



Designation: F3541 – 22

Standard Practice for Sectional Repair of Existing Gravity Flow, Non-Pressure Pipelines and Conduits by Pushed or Pulled-In-Place Installation of Cured-In-Place Thermosetting Resin Pipe (CIPP)¹

This standard is issued under the fixed designation F3541; 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 describes the procedures for the sectional repair of gravity flow, non-pressure pipelines and conduits 3 in. to 60 in. (75 mm to 1500 mm) diameter by the installation of a resin-saturated liner which is placed onto or wrapped around a carrier device, pushed or pulled into an existing pipeline or conduit and expanded against the interior of the host pipe or conduit with air pressure. The resin is cured under ambient conditions, by photoinitiated reaction or with the application of heat. When cured, the finished sectional repair will be tight-fitting across its installed length. This repair process is used in a variety of gravity flow, non-pressure applications such as sanitary sewers, storm sewers, drains, electrical conduits and ventilation systems.

1.2 *Units*—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 *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.*

1.4 *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.*

¹ This test method 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. Referenced Documents

2.1 *ASTM Standards*:²

D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents

D578/D578M Specification for Glass Fiber Strands

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

D1600 Terminology for Abbreviated Terms Relating to Plastics

D3567 Practice for Determining Dimensions of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings

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

F2019 Practice for Rehabilitation of Existing Pipelines and Conduits by the Pulled in Place Installation of Glass Reinforced Plastic Cured-in-Place (GRP-CIPP) Using the UV-Light Curing Method

2.2 *ASCE Standard*:³

Manual of Practice 145, Design of Close-Fit Liners for the Rehabilitation of Gravity Pipes

² 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 Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, <http://www.asce.org>.

2.3 ISO Standard:⁴

ISO 11296-4, *Plastics piping systems for renovation of underground non-pressure drainage and sewerage networks — Part 4: Lining with cured-in-place pipes*

2.4 NSF Standard:⁵

NSF/ANSI-14, SE10990 – *Rehabilitation by Point Repair of Existing Pipe*

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 *binding material, n*—A material utilized to secure the resin-saturated liner to the carrier device prior to placement into the pipeline.

3.2.1.1 *Discussion*—Examples include, but are not limited to, wire, nylon ties, adhesive tape or elastomeric bands.

3.2.2 *carrier device, n*—An apparatus utilized to deliver the resin-saturated liner to a section of host pipe identified for repair by pushing or pulling force.

3.2.3 *catalyst, n*—A curing agent, hardener, initiator, diluent, admixture, or combination thereof.

3.2.4 *cured-in-place pipe (CIPP), n*—A hollow cylinder consisting of a liner cured (cross-linked) with a thermosetting resin. The CIPP is installed inside an existing pipe and pressed against the pipe interior to form a tight fit.

3.2.5 *delamination, n*—Separation of layers of the CIPP.

3.2.6 *design reconciliation, n*—A process conducted post-construction to determine whether the original design objectives for the installation have been met.

3.2.6.1 *Discussion*—Design reconciliation is completed to assess the net impact of post-construction variations present including fit, finish, wall thickness and mechanical properties on the installed product's ability to conform to design requirements as established by the owner or engineer.

3.2.7 *dry spot, n*—An area of the installed CIPP which is deficient or void of resin.

3.2.8 *lift, n*—A portion of the CIPP that has cured in a position such that it has pulled away from the existing pipe wall.

3.2.9 *photoinitiated reaction, n*—The polymerization of a resin system initiated by light or other electromagnetic radiation.

3.2.10 *protective membrane, n*—An impermeable polymer sleeve or film that is used to prevent resin contact with the carrier device, resin contamination or washout, when required, is properly sized for the host pipe diameter, and is designed to accommodate the application, installation, resin system and curing process.

3.2.11 *release agent, n*—A non-reactive, sacrificial chemical applied to a surface to prevent bonding.

3.2.12 *tight-fitting, adj*—conformance of a lining system to the host pipe interior geometry whereas intimate contact is realized across the entire perimeter.

3.2.13 *wellpoint system, n*—A series of closely spaced, small diameter, shallow wells connected to a common header pipe and pumped with a high-efficiency vacuum dewatering pump.

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 gravity flow, non-pressure pipes through the use of a resin-saturated liner installed within a section of damaged or leaking existing pipe. As for any practice, modifications may be required for specific job conditions.

5. Materials

5.1 *Liner*—The liner utilized shall consist of one or more layers of fiberglass matting, reinforced composite, flexible needled felt or an equivalent nonwoven or woven material, or a combination thereof. The liner shall be capable of carrying resin, withstanding installation pressures and curing temperatures, bridging pipe defects, conforming to irregular shapes and negotiating bends as applicable. The liner shall be a manufactured tube or an overlapping flat sheet, with or without a plastic coating, that is compatible with the resin system used, and fabricated to a size that, when installed, will be tight-fitting across the entire length identified for sectional repair. The liner shall be appropriately sized to extend at least 1 ft (0.30 m) in all directions beyond the limits of the host pipe defect when installed.

5.1.1 *Fiberglass Matting*—Chemically resistant E-CR fiberglass meeting Specification D578/D578M or similar material meeting the requirements herein; consisting of single or multiple layers of woven or nonwoven material, with or without chopped strand mat.

5.1.2 *Reinforced Composite*—Needled felt, or an equivalent woven or non-woven material, with E-CR fiberglass meeting Specification D578/D578M or similar reinforcement material meeting the requirements herein.

5.1.3 *Overlapping Flat Sheet*—Liners designed as overlapping flat sheets having a minimum circumference = $\pi \times D_i \times 1.1$, where D_i = inside diameter of the host pipe. When multiple layers of liner are required to achieve the desired thickness, the ends of the liner are tapered as required to obtain a smooth transition to the host pipe by adding additional layers in a stepwise fashion in accordance with the manufacturer's guidelines such that each subsequent layer is slightly longer than the adjacent, underlying layer.

5.1.4 *Manufactured Tubes*—Liners manufactured as tubes shall be sized per the manufacturer's recommendations relative to the host pipe inside diameter to permit radial expansion and a tight fit against the host pipe during installation and cure.

5.1.5 *Resin*—A chemically resistant, thermosetting resin and catalyst system that is cured under ambient conditions, by

⁴ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandinnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

⁵ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48105, <http://www.nsf.org>.