

SECTION 814

PIPE REHABILITATION BY FOLD AND FORM 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 1504 – Standard Specification for Folded Poly(Vinyl Chloride) (PVC) Pipe for Existing Sewer and Conduit Rehabilitation
 - 2. ASTM D 1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - 3. ASTM F 1867 - Standard Practice for Installation of Folded/Formed Poly(Vinyl Chloride) (PVC) Pipe Type A for Existing Sewer Conduit Rehabilitation
 - 4. ASTM F 1871 – Standard Specification for Folded/Formed Poly(Vinyl Chloride) Pipe Type A for Existing Sewer and Conduit Rehabilitation
 - 5. ASTM F 1947 – Standard Practice for Installation of Folded Poly(Vinyl Chloride) (PVC) Pipe into Existing Sewers and Conduits
 - 6. ASTM D 3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
- 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 County, State, City or Municipal rights-of-way upon completion of the grouting 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 the fold and form pipe method. 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 accomplishing 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 completed system with watertight mainline sewer and all active lateral connections in operational condition.

2. The Contractor shall perform all required permanent landscape restoration of disturbed areas on private property and within County, State, City or Municipal rights-of-way upon completion of pipe rehabilitation, to the satisfaction of the Owner and VDOT.
3. The Contractor shall comply with erosion and sediment control and other applicable requirements to protect drainage structures, systems, and waters of the Commonwealth.
4. Potable water usage shall be in accordance with Section 810 - Sewer Line Cleaning.
5. Lining Contractor Experience:
 - a. The Contractor for the fold and form 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 fold and form of sewer must be certified by the fold and form rehabilitation system supplier as qualified to perform work with the proposed product.
 - b. The superintendent for the job must have supervised jobs in which at least 30,000 linear feet 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.

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 submit 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 the VDOT requirements.
 2. Letter identifying the crew members performing the lining. If any of the crew member(s) are not identified in the original certification letter received during the

pre-qualification, then a new certification letter listing the crew members must be received from the rehabilitation system supplier prior to initiation of the specific project.

3. Calculations supporting appropriateness of SDR 35 liner thickness for the installation, assuming a fully deteriorated host pipe condition, shall be provided by the Contractor. A registered Professional Engineer shall seal the calculations and provide an executed copy of the following form:

Professional Engineer Certification Form	
<i>The undersigned hereby certifies that he/she is a Professional Engineer registered in the State of Virginia and that he/she is employed by:</i>	
<i>_____ (Name of Contractor)</i>	
<i>to design fold and form 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.</i>	
<i>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.</i>	
<i>Professional Engineer Stamp</i>	_____
	<i>By</i> _____

- B. Prior to initiation of a specific project, the Contractor shall submit the following information 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. Manufacturer's recommended pull forces based on seasonal ambient temperatures and higher temperatures that the liner may be heated to prior to and during the installation.
 3. The lb/ft ratio for the proposed product.

4. Quality assurance and quality control information from product manufacturer including recommended heating and cooling procedures (including temperatures) from the rehabilitation system supplier.
5. All measurements made by the Contractor to verify length and diameter of pipe prior to ordering of material.
6. Samples of the PVC pipe material shall be provided for prior approval of the Engineer.
7. Results of testing for materials provided for this job, as specified in this Specification.
8. One complete set of CDs/DVDs from each of the television inspections performed (Pre- and 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, the Contractor shall inspect the cleaned line by use of closed-circuit TV cameras (in accordance with Section 811 - Television Inspection), and shall confirm to his own satisfaction that the lines are adequately cleaned. Insertion of the liner 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. 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 timely 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.
3. Upon substantial completion of the work the Contractor shall, in the presence of the Owner's inspector, inspect the line using closed-circuit television equipment. 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 fold and form process and timing of the project. The written information shall be delivered to each home or business at least 72 hours prior to the start of insertion, and at minimum shall describe the work, schedule, how it affects the home/business, and a local telephone number of the Contractor. The Contractor shall communicate verbally with the homeowners/business owners the day prior to the beginning of work being conducted on the section relative to the homeowners/business owners.
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. is 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. The utilities must be marked by "Miss Utility" prior to construction layout.
5. The actual sizes, lengths and materials of the pipes to be relined shall be as 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. Inspection of sewer lines shall be performed as specified in Section 811 - Television Inspection.
8. 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.
9. The line shall be cleared of obstructions such as solids, dropped joints, intruding service connections or collapsed pipe that may prevent liner installation. If 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.
10. 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.

11. Refer to Section 810 - Sewer Line Cleaning, for material removal.
12. Refer to Section 810 - Sewer Line Cleaning, for disposal of materials.

2.2 LINER INSTALLATION

A. Procedures:

1. Installation of fold and form pipe shall meet the minimum requirements demonstrated in ASTM F 1867.
2. Conduct operations in accordance with applicable OSHA standards. Make suitable precautions to eliminate hazards to personnel near construction activities when pressurized air is being used.
3. The spool of folded PVC pipe shall be heated to make the PVC pipe flexible for insertion into the host pipe.
4. After the folded pipe is inserted into the host pipe, it shall be cut at each end and equipped with fittings to allow for the controlled introduction and release of steam and pressure.
5. Thermocouples shall be placed in the invert of the sewer at both the upstream and downstream end to monitor installation temperatures. If the liner is installed through manhole structures, thermocouples shall also be placed at each structure.
6. Through the use of steam, the folded pipe shall be fully expanded from the insertion point to the termination point. Temperature and pressure shall be sufficient to overcome the extrusion memory of the thermoplastic material. The manufacturer shall be consulted for recommended temperature and pressure.
7. After the PVC is completely rounded, the Contractor shall cool the pipe to a temperature as directed by the manufacturer before relieving the pressure required to hold the PVC pipe against the host pipe. In no case shall this temperature be in excess of 100° F.
8. Cut-Off: The Contractor shall cut the PVC pipe free at the upstream manhole and the downstream manhole. The Contractor shall ensure that the PVC pipe is cut off neatly and smoothly at each end of the host pipe to preclude snagging and shoaling of debris.
9. 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 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.

2.3 SEALING AT MANHOLES

- A. Form a tight seal between the liner and the host pipe at the pipe penetration. Do not leave any annular gaps. Seal the annular space with a ½-inch-diameter activated Oakum band soaked in chemical sealant. 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 and smooth at 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 judgement of the Owner, will affect the integrity or strength of the lining shall be repaired or the liner replaced at the Contractor's expense. Prior to the repair of defective work, the Contractor shall submit a Shop Drawing indicating the method of repair, for the Owner's approval. The Contractor shall obtain approval of the Engineer 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 additional 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 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 compound samples shall be prepared in accordance with ASTM D 3034. These specimens shall be tested independently and shall comply with the minimum property values identified in ASTM F 1871.
- E. The Contractor shall in preparation for insertion of the liner, 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 an 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 shall reinspect the rehabilitated pipeline by the use of closed-circuit TV cameras and shall submit color CDs, or DVDs of the rehabilitated pipeline to the Engineer for approval/acceptance of the work in accordance with Section 811 - Television Inspection.

III. MEASUREMENT FOR PAYMENT

3.1 GENERAL

- A. Measurement will be made on the basis of completion of the specific project in accordance with the Contract Documents.
- B. Measurement of quantities will be made by the Contractor in the presence of the Owner.

3.2 MEASUREMENTS OF QUANTITIES

- 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 fold and form thickness required for the deepest flow line of the rehabilitated segment.
- B. Measurement for payment for removal of intruding service connections 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.

3.3 PAY ITEMS

- A. Payment for rehabilitating sanitary sewer pipelines is made at the contract unit prices per linear foot rehabilitated, using the fold and form method. The price per linear foot shall include all labor, incidentals, materials, resident notification, testing, necessary permits, ingress and egress procedures, by-pass pumping (up to 2 mgd), pre-construction video, sediment and root removal, removal of protruding service connections, dewatering, traffic control, erosion and sediment control, excavation pits, removal and replacement of manhole frames and covers as necessary, re-instatement of active service connections, sealing liner at service connections, clearing and grubbing required for mains located off street, pipeline cleaning, debris collection and disposal, root removal, pre- and post-television inspection, sealing the liner in the manholes, the cost of potable water from the Owner, required compliance tests, site restoration, site cleanup, and all other rehabilitation work, not included under other items, necessary to complete the rehabilitation per the Contract Documents.
- B. Payment for removal of intruding service connections (ferrous or non-ferrous) 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