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Ballot Action: New Standard

Rationale: A continuous process has been developed to coat reinforcing bar products with zinc. This proposed specification describes the product requirements, which includes a coating that meets the bend test requirements of the substrate reinforcing bar specification without peeling or flaking.

Standard Specification for Zinc-Coated (Continuous Hot-Dip) Steel Bars for Concrete Reinforcement¹

This standard is issued under the fixed designation Annnn/AnnnnM; 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 steel reinforcing bars, with protective zinc coatings applied by the continuous hot-dip process.

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

1.3 The values stated in either inch-pound or SI units are to be regarded as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents. Therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with this specification.

2. Referenced Documents

2.1 ASTM Standards:²

A90/A90M Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings

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

A706/A706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

A780/A780M Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

A996/A996M Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

B487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

B852 Specification for Continuous Galvanizing Grade (CGG) Zinc Alloys for Hot-Dip Galvanizing of Sheet Steel

E376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods

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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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. Ordering Information

3.1 Orders for zinc-coated (continuous hot-dip) steel bars for concrete reinforcement shall contain the following information:

- 3.1.1 Quantity of bars;
- 3.1.2 Diameter of bars;
- 3.1.3 Reinforcing bar specification (ASTM designation and year of issue) and grade;
- 3.1.4 Inspection requirements (7); and
- 3.1.5 Specific requirements for number of tests and frequency of tests.
- 3.2 The purchaser shall have the option to specify additional requirements, including but not limited to, the following:
 - 3.2.1 Specification for plain bars, if other than A615/A615M, and year of issue (5.1);
 - 3.2.2 Length of bars;
 - 3.2.3 Chromate treated or not chromate treated (4.4)
 - 3.2.4 Test report for coating weight [mass] or thickness

4. Galvanizing

4.1 Coating Bath Metal:

4.1.1 The bath metal used to produce continuous hot-dip zinc-coated (galvanized) steel reinforcing bars shall meet the requirements of B852.

4.2 Coating Process:

4.2.1 The reinforcing bars shall be coated by passing individual bars through a zinc-flooded trough or tube located above a zinc bath, then immediately through an air or steam wiping device to remove excess zinc from the bars.

NOTE 2—During the wiping process, care should be taken to maintain a uniformly thick coating around the perimeter of the bar.

4.2.2 It shall be the responsibility of the galvanizer to maintain identity of the reinforcing bars throughout the galvanizing process and to the point of shipment.

4.3 Weight [mass] of Coating and Testing:

4.3.1 The weight [mass] of zinc coating per unit area of the bar shall not be less than 360 g/m² [1.20 oz/ft²].

4.3.1.1 If the coating thickness is requested in inches (in.) [micrometres (μm)], it shall be calculated by the formula:

$$t = w/588 \text{ [m/7.14]}$$

where

t = thickness in in. [μm]

w [m] = weight [mass] per unit area

NOTE 3—The nominal diameter of a deformed bar is equivalent to that of a plain round bar having the same weight per foot [mass per metre] as the deformed bar. Coating weight [mass] shown is based on an assumed area ratio of 1.2:1 (actual to nominal surface area of the steel reinforcing bar).

4.3.2 *Magnetic Thickness Measurements*—The weight [mass] of the coating shall be determined by magnetic thickness gage measurements in accordance with Practice E376. One or more of the following methods shall be used to referee the results obtained by magnetic thickness measurements.

4.3.2.1 *Stripping Method*—The weight [mass] shall be determined by stripping the coating from the steel reinforcing bar section in accordance with Test Method A90/A90M.

NOTE 4—This is a destructive test appropriate for small samples of a minimum of 3 in.² [2000 mm²] of surface area.

4.3.2.2 *Microscopy*—The weight [mass] shall be determined by cross-sectional and optical measurement in accordance with Test Method B487. A cross-section sample of the steel shall be polished and examined with an optical microscope to determine the coating thickness. The coating weight [mass] shall be determined by multiplying coating thickness by the surface area of the coated sample and by the density of zinc.

4.3.3 *Number of Tests*—For determination of the coating weight [mass], three random samples shall be tested from each lot. For each magnetic thickness measurement sample, five or more measurements shall be made at various points throughout



the sample so as to represent the entire surface of the sample. A total of at least fifteen measurements shall be averaged to obtain the coating thickness. For the microscopy method, five samples shall be tested per lot. Each sample shall be measured on four sides and the total of twenty measurements shall be averaged to obtain the coating thickness. For the stripping method and the weighing method, three samples per lot shall be measured.

NOTE 5—A lot shall be as follows: All bars of one size furnished to the same steel reinforcing bar specification that have been galvanized within a single production shift.

4.3.4 *Retests*—If the average zinc coating weight [mass] fails to meet the requirements of 4.3.1, six additional random samples from the lot shall be tested. If the average zinc coating weight [mass] of the six samples conforms to the requirements of 4.3.1, the lot shall be accepted.

4.4 *Chromating*—The zinc coating shall be chromate treated unless waived by the purchaser. Chromate can preclude a reaction between the bars and fresh portland cement paste. Proprietary chromating solutions of equivalent strength are permitted in place of the generic chemical treatment specified.

4.4.1 If the chromate treatment is performed immediately after galvanizing, it may be accomplished by quenching the steel reinforcing bars in a solution containing at least 0.2 weight [mass] % of sodium dichromate in water (such as 3 oz/10 gal [2kg/m³] of quench water) or by quench chromating in a minimum of 0.2 % chromic acid solution. The solution shall be at least 90°F [32°C]. The galvanized reinforcing bars shall be immersed in the solution for at least 20 s.

4.4.2 If the galvanized reinforcing bars are at ambient temperature, the chromate treatment shall be the same as specified in 4.4.1 except that 0.5 to 1.0 % concentration of sulfuric acid shall be added as an activator of the chromate solution. In this case, there is no temperature requirement for the activated chromate solution.

5. General Requirements

5.1 The steel reinforcing bars shall conform to one of the following specifications: **A615/A615M**, **A706/A706M**, or **A996/A996M**.

6. Finish and Adherence of Coating

6.1 The metallic coating shall have no bare spots. The coating shall be free of blisters, flux spots or inclusions, dross, and acid or black spots. In addition, the presence of tears or sharp spikes, which make the bar hazardous to handle, shall be cause for rejection.

6.3 The coating shall not peel or flake off in any bend test meeting the requirements of **A615/A615M**, **A706/A706M** or **A996/A996M** and be adherent so it cannot be removed by any reasonable process of handling or erection.

7. Inspection

7.1 Inspection of the material shall be agreed upon between the purchaser and the supplier as part of the purchase order or contract.

8. Permissible Amount of Damaged Coating and Repair of Damaged Coating

8.1 The maximum amount of repaired damaged coating shall not exceed 1 % of the total surface area in each 1-ft [0.3-m] length of the bar. This limit on repaired damaged coating shall not include sheared or cut ends that are repaired with a zinc-rich formulation in accordance with Practice **A780/A780M** (see 9.3).

9. Certification

9.1 Upon request of the purchaser in the contract or order, the galvanizer's certification that the material was manufactured and tested in accordance with this specification, together with the report of the tests results, shall be furnished at the time of shipment.

9.2 When Specification **A615/A615M** steel is supplied, a silicon analysis shall be provided.

9.3 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 must meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the supplier. 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.

10. Keywords

11.1 galvanizing; steel reinforcing bars; metallic-coated; zinc-coated.

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