

IAPMO IGC 351-2018a

Applied in Place Pipe Rehabilitation (AIPPR) Systems



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IAPMO Standard

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Applied in Place Pipe Rehabilitation (AIPPR) Systems

1 Scope

1.1 General

1.1.1 This Standard covers applied in place pipe rehabilitation (AIPPR) systems intended for use in 40 to 400 DN (1.5 to 16 NPS) gravity and pressure applications such as DWV, sanitary sewer, storm sewer, electrical conduit, ventilation, process piping, and non-potable supply piping systems and specifies requirements for materials, physical characteristics, performance testing, and markings.

1.1.2 Applied in place pipe rehabilitation systems (AIPPR) covered by this Standard

- (a) employ a general purpose two component polyurea derived from the reaction product of an isocyanate component and a synthetic resin blend component through step-growth polymerization; and,
- (b) are applied to the pipe and fitting system through using spray, brush or troweling to a finished thickness of not less than SDR 100.

1.2 Alternative Materials

The requirements of this Standard are not intended to prevent the use of alternative materials or methods of construction provided such alternatives meet the intent and requirements of this Standard.

1.3 Terminology

In this Standard,

- (a) “shall” is used to express a requirement, i.e., a provision that the user is obliged to satisfy to comply with the Standard;
- (b) “should” is used to express a recommendation, but not a requirement;
- (c) “may” is used to express an option or something permissible within the scope of the Standard; and
- (d) “can” is used to express a possibility or a capability.

Notes accompanying sections of the Standard do not specify requirements or alternative requirements; their purpose is to separate explanatory or informative material from the text. Notes to tables and figures are considered part of the table or figure and can be written as requirements.

1.4 Units of Measurement

SI units are the primary units of record in global commerce. In this Standard, the inch/pound units are shown in parentheses. The values stated in each measurement system are equivalent in application, but each unit system is to be used independently. All references to gallons are to U.S. gallons.

1.5 Amendments

Proposals for amendments to this Standard will be processed in accordance with the standards-writing procedures of IAPMO.

2 Reference Publications

This Standard refers to the following publications and, where such reference is made, it shall be to the current edition of those publications, including all amendments published thereto.

ASTM D638	Standard Test Method for Tensile Properties of Plastics
ASTM D790	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D2235	Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D2240	Standard Test Method for Rubber Property—Durometer Hardness
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D7091	Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
ASTM E376	Standard Practice for Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods
ASTM E797	Standard Practice for Measuring Thickness by Manual Ultra-Sonic Pulse-Echo Contact Method
ASTM F412	Standard Terminology Relating to Plastic Piping Systems
ASTM F1216	Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube

3 Definitions and Abbreviations

3.1 Definitions

In addition to the definitions specified in ASTM F412 the following definitions shall apply in this Standard:

Applied in Place Pipe Rehabilitation (AIPPR) — A coating of a thermoplastic resin is adhered to the inside surface of an existing pipe and cured through the natural reaction of the resin components to form a hardened shell integral to the existing pipe.

Note: An AIPPR system is adhered to the inside surface of an existing pipe by means of a spray, brush or spreader filling voids and areas of deteriorated pipe.

Delaminated — Separation of the layers of the AIPPR.

Drip — The presence of overlapping resin to the pipe causing a drip or run of resin in the pipe.

Layers — The process of applying several coats of resin to form the finished new pipe. The number of layers is determined by the standard calculation of partially pipe design

3.2 Abbreviations

The following abbreviations apply in this Standard:

AIPPR — Applied in Place Pipe Rehabilitation

SDR — Standard Dimension Ratio

4 General Requirements

4.1 Materials

Applied in place pipe rehabilitation systems employ a general purpose two component polyurea derived through step-growth polymerization consisting of an isocyanate component and a synthetic resin blend that is compatible with the application process.

The AIPPR must be able to cure in dry pipe conditions and the initiation temperature for cure should be less than 82.2°C (180°F).

4.2 Thickness

The coating thickness shall be as specified by the manufacturer. In no case shall the minimum thickness be less than SDR=100 when calculated in accordance with Equation 1.

Note: Coating thicknesses specified by the manufacturer may vary depending on the pipe size, pipe material and other conditions.

$$\text{Equation 1: } SDR = d_0 / s$$

d_0 = Coating outside diameter
 s = Coating thickness

5 Testing Requirements

5.1 Test Specimen

5.1.1 Preparation

Test specimens may be harvested from the test assembly following the Minimum Thickness Coating test conducted in Section 5.2. When new or additional test samples to those harvested from the test assembly in Section 5.2 are needed, except where specified directly in the test procedures, test specimens shall be prepared as follows:

- (a) Assemble a pipe and fitting connection using two 3m (10 ft) lengths of pipe and one 90-degree fitting.
 - (i) The pipe used for sample preparation shall be new and listed to the applicable standard; and
 - (ii) The fittings used for sample preparation shall be new and listed to the applicable standard;
- (b) Install the AIPPR system into the pipes and fitting assembly and allowed to cure in the lab in accordance with the manufacturers installation instructions.
- (c) Test specimens shall be prepared for each combination of the intended applications indicated by the manufacturer's literature.

5.1.2 Test Cases

Specimens shall be prepared and tested in the combinations required to ensure the intended applications are addressed. At a minimum, test specimens shall be prepared for testing under the following test cases:

- (a) Each type of pipe material that the AIPPR is specified for use in; and,
- (b) The minimum coating thickness specified;

5.2 Minimum Coating Thickness Test

5.2.1 Assembly and Preparation

The test assembly shall be set up for each coating as follows:

- (a) Using appropriate fittings to simulate an actual installation for the pipe material and application (e.g. CPVC processing/pressure pipe system or ABS DWV system).
- (b) Connect five 3 m (10 ft) lengths of pipe.
- (c) Install the AIPPR system in accordance with the manufacturer's instructions to the minimum allowable thickness;
- (d) The coated pipes and fittings shall be allowed to dry in accordance with the manufacturer's installation instructions before use.

5.2.2 Test Procedure

The minimum coating thickness shall be measured in accordance with ASTM D7091, ASTM E376, ASTM E797 or as follows:

- (a) Note the average wall thicknesses of the pipe and fittings before connection and assembly in accordance with Section 5.2.1(b).
 - (i) Measure at least 5 locations, around the pipe and fitting openings and as far inside each as practical.
- (b) Calculate and record the average thicknesses of the pipe and the fittings before installation of the AIPPR system.
- (c) Remove and section the end fitting and at least one additional fitting from the assembly.
- (d) Cut the fittings to obtain a section for measurement of the AIPPR layer (e.g. Bisect axially, longitudinally, or laterally to expose the original fitting thickness and the AIPPR layer to measurement.
- (e) Cut and remove at least six pipe specimens from various locations in the test assembly.
 - (i) Measure the external diameter of the ends of each test specimen (D1)
 - (ii) Measure the internal diameter of the ends of each test specimen (D3);
 - (iii) Measure the thickness of the pipe without the AIPPR layer (T1).

***Note:** If the thickness of the pipe without the AIPPR layer is not clear the average thickness of the pipe measured prior to specimen preparation may be used as (T1).*
 - (iv) Determine the thickness of the AIPPR layer (T3) in accordance with Figure 1 and Equation 2.

$$\text{Equation 2: } T3 = \frac{(D1-D3)}{2} - T1$$

5.2.3 Performance Requirements

The coating thickness shall be uniform throughout the sample with an allowable variation of no more than $\pm 25\%$ from the manufacturers specification.

***Note:** The minimum coating thickness test is intended to confirm that within a practical range a uniform coating can be applied based on manufacturer's instructions.*

5.3 Tear Strength Test

5.3.1 Test Procedure

The pull-off strength test shall be conducted in accordance with ASTM D4541, Test Method E.

5.3.2 Performance Requirements

The surfaces adhesion strength shall be at least 6.9 MPa (1000 psi)

5.4 Shear Test

5.4.1 Test Procedure

The shear test shall be conducted in accordance with Section 7.4, Lap Shear Strength (Qualification Tests) of ASTM D2235 except test specimens shall be 25 by 25 mm (1 by 1 in) cut sections harvested from the test assembly following the Minimum Thickness Coating test conducted in Section 5.2.

5.4.2 Performance Requirements

The minimum shear strength shall be as specified in Table 1.

5.5 Hardness Test

5.5.1 Test Procedure

The hardness test shall be performed in accordance with ASTM D2240 using a Type M durometer.

5.5.2 Performance Requirement

The minimum scratch hardness shall be as specified in Table 1.

5.6 Flexural Strength, Flexural Modulus

5.6.1 Test Procedure

The flexural strength, flexural modulus and elongation tests shall be conducted in accordance with ASTM D790.

5.6.2 Performance Requirements

The flexural strength and flexural modulus shall comply with the minimum requirement specified in Table 1.

5.7 Tensile Strength and Elongation Tests

5.7.1 Test Procedure

The tensile strength and elongation tests shall be conducted in accordance with ASTM D638.

5.7.2 Performance Requirements

The tensile strength and elongation shall comply with the minimum requirement specified in Table 1.

5.8 Gravity Pipe Leakage Test

The gravity pipe leakage test shall be conducted on AIPPR systems intended for use in DWV or other gravity pipe applications.

5.8.1 Test Procedure

The gravity pipe leakage test of the AIPPR system shall be conducted as follows:

- (a) Install the test specimen in accordance with the manufacturer's instructions.
- (b) Conduct the test in accordance with Section 8.2, Gravity Pipe Leakage Testing of ASTM F1216.

5.8.2 Performance Requirements

The allowable water exfiltration shall be as specified in Section 8.2, Gravity Pipe Leakage Testing of ASTM F1216.

5.9 Pressure Pipe Leakage Test

The pressure pipe leakage test shall be conducted on AIPPR systems intended for use in processing, supply or other pressure pipe applications.

5.9.1 Test Procedure

The pressure pipe leakage test of the AIPPR system shall be conducted as follows:

- (a) Install the test specimen in accordance with the manufacturer's instructions.
- (b) Conduct the test in accordance with Section 8.3, Pressure Pipe Testing of ASTM F1216.

5.9.2 Performance Requirements

The allowable water exfiltration shall be as specified in Section 8.3, Pressure Pipe Testing of ASTM F1216.

6 Markings and Accompanying Literature

6.1 The product packaging of applied in place pipe rehabilitation (AIPPR) systems complying with this Standard shall be marked with the:

- (a) manufacturer's name or trademark;
- (b) pipe size, pipe material and system types (e.g. DWV, sanitary sewer, storm sewer, electrical conduit) for which it is intended;
- (c) model number, model name or description of polyurea as applicable.

6.2 Product package markings shall be permanent, legible, and visible.

6.3 AIPPR systems complying with this standard shall be accompanied by instructions for their installation, care and maintenance, and repair and. The Installation instructions shall at a minimum specify that following the installation of internally applied polyurea material used in rehabilitation of plastic and metallic non-potable piping (AIPPR) in a system, the system shall be marked to indicate the presence of the AIPPR liner.

Table 1
Minimum Performance Requirements
(See Sections 5.3, 5.4, 5.5, 5.6, 5.7)

Property	Test Method	Minimum Requirement	
		SI	Imperial
Tear Strength	ASTM D4541, Method E	6.9 MPa	1000 psi
Shear Test	ASTM D2235	0.11 MPa	16 psi
Hardness Test	ASTM D2240	62 N	
Flexural Strength Test Method	ASTM D790	22.0 MPa	3200 psi
Flexural Modulus Test Method	ASTM D790	689.5 MPa	100,000 psi
Elongation	ASTM D638	< 1000 %	
Tensile Strength Test Method	ASTM D638	27.6 MPa	4000 psi

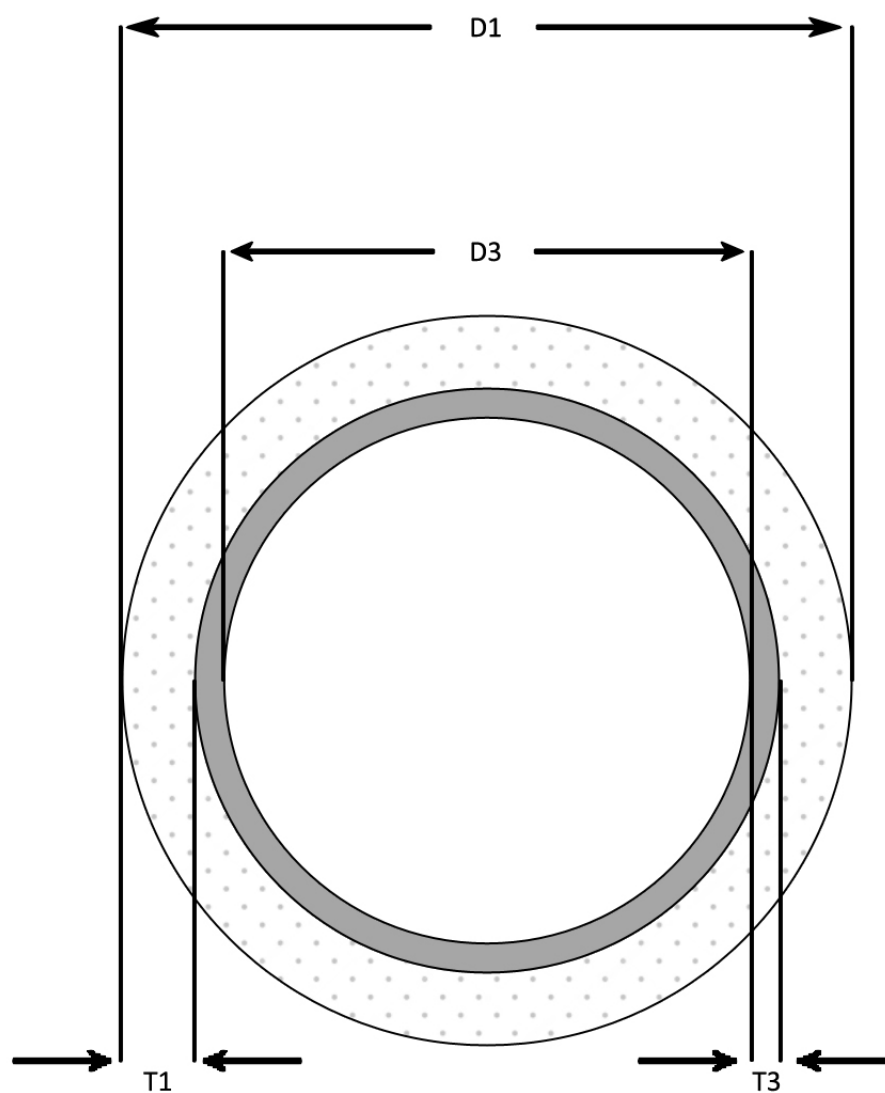


Figure 1
AIPPR Layer Thickness Dimensions
(See Section 5.2.2)