

Division 53: Slip-Lining of Existing Sewer Line

53.01 GENERAL: This section includes all labor, materials, transportation, equipment necessary to rehabilitate by means of Institutiform deteriorated sections of Sanitary Sewer within project limits, as relatively free of infiltration or inflow. It is the intent of this section of this specification to provide for rehabilitating sanitary sewer lines by the "Institutiform" process. When complete the liner pipe should extend from one manhole to the next manhole in a continuous watertight length.

53.02 REFERENCE SPECIFICATION: This specification references American Society For Testing Materials (ASTM) standard specifications which are made a part hereof by such reference and shall be the latest edition and revision thereof.

53.03 MATERIALS FOR SEWER LINER PIPE AND FITTINGS: The following materials are approved for installation in sanitary sewer lines:

The sewer liner pipe and fittings shall be manufactured from a polyethylene compound which conforms to ASTM D-1248 and meets the requirements for Type II or III, Class B or C, Grades P23, P33, or P34, Category 5.

- A. Pipe made from this compound must have a long-term hydrostatic strength rating of 1250 psi or more.
- B. When the environmental stress crack resistance (ESCR) of the compound is measured in accordance with ASTM D-1693, Condition C, the compound shall withstand not less than 192 hours in 100% solution Igepal CO-630 at 100 degrees F. before reaching a 20% failure point (F₂₀).

53.04 LINER MATERIAL TESTS: Tests for compliance with this specification shall be made according to the applicable ASTM Specification. A certificate of compliance with this specification upon request shall be provided by the manufacturer for all material furnished under this specification. In addition, the Owner and/or Engineer may, at his own expense, witness inspection and test of the materials.

53.05 LINER PIPE DIMENSIONS: The outside diameter and minimum wall thickness shall be as shown on the plans when measured in accordance with ASTM D-2122. Where existing conditions prevent the use of the size stated on the plans, appropriate corrective actions shall be taken as detailed later in these specifications to permit installation of the size noted in the Plans.

The following Table I gives the Standard Dimension Ratios for line pipe when measured in accordance with ASTM D-2122 TABLE I.

I.D. of Original Sewer (Inches)	O.D. of the Liner Pipe (Inches)	Minimum Wall Thickness (Inches)		
		SDR 26	SDR 21	SDR 17
4	3.500			.167
6	4.500			.215
6	5.375	.207	.257	.317
8	6.625	.316	.390	
8	7.125	.274	.340	.420
10	8.625	.332	.411	.508
12	10.75	.414	.512	.633
15	12.75	.491	.607	.750
15	13.38	.515	.638	.788
18	16.00	.616	.762	.942
21	18.00	.693	.858	1.058
21	18.70	.720	.891	1.100

24	22.00	.848	1.050	1.248
27	24.80	.954	1.181	1.406
30	28.00	1.075		
36	31.50			
42	35.43			
42	39.37			
8	38.37			
54	47.24			

The Standard Dimension Ratios (SDR's) are 32.5, 26, 21 and 17. These are referred to as SDR 32.5, SDR 26, SDR 21 and SDR 17. Standard Dimension Ratio is calculated by dividing the specified outside diameter by the minimum wall thickness.

The wall thickness tolerance shall be within plus 12%.

53.06 REJECTION: Any materials may be rejected for failure to meet any of the requirements of this specification.

53.07 INSTALLATION PROCEDURES: The following installation procedures shall be adhered to unless otherwise approved by the Engineer.

- A. **Cleaning of Sewer Line:** Prior to any slip-lining of a line so designated, it shall be the responsibility of the Contractor to clean the debris out of the sewer line in accordance with Section III "Sewer Line Cleaning" NASSCO Specifications for Sewer Collection System Rehabilitation. This work shall be considered incidental and shall be paid for as part of "Slip-Lining of Sewers: for the appropriate manhole section.
- B. **Television Inspection:** The Contractor shall inspect by closed circuit T.V. the section to be slip-lined and shall record the locations of all obstructions and service taps. This work shall be considered incidental and shall be paid for as part of "Slip-Lining of Sewers" for the appropriate manhole section.
- C. **Bypassing Sewage:** The Contractor shall bypass the sewage around the sections of line that are to be slip-lined if the annular space and pulling head openings are incapable of handling the flow. The bypass shall be made by plugging an existing upstream manhole if necessary and pumping the sewage into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. All bypassing systems shall be approved by the Engineer. Approval of the bypassing system by the Engineer shall in no way be construed as relieving the Contractor of any responsibility under this Contract as related to protection of the interest of the Owner and the general public.

At the end of each working day, temporary tie-in shall be made between the relined section and the existing system and the bypass plug removed.

Under no circumstances will the dumping of raw sewage on private property or in city streets be allowed.

This work shall be considered incidental to the Contract and be paid for under "Slip-lining of Sewer" for the appropriate manhole section.

- D. **Line Obstructions:** It shall be the responsibility of the Contractor to clear the line of obstructions, solids, dropped joints, or collapsed pipe that will prevent the insertion of the liner. If inspection reveals an obstruction which would prevent the installation of the specified size liner, such as a badly dropped or misaligned joint, protruding services, that are not at the point of the entry shaft, 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 the Engineer prior to the commencement of the work and shall be considered as a pay item under Point Repairs if the misaligned or protrusion is equal to or more than fifteen (15) percent of the internal diameter of the sewer pipe being lined. If the obstruction or protrusion is less than fifteen (15)

percent of the internal diameter of the sewer to be lined, or could have been removed by bucket machines or swabbing using conventional cleaning methods, no pay item will be granted.

- E. Excavation: Where excavations for insertion of the polyethylene line are made in a line section between two manholes, the Contractor will establish the excavation points on the basis of location of the lines to be slip-lined, pulling distances and traffic conditions. When possible, intermediate access excavations can coincide with building service connection excavations or critical obstructions in the sewer. The locations of the excavation points should be such as to minimize traffic disruption. The number of excavations can be reduced by planning to insert the pipe in both directions from a single opening. Normally, a pipe length of 2-3 manhole sections can be lined from a single excavation. The insertion pit(s) should be long enough to avoid imposing a bending radius of less than 35 times the outside diameter of the pipe liner during insertion. The insertion pit(s) should be sufficient to allow the entry of the workmen. Sheathing and bracing requirements will depend on depth and ground conditions and the Contractor shall determine the necessity for such sheathing and bracing. The top of the existing sewerline shall be exposed to the springline and the crown of the pipe shall be removed as necessary for insertion of the liner. Care should be taken not to disturb the bottom portion of the existing sewer line as this will afford a stable base for the liner pipe. All locations for insertion pits shall be approved by the Engineer prior to any work being done.
- F. Pipe Joining: Sections of the polyethylene pipe shall be assembled and joined together prior to insertion of the pipe. Assembly shall be accomplished above ground, either at the job site or a remote location. Joining shall be accomplished by the Thermal Butt Fusion method, in strict accordance with the manufacturer's recommendations and in accordance with applicable specifications of ASTM D-2657. All fusion joining shall be performed with equipment designed for butt fusion of thermoplastic pipe and by trained personnel. Tensile strength at yield of the butt-fusion joints shall not be less than the pipe. Joining of the liner, in cases where the insertion pit is not a manhole, may be accomplished by use of a stainless steel full encirclement clamp or the installation of a new manhole. Table II details the recommended minimum length of such clamps to afford adequate pull-out protection. Exposed steel liner clamps shall be encased with a minimum of six (6) inches of concrete.

TABLE II

O.D. of the Liner Pipe (Inches)	Minimum Length of Clamp (Inches)
3.500	7.50
4.500	10
5.375	10
6.625	15
7.125	15
8.625	15
10.750	20
12.750	20
13.375	20
16.000	30
18.000	30
22.050	30
24.800	30
27.950	30
31.500	48
35.430	48
39.370	60
47.240	60

- G. Insertion of the Liner: The polyethylene liner shall be inserted into the existing sewer line with a power

winch and steel cable connected to the end of the liner by use of an appropriate pulling head. A second pulling head may be attached to the other end of the liner for attachment of a tag line to pull the liner back out of the sewer line, if necessary. Length of the liner pipe to be inserted at any one time shall be governed by the winch drum capacity and winching power available and consideration of the size and condition of the sewer.

During insertion, precautions should be taken to protect the liner pipe from scoring the outside of the liner as it is being pulled into the sewer.

Once the insertion is initiated, it is desirable to continue the pull to completion without interruption.

The manufacturer's recommendations should be followed regarding relaxation of the liner prior to connecting services and sealing the annular space between the liner and the existing sewer pipe at the manhole.

- H. Manhole Replacement: In those places where the entrance shaft is excavated at an existing manhole, the manhole shall be replaced with a new manhole in accordance with the engineering drawings.
- I. Sealing Polyethylene Pipe in Manhole: The annular space between the polyethylene liner and the existing sewer line shall be sealed where the sewer line enters or exists each manhole. This annular space shall be sealed for a distance of 12 to 18 inches inside the old sewer line. The method of sealing shall be approved by the Engineer, but activated oakum and grout are acceptable.

Form sealant should not protrude into the manhole and should be finished over with a quick-set, non-shrink type of cement grout. Finishing inside the manhole shall be accomplished using a quick-set cement type grout to raise the invert to the grade of the line pipe. Note: Only the upstream seal should be made prior to connecting services.

- 53.09 SERVICE CONNECTIONS:** After the liner has been secured in the upstream manhole, all existing active services shall be reconnected. All existing inactive services serving vacant or undeveloped properties shall be reconnected. A portion of the existing sewer, at the liner pipe around each service connection shall be removed to expose the liner pipe to provide adequate working space for making the new service connection. Service laterals shall be connected to the liner pipe using either polyethylene heat fusion saddles or strap-on saddles as conditions require or as specified. Strap-on saddles shall be secured to the liner pipe using stainless steel bands. A neoprene gasket shall be inserted between the liner and the strap-on saddle.

Connections of the saddle fittings to the existing lateral shall be made using elastomeric boots, full encirclement clamps or by other methods specified by the Engineer.

Prior to backfilling, the annular space between the existing sewer and the new liner shall be sealed to preclude migration of the backfill material into this annular space. This annular space may be sealed with cement, expandable foam or the upper half of the sewer pipe may be replaced and grouted. The exposed connection shall be completely replaced and grouted. The exposed connection shall be completely encased in 6 inches (min.) of concrete. The cost of testing for and reconnecting service connections shall be considered incidental to the cost for "Slip Lining of Sewers" for the appropriate manhole section.

- 53.10 BACKFILL:** At all points where the polyethylene pipe has been exposed, such as at the insertion shafts, at service connection fittings, or other points where the old pipe must be removed, the polyethylene pipe and fittings shall be encased in 6 inches (min.) concrete or other high density material as specified by the Engineer to prevent deflection due to earth loading or subsidence.

At this point, in preparation for the placing of the encasement material, debris and soil shall be removed along each side of the existing pipe down to the spring line to exposed undisturbed soil.

After the encasement material is in place and accepted by the Engineer, it shall be allowed to set up for a minimum of 16 hours prior to backfilling; backfill is placed and compacted to required finished grade in accordance with these specifications. Particular care shall be taken to ensure compaction of earth beneath the lateral pipe in order to reduce subsidence and resultant bending at the lateral connection at the sewer main, care shall be taken to prevent damage or collapse of the liner.

53.11 TESTING

A. Air Test: After installation of the liner and before any taps are made, the Contractor shall run a test on the sewer line to determine if it is watertight.

The Contractor shall furnish all necessary equipment to conduct the test. Acceptable method is a low pressure air test. Air test procedure shall be as follows:

1. Pressurize the test section to 4.0 psi and hold above 3.5 psi for not less than 2 minutes. Add air if necessary to keep the pressure above 3.5 psi. At the end of this 2 minute saturation period, note the pressure (must be 3.5 psi minimum) and begin the timed period. If the pressure drops 0.5 psi in less than the time given in Table 3, the section of pipe shall not have passed the test.

Sewer Size (Inches)	Minimum Test Time (Minutes)
4	2
6	3
8	4
10	5
12	6
15	7 ½
18	9
21	10 ½
24	12
27	13 ½
30	15
36	18
42	21
48	24
54	27

2. When the prevailing ground water is above the sewer being tested, air pressure shall be increased 0.43 psi for each foot the water table is above the flow line of the sewer.
3. If the time for the pressure to drop 0.5 psi is 125 percent or less of the time given in the table, the line shall immediately be repressurized to 3.5 psi and the test repeated.
4. If building sewers have been preconnected they shall be considered part of the lateral to which they are connected and no adjustment of test time shall be allowed to compensate for the smaller diameter of the house sewers.

5. The pressure gauge used shall be supplied by the Contractor, shall have a minimum divisions of 0.10 psi, and shall have an accuracy of 0.004 psi.

B. Manholes shall be tested in accordance with requirements in Division 34.

53.12 CLEAN-UP: After the installation work has been completed and all testing acceptable, the Contractor shall clean up the entire project area and return the ground cover to grade. All excess material and debris not incorporated in the permanent installation shall be disposed of by the Contractor. Sidewalks, driveways, street surfaces, and other surface restoration not part an eligible Point Repair shall be considered incidental to "Slip-Lining of Sewers" of the appropriate manhole section.

53.13 METHOD OF MEASUREMENT AND BASIS OF PAYMENT: It is the intent of these Specifications that Slip-lining, excluding eligible Point Repairs to be a complete process. The total footage to be bid for rehabilitation by Base Bid, Alternate I and Alternate II are different. Certain areas cannot be lined because of cave-in already occurred. Cost comparison will be made between Base Bid, Alternate I and Alternate II in all areas where all of these rehabilitation techniques can be used.

A. The length of sewer pipe satisfactorily slip-lined will be measured in place by the engineer. The pipe shall not be measured through manholes.

B. Payment will be made for the quantities so measured at the unit prices specified in the Bid Proposal.