SECTION 823

SLIPLINING

I. GENERAL

1.1 DESCRIPTION OF WORK

The Work specified in this section includes all labor, materials, accessories, equipment and tools necessary to rehabilitate sewer lines greater than 24-inches in diameter using glass reinforced polymer (GRP) Pipe, high density polyethylene (HDPE), PVC, or fusible polyvinyl chloride (fPVC) liner pipe. When completed the new pipe shall extend from one manhole or catch basin (storm sewer) to the next manhole or catch basin (storm sewer) in a continuous, watertight length. Work will include but not be limited to installation of pipe by sliplining it into an existing pipe, grouting of annular space, grouting of manhole/catch basin bench, testing and all other related work.

A. Products and materials shall conform to Section 200 and as specified herein.

B. Sewer line cleaning shall conform to Section 810.

C. Televising shall be in accordance with Section 811.

D. Bypass pumping shall conform to Section 812.

E. Reconnection of existing laterals shall conform to Section 821.

F. 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 pipe rehabilitation, to the satisfaction of the Owner.

1.2 RELATED DOCUMENTS

A. ASTM D638 - Standard Test Method for Tensile Properties of Plastics

B. ASTM D3262 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe

C. ASTM D4161 - Standard Specification for "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals

D. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field

E. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

F. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

G. ASTM C138 - Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete

H. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete

I. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration

Resistance

J. ASTM C495 - Standard Test Method for Compressive Strength of Lightweight Insulating Concrete

K. ASTM C939 - Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete

L. Products not included above, shall conform to Section 200

1.3 CONTRACTOR QUALIFICATIONS

A. Lining

1. The Contractor for the sliplining 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 sliplining rehabilitation of sewer must be certified by the sliplining rehabilitation system manufacturer/supplier as qualified to perform Work with the proposed product.

2. 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.

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

B. Grouting

The Contractor shall demonstrate in writing to the Owner that it or its subcontractor is capable of grouting the annulus and meeting the specifications regarding that portion of the Work. Only a company specializing in the design and placement of annular fill with a minimum of 5 years of successful experience shall be employed. The company must have experience in design, placement, and testing on at least two relevant projects where annular fill was placed to strict quality control requirements in an annulus similar to or equal to around similar pipe with similar distances between access points at injection pressures proposed.

1.4 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.

The product proposed for the rehabilitation of the sewers must have been in use for at least three (3) years. The pipe to be used for sliplining shall be furnished by a single manufacturer who regularly engages in the production of the pipe made for sliplining applications and who is fully experienced, reputable, and qualified in the manufacture of the pipe to be furnished.

The Contractor shall provide the following information for review and approval:

A. Shop drawings and product data for the rehabilitation method, including a report outlining:

1. the process to be used in the rehabilitation of the sewer line;
2. information specific to the job, such as coordination issues, access, and timing/schedule;
3. manufacturer's design analysis and installation instructions;
4. manufacturer's literature for materials used in liner, gaskets and fittings;
5. bypass pumping plan;
6. details identifying proposed installation method, equipment, and location of access shaft, pits or approach tunnel;
7. protection of the leading edge of the pipe during the sliplining installation;
8. protection of the annulus between the existing pipe and the new pipe to prevent debris from entering from the upstream end of the new pipe;
9. control of flows in the new pipe and in the annulus to control flotation and friction forces;
10. installation of the pipe at the installation shafts to ensure a continuous pipe through the length of the shaft;
11. proposed method of reconnecting service laterals, if applicable; and,
12. measurements made by the Contractor to verify length and diameter of pipe prior to ordering of material.

B. Prior to each shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with all ASTM Standards specified and referenced herein.

C. The Contractor shall submit his proposed blocking scheme to maintain line and grade within the host pipe to the Owner for approval at least one week prior to beginning liner insertion.

D. Equipment employed in the sliplining shall conform to the requirements below and shall be approved by the Owner and the pipe supplier prior to award of contract. A hydraulic, mechanical, or which exerts pressure on the liner pipe may be used.

E. One complete set of video CDs, or 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.

F. The Contractor shall provide written warranties for all materials.

G. The Contractor shall provide a letter from the liner pipe manufacturer accepting the proposed annular space grouting procedures, grout mix design, the number of grouting stages, maximum grouting pressures, and the grouting materials.

H. The Contractor shall submit the following at least 30 working days prior to the start of the grouting operation:

1. The proposed grouting mix.
2. The proposed grouting densities and viscosities per ASTM C138 and ASTM C139
3. Initial set time of grout
4. The 24-hour and 28-days compressive strengths per ASTM C495 and ASTMC109
5. The grout working time before 15 percent change in density or viscosity occurs
6. The bulkhead design
7. Buoyant force calculations
8. Vent location plan
9. Installation details of at least three successful grouting operations of similar nature completed within the previous 2 years.

1.5 GROUT

A. The grout materials shall consist of Portland cement and/or additives. The grout shall have a minimum penetration resistance of 100 psi in 24 hours when tested in accordance with ASTM C403 and a minimum compressive strength of 200 psi in 7 days and a compressive strength of 300 psi in 28 days when tested in accordance with ASTM C495.

B. The Contractor shall design a grout mix and procedures to prevent floating of the liner pipe. The apparent viscosity shall not exceed 18 seconds in accordance with ASTM C939. The grout will not bleed or segregate.

C. The initial set time shall not be less than 3 hours. The grout shall have a minimum density of 55 pcf and a maximum density of 61 pcf. The grout shall have less than 1 percent shrinkage by volume.

D. Contractor shall seal the annular space between the new pipe and the existing sewer pipe with grout as specified. Contractor shall take appropriate precautions to avoid overpressurization, buckling and floating of the new pipe during the grouting process. Contractor shall comply with pipe manufacturer's recommendations for grouting procedures and with the grout manufacturer's procedures for placement of grout, grout pressures and grout quantity. Multiple grout lift installations may be required to avoid buckling of the new pipe. Contractor shall also take precautions to avoid movement of the pipe during the grouting operation. No grout shall be placed until service connections have been restored, if required.

1.6 WARRANTY

During the two year warranty period, any defects which affect the integrity or strength of the pipe shall be repaired at the Contractor's expense. Prior to the repair of the defective work, the Contractor shall submit a Shop Drawing indicating the method of repair, for the Owner's approval. The Contractor shall obtain approval for the Owner for method of repair, which may require field or workshop demonstration.

II. EXECUTION

2.1 GENERAL

A. The Contractor shall furnish and install a complete system as shown in the Contract Documents and in accordance with the Contract Documents. Pipe liner shall be installed in accordance with the manufacturer's recommendations.

B. Prior to any lining of a pipe so designated, it shall be the responsibility of the Contractor to remove internal deposits from the pipeline in accordance with Section 810 – Sewer Line Cleaning.

C. Inspection of pipelines shall be performed by experienced, NASSCO PACP-certified, personnel trained in locating breaks, obstacles, and service connections by closed circuit television. The interior of the pipeline shall be carefully inspected to determine the locations and extent of any structural failures. The location of any conditions which may prevent proper installation of lining materials into the pipelines shall be noted so that these conditions can be corrected. A video and suitable log shall be kept and turned over to the Owner. Television survey shall be performed in accordance with Section 811 - Television Inspection, including Preconstruction Post Construction and Warranty Surveys.

D. The Contractor, when required, shall provide for the transfer of flow, through or around section or sections of pipe that are to be repaired. The proposed bypassing system shall be acceptable in advance by the Owner. The acceptance of the bypassing system in advance by the Owner shall in no way relieve the Contractor of his responsibility and/or public liability. The flow bypassing shall be done in accordance with Section 812 - Bypass Pumping.

E. It shall be the responsibility of the Contractor to clear the line of obstructions. If the inspection reveals an obstruction that cannot be removed by conventional cleaning equipment, then the Contractor shall make a point repair excavation. Such excavation shall be proposed to the Owner in writing for approval prior to the commencement of the Work.

F. Following the cleaning and inspection of the pipe to be lined, the contractor shall conduct a test to determine that the proposed liner can be properly inserted in the existing sewer. The Contractor shall pull a 10-ft section of the liner pipe through the host pipe using the same techniques proposed for the actual sliplining. Any difficulty in pulling the section through the line or any damage to the test section shall be noted. Measures to correct any problems identified in this test shall be incorporated into the final installation of the full sliplining.

G. The location and number of insertion/access pits (if necessary) shall be planned by the Contractor and submitted in writing for approval by the Owner prior to excavation. The pits shall be located such that their total number shall be minimized, and the footage of liner pipe installed in a single pull shall be maximized. Where possible, excavations for liner insertion are to be at intermediate manholes, or other intermediate points, that coincide with service connection excavations, or where structurally unsound areas of the main are to be repaired.

H. All excavations shall be properly sheeted/shored in accordance current OSHA regulations. Supports to trench sheets shall remain completely separate from the pipe support system and shall be designed so that neither the pipe nor winch cable shall be in contact with them. Contractor shall provide K-rails and fencing around the pits as directed by the Owner.

I. The size of the insertion pits shall be a practical minimum to allow for the proper installation of the new pipe. All excavations shall be covered with steel plates when not in use to prevent unauthorized entry.

2.2 LINER INSTALLATION

A. Prior to the installation of the liner, the Contractor shall install gasket waterstops to the interior circumference of the existing sewer at the inlet and outlet of each manhole or as otherwise directed by the Owner.

B. Unless otherwise specifically required, Contractor shall locate excavation(s) for insertion of the new pipe to cause the least disruption to existing utilities, traffic and area business. The existing sewer line shall be exposed from crown to spring line for the length necessary to accommodate the maximum length of liner pipe plus an auxiliary pushing or pulling length for equipment. Contractor shall carefully remove the upper half of the existing pipeline necessary for installation of the liner. Care shall be exercised so as not to disturb the lower half of the existing sewer. If Contractor locates insertion pit at an existing precast concrete manhole location, Contractor shall remove manhole frame, cover, cone, riser and manhole sections as necessary and store for reinstallation upon completion.

C. For each section to be lined, insertion shall be one continuous operation until the planned

termination point is reached. Pipe jointing shall be accomplished in strict accordance with the pipe manufacturer's recommendations and each joint shall be completely made up in full view of the Owner.

D. Total pushing or pulling loads shall not exceed the pipe manufacturer's recommendation. The Contractor shall provide a suitable means of measuring pushing or pulling loads and shall monitor the load as the liner pipe is being installed. If at any time the load appears to rise non-uniformly, indicating possible obstruction of the pipe, jacking operations shall be terminated and the obstruction or other impediment removed before continuing. The entire cost for all Work associated with an unanticipated access pit shall be borne by the Contractor.

E. The new pipe shall be blocked to maintain line and grade within the host pipe.

F. Closure in the insertion pit after the pipe has been inserted into place may be accomplished using a special closure kit, standard inverted bell and spigot joint, or other method approved by the Owner and the pipe manufacturer.

G. The machine operator must closely and continuously monitor and control the jacking load imposed on the liner pipe. A jacking ring or device shall be used to distribute the jacking load evenly on the entire surface perimeter of the end of the liner pipe. The Contractor shall also utilize a device capable of holding a newly inserted joint of liner pipe without damage or danger while the following joint is shoved home to complete the joint make-up. Joints shall be made in full view of the Owner.

H. Jointing

1. Clean ends of pipe and joint components
2. Apply joint lubricant to the bell interior surface and the elastomeric seals. Use only lubricants approved by the pipe manufacturer.
3. Use suitable equipment and end protection to push or pull the pipes together
4. Do not exceed forces recommended by the manufacturer for joining or pushing pipe
5. Join pipes in straight alignment then deflect to the required angle. Do not allow the deflection angle to exceed the deflection permitted by the pipe manufacturer.

I. Liner Relaxation

The Contractor shall allow 24 hours for HDPE, PVC and fPVC liner to relax by natural relaxation to its final installed length.

J. Service connections shall be reconnected as specified in Section 821 – Sanitary Sewer Service Reconnections.

2.3 GROUTING OF ANNULAR SPACE

A. Grouting Equipment

The materials shall be mixed in equipment of sufficient size and capacity to provide the desired amount of grout material for each stage in a single operation. The equipment shall be capable of mixing and pumping at least 40 cubic yards per hour at densities required for the approved procedure and shall also be capable of changing density as dictated by field conditions any time during the grouting operation

B. Injection Procedure and Pressure

The gaged pumping pressure shall not exceed the pipe manufacturer's approved recommendations. Pumping equipment shall be of a size sufficient to inject grout at a velocity and pressure relative to the size of the annular space. Gages to monitor grout pressure shall be attached immediately adjacent to each injection port. The gage shall conform to an accuracy of no more than one-half percent (0.5%) error over the full range of the gage. The range of the gage should not be more than 100 percent greater than the design grout pressure. Pressure gages shall be instrument oil filled and attached to a saddle-type diaphragm seal (gage saver) to prevent clogging with grout. All gages shall be certified and calibrated in accordance with ANSI B40, Grade 2A.

C. Pressure must be continuously monitored and recorded during injection using a pressure chart recorder. The range of the chart recorder should not be more than 200 percent greater than the design grout pressure.

D. On-Site Test Equipment

Density for each batch shall be verified by ASTM C138 or by other methods as approved by the Owner. Viscosities shall be checked with a flow cone provided by the Contractor. The apparent viscosity should not exceed 18 seconds in accordance with ASTM C939

E. Grout Testing

One set of three standard cylinders shall be cast for each batch. Testing of the specimens for compressive strength shall be in accordance with ASTMC39. One test shall be made one day from the time of casting and two tests shall be made 28 days from the time of casting. The average of the 28-day strength tests shall be equal to or greater than 300 psi. All testing shall be done by an independent testing laboratory at the expense of the Contractor. The grout shall have a minimum penetration resistance of 100 psi in 24 hours when tested in accordance with ASTM C403 and a minimum compressive strength of 300 psi in 28 days when tested in accordance with ASTM C495 or C109.

2.4 SEALING AT MANHOLES

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.

2.5 SERVICE CONNECTIONS

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

2.6 ACCEPTANCE

After all sliplining work is completed, the Contractor shall provide Owner with a CD/DVD showing both the pre- and post-installation internal pipe conditions including the restored connections. The finished pipe shall be continuous over the entire length of the installation and free from visual defects, damage, deflection, holes, delamination, and uncured resin. There shall be no visible infiltration through the liner or from behind the liner.

The Owner will review the TV inspection video and indicate where the following defects are located:

A. Joint separation

B. Offset Joint

C. Cracked or damaged liner pipe

D. Out of round liner pipe

E. Infiltration point

F. Debris including grout in the line

All defects discovered during the post-installation television inspection shall be corrected by the Contractor at his expense before the Work will be accepted. After the defects, if any, are corrected, the affected sewer segment(s) shall be televised again. The post-installation television inspection CD/DVD shall be submitted to the Owner in sufficient time to allow the Owner to review the videotape prior final acceptance. If any defective pipe is discovered after it has been installed, it shall be repaired per manufacturer's recommendations, or removed and replaced with either a sound short liner or a new pipe at no additional cost to the Owner.

2.7 CLEANUP

After the sliplining installation has been completed and accepted, the Contractor shall clean up the entire project area and return the ground pre-existing conditions or better. All excess material and debris not incorporated into the permanent installation shall be disposed of by the Contractor.

III. MEASUREMENT FOR PAYMENT

A. Measurement for payment for point repairs will be based upon the actual quantity of repairs completed, all in accordance with the Contract Documents.

B. Payment for rehabilitating sanitary sewer pipelines is made at the contract unit prices per linear foot rehabilitated, using the sliplining method.

C. The price per linear foot shall include all:

1. By-pass pumping,
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. Grout,
9. Ingress and egress procedures,
10. Labor,
11. Materials,
12. Permits,
13. Pipeline cleaning,

14. Pre- and post-television inspection,
15. Re-instatement of service connections,
16. Removal and replacement of manhole frames and covers as necessary,
17. Removal of protruding service connections,
18. Resident/Business owner notification,
19. Root removal,
20. Sediment and root removal,
21. Sealing liner at service connections,
22. Sealing the liner in the manholes,
23. Site restoration,
24. Site cleanup,
25. Testing,
26. Traffic control, and
27. Waterstops.

End of Section