



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.

NOTE 1—If the galvanized material covered by this specification is bent or otherwise fabricated to the degree that causes the zinc coatings to stretch or compress beyond the limit of elasticity, some cracking or flaking of the coating may occur.

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

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

3. Materials and Manufacture

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

3.2 *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."

3.3 *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.

3.4 *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. Threads in nuts may be tapped after galvanizing.

4. Workmanship, Finish, and Appearance

4.1 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.

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

NOTE 2—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 3—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

¹ This specification is under the jurisdiction of ASTM Committee A05 on Metallic-Coated Iron and Steel Products and is the direct responsibility of Subcommittee A05.13 on Structural Shapes and Hardware Specifications.

Current edition approved July 10, 2000. Published October 2000. Originally published as A 153 – 33 T. Last previous edition A 153/A 153M – 98 (1999)⁴.

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.

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
<i>Class A</i> —Castings—Malleable Iron, Steel	2.00 (610)	1.80 (550)
<i>Class B</i> —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)
<i>Class C</i> —Fasteners over $\frac{3}{16}$ 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)
<i>Class D</i> —Fasteners $\frac{3}{16}$ 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 7.

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 5.1.

4.3 Steel that is cold-worked may become embrittled, depending on such factors as the type (strength level, aging characteristics), thickness, and degree of cold work. Galvanizing may accelerate embrittlement. Precautions against embrittlement shall be taken by the designer and the fabricator. The precautions to fabricate properly and prepare the material for galvanizing to prevent embrittlement are described in Practice A 143.

NOTE 4—Low service temperatures increase the risk of brittle failure of all plain carbon steels including those which have been galvanized. This temperature embrittling effect varies with type of steel. The expected service temperature should thus be taken into account when selecting steels for galvanizing.

4.4 Malleable castings shall be of such composition as will preclude the possibility that they become embrittled by the galvanizing process, or they shall be either cooled from the anneal, or subsequently heat-treated so as to immunize them against embrittlement.

4.5 The zinc coating shall adhere tenaciously to the surface of the basis metal (see Section 8).

5. Sampling

5.1 Test specimens shall be selected at random from each inspection lot. An inspection lot is defined as a collection of galvanized articles of the same kind that has been galvanized at approximately the same time, in the same manner, and in the same pot, and that is being submitted for acceptance as a group.

5.2 The method of selection and sample size shall be agreed upon between the galvanizer and the purchaser. Otherwise, the sample size selected from each lot shall be as follows:

Number of Pieces in Lot	Sample Size
3 or less	all
4 to 500	3
501 to 1200	5
1201 to 3200	8
3201 to 10 000	13
10 001 and over	20

5.3 A specimen that fails to conform to a requirement of this specification shall not be used to determine the conformance to other requirements.

6. Test Methods

6.1 Tests shall be made to ensure that the zinc coating is being furnished in accordance with this specification and as specified for the following:

- 6.1.1 Thickness of coating in 3.3.
- 6.1.2 Finish and appearance in 4.1 and 4.2.
- 6.1.3 Embrittlement in 4.3 and 4.4.
- 6.1.4 Adherence in 4.5.

6.2 Thickness of Coating:

6.2.1 The average weight of the zinc coating may be determined by weighing specimens after pickling and drying and again after galvanizing.

NOTE 5—This method does not take into account the weight of iron reacted from the article that is incorporated into the coating. It will thus underestimate coating weight by up to approximately 10 %. Base metal reactivity will affect the extent of underestimation.

6.2.2 In the case of materials inspected after galvanizing, the weight of coating may be determined by stripping one or more specimens in accordance with Test Method A 90/A 90M, or the average thickness of coating may be determined with the use of a magnetic thickness gage in conformity with Practice E 376.

6.2.2.1 In the case of fasteners such as bolts, nuts, and screws, the determination of the thickness of coating shall be made on a portion of the article that does not include any threads.

6.2.3 The thickness of coating may be determined by cross

section and optical measurement. The thickness thus determined is a point value. No less than five such measurements shall be made at locations on the test article, which are as widely dispersed as practical, so as to be representative of the whole surface of the test article. The average of no less than five such measurements is the specimen coating thickness.

6.3 *Embrittlement*—Test for embrittlement in accordance with Practice A 143.

6.4 *Adherence*—Determine adherence of the zinc coating to the surface of the base metal by cutting or prying with the point of a stout knife, applied with considerable pressure in a manner tending to remove a portion of the coating. The adherence shall be considered inadequate if the coating flakes off in the form of a layer of skin so as to expose the base metal in advance of the knife point. Do not use testing carried out at edges or corners (points of lowest coating adherence) to determine adherence of coating. Likewise, do not use removal of small particles of the coating by paring or whittling to determine failure.

7. Inspection

7.1 The inspector representing the purchaser shall have access at all times while work on the contract of the purchaser is being performed, to those areas of the manufacturer's work which concern the application of the zinc coating to the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the zinc coating is being furnished in accordance with this specification. All inspection and tests shall be made at the place of manufacture prior to shipments, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

8. Rejection and Retest

8.1 When partial inspection of materials to determine conformity with visual requirements of Section 5 warrants rejection of a lot, the galvanizer may sort the lot and submit it once again for inspection.

8.2 The number of specimens in a sample of a lot permitted to fail to conformance tests shall be agreed upon between the galvanizer and the purchaser.

8.3 If a set of test specimens fails to conform to the requirements of this specification, two additional sets shall be tested, both of which shall conform to the requirements in every respect, or the lot of material represented by the specimens shall be rejected.

8.4 Materials that have been rejected for reasons other than embrittlement may be stripped and regalvanized and again submitted for test and inspection. They shall then conform to the requirements of this specification.

9. Packaging

9.1 The supplier shall employ such methods of packaging zinc-coated articles as may reasonably be required to ensure their receipt by the purchaser in satisfactory condition, with the use to be made of the article being taken into consideration.

9.2 Zinc-coated items should not be packed in unventilated containers, especially if these are fabricated from unseasoned wood.

10. Certification

10.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed 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.

11. Keywords

11.1 coatings, zinc; galvanized coatings; steel hardware, zinc coated; steel products, metallic coated; zinc coatings, steel products

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).