Designation: F3033 – 16 (Reapproved 2021)

Standard Practice for Installation of a Single-Sized, Cured-In-Place Liner Utilizing an Inflatable Bladder for Resurfacing Manhole Walls of Various Shapes and Sizes[1,2]

This standard is issued under the fixed designation F3033; 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 for the cured-in-place rehabilitation of manholes without excavation, utilizing an inflatable bladder, and not limited to sanitary sewer manholes.

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 *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.* Particular attention is drawn to those safety regulations and requirements involving entering into and working in confined spaces.

1.5 *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]

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D1600 Terminology for Abbreviated Terms Relating to Plastics

F412 Terminology Relating to Plastic Piping Systems

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 *bonded*—adhered to the manhole walls.

3.2.2 *chimney*—the upper portion of a manhole - including the corbel section, adjusting rings, and the frame/lid.

3.2.3 *CIPMH*—Cured-In-Place Manhole.

3.2.4 *close-fitting*—fitting tightly to the manhole walls.

3.2.5 *compression seal*—a gasket that forms a seal between the original manhole and the cured-in-place liner.

3.2.6 *design engineer*—a licensed professional engineer in the state where the installation is to take place.

3.2.7 *freeze/thaw cycle*—occurs when an area experiences fluctuations in a temperature range from 28 °F (-2.2 °C) to 50 °F (10 °C).

3.2.8 *impermeable barrier*—an air-tight corrosion resistant film formed when the inflation bladder is left behind permanently bonded to the interior of the cured-in-place manhole, when a compatible epoxy resin system is used.

[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 Standard Practice For The Installation Of A Single-Sized Cured-In-Place Liner For Manholes Having Various Sizes is covered by patents (LMK Technologies, 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.

3.2.9 *inflation bladder*—is a single sized polymer based air-tight tube that is sized equal to or less than the smallest cross section of a manhole corbel area.

3.2.9.1 *Discussion*—The bladder is subjected to a pressurized fluid. It expands and presses the liner against the walls of the manhole.

3.2.10 *inflation device*—a device that is outfitted with an inflation bladder that when inflated presses the liner tube against the manhole walls.

3.2.11 *inflow and infiltration*—the intrusion of extraneous water through a manhole.

3.2.12 *glass reinforcing mat*—a woven roving glass mat used to increase tensile strength in the upper corbel section for increased freeze/thaw resistance.

3.2.13 *single sized liner*—a textile liner tube that is constructed having expansive properties, sufficient to stretch conforming to both the barrel and the corbel sections by the action of an inflation bladder.

3.2.13.1 *Discussion*—In the upper corbel section the textile tube may overlap and provide a more substantial wall thickness, producing a cured in place liner that resists freeze/thaw cycles.

3.2.14 *small voids*—a crack in the manhole walls that is no greater than ½ in. (1.3 cm) along any dimension.

3.2.15 *thermoset resin*— polyester, vinyl ester, epoxy, or silicate resin systems being ambient, steam, or hot water cured.

3.2.15.1 *Discussion*—The resin of choice is selected based upon the project criteria.

Criteria 1– Resurfacing the interior surface of the host manhole; use any of the four applicable resins listed above.

Criteria 2– Elimination of infiltration and inflow; use any of the four resins listed above with the inclusion of the gaskets.

Criteria 3– Resurfacing the interior surface of the host manhole and elimination of infiltration and inflow limited to the chimney section; use the silicate resin.

4. Summary of Practice

4.1 The manhole is accessed through the existing manhole cover, without removal of manhole frame. The partial or full-depth rehabilitation is accomplished by the installation of a single piece resin impregnated stretchable liner that is cured under pressure. The liner is pressed against the existing manhole by a pressurized bladder until the thermoset resins have cured. The liner shall start at the manhole cover seat and extend to a pre-determined depth in the manhole, without covering the manhole bottom/bench. The cured-in-place manhole liner shall conform to the contours of the existing manhole, resurface the interior of the manhole, reduce or eliminate inflow and infiltration, and provide a surface resistant to sewer gases.

5. Significance and Use

5.1 This practice is for use by designers and specifiers, regulatory agencies, owners, and inspection organizations who are involved in the rehabilitation of manholes ranging from 24 in. (0.61 m) and larger in diameter without excavation through the use of a resin-impregnated tube installed within an existing manhole. As for any practice, modifications may be required for specific job conditions.

5.1.1 The CIPMH liner is suitable for circular and non-circular manholes with varying diameters along the depth of the manhole.

5.2 The design engineer shall determine the CIPMH liner requirement to withstand external loads.

6. Procedure

6.1 *Preparation*—All surfaces to be lined must be properly prepared by pressure washing with a minimum of 3500 psi (6.9 kPa) at 5 gal/min (63.1 cm^3/s) pressure washer at a distance of no greater than 1 ft (0.305 m) from the manhole wall; using no less than 140 °F (60 °C) water temperature, and an environmentally safe detergent designed to remove fats, oils, and grease. Other alternatives to clean the manhole may be used along with pressure washing such as abrasive blasting. The existing casting shall be cleaned using a grinder or by sand blasting. Large voids and missing bricks shall be filled with hydraulic cement to provide an area that the liner can press up against. Small voids and missing mortar may go unpatched, since these areas will be filled with excess resin. Active infiltration is temporarily sealed by use of chemical grout injection or fast setting plugging materials. Steps that are located in the area to be lined shall be removed. The rehabilitation is accomplished using a stretchable, textile tube of particular length and a thermoset resin with chemical properties appropriate for the application. Chemical resistance tests shall be completed in accordance with Test Method D543 as noted in Appendix X1. In areas that experience freeze/thaw conditions, a glass reinforcing mat may be inserted into the corbel section prior to the insertion of the stretchable liner tube. The liner tube is vacuum-impregnated (saturated) on-site with the thermoset resin. In cases where ground water infiltration is prevalent and the owner requires a leak-free CIPMH, compression gaskets shall be positioned at the upper and lower ends of the liner tube and at pipe penetrations forming a compression gasket seal. The saturated liner is then lowered into the manhole and is temporarily held in position. The inflation device is then lowered and properly positioned inside of the liner. The inflation device is then pressurized expanding the bladder and pressing the liner tube against the manhole walls. The inflation pressures are relevant to the specific bladder and liner tube utilized by the installer. For specific information, refer to the manufacturer's guidelines/quality controls. Once the resin-saturated liner is cured, the inflation device is removed. The liner is then trimmed flush with the manhole cover seat.

6.2 *Vacuum Impregnation*—The liner shall be vacuum impregnated (saturated) onsite under controlled conditions. The resins shall be sufficient to fill all voids in the liner material at nominal thickness and diameter. No dry or unsaturated areas in the liner shall be acceptable upon visual inspection.

6.3 *Inflation Device*—Once the liner is placed in the manhole the inflation device is inserted inside the liner. Spacing rings on top of the manhole allow the inflation device to rest at the correct depth. Once inserted, the inflation device bladder is

pressurized so as to cause the liner to fully contact the manhole walls. The inflation device stays in-place and pressurized until the liner is cured.

6.4 *Curing*—The liner is cured at ambient temperatures or by a suitable heat source as it is pressed firmly against the manhole. The curing time must take into consideration the resin system, ground conditions (temperature and moisture levels), and weather conditions. Typically, 1-2 h are needed to cure the liner. A curing log shall be used to document the resin usage, and other pertinent information, and will be available for submittal to the owner if requested. A representative identical to the resin mixture in the liner should be kept in a container next to the manhole to ascertain when the resin thermoset reaction occurs. The curing controls shall be subject to manufacturer's guidelines, including a cool down cycle. When surcharge conditions arise, while the manhole liner is being cured, a temporary flow bypass shall be installed.

6.5 *Trimming*—Once cured, the inflation bladder may be removed or when a compatible epoxy resin system is used, the inflation bladder shall be permanently bonded to the resin saturated liner providing an impermeable barrier. Any condensation or water accumulated within the bladder shall be removed by a pump or in the application of a sewer manhole, the lower end of the bladder is opened allowing any water to drain into the sewer. The inflation device is removed and the liner is trimmed at the manhole cover seat. If any active pipe openings are covered by the manhole lining, they shall be reopened.

Field Inspection

7. Scope

7.1 *Hazards*—Prior to entering a manhole, an evaluation of the atmosphere to determine the presence of toxic or flammable vapors or lack of oxygen must be undertaken in accordance with local, state, or federal regulations.

8. Precision and Bias

8.1 *Manhole Liner Wall Thickness*—The installer shall provide an onsite wetout log that includes nominal liner thickness, resin quantity, liner size, and time of resin saturation. The average wall thickness for the manhole liner shall not be less than 0.177 in. (4.5 mm). Increased wall thickness will be determined by the Design Engineer.

NOTE 1—This standard is an installation practice and therefore a design appendix is not mandatory.

9. Quality Control

9.1 The installer shall visually inspect for the following:

9.1.1 that the liner is firmly pressed, bonded, and close fitting against the manhole walls;

9.1.2 that it is completely cured; and

9.1.3 that its surface is free from cracks or hollow spots.

10. Keywords

10.1 Ambient cure; CIPMH (cured-in-place manhole); continuous; dry spots; inflation bladder; manhole liner; resurfacing; single-sized liner; steam cure; variable sized manholes

APPENDIX

(Nonmandatory Information)

X1. CHEMICAL-RESISTANCE TESTS

X1.1 *Scope:*

X1.1.1 This appendix covers the test procedures for chemical-resistance properties of CIPP. Minimum standards are presented for standard domestic sewer applications.

X1.2 *Procedure for Chemical-Resistance Testing:*

X1.2.1 Chemical resistance tests should be completed in accordance with Practices D543. Exposure should be for a minimum of one month at 73.4 °F (23 °C). During this period, the CIPP test specimens should lose no more than 20 % of their initial flexural strength and flexural modulus when tested in accordance with Section 8 of this practice.

X1.2.2 Table X1.1 presents a list of chemical solutions that serve as a recommended minimum requirement for the chemical-resistant properties of CIPP in standard domestic sanitary sewer applications.

TABLE X1.1 Minimum Chemical Resistance Requirements for Domestic Sanitary Sewer Applications

Chemical Solution	Concentration, %
Tap water (pH 6–9)	100
Nitric acid	5
Phosphoric acid	10
Sulfuric acid	10
Gasoline	100
Vegetable oil	100
Detergent	0.1
Soap	0.1

X1.2.3 For applications other than standard domestic sewage, it is recommended that chemical-resistance tests be conducted with actual samples of the fluid flowing in the pipe. These tests can also be accomplished by depositing CIPP test specimens in the active pipe.