Designation: F2718 – 09 (Reapproved 2015)

Standard Specification for Polyethylene (PE) and Cement Materials for an Encapsulated Cement Mortar Formed in Place Liner System (FIPLS) for the Rehabilitation of Water Pipelines[1]

This standard is issued under the fixed designation F2718; 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 specification covers requirements and test methods for materials for a semi-structural polyethylene (PE) encapsulated cement mortar formed-in-place liner system (FIPLS) intended for the rehabilitation of water pipelines of nominal size 4 in. to 12 in. This renewal process involves installing a collapsed PE liner, folded at the time of insertion, into an existing pipeline, expanding the PE liner, and then pumping cement mortar into the annulus between the liner and the main.

1.2 The liner and cement mortar are progressively rounded by means of an air pressure propelled pig and expanded against the interior surface of the original host pipe. After rounding, the line is maintained under pressure until the cement mortar cures and the liner is completely self supporting.

1.3 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.

1.4 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

1.5 There is no similar or equivalent ISO standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C109/C109M Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens)

D638 Test Method for Tensile Properties of Plastics

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

D1505 Test Method for Density of Plastics by the Density-Gradient Technique

D1525 Test Method for Vicat Softening Temperature of Plastics

D1600 Terminology for Abbreviated Terms Relating to Plastics

D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics

F412 Terminology Relating to Plastic Piping Systems

2.2 *NSF/ANSI:*[3]

NSF/ANSI 14 for Plastic Piping Components and related Materials

NSF/ANSI 61 for Drinking Water Systems Components – Health Effects

2.3 *American Water Works Association Standards*[4]

Manual M28 Rehabilitation of Water Mains

3. Terminology

3.1 Unless otherwise indicated, definitions are in accordance with Terminology F412, and abbreviations are in accordance with Terminology D1600. The abbreviation of polyethylene is PE.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *cement mortar, n*—a specially formulated cement based grout.

[1] This specification 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] 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 NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48105, http://www.nsf.org.

[4] Available from American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, http://www.awwa.org.

3.2.2 *formed-in-place-liner system (FIPLS), n*—after insertion of the liner and cement mortar, sequential insertion and reforming of the liner and cement mortar in the host pipe, a composite system of cement mortar PE liner is formed. See Fig. 1 and Fig. 2.

3.2.3 *liner, n*—a PE sheet with integral anchors or hooks extruded in a flat shape then formed with overlapping edges and welded into a cylindrical shape, which is then collapsed, folded into a C configuration, thereby reducing its area and then pulled into the host pipe.

3.3 *semi-structural, adj*—liner systems designed to bridge holes and gaps and seal leaking joints in the host pipe and having sufficient inherent stiffness to be self supporting without dependence on adhesion to the pipe wall.

3.3.1 *Discussion*—Appendix A of AWWA Manual M28 – "Structural Lining Design Issues," contains a more detailed discussion of structural classification of lining techniques. The following is taken from Manual M28: "Class II and Class III Linings are both interactive and semi-structural systems. Since the stiffness of such a lining is less than that of the host pipe, all internal pressure loads are transferred to the host pipe leading to their classification as interactive. Such a lining is required only to independently sustain internal pressure loads at discontinuities in the host pipe, such as corrosion holes or joint gaps, or if the host pipe is subject to structural failure."

4. Materials

4.1 *Basic Materials*:

4.1.1 *PE Materials*—The liner and the hooks shall be made from PE material meeting the minimum physical properties as listed in Table 1.

4.1.2 The cement mortar is used to fill the ring cavity between the polyethylene liner and the host pipe. The cement mortar shall have the minimum physical properties as in Table 2.

5. Sampling

5.1 *Cement mortar:*

5.1.1 Samples will be taken of the cement mortar material and tested throughout the installation process to confirm its compliance to the properties listed in Table 2.

6. Requirements

6.1 The cement mortar component of the formed-in-place liner system (FIPLS) shall have a 28 d compressive strength of 7000 psi (48.2 MPa) as tested by Test Method C109/C109M.

6.2 *Workmanship*—The PE liner shall be essentially uniform in color and opacity. There shall be no evidence of splits, cracks, crazing, or breaks.

7. Inspection

7.1 Inspection of the materials shall be made as agreed upon by the purchaser and the seller as part of the purchase agreement.

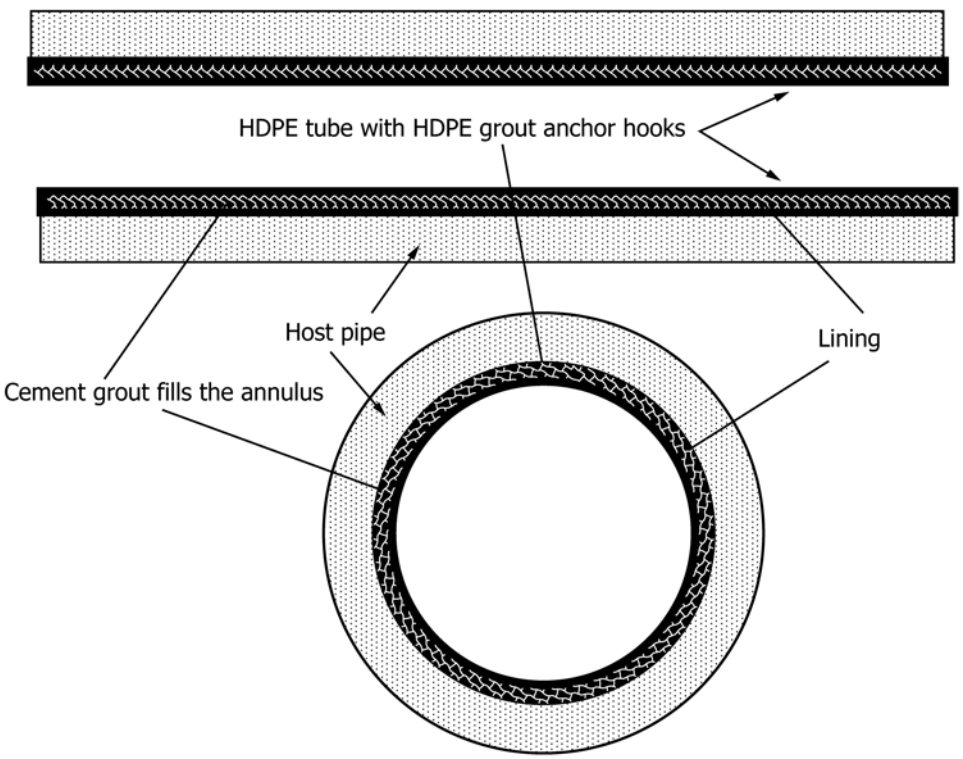

FIG. 1 PE and Encapsulated Cement Mortar Formed-In-Place-Liner System (FIPLS)

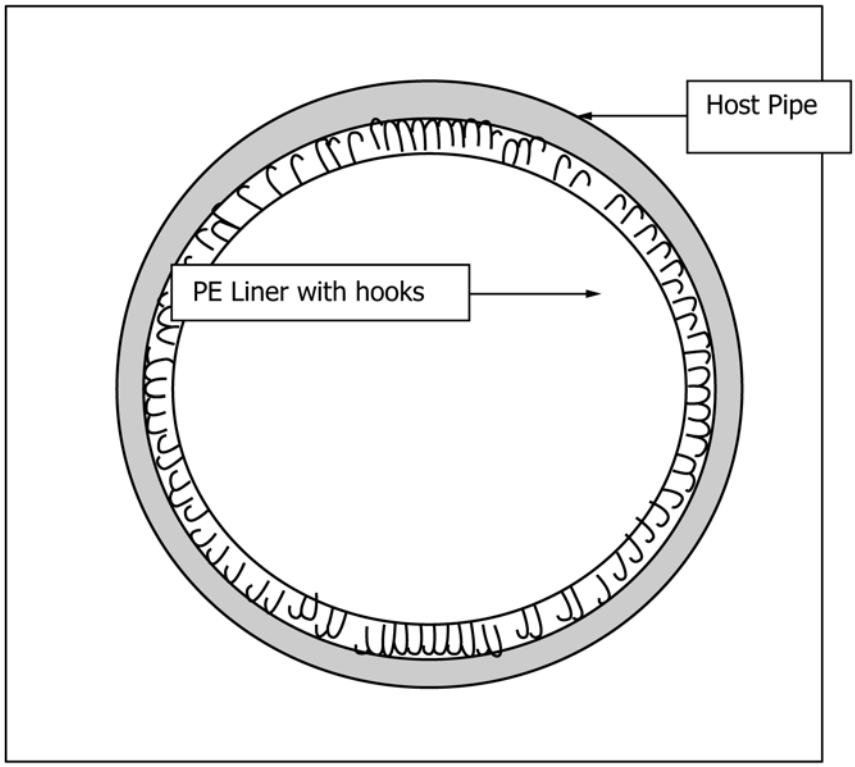

FIG. 2 PE Liner with Protruding Hooks

TABLE 1 Polyethylene Material Properties

Property	Test Method	Minimum Value
Tensile strength at break	D638	3,400 psi (23.4 MPa)
Elongation at break	D638	500 %
Flexural modulus	D790	75,000 psi (517 MPa)
Vicat softening point	D1525 (Vel-A)	259°F (126°C)
Density at 23°C	D1505	0.034 lb/in^3 (0.942 g/cm ^{3})
Environmental Stress Crack Resistance	D1693 (Condition C)	192 hours

TABLE 2 Cement Mortar Properties

Property	Test Method	Minimum Value	Maximum Value
24 Hour Compressive Strength	C109/ C109M	2,000 psi (13.8 MPa)	...
7 Day Compressive Strength	C109/ C109M	5,000 psi (34.5 MPa)	...
28 Day Compressive Strength	C109/ C109M	7,000 psi (48.2 MPa)	...
Set Time	...	10 hours	...
Mud Balance Density Test	...	0.069 lb/in^3 (1.90 g/cm ^{3})	0.074 lb/in^3 (2.05 g/cm ^{3})
Shrinkage	...	...	0%

8. Rejection and Rehearing

8.1 If the results of any test do not meet the requirements of this specification, these test(s) may be conducted again in accordance with an agreement between the purchaser and the seller. There shall be no agreement to lower the minimum requirement of the specification by such means as omitting tests that are a part of the specification, submitting or modifying a test method, or by changing the specification limits. In retesting, the product requirements of this specification shall be met and the test methods designated in the specification shall be followed. If, upon retest, failure occurs, the quantity of product represented by the testing does not meet the requirements of this specification.

9. Quality Assurance

9.1 When the product is marked with this designation, ASTM F2718, the manufacturer affirms that the product was manufactured, inspected, sampled and tested in accordance with this specification and has been found to meet the requirements of this specification.

10. Certification

10.1 When specified in the purchase order or contract, the manufacturer's certification shall be furnished to the purchaser that the liner was manufactured, sampled, tested and inspected in accordance with this specification, and has been found to meet the requirements. If specified, a report of the test results shall be furnished.

11. Product Marking

11.1 Markings shall be applied to each package of PE liner in such a manner that they remain legible during normal handling, shipment, storage and installation.

11.1.1 The letters ASTM followed by the designation number of this standard.

11.1.2 The liner manufacturer's name or trademark and production code to include location, date of manufacture, and lot number.

11.2 The legend "PE/Cement Mortar Formed In Place Liner System."

11.3 Liner intended for the transport of potable water shall also include the seal or mark of the accredited certifying laboratory.

12. Keywords

12.1 cement mortar; encapsulated; FIPLS; formed-in-place liner system; grout; liner; main; pipelines; polyethylene; rehabilitation; water

SUPPLEMENTARY REQUIREMENTS

This requirement applies whenever a regulatory authority of user calls for the products to be used to convey or to be in contact with potable water.

S1. Potable Water Requirement

Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF/ANSI 61 or the health effects portion of NSF/ANSI 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.