



# Standard Specification for Epoxy-Coated Steel Dowels for Concrete Pavement<sup>1</sup>

This standard is issued under the fixed designation A1078/A1078M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

<sup>ε1</sup> NOTE—Editorial corrections were made to 7.7 in August 2015.

## 1. Scope

1.1 This specification covers plain steel dowel bars with protective fusion-bonded epoxy coating for use in concrete pavements.

1.2 This specification is applicable for orders in either inch-pound units (as Specification A1078) or in SI units (as Specification A1078M).

1.3 The values stated in either inch-pound or SI 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 this specification.

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.*

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

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

**A615/A615M** Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

**A775/A775M** Specification for Epoxy-Coated Steel Reinforcing Bars

**A934/A934M** Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars

**A1055/A1055M** Specification for Zinc and Epoxy Dual-Coated Steel Reinforcing Bars

**D4417** Test Methods for Field Measurement of Surface

### Profile of Blast Cleaned Steel

### 2.2 Society for Protective Coatings (SSPC):<sup>3</sup>

**SSPC-PA 2** Measurement of Dry Coating Thickness with Magnetic Gauges

**SSPC-SP 10** Near-White Blast Cleaning

**SSPC-VIS 1** Pictorial Surface Preparation Standards for Painting Steel Surfaces

### 2.3 Concrete Reinforcing Steel Institute Documents:<sup>4</sup>

**CRSI Voluntary Certification Program** for Fusion Bonded Epoxy Coating Applicator Plants

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

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

3.1.2 *final coat, n*—the last application of the Type 1 or Type 2 coating.

3.1.3 *holiday, n*—discontinuity in a coating that is not discernible to a person with normal or corrected vision.

3.1.4 *patching material, n*—liquid two-part epoxy coating used to repair damaged or uncoated areas.

3.1.5 *plain bar, n*—steel bar without protrusions.

3.1.6 *pretreatment, n*—a preparation of the blast-cleaned steel surface prior to coating application that is formulated to pre-treat the metal to promote coating adhesion, reduce metal/coating reactions, improve corrosion resistance, and increase blister resistance.

3.1.7 *Type 1 coating, n*—epoxy powder coating meeting Annex A1 of Specification **A775/A775M** or Annex A1 of Specification **A1055/A1055M**.

3.1.8 *Type 2 coating, n*—epoxy powder coating meeting Annex A1 of Specification **A934/A934M**.

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from Society for Protective Coatings (SSPC), 40 24th St., 6th Floor, Pittsburgh, PA 15222-4656, <http://www.sspc.org>.

<sup>4</sup> Available from Concrete Reinforcing Steel Institute (CRSI), 933 N. Plum Grove Rd., Schaumburg, IL 60173-4758, <http://www.crsi.org>.

## 4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for the coated dowels under this specification. Such requirements to be considered include, but are not limited to, the following:

- 4.1.1 Quantity of dowels;
- 4.1.2 Specification for plain bars, if other than **A615/A615M**, and year of issue (5.1);
- 4.1.3 Diameter of dowels (5.3);
- 4.1.4 Length of dowels, if other than 18 in. (5.4);
- 4.1.5 Grade of steel if other than Grade 60 [420] (5.1)
- 4.1.6 Type of coating (5.5);
- 4.1.7 Test report for type of coating used, if desired (5.6);
- 4.1.8 Sample of epoxy powder (5.10);
- 4.1.9 Quantity of patching material (5.11);
- 4.1.10 Pretreatment of the abrasive blast-cleaned steel surface, if required (6.5);
- 4.1.11 Cutting of dowels with Type 2 coating, if permitted (7.6);
- 4.1.12 Requirements for patching (7.7);
- 4.1.13 Coating thickness, if other than greater than 8 mils [200  $\mu$ m] (8.1.1);
- 4.1.14 Place of testing, if other than manufacturers plant (8.2.3);
- 4.1.15 Timing of holiday checks for Type 1 coatings, if other than before cutting (8.2.2);
- 4.1.16 Report on tests performed on the coated dowels being furnished, if required (8.3.3);
- 4.1.17 Specific requirements for number of tests and frequency of tests (Section 9);
- 4.1.18 Additional specimens to be provided to the purchaser for testing from the coated dowels being furnished, if required (12.2);
- 4.1.19 Patching of dowels prior to shipment, if waived (13.1);
- 4.1.20 Thickness of patching material, if other than as specified in Specifications **A775/A775M**, **A1055/A1055M**, or **A934/A934M** (13.3); and
- 4.1.21 Manufacturer qualification and certification requirements (if any).

NOTE 2—It is recommended that the coating application procedures and processes be audited by an independent certification program for epoxy coating applicator plants such as that provided by the CRSI Voluntary Certification Program, or equivalent.

## 5. Materials

5.1 Dowels shall consist of plain bars. Unless otherwise specified, the bars shall be Grade 60 [420] and conform to Specification A615 [Specification A615M]. The bars shall be free of contaminants such as oil, grease, paint or chlorides.

5.2 Incoming steel found to be salt contaminated shall be rejected.

5.3 Dowels shall be 1¼ in. [32 mm] or 1½ in. [38 mm] in diameter or as specified by the purchaser.

5.4 The coated dowels shall have an overall length of 18 in. [460 mm] or as specified by the purchaser.

5.5 The coating type shall be specified by the purchaser. Type 1 coatings shall be qualified in accordance with Annex A1 of Specification **A775/A775M** or Specification **A1055/A1055M**. Type 2 coatings shall be qualified in accordance with Annex A1 of Specification **A934/A934M**.

5.6 Upon request, the purchaser shall be provided with the test report for coatings used.

5.7 A written certification shall be furnished to the purchaser that properly identifies the designation of each lot of epoxy powder coating used in the order, material quantity represented, date of manufacture, name and address of the epoxy powder coating manufacturer, and a statement that the supplied powder coating is the same composition as that qualified in accordance with 5.5.

5.8 The powder coating shall be stored in a temperature-controlled environment following the documented recommendations of the powder coating manufacturer until ready for use. At this point, if the storage temperature is below the plant ambient temperature, the powder coating shall be given sufficient time to reach a temperature that is within  $\pm 5^{\circ}\text{F}$  [ $\pm 2^{\circ}\text{C}$ ] of the plant ambient temperature.

5.9 The powder coating shall be used within the powder coating manufacturer's written recommended shelf life.

5.10 If specified in the order, 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 lot number.

5.11 If specified in the order, patching material, compatible with the coating, inert in concrete and recommended by the coating manufacturer shall be supplied to the purchaser.

## 6. Surface Preparation

6.1 Blast media found to be salt contaminated from exposure to deicing salt, salt spray or the manufacturing process, shall not be used.

6.2 The surface of the steel to be coated shall be cleaned by abrasive blast-cleaning to near-white metal in accordance with SSPC-SP 10. The final surface condition shall be defined according to SSPC-VIS 1.

6.3 Average blast profile maximum roughness depth readings of 1.5 to 4.0 mils [40 to 100  $\mu$ m] as determined by the use of a profilometer type surface measurement instrument that measures the peak count as well as the maximum profile depth, according to Test Methods **D4417**, Method B, or as determined by replica tape measurements using Test Methods **D4417**, Method C, shall be considered suitable as an anchor pattern.

6.4 Multidirectional, high-pressure, dry air knives shall be used after blast cleaning to remove dust, grit, and other foreign matter from the steel surface. The air knives shall not deposit oil on the steel.

6.5 Pretreatment of the blast-cleaned steel shall be applied when specified by the purchaser. The pretreatment shall be applied after abrasive cleaning and before coating, in accordance with the written application instructions specified by the

pretreatment manufacturer. If compatible with the epoxy powder coating, additional steel pretreatments prior to coating with the epoxy may be specified by the purchaser.

## 7. Coating Application

7.1 The epoxy powder coating shall be applied to the cleaned steel surface as soon as possible after steel surface treatments have been completed and before visible oxidation of the steel surface is discernible to a person with normal or corrected vision. In no case shall application of the coating be delayed more than 3 hours after cleaning.

7.2 The epoxy powder coating shall be applied in accordance with the written recommendations of the manufacturer of the powder coating for initial steel surface temperature range and post-application cure requirements.

7.3 During continuous operations, the temperature of the steel surface immediately prior to coating shall be measured using infrared guns or temperature-indicating crayons, or both, at least once every 30 minutes.

NOTE 3—The use of temperature-indicating crayons prior to coating and infrared guns after coating are recommended.

7.4 The coating shall be applied by electrostatic spray or other suitable method, in one or more coating applications.

7.5 It is permissible to saw-cut or shear dowels with Type 1 coating. The ends of the dowels shall be free of burrs and projections. Coated dowels shall not be flame cut.

7.6 Dowels with Type 2 coating shall not be cut after the final coating application unless permitted by the purchaser.

7.7 Unless otherwise specified, cut ends of coated dowels shall be coated with a minimum thickness of 5 mil [125 µm] of patching material meeting Specification **A775/A775M**, Annex A2, or Specification **A1055/A1055M** for Type 1 coatings; or Specification **A934/A934M** for Type 2 coatings.

7.8 Multiple applications of repair material shall be permitted.

## 8. Requirements For Coated Dowels

### 8.1 Coating Thickness:

8.1.1 The coating thickness after curing for Type 1 and Type 2 coatings shall be greater than 8 mils [200 µm] or as requested by the purchaser in the purchase order or contract.

8.1.2 A single recorded coating thickness measurement is the average of three individual gauge readings. A minimum of five recorded measurements shall be taken approximately evenly spaced along opposite sides of the test specimen (A minimum of 10 recorded measurements per test specimen). No individual gauge reading shall be taken closer than 0.5 in. [13 mm] of the dowel ends.

8.1.3 For acceptance purposes, the average of all coating thickness measurements shall not be less than the specified minimum thickness. No single coating thickness measurement shall be less than 80 % of the specified minimum thickness.

8.1.4 Measurements shall be made in accordance with SSPC-PA 2 following the instructions for calibration and use recommended by the thickness gauge manufacturer. 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.

### 8.2 Coating Continuity:

8.2.1 There shall not be more than an average of one holiday per foot [three holidays per metre] on the coated dowel.

8.2.2 Holiday checks to determine conformance with **8.2.1** shall be made at the manufacturer's plant with a 67.5-V, 80 000-ohm, wet-sponge-type direct current holiday detector. For dowels that are cut after the coating application, coating continuity may be conducted prior to cutting, unless otherwise specified by the purchaser.

NOTE 4—Holiday detection is generally intended for in-process use, but can be used for outside testing for quality control purposes.

8.2.3 *Place of Testing*—Testing of coated dowels shall be done at the manufacturer's plant prior to shipment or as specified by the purchaser.

### 8.3 Coating Adhesion:

8.3.1 For Type 1 coatings, perform the cathodic disbondment test in accordance with Specification **A775/A775M** or Specification **A1055/A1055M**, Annex Section A1.3.2.

8.3.2 For Type 2 coatings, perform the cathodic disbondment test in accordance with Specification **A934/A934M**, Section 9.4.

NOTE 5—It is recommended that the manufacturer retain test specimens for 30 days of production and use a 30-day rolling average of coating disbondment test data as a basis for its statistical process control program for the steel dowel coating operation.

8.3.3 Data from testing pertaining to the coated dowels being furnished shall be made available to the purchaser upon request.

## 9. Number of Tests

9.1 The purchaser shall have the option to specify the sampling and test schedule for the number and frequency of tests for coating thickness, adhesion, and continuity.

9.2 If the number and frequency of tests are not specified by the purchaser, tests for coating thickness and continuity shall be made on a minimum of one coated dowel of each diameter of dowels coated during each hour of production.

9.3 Coating adhesion tests as measured by cathodic disbondment testing shall be conducted on at least one dowel every eight production hours.

## 10. Retests

10.1 If the specimen for coating thickness, continuity, or coating adhesion test fails to meet the specified requirements, two retests on random specimens shall be conducted for each failed test. Both retest specimens shall meet the requirements of this specification.

## 11. Handling And Identification

### 11.1 Handling:

11.1.1 All systems for handling coated dowels shall have padded contact areas.

11.1.2 Bundling bands shall be padded, or suitable banding shall be used to prevent damage to the coating.

11.1.3 Bundles of coated dowels shall be transported to minimize damage. They shall be stored off the ground on protective cribbing or surfaces.

11.1.4 Coated dowels shall not be dropped or dragged.

#### 11.2 *Storage:*

11.2.1 If circumstances require storing coated dowels outdoors for more than two months, protective storage measures shall be implemented to protect the coated dowels from sunlight, salt spray, and weather exposure.

11.2.2 If the manufacturer stores coated dowels without protective covering, the date on which the coated dowels are placed outdoors shall be recorded on its identification tag.

11.2.3 Coated dowels or bundles of coated dowels, shall be covered with opaque polyethylene sheeting or other suitable opaque protective material.

11.2.4 For stacked coated dowels, the protective covering shall be draped around the perimeter of the stack.

11.2.5 The covering shall be secured adequately and allow for air circulation around the coated dowels to minimize condensation under the covering.

### 12. Inspection

12.1 The inspector representing the purchaser shall have free entry, at all times while work on the contract of the purchaser is being performed, to all parts of the manufacturer's coating-plant that concern the manufacture of the coated-dowels ordered. The manufacturer shall afford the inspector reasonable access to the plant to satisfy the inspector that the material is being furnished in accordance with this specification. All tests (except product analysis) and inspection, shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the manufacturer's operation.

12.2 At a mutually agreed upon frequency, the purchaser or the purchaser's representative shall be permitted to take coated specimens from the production run for testing.

### 13. Permissible Amount of Damaged Coating Due To Handling and Processing

13.1 Prior to shipment, all areas of exposed steel on each coated dowel shall be repaired with patching material, unless waived by the purchaser.

13.2 Uncoated areas that result from hanging or supporting dowels during the coating application process shall be repaired with patching material.

13.3 Unless otherwise specified, repaired areas shall have a minimum coating thickness as specified in either Specification

**A775/A775M** or Specification **A1055/A1055M** for Type 1 coatings or Specification **A934/A934M** for Type 2 coatings.

13.4 The coating thickness shall be measured in accordance with SSPC-PA 2 at a single location.

13.5 Multiple applications of repair material shall be permitted.

13.6 The maximum amount of repaired damaged coating shall not exceed 1 % of the total surface area of each dowel. This limit shall not include dowel ends that are coated with patching material.

13.7 Patching shall be done in accordance with the patching material manufacturer's written recommendations.

### 14. Rejection

14.1 Coated dowels represented by test specimens that do not meet the requirements of this specification shall be rejected and marked with contrasting color paint or other suitable identification. At the manufacturer's option, the affected lot shall be replaced or, alternately, stripped of coating, re-cleaned, recoated, and resubmitted for acceptance testing in accordance with the requirements of this specification.

### 15. Certification

15.1 At the time of shipment, the purchaser shall be furnished with a written certification that specimens representing each lot of coated dowels have been either tested or inspected as required by this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

15.2 A material test report, certificate of inspection, or similar document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifier's facility. The content of the EDI transmitted document shall meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the manufacturer. Notwithstanding the absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

NOTE 6—The industry definition as invoked here is: EDI is the computer-to-computer exchange of business information in a standard format such as ANSI ASC X12.

### 16. Keywords

16.1 coating requirements; concrete pavement; epoxy coating; steel dowels

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