps. Seal the annular space with a hydrophillic band (maximum thickness shall not be greater than 5 mm), or equivalent. Seal any annular spaces greater than ½-inch with manhole wall repair material. Finish off the seal with a non-shrink grout or cementitious liner material placed around the pipe opening from inside the manhole in a band at least 4

inches wide. Complete the sealing procedure for each liner segment immediately after the liner is cured.

B. Reshape the manhole invert as specified in Section 822 – Manhole Rehabilitation. The Contractor shall repair any manhole benches and inverts that have been damaged during the liner installation.

2.4. SERVICE CONNECTIONS

Restore and install service reconnections as specified in Section 821 – Sanitary Sewer Service Reconnections.

2.5. DEFECTIVE WORK

Any defects which, in the judgment of the Owner, will affect the integrity or strength of the lining, shall be repaired or the liner replaced at the Contractor's expense. Obtain approval of the Owner for method of repair, which may require field or workshop demonstration.

2.6. TESTING

A. The Contractor shall collect representative sample coupons for testing as described herein this section. Coupons shall be taken from the lesser of either 10% of manholes on the project or a representative sample for each liner diameter installed on the project. The Contractor shall stamp or mark the test pieces with the date of manufacture and batch number. These samples shall be incidental to the price for the liner installation.

B. Should the Owner desire to make independent tests, the Contractor shall, upon request of the Owner, furnish any reasonable number of test pieces of raw material samples as the Owner may require, stamped or marked with the date of manufacture and batch number if applicable.

C. Tests shall be made on specimens of resin, catalyst and felt as supplied or pieces of cured liner cut from waste areas when possible. Otherwise, the specimens shall be cut from a piece of cured liner representative of the material inserted and prepared and cured in a similar technique to the process employed.

D. The test specimen shall be conditioned in accordance with procedure 'A' of ASTM D 618-61.

E. The test specimen shall be prepared and physical properties tested in accordance with ASTM F 1216. The properties shall meet or exceed the values identified in ASTM F 1216.

F. The Contractor shall, in preparation for insertion of the liner bag, and in placing of stops within the terminal manholes of an insertion run, allow sufficient length to facilitate the cutting out of one (1) full size cured liner section, for each thickness of liner installed, from the waste portion at the end of the insertion run. The lengths of the full size section thus provided shall be as practicable, in order to facilitate load testing if desired by the Owner.

2.7. FINAL ACCEPTANCE

Upon completion and before acceptance by the Owner, the Contractor will re-inspect the

rehabilitated pipeline by the use of closed-circuit TV cameras and shall submit color CDs or DVDs of the rehabilitated pipeline to the Owner for approval/acceptance of the Work in accordance with Section 811 - Television Inspection.

2.8. WARRANTY INSPECTION

The contractor shall clean & T.V. the pipes at the end of the one year warranty period to assure quality.

III. MEASUREMENT FOR PAYMENT

A. Measurement for payment will be the actual distance measured along the centerline of the pipe from centerline to centerline for manholes, of each size pipe, excluding manhole diameter. Payment is based on the CIPP thickness required for the specified pipe diameter.

The price per linear foot shall include all:

1. Bypass pumping (up to 2 mgd),
2. Clearing and grubbing,
3. Cost of potable water from the Owner,
4. Debris collection and disposal,
5. Dewatering,
6. Erosion and sediment control,
7. Excavation pits,
8. Infiltration control,
9. Ingress and egress procedures,
10. Labor,
11. Manhole invert reshaping,
12. Materials,
13. Permits,
14. Pipeline cleaning,
15. Pre- and post-television inspection
16. Re-instatement of service connections,
17. Removal and replacement of manhole frames and covers as necessary,
18. Resident notification,
19. Sealing at manholes,
20. Sediment and root removal,
21. Site cleanup,
22. Site restoration,
23. Temporary service to affected properties,
24. Testing,
25. Traffic control,
26. Other Work, not included under other items, necessary to complete the rehabilitation per the Contract Documents.

B. Measurement for payment for removal of intruding service connections (ferrous or non-ferrous) shall be based on the actual number of removed intruding connections. Connections shall be classified as either ferrous or non-ferrous, as separate bid items.
Payment for removal of intruding service connections is made at the contract unit prices per each intruding connection removed. The price shall include all labor, incidentals, and

materials to complete the Work. No payment shall be made for any incidentals that are required to complete the Work.

End of Section