Designation: F2561 – 17

Standard Practice for Rehabilitation of a Sewer Service Lateral and Its Connection to the Main Using a One Piece Main and Lateral Cured-in-Place Liner[1,2]

This standard is issued under the fixed designation F2561; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice covers requirements and test methods for the reconstruction of a sewer service lateral pipe having an inner diameter of 3 to 12 in. (7.6 to 30.5 cm) and its connection to the main pipe having an inner diameter of 6 to 24 in. (15.2 to 61.0 cm) and up the lateral a maximum of 150 ft without excavation. The lateral pipe is accessed remotely from the main pipe and from a lateral access point. This will be accomplished by the installation of a resin impregnated one-piece main and lateral cured-in-place lining (MLCIPL) by means of air inflation and inversion. The MLCIPL is pressed against the host pipe by pressurizing a bladder and is held in place until the thermoset resins have cured. When cured, the MLCIPL shall be a continuous, one piece, tight fitting, corrosion resistant lining extending over a predetermined length of the lateral pipe and the adjacent section of the main pipe, providing a verifiable non-leaking structural connection and seal.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 There is no similar or equivalent ISO Standard.

1.4 **Warning—**Mercury has been designated by many regulatory agencies as a hazardous substance that can cause serious medical issues. Mercury, or its vapor, has been demonstrated to be hazardous to health and corrosive to materials. Caution should be taken when handling mercury and mercury-containing products. See the applicable product Safety Data Sheet (SDS) for additional information. Users should be aware that selling mercury or mercury-containing products, or both, may be prohibited by local or national law.

1.5 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D618 Practice for Conditioning Plastics for Testing

D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

D1600 Terminology for Abbreviated Terms Relating to Plastics

D3681 Test Method for Chemical Resistance of "Fiberglass" (Glass–Fiber–Reinforced Thermosetting-Resin) Pipe in a Deflected Condition

D5813 Specification for Cured-In-Place Thermosetting Resin Sewer Piping Systems

F412 Terminology Relating to Plastic Piping Systems

F1216 Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

F3097 Practice for Installation of an Outside Sewer Service Cleanout through a Minimally Invasive Small Bore Vacuum Excavation

[1] This practice is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.67 on Trenchless Plastic Pipeline Technology.

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[2] The rehabilitation of a sewer service lateral and its connection to the main using a one-piece main and lateral cured-in-place liner is covered by patents (LMK Enterprises, Inc. 1779 Chessie Lane, Ottawa, IL 61350). Interested parties are invited to submit information regarding the identification of acceptable alternatives to this patented item to the Committee on Standards, ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959. Your comments will receive careful consideration at a meeting of the responsible technical committee which may attend.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

2.2 *NASSCO Guidelines:*[4]
Recommended Specifications for Sewer Collection System Rehabilitation

3. Terminology

3.1 *Definitions*—Unless otherwise indicated, definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *access point*—an existing manhole at either the upstream or downstream end of a sewer main or a cleanout or a pipe opening located on the lateral pipe.

3.2.2 *bladder*—a translucent flexible plastic hose that when pressurized, causes the main sheet to be pressed against the main pipe walls and the lateral tube to invert up into the sewer service lateral. The bladder joined with the textile lining creates a liner/bladder assembly.

3.2.3 *inversion*—the process of turning a resin-impregnated tube inside out by the use of air or water pressure.

3.2.4 *launcher*—combination of a rigid elongated tube and lay-flat hose apparatus where the main bladder is attached and the main sheet is wrapped around the exterior of the rigid portion. The lateral bladder and lateral tube are drawn inside the hose. The launcher is positioned within the main pipe; air pressure is introduced into the hose causing inflation of the main bladder/sheet and inversion of the lateral bladder tube.

3.2.5 *lift*—a portion of the MLCIPL that has cured in a position such that it has pulled away from the host pipe wall.

3.2.6 *main and lateral cured-in-place lining (MLCIPL)*—a textile including plastic coating impregnated by a thermosetting resin. This pipe is formed within a portion of the existing main pipe and the lateral pipe. Therefore, it takes the shape of an existing TEE or WYE fitting and fits tightly to the existing pipes.

3.2.7 *resin*—polyester, vinyl ester, epoxy or silicate resin systems being ambient, steam, hot water, or cured UV light.

3.2.8 *resin slug*—excess resin at a terminating end of a CIPP lateral lining.

3.2.9 *sewer service lateral*—a pipe servicing a commerical, industrial or residential building.

3.2.10 *sheet*—a flat textile sheet that is formed into a 16 in. (40.6 cm) long tube within the main pipe. The sheet is connected to the lateral tube forming a one-piece TEE or WYE shaped fitting.

3.2.11 *transition*—the change in pipe diameter commonly found in lateral pipes.

4. Significance and Use

4.1 This practice is for use by designers and specifiers, regulatory agencies, owners, and inspection organizations who are involved in the rehabilitation of sewer service laterals and its connection to the main through the use of a resin-impregnated tube installed within an existing sewer lateral. As for any practice, modifications may be required for specific job conditions.

5. Materials

5.1 *Tube and Sheet:*

5.1.1 The main sheet and lateral tube shall consist of one or more layers of absorbent textile that is, needle punched felt or circular knit that meet the requirements of Practice F1216 and Specification D5813, Sections 6 and 8. The main sheet and lateral tube shall be constructed to withstand installation pressures and to have sufficient strength to bridge missing pipe segments and flexibility to fit irregular pipe sections. The assembly of the tube and main sheet must be stitched and sealed. The interface of the main sheet and tube shall be vacuum tested with 10 in. of Mercury (Hg) by the manufacturer to verify a leak-free connection. The volume of resin used should be sufficient to fill all voids in the tube material at nominal thickness and diameter. The wet-out main sheet and lateral tube shall have a uniform thickness and excess resin distribution that when compressed at installation pressures, the MLCIPL will meet or exceed the design thickness after cure.

5.1.2 The outside layer of the tube (before inversion) and the interior of the main sheet (before inflation) shall be coated with an impermeable, translucent flexible membrane. The main sheet before insertion shall be permanently marked with a lateral identification correlating to the address of the building that the lateral pipe services. In addition the manufacturers material batch codes for the liner and the resin shall be marked on the main sheet. The main sheet and lateral tube shall be surrounded by a second impermeable, flexible translucent membrane (translucent bladder) that will contain the resin and facilitate vacuum impregnation and monitoring of the resin saturation during the resin impregnation (wet-out) procedure.

5.1.3 The main sheet and lateral tube shall be a one-piece assembly formed as a TEE or WYE shaped fitting. No intermediate or encapsulated elastomeric layers shall be in the textile that may cause delamination in the cured-in-place pipe. The main sheet will be flat with one end overlapping the second end and sized accordingly to create a circular lining equal to the inner diameter of the main pipe. The lateral tube will be continuous in length and the wall thickness shall be uniform. The lateral tube shall include a hydrophilic O-ring attached to the interior surface at the tail end of the tube. One O-ring shall be attached four inches from the end of the liner and the other shall be attached six inches from the end of the liner. The lateral tube will be capable of conforming to offset joints, bells, and disfigured pipe sections.

5.2 *Resin:*

5.2.1 The resin/liner system shall conform to Test Method D3681, 10 000-h test.

5.2.2 The resin shall be a corrosion resistant polyester, vinyl ester, epoxy or silicate resin and catalyst system that when properly cured within the composite pipe assembly, meets the requirements of Practice F1216, the physical properties herein, and those, which are to be utilized in the design of the MLCIPL for this project.

[4] NASSCO, Inc. 11521 Cronridge Drive, Suite J, Owings Mills, MD 21117. www.nassco.org

5.2.3 The resin shall produce a MLCIPL, which will comply with the structural and chemical resistance requirements of Practice F1216.

6. Design Considerations

6.1 The MLCIPL shall be designed in accordance with Practice F1216, Appendix X1, with respect to the lateral and main line tubes. If the mainline pipe has been renewed with a structural lining from manhole to manhole, then the mainline portion of the MLCIPL is designed only for hydrostatic buckling.

6.1.1 The design for the main sheet and lateral tube shall assume no bonding to the host pipe.

7. Installation Recommendations

7.1 *Access Safety*—Prior to entering access areas such as manholes or an excavation pit, performing inspection, or cleaning operations, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen shall be undertaken in accordance with local, state, or federal safety regulations.

7.1.1 *Cleaning and Pre-Inspection and Post Inspection,* in accordance with NASSCO (National Association of Sewer Service Companies) Guidelines.

7.1.2 *Accessing the Lateral*—The access point shall be located outside of the building and upstream at the upper terminating end of the finished lateral lining. In order to access both the upstream and downstream sides of the lateral pipe, it is recommended that the access point is TEE shaped where the lateral and riser pipe join. The Tee serves the purpose of CCTV and proper maintenance for both the upstream and downstream side. One approved method of providing an access point is described in Practice F3097. See Fig. 1.

7.1.3 *Plugging the Lateral*—The upstream side of the access point shall be plugged during insertion and curing of the MLCIPL assembly, ensuring the following:

(1) Public Safety by putting controls in place that prevents the potential for air, steam, or unwanted vapors to enter the building or private residence.

(2) Quality Control by preventing flows and unwanted waste from entering the pipe during liner insertion and contaminating the resin saturated liner resulting in low physical properties.

FIG. 1 Practice F3097 Access Point

(3) Quality Assurance by inserting a sewer camera to confirm the liner is fully deployed and provides access to effectively remove resin slugs.

7.1.4 *Plugging the Main*—When required, the main pipe flows will be bypassed. The pumping system will be sufficiently sized for normal to peak flow conditions. The upstream manhole is monitored at all times and an emergency deflate system will be incorporated so that the plugs may be removed at any time without requiring confined space entry

7.1.5 *Inspection of Pipelines*—The interior of the pipeline shall be carefully inspected to determine the location of any condition that shall prevent proper installation, such as roots and collapsed or crushed pipe. These conditions shall be noted so that they can be corrected before installation of the MLCIPL. Experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television shall perform inspection of pipelines.

7.1.6 *Line Obstructions*—The existing service lateral shall be clear of obstructions to ensure proper installation. Obstructions may include dropped or offset joints of no more than 20 % of the inside pipe diameter.

7.2 *Transition of Pipe Diameter*—Changes in pipe diameter shall be accommodated by properly sizing the lateral tube according to the design of Practice F1216 for pipe diameter and conditions.

7.3 *Resin Impregnation*—The lateral tube and main sheet encapsulated within the translucent bladder (liner/bladder assembly) shall be vacuum-impregnated with resin (wet-out) under controlled conditions. The volume of resin used shall be sufficient to fill all voids in the textile lining material at nominal thickness and diameter. The volume shall be adjusted by adding 5 to 10 % excess resin for the change in resin volume due to polymerization and to allow for any migration of resin into pipe defects and open joints in the host pipe in accordance with Practice F1216. No dry or unsaturated area in the main sheet or lateral tube shall be acceptable upon visual inspection.

7.4 *MLCIPL Insertion*—The lateral tube and inversion bladder will be inserted into the carrying device. The main bladder is connected to the launching device by an airtight clamping system. The main sheet is wrapped around the "T" launching device. The mainsheet shall be outfitted with one of the approved seamless molded hydrophilic gasket sealing systems; *(1)* Four hydrophilic O-rings with two O-rings being placed on each side of the connection on the mainsheet (see Fig. 2) or *(2)* Hydrophilic flange shaped gasket (see Fig. 3) placed at the

FIG. 2 O-rings

FIG. 3 Flanged Shaped Gasket

connection. The hydrophilic gaskets expand in a humid environment and when in contact with water providing the sealing mechanism for a watertight MLCIPL. The launching and carrying device are inserted into the main pipe and positioning is complete when the main sheet/ lateral tube interface is aligned with the service connection within the main pipe. The lateral tube is completely protected during the pull. The main sheet is supported upon the rigid "T" launcher that is elevated above the pipe invert by means of a rotating skid system. The MLCIPL assembly shall not be contaminated or diluted by exposure to dirt, debris, or water during the pull.

7.5 *Inflation*—The bladder is inflated causing the tubular main sheet to be unfolded and pressed tight against the host pipe. The gasket sealing system is thereby positioned between the host pipe and the main sheet forming a pipe seal.

7.6 *Inversion*—The lateral tube is inverted through the center of the tubular shaped main sheet up into the existing lateral pipe by the action of the lateral bladder. The inversion is complete when the lateral tube is fully extended to the designated termination point. The bladders shall extend past the termination points of the main sheet and the lateral tube, respectively, causing the ends to remain open whereby no cutting for reinstatement is required.

7.7 *Curing*—After insertion is complete, pressure is maintained, pressing the MLCIPL firmly against the inner pipe wall. The MLCIPL is chemically cured at ambient temperature or by a suitable heat source. The heating equipment shall be capable of delivering and circulating a mixture of steam and air or hot water throughout the MLCIPL to uniformly raise the temperature necessary to properly cure the resin. The curing of the MLCIPL must take into account the existing pipe material, the resin system, and ground conditions (temperature, moisture level, and thermal conductivity of the soil). When using a heat source, temperatures shall be monitored and logged at the upstream end of the lateral lining during the cure and cool down cycles. The manufacturer's recommended cure schedule shall be submitted.

7.8 *MLCIPL Processing*—Curing shall be done with air or a mixture of air and steam without pressure interruption, for the proper duration of time in accordance with the resin manufacturer's recommendations. When the heat source is removed and the temperature at the upper end of the lateral tube is reduced to 100°F (37.8°C) or less, the processing shall be finished.

8. Finish

8.1 The finished MLCIPL shall be one continuous homogenous liner renewing the full circumference for 16 in. (40.6 cm) of the main pipe and a predetermined length of a sewer service lateral. The MLCIPL shall provide a smooth bore interior. The MLCIPL shall be free of dry spots, lifts, and delamination. The MLCIPL shall taper at each end so as to accept video equipment and maintain a proper flow. After the work is completed, the installer will provide the owner with video footage in accordance with NASSCO, PACP, and LACP pipeline assessment codes. This documents the overall integrity of the MLCIPL and the visual lateral identification address and manufacturer's material code markings as completed work. The finished product must provide an airtight/watertight, verifiable non-leaking connection between the main sewer and sewer service lateral. A visual inspection from post lining CCTV shall reveal the location of the impression of the gaskets that are located behind the liner. (See Fig. 4 and Fig. 5.)

9. Recommended Inspection Practices

9.1 *Sampling*—As designated by the purchaser in the purchase agreement, the preparation of a MLCIPL sample is required. The sample shall be prepared by securing a flat plate mold using the textile tube material and resin system as used for the rehabilitated lateral and main line sheet. See Fig. 6.

9.1.1 The pressure applied on the plate sample will be equal to the highest sustained pressure exerted on the textile lining during the cure process, determined by a cured liner thickness space.

9.1.2 The minimum length of the sample must be able to produce at least five specimens for testing in accordance with Test Method D790. The minimum length is determined by the thickness of the sample and the testing laboratory requirements.

9.2 *Conditioning*—Condition the test specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Practice D618, for those tests where conditioning is required.

9.3 *Short-Term Flexural Properties*—The flexural strength and flexural modulus of the MLCIPL shall be determined in accordance with Test Method D790. The values shall meet the minimum requirements of Table 1 or the values used in design, whichever are higher.

9.4 *MLCIPL Wall Thickness*—The average wall thickness for the lateral section shall meet the thickness determined by the design or as otherwise specified. The average wall thickness for the main line section shall meet the thickness determined by the design or as otherwise specified. The average thickness shall be determined in accordance with

FIG. 4 O-rings

FIG. 5 Flanged Shaped Gasket

FIG. 6 Flat Plate Mold

Specification D5813. The minimum wall thickness at any one point, as determined in accordance with Specification D5813, shall not be less than 87.5 % of the thickness required by design or as otherwise specified.

TABLE 1 MLCIPL Initial Physical Properties

Property	ASTM Test	Minimum Value	
		psi	(MPa)
Flexural Strength	D790	4500	(31)
Flexural Modulus	D790	250 000	(1724)

9.5 *Gravity Pipe Leakage Testing*—If required by the owner in the contract documents or purchase order, gravity pipes should be tested using an air test method, where test plugs are placed adjacent to the upstream and downstream ends of the main sheet and at the uppermost end of the lateral tube. This test should take place after the MLCIPL has cooled down to ambient temperature. This test is limited to pipe lengths with no service connections. The test pressure shall be 4 psi (27.6 kPa) for a 3-min test time and during this time the pressure shall not drop below 3.5 psi (24.1 kPa).

10. Keywords

10.1 ambient cure; continuous; cured-in-place pipe; epoxy; felt; hydrophilic O-rings; inflation; inversion; knit; lateral identification; lateral pipe; lateral tube; launcher; liner/bladder assembly; main pipe; main sheet; main to lateral connection; MLCIPL; one-piece; resin; sewer lateral lines; sheet; steam cure; TEE; textile sheet; textile tube; transition; translucent bladder; tube; vacuum impregnate; WYE; Vac-A-Tee

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F2561–16) that may impact the use of this standard.

(1) Revised—3.2.1, 3.2.2, 3.2.8, and 3.2.9.
(2) Revised—Section 5.
(3) Revised—Section 7.
(4) Revised—Section 8.
(5) Revised—Section 9.
(6) Revised—Section 10, Keywords.