

SECTION 02761

SLIPLINING SANITARY SEWERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sliplining existing sanitary sewers.

1.02 UNIT PRICES

- A. Measurement for sliplining is on a linear foot basis for installed liner, measured along the center line of the pipe for each size and wall thickness at each installed depth range and measured from center line of upstream manhole to center line of downstream manhole. Depth range for payment shall be based on the depth of the lowest manhole for a given pipeline segment between two adjacent manholes.
- B. Insertion or access pits, clamp installation, encasement, field quality control (testing), sealing liner at manhole, grouting annular space, post-televising of completed work, and final cleanup shall be incidental to installation of sliplining.
- C. Measurement and payment for diversion pumping is incidental.
- D. Obstruction removal may be effected as a point repair if approved in advance by Owner's Representative. Refer to Section 02763 - Point Repairs to Sanitary Sewers for measurement of point repairs.
- E. Measurement for obstruction removal by remote device is on a unit price basis for each removal operation for one or more manhole sections up to a continuous length of 800 feet.

1.03 PERFORMANCE REQUIREMENTS

- A. Maintain flow of sewage by diversion pumping or other method approved by the Owner's Representative.
- B. Clear existing sewer of debris, obstructions, or other material and make point repairs to existing sewers as specified in Section 02763 - Point Repairs to Sanitary Sewers.
- C. Install sliplining according to this Section.
- D. Grout annular space as specified in Section 02331 - Sliplining Grout.
- E. Shape manhole invert as specified in Section 02764 - Manhole Rehabilitation.

- F. Test and televise lines as specified in Section 02732 - Acceptance Testing of Sanitary Sewers.

#### 1.04 SUBMITTALS

- A. Submittals shall conform to requirements of all provisions and sections of these specifications.
- B. Submit manufacturer's product data with complete information on pipeline materials, physical properties, and dimensions pertinent to this job. Furnish a certificate of compliance with specifications for materials to be supplied.
- C. Submit test reports prepared by an independent testing laboratory certifying that polyethylene pipe conforms to the requirements of ASTM D1248 and ASTM D3350 or that FRP pipe conforms to requirements of ASTM D2992 and ASTM D3681, as applicable.
- D. Submit grouting plan showing where grout is to be injected, materials, and chemicals to be used in grout, anchoring methods, and planned grouting pressure.
- E. Submit DVD's at standard play showing the initial condition of sewer, if needed, and tapes showing completed installations.
- F. Submit a Quality Control Program defining Contractor's and material supplier's field quality control procedures. Owner's Representative may request evidence that work is progressing or has been done in compliance with the submitted quality control program.

#### 1.05 TESTING

- A. The Owner may run tests on field samples following applicable ASTM specifications at an independent laboratory to verify the required physical properties and characteristics of supplied materials. Provide product samples as requested by Owner's Representative.
- B. The Owner will pay for tests on liner material which meets specification requirements. Contractor shall pay for failed tests and retesting of failed materials.

### PART 2 PRODUCTS

#### 2.01 MANUFACTURERS

- A. Liner pipe systems shall be polyethylene or fiberglass reinforced plastic (FRP) products as approved by the City.

- B. Polyethylene liner manufacturers shall be Chevron Phillips, or approved equal. FRP liner manufacturer shall be Hobas USA, Inc., or approved equal.

2.02 POLYETHYLENE LINER PIPE AND FITTINGS

- A. The polyethylene liner pipe shall be solid wall, high density, high molecular weight, polyethylene compound conforming to ASTM D1248, Type III, Class C, Grade P-34, Category 5, with a PPI rating of PE 3408. The polyethylene material shall have a minimum cell classification of 3454 34D or E (inner wall shall be light in color) under ASTM D3350. A higher numbered cell classification limit which gives a desirable higher primary property, according to ASTM D3350, is also acceptable. Hydrostatic design value shall not be less than 1600 psi when tested according to ASTM D2837. Dimensions and workmanship shall be in accordance with ASTM F714 and ASTM D2122.
- B. The maximum Standard Dimension Ratio (SDR), the ratio of outside diameter of pipe to wall thickness, shall be as specified below. SDR shall be selected for the deeper of the two manholes in a particular pipeline segment between two adjacent manholes.

Maximum Liner SDR	Maximum Depth (Feet)
26	10
21	15
19	20
17	Over 20

- C. Minimum outside diameter of liner shall be as shown in the following table:

Existing Sewer Nominal Diameter (Inches)	Minimum O.D. Of Liner (Inches)
8	7.125

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10	8.625
12	10.75
15	12.75
18	16.00
21	18.00
24	22.00
27	24.00
30	28.00
36	32.00
42	36.00
48	42.00

- D. Liner Acceptance: Liner material shall be homogeneous without defects and shall be manufactured to the standards and dimensions specified. Cause for rejection includes physical defects of the polyethylene liner, such as concentrated ridges, discoloration, excessive spot roughness, pitting, visible cracks, foreign inclusions, and varying wall thickness.

### 2.03 FRP LINER PIPE AND FITTINGS

- A. All pipe, joints, and fittings shall conform to the requirements of ASTM D3262, Type 1, Liner 2, Grade 3. Pipe shall be manufactured by the centrifugal casting process resulting in a dense, nonporous, corrosion resistant, consistent, composite structure to meet conditions as shown on Drawings.
- B. Resin systems shall be thermosetting polyester epoxy resin, with or without filler, producing a pipe conforming to requirements of ASTM D3262.
- C. Reinforcing glass fibers shall be commercial grade, E-type glass filaments with binder and sizing compatible with impregnating resins.
- D. Filler shall be sand with a minimum 98 percent silica content and a maximum moisture content of 0.2 percent.

- E. Joints shall be low-profile FRP jacking bell-and-spigot joints with elastomeric sealing gaskets to produce watertight joint. Joints shall conform to the requirements of ASTM D4161.
- F. Dimensions and Tolerances:
  - 1. Pipe outside diameters shall be in accordance with AWWA C151.
  - 2. Supply pipe in nominal lengths of 20 feet, when possible. Where radius curves in existing pipe or limitations in entry pit dimensions restrict pipe to shorter lengths, use nominal sections of 10 feet or 6.67 feet. Actual laying length shall be the nominal length plus 2 inches. Furnish at least 90 percent of total footage of each size and class of pipe, excluding special order lengths, in nominal length sections.
  - 3. The FRP pipe maximum outside diameter and minimum wall thickness shall be as specified in the following table:

Minimum Existing Sewer Nominal Diameter (Inches)	Minimum Liner O.D. (Inches)	Minimum CL SN46 Wall Thickness (Inches)	Minimum CL SN72 Wall Thickness (Inches)
21	19.50	0.42	0.48
24	21.60	0.46	0.53
30	25.80	0.54	0.63
36	32.00	0.66	0.77
42	38.30	0.78	0.91
48	44.50	0.90	1.05
54	50.80	1.02	1.19
60	57.10	1.14	1.33
66	62.90	1.26	1.47
72	69.20	1.38	1.61

78                                      75.40                                      1.50                                      1.75

- 4. Fabricate pipe ends square to pipe axis plus or minus 0.25 inches, or plus or minus 0.5 percent of nominal diameter, whichever is greater.

G. Flanges and Fittings:

- 1. Flanges, elbows, reducers, tees, wyes, and other fittings shall be capable of withstanding operating conditions. Fittings shall be contact-molded or manufactured from mitered sections of pipe joined by glass fiber reinforced overlays.
- 2. Manufacture the angle of an elbow and angle between main and leg of a wye or tee to a tolerance of plus or minus 2 degrees. Maintain a tolerance on laying length of a fitting to plus or minus 2 inches.

- H. FRP pipe shall have a minimum stiffness of 46 psi measured in accordance with ASTM D2412. Pipes with a stiffness class of 72 psi may be used with approval of Owner’s Representative.

2.04 MANHOLE SEAL

- A. A manhole seal between liner pipe and existing host sewer shall be formed with oakum strips soaked in Scotchseal 5600 as manufactured by 3M Corporation, or an approved equal.

2.05 CLAMPS AND GASKETS

- A. Clamps shall be stainless steel, including bolts and lugs as manufactured by JCM Industries, Type 108. Furnish full circle, universal clamp couplings with -1/4-inch thick grid gasket. Select clamps to fit outside diameter of liner pipe. Use minimum clamp width as specified in the following table:

Linear Pipe	Minimum Width
O.D.	Of Clamp
<u>(Inches)</u>	<u>(Inches)</u>
7.125	15
8.625	18

10.750 or  
greater

30

## 2.06 BEDDING MATERIAL

- A. Provide bedding conforming to requirements of Section 02229 - Utility Backfill Material and Section 02252 - Cement Stabilized Sand.

## PART 3 EXECUTION

### 3.01 DELIVERY, STORAGE, AND HANDLING

- A. Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.
- B. Pipe with cuts, gashes, nicks, abrasions, or any such physical damage which may have occurred during shipping, storage, or handling, which are deeper than 10 percent of the wall thickness shall not be used and shall be removed from the construction site.

### 3.02 OBSTRUCTION REMOVAL AND POINT REPAIR

- A. Make point repairs and remove obstructions such as roots, rocks or other debris, prior to installing liner pipe. Debris shall be removed and disposed of in accordance with Section 01564 - Waste Material Disposal. Water jetting of debris downstream of project limits shall not be permitted.
- B. Refer to Section 02763 - Point Repairs to Sanitary Sewers for requirement and procedures for point repairs.
- C. Obstruction removal may be effected as a point repair or by use of a remote device. For removal by remote device, obtain prior approval of Owner's Representative.
- D. To remove obstructions by remote device, use a solid steel mandrel or porcupine mandrels winched from one manhole to another. Use mandrels of adequate size to remove obstructions encountered. Use of bucket machines to break obstruction is acceptable if no damage to sewer pipe is caused.

### 3.03 DIVERSION PUMPING

- A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner's Representative.
- B. Design all piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.
- C. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify Owner's Representative so that required reporting can be made to the Texas Committee on Environmental Quality and Environmental Protection Agency.

#### 3.04 INSERTION OR ACCESS PITS

- A. Locate pits so that the total number is minimized and footage of liner pipe installed in a single pull is maximized. Use excavations at point repair locations for insertion pits, where possible.
- B. Before excavating, check with various utility companies and determine the location of utilities in the vicinity of the work area. Arrange for temporary construction easements and rights-of-way. Damage done to utilities and the resulting repair, temporary service, and other such costs shall be borne by Contractor.
- C. Perform excavation and backfill in accordance with requirements of Section 02227 - Excavation and Backfill for Utilities.
- D. Perform work in accordance with OSHA standards. Employ a Trench Safety System as specified in Section 01526 - Trench Safety System for excavations over 5 feet deep.
- E. Install and operate necessary dewatering and surface water control measures in accordance with requirements of Section 01563 - Control of Ground Water and Surface Water.

#### 3.05 TESTING OF HOST SEWER

- A. The Contractor shall provide a rigid, solid wall, cylindrical mandrel with a maximum length equivalent to two times the host sewer inside diameter and outer diameter 1.5-inch larger than the actual sliplining pipe. The Contractor shall pull this mandrel through the entire length of sewer to be sliplined prior to liner insertion in order to test the inside diameter of the host pipe, to locate undersized or obstructed sections of the host sewer, and as a method of removing accumulated debris.
- B. If a section of host pipe is discovered which will not allow the mandrel to pass, the Contractor shall record the physical position of the mandrel and removed it from the



sewer. He shall then insert the mandrel from the other end of the section and record the position at which it will not pass. This will define both ends of the undersized section of host sewer.

- C. The Contractor shall excavate the undersized portion of the host sewer as located above, remove the crown of the host sewer, and enlarge the host sewer sufficiently to allow the liner to be laid in the half section (invert to springline) of the host sewer with the liner pipe resting fully on the invert of the host sewer.
- D. The liner shall be bedded and backfill in accordance with Section 02227 - Excavation and Backfill for Utilities.

### 3.06 POLYETHYLENE LINER INSTALLATION

- A. Preparation: After completing insertion pit excavation, remove top of existing sanitary sewer line down to the spring line. Connect a power winch cable to the end of liner by use of a suitable pulling head equal to the outside diameter of liner. Secure pulling head to liner and attach to power winch cable so that liner can be satisfactorily fed and pulled through sanitary sewer main. Provide proper bumpers in insertion pit to prevent ragged edges of existing pipe from scarring liner pipe. Refer to insertion procedures given in ASTM F585. Do not allow sand or other debris to enter the liner.
- B. Joints:
  - 1. Assemble and joint sections of polyethylene liner pipe on site above the ground. Make joints by heating and butt-fusion method in strict conformance with manufacturer's instructions.
  - 2. Use operators who are experienced with the butt-fusion method for pipe jointing in the field. Operators should be trained in fusing polyethylene pipe with similar equipment using proper jigs and tools per standard procedures outlined by pipe manufacturer.
  - 3. Form joints with a smooth, uniform double rolled back bead made while applying the proper melt, pressure, and alignment. Joints shall be inspected by Owner's Representative before insertion.
  - 4. The maximum length of continuous liner which may be assembled above ground and pulled at any one time is 500 linear feet. Limit length of liner pulled in any one segment to prevent backup in service lines which may result due to restricted flow through the annular space.
  - 5. Prevent damage to liner or breakage of butt-fused joints. Allow sufficient time for liner to return to its normal length.

C. Pulling Liner:

1. Limit pulling force exerted on liner to that indicated below for the appropriate outside diameter of the polyethylene liner:

Polyethylene Liner	Maximum Pulling
<u>O.D. (Inches)</u>	<u>Force (Tons)</u>
6	3.5
8	4.0
10	7.5
12	10.5
15	12.0
18	21.5
21	35.0
24	52.0

2. Use a suitable pulling head so that pulling head and liner will separate from each other when pulling force exerted on liner reaches the specified amount.
3. As an alternate, use of a measuring device, such as a spring gauge, will be permitted when approved in advance by the Owner’s Representative. Connect the device to pulling cable so that it registers the pulling force being exerted on liner. Do not exceed pulling force indicated above for applicable outside diameter of polyethylene liner.

- D. Alternate Installation Techniques. Pushing the liner as an insertion method, or a combination of pulling and pushing, may be used subject to Owner’s Representative’s approval. Avoid liner buckling by limiting the stroke of the pushing implement. Cut out and remove any portion damaged during insertion process.

3.07 FRP PIPE INSTALLATION

- A. FRP liner pipes may be pushed or pulled into the existing sewer. Insert the pipes, spigot end first, with the bell end trailing. Apply pushing force to pipe wall end inside of bell in accordance with manufacturer’s instructions. Do not apply a jacking load to end of bell. Keep within safe jacking loads given in the following table. Maximum allowable joint angular deflection shall be 1.0 degree:

Nominal Diameter (Inches)	Maximum Jacking Load (Tons) For SN46
18	16
20	20
24	30
30	42
36	50
42	65
48	80
54	100
60	120
66	140
72	160

### 3.08 CLAMP INSTALLATION

- A. Where excavations for liner insertion are made between two manholes, cut ends of the liner smooth, square to axis of the liner. Join liners with appropriately sized stainless steel universal clamp couplings.

### 3.09 ENCASEMENT

- A. In excavations where liner is not enclosed by existing host sewer, encase liner with stabilized cement sand bedding conforming to requirements of Section 02252 - Cement Stabilized Sand. Visual inspection by Owner's Representative is required for approval of bedding before backfill is completed.

### 3.10 FIELD QUALITY CONTROL

- A. After liner installation, perform the following tests:
1. Low-pressure air test before liner has been sealed in place at the manholes, and before any service reconnections have been made to the liner. Check

integrity of joints that have been made and verify that liner has not been damaged by inserting it into sanitary sewer.

2. Service lateral connection test; after all service laterals have been completed for a particular sewer section. Verify integrity of connections at points where they join the liners and existing service lines.
3. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers for applicable test procedures.

B. Inspection: Perform a visual and closed-circuit television inspection of lines.

### 3.11 SEALING LINER IN MANHOLE

- A. Allow liner pipe to normalize to ambient temperatures as well as recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and manhole invert shaping. Normalization usually takes 8 to 10 hours for polyethylene.
- B. Cut liner so that it extends 4 inches into manhole. Make a smooth, vertical cut and slope area over top of exposed liner using non-shrink grout.
- C. Seal the annular space between liner and sanitary sewer main at each manhole with a chemical seal and nonshrink grout. Place a strip of oakum soaked in sealer in a band to form an effective watertight gasket in the annular space between liner and existing pipes in manhole.
- D. Make width of the sealing band a minimum of 12 inches or one-half the diameter of pipe, whichever is greater. Finish seal with a non-shrink grout placed around annular space from inside manhole. Apply grout in a band not less than 6 inches wide. Sealing method, including chemicals and materials, shall be approved by Owner's Representative.
- E. Use cementitious grout to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new liner.

### 3.12 GROUTING ANNULAR SPACE

- A. Obtain approval of grouting plan from Owner's Representative before proceeding with the Work.
- B. Grout annular space between the outside diameter of liner and inside diameter of existing pipe for all sewer pipes 18 inches and larger, in accordance with Section 02331- Sliplining Grout.

3.13 POST-TELEVISIONING OF COMPLETED WORK

- A. Provide Owner's Representative with a quality color DVD at standard play showing completed Work including condition of restored connections prior to requesting payment. Refer to Section 02732 - Acceptance Testing for Sanitary Sewers.

3.14 FINAL CLEANUP

- A. Upon completion of installation work and testing, clean and restore project area affected by the Work.
- B. Replace pavement or sidewalks removed or damaged by excavation in accordance with Section 02571 - Pavement Repair and Resurfacing.
- C. In unpaved areas, bring surface to grade and slope of surrounding excavation. Replace a minimum of 4 inches of topsoil and seed the area in accordance with Section 02932 - Hydromulch Seeding, or sod the area in accordance with Section 02935 - Sodding, as required.

END OF SECTION