



Designation: A 849 – 00

Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe¹

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This standard has been approved for use by agencies of the Department of Defense.

1. Scope

1.1 This specification covers post-applied coatings, pavings, and linings for corrugated steel pipe and corrugated steel structural plate pipe, pipe-arches, and arches coated, paved, or lined with specified materials over either metallic coatings or metallic coatings with polymer coatings. This specification includes asphalt, polymerized asphalt, polymer, mastic, and emulsion coatings and asphalt and concrete pavements and linings applied to the pipe in the producing plant, as well as, asphalt and mastic coatings applied in the field. Field-applied concrete pavements and linings are covered by Specification A 979/A 979 M. The pipe to which the coatings are applied is described in Specifications A 760/A 760M, A 761/A 761M, and A 762/A 762M.

1.2 There is no cleaning operation currently included in pipe coating practice. However, experience has shown that a clean substrate provides good adherence for both cold- and hot-applied post coatings. The performance of post coating or lining, or both, will depend on the surface cleanliness over which it is applied.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in brackets are for information only.

1.4 The following safety hazards caveat pertains only to the test methods portions, Sections 11 and 12, of this specification. *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.*

2. Referenced Documents

2.1 ASTM Standards:

A 185 Specification for Steel Welded Wire, Fabric, Plain, for Concrete Reinforcement²

A 615/A 615M Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement²
A 742/A 742M Specification for Steel Sheet, Metallic-Coated and Polymer Precoated for Corrugated Steel Pipe³
A 760/A 760M Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains³
A 761/A 761M Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches³
A 762/A 762M Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains³
A 862 Practice for Application of Bituminous (Asphalt) Coatings to Corrugated Steel Sewer and Drainage Pipe³
A 885/A 885M Specification for Steel Sheet, Zinc and Aramid Fiber Composite Coated for Corrugated Steel Sewer, Culvert, and Underdrain Pipe³
A 926 Test Method for Comparing the Abrasion Resistance of Coating Materials for Corrugated Metal Pipe³
A 979/A 979M Specification for Concrete Pavements and Linings Installed in Corrugated Steel Structures in the Field³
C 31/C 31M Practice for Making and Curing Concrete Test Specimens in the Field⁴
C 33 Specification for Concrete Aggregates⁴
C 39 Test Method for Compressive Strength of Cylindrical Concrete Specimens⁴
C 150 Specification for Portland Cement⁵
C 309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete⁴
C 595 Specifications for Blended Hydraulic Cements⁵
C 618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete⁴
C 670 Practice for Preparing Precision and Bias Statements for Test Methods of Construction Materials⁴

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² Annual Book of ASTM Standards, Vol 01.04.

³ Annual Book of ASTM Standards, Vol 01.06.

⁴ Annual Book of ASTM Standards, Vol 04.02.

⁵ Annual Book of ASTM Standards, Vol 04.01.

- D 5 Test Method for Penetration of Bituminous Materials⁶
 D 6 Test Method for Loss on Heating of Oil and Asphaltic Compounds⁷
 D 20 Test Method for Distillation of Road Tars⁶
 D 36 Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)⁷
 D 70 Test Method for Density of Semi-Solid Bituminous Materials (Pycnometer Method)⁶
 D 92 Test Methods for Flash and Fire Points by Cleveland Open Cup⁸
 D 1005 Test Methods for Measurement of Dry-Film Thickness of Organic Coatings Using Micrometers⁹
 D 1187 Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal⁷
 D 2042 Test Method for Solubility of Asphalt Materials in Trichloroethylene⁶
 D 4402 Test Method for Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus⁷

3. Terminology

3.1 Definitions:

3.1.1 *fabricator, n*—refers to the producer of the pipe who generally applies the post coatings, pavings, and linings, except for those pipes that are coated in the field.

3.1.2 *lining, n*—for *corrugated metal pipe*, a layer of nonmetallic material applied to the interior of a fabricated pipe, of sufficient thickness to fill and cover the corrugations.

3.1.3 *manufacturer, n*—refers to the producer of the sheet.

3.1.4 *paving, n*—for *corrugated metal pipe*, a lining applied only to a portion of the interior circumference, usually the lower portion as installed.

3.1.5 *post coating, n*—for *corrugated metal pipe*, a layer of nonmetallic material applied to the interior or exterior surface of the pipe, or both, after fabrication of the pipe.

3.1.6 *Discussion—Coating* is generally used to refer to a layer or layers of material applied to the base metal in sheet form prior to fabrication into pipe. *Post coating* applies to a layer of nonmetallic material applied after fabrication into pipe. Where the context is clear, *coating* may be used in place of *post coating*.

3.1.7 *purchaser, n*—refers to the purchaser of the finished product.

4. Significance and Use

4.1 Post-applied coatings, linings, and pavements are used to improve hydraulic characteristics, corrosion resistance, or abrasion resistance, or a combination thereof. Generally, coatings improve corrosion resistance and are especially effective on the outside (soil side) of the pipe. While coatings improve abrasion resistance to varying degrees, pavements generally are used where abrasion is a significant consideration. Pavements improve abrasion resistance, protect the metallic and other coatings, and increase corrosion resistance. Smooth

pavements, even though they typically cover only the invert of the pipe, improve hydraulic flow characteristics. Full linings and pavements, generally, provide all three benefits.

4.2 Applications:

4.2.1 Asphalt, polymer-modified asphalt, and polymer provide excellent corrosion resistance to the outside (soil side) of the pipe. These materials provide varying degrees of internal (water side) corrosion protection depending on the severity of abrasive flow conditions. Polymer-modified asphalt and polymer coatings provide longer-term protection than asphalt in more abrasive conditions.

4.2.2 Asphalt pavements are used for abrasive conditions. Where conditions involve repeated high flow velocities moving a heavy bed load of gravel or rocks, or both, concrete pavements are appropriate (see Specification A 979/A 979M).

4.2.3 Full asphalt linings enhance hydraulics while providing a completely “paved” interior. Full concrete linings are high-strength concrete that provides a lining similar in thickness to asphalt linings. They enhance hydraulic performance and offer abrasion protection, which is not as effective as the abrasion protection offered by a thicker concrete pavement.

5. Classification

5.1 The post-applied coatings, pavings, and linings are described in this section as a two-step classification procedure. The first classification is the type of coating, paving, or lining material to be used, for example, hot-applied asphalt, concrete, cold-applied mastic, cold-applied emulsion, polymer, or combination thereof. The second is a coating, paving, and lining type giving the physical location of the coating or lining on the pipe (see Table 1).

5.2 Material Classes:

5.2.1 *Class A*—Asphalt,

5.2.2 *Class PA*—Polymer modified asphalt, hot applied,

5.2.3 *Class C*—Concrete,

5.2.4 *Class M*—Mastic, either asphalt base or tar base, cold applied,

5.2.5 *Class P*—Polymer, and

5.2.6 *Class E*—Asphaltic emulsion.

5.3 Coating, Paving, and Lining Types:

5.3.1 *Fully Coated*—A uniform coating applied to the interior and exterior of the pipe.

5.3.2 *Half Coated*—A uniform coating applied to the interior and exterior of the pipe covering at least 50 % of the circumference on the lower portion of the pipe as installed.

5.3.3 *Exterior Coated*—A uniform coating applied to the exterior of the pipe.

TABLE 1 Location and Material Class

Physical Location	A Asphalt, Hot- Applied	PA Polymerized Asphalt, Hot-Applied	C Concrete	M/E Cold- Applied ⁴	P Polymer
Interior-coated	—	—	—	M/E	P
Exterior-coated	—	—	—	M/E	P
Fully-coated	A	PA	—	M/E	P
Half-coated	A	PA	—	M/E	P
Fully-lined	A	—	C	—	—
Invert-paved	A	PA	C	—	P
Invert-coated	—	PA	—	—	P

⁴May be plant or field applied.

⁶ Annual Book of ASTM Standards, Vol 04.03.

⁷ Annual Book of ASTM Standards, Vol 04.04.

⁸ Annual Book of ASTM Standards, Vol 05.01.

⁹ Annual Book of ASTM Standards, Vol 06.01.

5.3.4 *Interior Coated*—A uniform coating applied to the interior of the pipe.

5.3.5 *Invert Coating*—A uniform coating on the lower portion of the interior of the pipe as installed (the invert) to provide abrasion and corrosion resistance without filling the corrugations.

5.3.6 *Invert Paved*—A paving on the lower portion of the interior of the pipe as installed (the invert) to provide an abrasion-resistant smooth flow line.

5.3.7 *Fully Lined*—A lining filling the corrugations on the full interior of the pipe to provide a smooth interior.

6. Ordering Information

6.1 The pipe to be coated shall be described as to the applicable standard (Specification A 760/A 760M, A 761/A 761M, or A 762/A 762M), including all detailed ordering provisions of that specification.

6.2 Orders for pipe coatings to this specification shall include the following information as necessary to adequately describe the desired product,

6.2.1 Class of material,

6.2.2 Type of coating, paving, or lining,

6.2.3 If post coating is to be applied in the plant or in the field (Note 1).

NOTE 1—Class M (mastic) and Class E (emulsions) coatings are suitable for either plant application or field application.

6.2.4 For Class M, whether asphalt base or tar base material,

6.2.5 For concrete *invert paved* material Class C, amount of reinforcement (see 7.2.2.5),

6.2.6 ASTM designation and year of issue,

6.2.7 Certification, if required, on the post coating, and,

6.2.8 Any special requirements.

7. Material Requirements

7.1 *Material Class A (Asphalt Material)*—The asphalt material shall be applied in accordance with Practice A 862 and shall meet the following requirements as applied to a pipe:

7.1.1 *Softening Point*—200°F [93°C] min.

7.1.2 *Penetration (Original Material)*—35 to 65 dmm.

7.1.3 *Penetration (Residue from Loss on Heating)*—85 % of original penetration, min.

7.1.4 *Flash Point*—450°F [232°C] min.

7.1.5 *Solubility*—99 % min.

7.1.6 *Specific Gravity*—0.98 min at 77°F [25°C].

7.1.7 *Loss on Heating*—1 % max.

7.1.8 *Shock*—The asphalt shall be considered acceptable if not more than one of the four test specimens shows a crack. Test as described in 11.2.

7.1.9 *Flow*—The asphalt shall be considered acceptable if the flow does not exceed $\frac{3}{8}$ in. [9.5 mm] for either of the two test specimens. Test as described in 11.3.

7.1.10 *Imperviousness*—There shall not be any loosening or separation of the asphalt coating from the substrate at the end of 48 h when tested as described in 11.4.

7.2 *Material Class C (Concrete Material)*—Full concrete linings shall meet the requirements of 7.2.1. Concrete paved inverts shall meet the requirements of 7.2.2.

7.2.1 *Concrete Linings*—Full concrete linings shall cover 100 % of the pipe circumference. Linings shall be placed by a machine that, in one or more passes, completely fills the corrugation and provides a minimum $\frac{1}{8}$ in. [3.2 mm] concrete thickness over the corrugation crests. Hand placement methods are acceptable for lining fittings and elbows when machine placement is not practical and the above results are achieved. The lining shall conform to the shape of the pipe and have a troweled surface finish meeting the requirements of 9.1.2.1.

7.2.1.1 The concrete shall be composed of cement, fly ash (when used), fine aggregates, and water that are well mixed and of such consistency as to produce a dense, homogeneous, nonsegregated lining. In no case shall the proportions of portland cement, blended cement, or portland cement plus pozzolanic material in the mixture be less than 470 lb/yd³ [279 kg/m³] of concrete. The concrete mix shall provide a minimum seven day compressive strength of 5000 psi [34.5 MPa] when tested in accordance with Practice C 31 and Test Method C 39. Concrete linings shall be cured to meet the requirements of 7.2.3. All concrete shall have a water-cement ratio not exceeding 0.50 by weight.

7.2.1.2 *Cement*—Cement shall conform to the requirements of Specification C 150, Type I or II or Specification C 595, Type IP. When Type IP cement is used, no fly ash shall be used in the mix.

7.2.1.3 *Fly Ash*—Fly ash shall conform to the requirements of Specification C 618, Class F or Class C. When fly ash is used, it shall not exceed 20 % by weight of the total cementitious materials in the mix.

7.2.1.4 *Aggregates*—Aggregates shall conform to the requirements of Specification C 33 except that the requirement for gradation and uniformity of gradation shall not apply. The aggregate shall be well graded with 100 % passing the No. 16 [1.18 mm] sieve with no more than 5 % passing the No. 100 [150 μ m] sieve.

7.2.1.5 Only potable water shall be used.

7.2.2 *Concrete Pavements*—Special pavement designs that meet or exceed the requirements of this specification shall be fully detailed in the purchase documents. In lieu of a special design, pavements shall cover the bottom 25 % of a round pipe's circumference and the 40 % of the circumference of a pipe arch that constitutes the invert. Pavements shall conform to the shape of the pipe and have either a screeded or troweled surface finish as specified in the purchase documents. The troweled finish shall meet the requirements of 9.1.2.1.

7.2.2.1 The pavement shall provide a minimum 3 in. [76.2 mm] thickness over the corrugation crests, when concrete with a minimum 28-day compressive strength of 3250 psi [22.4 MPa] is used. Alternatively, the pavement shall provide a minimum $1\frac{1}{2}$ in. [38.1 mm] thickness over the corrugation crests, when concrete with a minimum 28-day compressive strength of 9600 psi [66.2 MPa] is used. Concrete compressive strength shall be determined in accordance with Practice C 31 and Test Method C 39. All concrete pavements shall be cured to meet the requirements of 7.2.3.

7.2.2.2 *Cement*—The cement to be used shall be Type II portland cement conforming to Specification C 150 with alkali content not more than 0.60 % expressed as Na₂O + 0.658 K₂O.