



Designation: A 153/A 153M – 02

American Association State Highway
and Transportation Officials Standard
AASHTO No. M232

Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware¹

This standard is issued under the fixed designation A 153/A 153M; 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.

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

1. Scope

1.1 This specification covers zinc coatings applied by the hot-dip process on iron and steel hardware.

1.2 This specification is intended to be applicable to hardware items that are centrifuged or otherwise handled to remove excess galvanizing bath metal (free zinc). Coating thickness grade requirements reflect this.

1.3 This specification is applicable to orders in either inch-pound units (as A 153) or in SI units (as A 153M). Inch-pound units and SI units are not necessarily exact equivalents. Within the text of this specification and where appropriate, SI units are shown in parentheses. Each system shall be used independently of the other without combining values in any way. In the case of orders in SI units, all testing and inspection shall be done using the metric equivalent of the test or inspection method as appropriate. In the case of orders in SI units, such shall be stated to the galvanizer when the order is placed.

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.*

2. Referenced Documents

2.1 ASTM Standards:

A 90/A 90M Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles²

A 143 Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement²

A 385 Practice for Providing High-Quality Zinc Coatings (Hot-Dip)²

A 780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings²

A 902 Terminology Relating to Metallic Coated Steel Products²

B 6 Specification for Zinc (Slab Zinc)³

B 487 Test Method for Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section⁴

B 602 Test Method for Attribute Sampling of Metallic and Inorganic Coatings⁴

E 376 Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods⁵

F 1470 Guide for Fastener Sampling for Specified Mechanical Properties and Performance Inspection⁶

F 1789 Terminology for F16 Mechanical Fasteners⁶

3. Terminology

3.1 Definitions:

3.1.1 The following terms and definitions are specific to this specification. Terminology A 902 contains other terms and definitions relating to metallic-coated steel products. Terminology F 1789 contains other terms and definitions relating to mechanical fasteners.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *average coating thickness, n*—the average of the specimen coating thickness values for the samples in an inspection lot.

3.2.2 *bare spots, n*—uncoated areas on the surface of the steel part that contain no measurable zinc coating.

3.2.3 *dross inclusions, n*—the iron/zinc intermetallics present in a galvanized coating in a form other than the layer growth of the coating.

3.2.4 *individual measurement, n*—the reading from a magnetic thickness gauge of a single coating spot thickness, or the

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² *Annual Book of ASTM Standards*, Vol 01.06.

³ *Annual Book of ASTM Standards*, Vol 02.04.

⁴ *Annual Book of ASTM Standards*, Vol 02.05.

⁵ *Annual Book of ASTM Standards*, Vol 03.03.

⁶ *Annual Book of ASTM Standards*, Vol 01.08.

 A 153/A 153M – 02

microscopic reading of a coating thickness as seen in an optical microscope at one spot.

3.2.5 *inspection lot, n*—the quantity of identical parts cleaned, fluxed and galvanized together at one time in an appropriate container that is being submitted for acceptance as a group.

3.2.6 *malleable casting, n*—a steel article that has been subjected to a prolonged anneal to decarburize or graphitize the part to remove as much of the carbon as possible or to convert the carbon to graphite, which permits plastic deformation in compression without rupture.

3.2.7 *sample, n*—a collection of individual units of product from a single inspection lot selected in accordance with Section 6 and intended to represent that inspection lot for acceptance.

3.2.8 *specimen, n*—an individual test article upon which thickness measurements or weight determinations are performed.

3.2.9 *specimen coating thickness, n*—the average thickness from no less than five test measurements on a specimen, when each measurement location is selected to provide the widest dispersion (in all applicable directions) of locations within the specimen volume.

3.2.10 *threaded areas, n*—the sections of a steel part that have threads formed before hot-dip galvanizing.

4. Materials and Manufacture

4.1 *Steel or Iron*—Ferrous articles to be hot-dip zinc coated shall conform to specifications designated by the purchaser.

4.2 *Zinc*—The zinc used for the coating shall conform to Specification B 6 and shall be at least equal to the grade designated as “Prime Western.”

4.3 *Coating Thickness Grade*—The thickness grades of the coating shall conform to the requirements prescribed in Table 1 for the material category and thickness of material in which the article belongs.

4.4 *Threaded Articles*—The zinc coating on threads shall not be subjected to a cutting, rolling, or finishing-tool operation, unless specifically authorized by the purchaser. In order to

meet overlapping allowances, tapping the threads of nuts or tapped holes after galvanizing is not prohibited.

4.5 Bare spots that are found on parts after galvanizing shall be renovated by use of the methods found in Practice A 780 if the following criteria are met. The bare spots shall have an area totalling not more than 1 % of the surface area to be coated excluding threaded areas of the piece and the bare spots shall not include any threaded areas of the piece. The thickness of the repair shall be equal to the surrounding galvanized coating except for repairs made by paints containing zinc dust in which case the thickness of the repair shall be 50 % greater than the thickness of the galvanized coating required for the class of material, but shall not be greater than 4.0 mils (100 μm). Repair thickness measurements shall be made in accordance with Practice A 780. The galvanizer shall make repairs unless directed by the purchaser to deliver items unrepaired for subsequent renovation by the purchaser.

5. Workmanship, Finish, and Appearance

5.1 The zinc-coated articles shall be free from uncoated areas, blisters, flux deposits, dross inclusions, and other types of projections that would interfere with the intended use of the articles, or other defects not consistent with good galvanizing practice.

5.2 The zinc coating shall be smooth and reasonably uniform in thickness.

NOTE 1—Smoothness of surface is a relative term. Minor roughness that does not interfere with the intended use of the part, or roughness that is related to the as-received (ungalvanized) surface condition of the part, shall not be grounds for rejection.

NOTE 2—Since this specification is applicable to items that are centrifuged or otherwise handled to remove excess bath metal (see 1.2), irregular coating distribution is not normally encountered. Drainage problems, which manifest themselves as local excess coating thickness that would interfere with function or as edge tears or spikes that present a safety hazard because of their sharpness, are grounds for rejection under the terms of 6.1.

5.3 Embrittlement is a potential condition of steel that is cold-worked, depending on such factors as the steel type

TABLE 1 Weight of Zinc Coating for Various Classes of Material

NOTE 1—Length of the piece, stated in Classes B-1, B-2, and B-3, refers to the overall dimension and not to its developed length.

NOTE 2—Based upon mathematical calculations, 1 oz./ft² of zinc surface corresponds to an average coating thickness of 1.7 mil. (Based upon mathematical calculations, 1 g/m² of zinc surface corresponds to an average coating thickness of 0.141 μm ; seven times the coating thickness in micrometres is approximately equal to the coating in g/m².) References to “coating thickness” or “coating thickness grade” throughout this standard are interchangeable with “weight” in Table 1, in accordance with the above calculation.

Class of Material	Minimum Weight of Zinc Coating, oz/ft ² (g/m ²) of Surface ^A	
	Average of Specimens Tested ^B	Any Individual Specimen
Class A—Castings—Malleable Iron, Steel	2.00 (610)	1.80 (550)
Class B—Rolled, pressed, and forged articles (except those which would be included under Classes C and D):		
B-1— $\frac{3}{16}$ in. (4.76 mm) and over in thickness and over 15 in. (381 mm) in length	2.00 (610)	1.80 (550)
B-2—under $\frac{3}{16}$ in. (4.76 mm) in thickness and over 15 in. (381 mm) in length	1.50 (458)	1.25 (381)
B-3—any thickness and 15 in. (381 mm) and under in length	1.30 (397)	1.10 (336)
Class C—Fasteners over $\frac{3}{8}$ in. (9.52 mm) in diameter and similar articles. Washers $\frac{3}{16}$ in. and $\frac{1}{4}$ in. (4.76 and 6.35 mm) in thickness	1.25 (381)	1.00 (305)
Class D—Fasteners $\frac{3}{8}$ in. (9.52 mm) and under in diameter, rivets, nails and similar articles. Washers under $\frac{3}{16}$ in. (4.76 mm) in thickness	1.00 (305)	0.85 (259)

^A In the case of long pieces, such as anchor rods and similar articles over 5 ft (1.52 m) in length, the weight of coating shall be determined at each end and the middle of the article. In no case shall individual measurements be below the minimum shown in the “Any Individual Specimen” column.

^B The number of specimens to be tested per order shall be as specified in Section 8.