



Designation: A882/A882M – 20

Standard Specification for Filled Epoxy-Coated Seven-Wire Steel Prestressing Strand¹

This standard is issued under the fixed designation A882/A882M; 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 seven-wire steel prestressing strand with protective fusion-bonded epoxy powder coating applied by the electrostatic deposition method or other suitable method, with the interstices of the seven wires filled with epoxy to minimize migration of corrosive media, either by capillary action or other hydrostatic forces.

NOTE 1—The manufacturer as identified throughout this specification is the coating applicator.

1.2 A supplementary requirement (S1) is provided for use where bond strength testing of 0.600-in. [15.24-mm] diameter grade 270 [1860] epoxy-coated strand for applications in prestressed ground anchors is required by the purchaser. The supplementary requirement applies only when specified in the purchase order or contract.

1.3 Requirements for epoxy powder coatings are contained in **Annex A1**.

1.4 The text of this specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables) shall not be considered as requirements of the specification.

1.5 This specification is applicable for orders in either inch-pound units (as Specification A882) or SI units [as Specification A882M].

1.6 The values stated in either SI units or inch-pound units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the specification.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

¹ This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.05 on Steel Reinforcement.

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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:²

A416/A416M Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

A981/A981M Test Method for Evaluating Bond Strength for 0.600-in. [15.24-mm] Diameter Steel Prestressing Strand, Grade 270 [1860], Uncoated, Used in Prestressed Ground Anchors

A1061/A1061M Test Methods for Testing Multi-Wire Steel Prestressing Strand

B117 Practice for Operating Salt Spray (Fog) Apparatus

D968 Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive

D7091 Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals

G14 Test Method for Impact Resistance of Pipeline Coatings (Falling Weight Test)

G20 Test Method for Chemical Resistance of Pipeline Coatings

2.2 Federal Highway Administration Report:³

FHWA-RD-74-18 Nonmetallic Coatings for Concrete Reinforcing Bars (February 1974)

2.3 SSPC Specification:⁴

SSPC-PA 2 Procedure for Determining Conformance to Dry Coating Thickness Requirements

2.4 U.S. Military Standard:⁵

MIL-STD-129 Marking for Shipment and Storage

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 National Technical Information Service (NTIS), 5285 Port Royal Rd., Springfield, VA 22161, <http://www.ntis.gov>.

⁴ Available from Society for Protective Coatings (SSPC), 800 Trumbull Dr., Pittsburgh, PA 15205, <http://www.sspc.org>.

⁵ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

2.5 U.S. Federal Standard:⁵

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *batch, n*—epoxy powder or patching material contained in an individual shipping release or shipping order.

3.1.2 *disbonding, n*—loss of adhesion between the fusion-bonded epoxy coating and the steel strand wires.

3.1.3 *fusion-bonded epoxy coating, n*—a product containing pigments, thermo-setting epoxy resins, cross-linking agents, and other substances, which is applied in the form of powder onto a clean, heated metallic substrate and fuses to form a continuous barrier coating.

3.1.4 *grit, n*—inert particles impregnated on the outer surface of the epoxy coating for improving bond with cement grout.

3.1.5 *holiday, n*—a flaw, void, crack, thin spot, foreign inclusion, or contamination in the coating film that significantly lowers the dielectric strength of the coating film. A holiday may also be identified as a pinhole.

3.1.6 *lot, n*—epoxy-coated strand of one size contained in an individual shipping release or shipping order.

3.1.7 *patching material, n*—a liquid two-part epoxy coating used to repair damaged coating, to coat the locations of holidays on a coated strand, or to coat uncoated areas on the surface of a coated strand.

4. Ordering Information

4.1 Orders for epoxy-coated seven-wire steel prestressing strand under this specification shall contain the following information:

4.1.1 Nominal diameter of uncoated strand in accordance with Specification **A416/A416M**,

4.1.2 Grade of uncoated strand in accordance with Specification **A416/A416M (5.1)**,

4.1.3 Smooth or grit-impregnated coating (**7.3**).

4.1.4 Quantity (in feet [metres]), and

4.1.5 ASTM designation A882 [A882M] and year of issue.

4.2 The purchaser shall have the option to specify additional requirements, including but not limited to, the following:

4.2.1 Certification of each batch of epoxy powder coating (**5.2.1**),

4.2.2 Representative sample of epoxy powder coating (**5.3**),

4.2.3 Requirements for patching material (**5.4**),

4.2.4 Additional pull-out tests (**9.1**),

4.2.5 Requirements for inspection (**11.1**),

4.2.6 Manufacturer's quality control tests (**13.1**),

4.2.7 Load-elongation curve (**13.2**),

4.2.8 Packaging and package marking (Section **14**),

4.2.9 Supplementary Requirement S1, and

4.2.10 Other special requirements, if any.

5. Materials

5.1 Seven-wire steel prestressing strand to be coated shall conform to Specification **A416/A416M**. The strand grade shall

be specified by the purchaser and shall be free of contaminants such as oil, grease, or paint.

5.1.1 Filled epoxy-coated strand shall not exhibit relaxation losses of more than 6.5 % after 1000 hours, when initially loaded to 70 % of the specified minimum breaking strength of the strand and tested under the conditions of Test Methods **A1061/A1061M**.

5.2 The epoxy powder coating shall meet the requirements listed in **Annex A1**. The epoxy powder coating shall be of organic composition except for the pigment, or grit if applicable, which may be inorganic if used.

5.2.1 A written certification shall be furnished to the purchaser that properly identifies the number of each batch of epoxy powder coating used in the purchase order, material quantity represented, date of manufacture, name and address of epoxy powder coating manufacturer, and a statement that the supplied epoxy powder coating is the same composition as that qualified in accordance with **Annex A1**.

5.3 If specified in the purchase order or contract, a representative 8-oz [0.2-kg] sample of the epoxy powder coating shall be supplied to the purchaser from each batch. The sample shall be packaged in an airtight container and identified by batch number.

5.4 If specified in the purchase order or contract, patching material for repairing damaged epoxy coating shall be supplied to the purchaser. The patching material shall be compatible with the coating and inert in concrete. The manufacturer of the patching material shall specify the steel and epoxy surface preparation, the minimum coating thickness, and the procedures for application of the patching material.

6. Surface Preparation

6.1 The surface of the steel strand to be coated shall be cleaned chemically or by another method that will impart the same cleanliness to ensure that the coated strand meets the requirements of Section **8**.

7. Application of Coating

7.1 The epoxy powder coating shall be applied to the cleaned surface as soon as possible after cleaning and before oxidation of the surface visible to a person with normal or corrected vision occurs.

7.2 The epoxy powder coating shall be applied by the electrostatic deposition method, or other method that will meet the coating requirements in Section **8**, and fully cured in accordance with the recommendations of the manufacturer of the epoxy powder coating.

7.3 The epoxy coating on the surface of the strand shall be smooth or grit-impregnated, as specified by the purchaser.

7.3.1 For grit-impregnated coated strand, inert particles (grit) shall be impregnated into the surface of the coating. Such particles shall not cause the coating to fail the requirements of Section **8**. The particles shall be inert in concrete and non-reactive with concrete additives and soluble salts.

7.3.2 The epoxy coating on the surface of grit-impregnated strand shall be capable of reaching a temperature of 150°F

[66°C] without reducing the transfer of prestress by bond from the strand to the surrounding concrete.

NOTE 2—At temperatures above 165°F [74°C], currently available epoxy begins to soften and lose its ability to transfer prestress from the strand to the concrete by bond. At 200°F [93°C] practically all transfer capacity will be lost.

8. Requirements for Coated Strands

8.1 Thickness of Coating:

8.1.1 The coating thickness after curing shall be 15 to 45 mils [380 to 1140 µm].

8.1.2 Thickness measurements shall be made in accordance with SSPC-PA 2, following the magnetic gauge manufacturer’s instructions for calibration and use; and in accordance with Section 5.2.1 of Test Method D7091, the foil shall be placed on the surface of the uncoated strand instead of on the steel plate. Pull-off or fixed probe gauges shall be used. “Pencil-type” pull-off gauges that require the operator to observe the reading at the instant the magnet is pulled from the surface shall not be used. The magnetic gauge shall be capable of measuring the coating thickness of a coated wire of circular cross-section with a diameter in the range of 0.1 to 0.3 in. [2.5 to 7.5 mm]. The allowable error on a single measurement of the coating thickness on the coated crown of an outer wire of the strand shall be ±5 %.

8.1.3 The coating thickness shall be measured on the crown of each of the six outer wires at least every 2000 ft [600 m] of continuous strand.

8.2 Continuity of Coating:

8.2.1 After application of the coating, a continuous in-line holiday detection procedure shall be employed using an aqueous electrolyte and a holiday detector with a minimum voltage setting of 67.5 V DC, following the procedure furnished by its manufacturer. The approximate location of holidays shall be recorded using automatic devices or markings on the strand for later patching.

8.2.2 During the continuous holiday detection procedure, all holidays shall be coated with patching material in accordance with the written recommendations of the patching material manufacturer. Coating of the locations of the holidays shall be performed such that the total thickness of the coating on the surface of the strand and the patching material complies with the requirements of 8.1.

NOTE 3—Hand-held holiday detector checks should be performed regularly to verify the accuracy of the in-line system.

8.3 Adhesion of Coating:

8.3.1 The adhesion of the coating shall be evaluated by bending a sample from a reel of coated strand 180° around a mandrel with a diameter equal to 32 times the nominal diameter of the strand. The test specimens shall be at thermal equilibrium between 68 and 86°F [20 and 30°C].

8.3.2 No cracking or disbonding of the coating shall be visible to a person with normal or corrected vision on the outside radius of the bent strand. Evidence of cracking or disbonding of the coating shall be considered cause for rejection of the coated strand represented by the bend test specimen. Retests shall be conducted in accordance with 10.1.

8.3.3 Fracture of an individual wire, or wires, or the strand itself in the bend test for adhesion of coating shall not be considered as an adhesion failure of the coating, and another specimen from the same production shift may be substituted.

8.3.4 The adhesion of coating shall also be evaluated by a tension test in accordance with Section 9 of Test Methods A1061/A1061M. The coated strand shall satisfy the requirements in Specification A416/A416M for breaking strength, yield strength, and total elongation. No cracks visible to a person with normal or corrected vision shall occur in the coating up to an elongation corresponding to the specified minimum yield strength.

8.3.5 Specimen length for the bend test shall be at least 5 ft, 0 in. long [1500 mm]. Specimen length for the tension test shall conform to the requirements of Test Methods A1061/A1061M.

8.4 Bond with Concrete or Grout:

8.4.1 Pull-out tests shall be conducted on grit-impregnated coated strand to ensure proper bond properties. Pull-out specimens shall be cast in concrete cylinders with dimensions shown in Table 1. The untensioned strand shall be embedded concentrically along the longitudinal axis of the specimen. The minimum force at 0.001 in. [0.025 mm] slip shall be applied as shown in Fig. 1, by a hydraulic or mechanical jack when the concrete reaches a compressive strength between 4000 and 5000 psi [30 and 35 MPa], and measured with a calibrated load indicator at a slip of 0.001 in. [0.025 mm]. A dial gauge shall be used at the unloaded end to indicate slip. Minimum force at 0.001 in. [0.025 mm] slip shall be at least equal to or greater than the values shown in Table 1.

9. Number of Tests

9.1 Three pullout tests shall be performed annually as a minimum or repeated when a process change is made that could decrease the bond capacity of the epoxy-coated strand. The purchaser shall have the right to request additional pullout tests to be performed on the lot of epoxy-coated strand ordered.

10. Retests

10.1 If the specimen for coating thickness, continuity, adhesion of coating, and pull-out tests fail to meet the specified requirements, two retest samples adjacent to the first specimen from the same reel shall be conducted for each failed test. If the results of both retests meet the specified requirements, the reels represented by the specimens shall be accepted.

TABLE 1 Requirements for Pull-Out Tests

Strand Diameter		Cylinder Diameter		Embedment Length		Minimum Force at 0.001 in. [0.025 mm] Slip	
in.	mm	in.	mm	in.	mm	lbf	kN
1/4 (0.250)	6.35	6	152	8.5	216	1700	7.56
5/16 (0.313)	7.94	6	152	8.0	203	1960	8.72
3/8 (0.375)	9.53	6	152	7.5	190	2210	9.83
7/16 (0.438)	11.11	6	152	6.5	165	2230	9.92
1/2 (0.500)	12.70	6	152	6.0	152	2350	10.45
9/16 (0.600)	15.25	6	152	5.5	140	2590	11.52