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

# Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware<sup>1</sup>

This standard is issued under the fixed designation A153/A153M; 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.

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

## 1. Scope\*

1.1 This specification covers zinc coatings applied by the hot-dip process on iron and steel hardware. The hot-dip galvanizing process consists of parts being immersed in molten zinc for a sufficient time to allow a metallurgical reaction between iron from the steel surface and the molten zinc, resulting in the formation of Zn/Fe alloy layers bonding the coating to the steel surface.

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 Fasteners that must comply with the Fastener Quality Act require specific statistical sampling during the inspection of the fastener lots. Requirements for the sampling of these fasteners can be found in **F2329/F2329M**.

1.4 This specification is applicable to orders in either inch-pound units (as A153) or in SI units (as A153M). 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 brackets. 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.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standard-*

*ization established in the Decision on Principles for the 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:<sup>2</sup>

- A90/A90M** Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
- A143/A143M** Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
- A780** Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- A902** Terminology Relating to Metallic Coated Steel Products
- B6** Specification for Zinc
- B487** Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section
- B960** Specification for Prime Western Grade-Recycled (PWG-R) Zinc
- E376** Practice for Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods
- F1470** Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection
- F1789** Terminology for F16 Mechanical Fasteners
- F2329/F2329M** Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

## 3. Terminology

### 3.1 Definitions:

3.1.1 The following terms and definitions are specific to this specification. Terminology **A902** contains other terms and

<sup>1</sup> 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.

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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.

\*A Summary of Changes section appears at the end of this standard



7.3.2 The average thickness of coating shall be determined by magnetic thickness gage in accordance with Practice **E376** unless the method described in **7.3.3** is used. The thickness shall be measured on at least five widely separated spots on a specimen. No individual spot measurement shall be cause for rejection. If an individual spot does not provide a coating thickness reading, this spot must be repaired in accordance with **4.5**. The five or more individual coating thickness measurements on a specimen must be averaged to determine the specimen average coating thickness. The average coating thickness for the inspection lot is determined by averaging the specimen average coating thickness values for the number of specimens derived from Section **6**.

7.3.3 The thickness of coating shall be determined by cross section and optical measurement in accordance with Test Method **B487**, unless the method described in **7.3.2** is used. The thickness thus determined is a point value. No less than five such measurements shall be made at locations on the specimen, which are as widely dispersed as practical, so as to be representative of the whole surface of the specimen. The average of no less than five such measurements is the specimen average coating thickness. The average coating thickness for the inspection lot is determined by averaging the specimen average coating thickness values for the number of specimens derived from Section **6**.

7.4 *Finish and Appearance*—The test for finish and appearance shall be conducted through visual inspection without additional magnification.

7.5 *Embrittlement*—Hardware that is susceptible to embrittlement shall be tested in accordance with Practice **A143/A143M**. The tests shall be performed through agreement between the galvanizer and the purchaser.

7.6 *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 delaminates 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.

## **8. Inspection**

8.1 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.

## **9. Rejection and Retest**

9.1 For all galvanized articles except those fasteners that must meet the requirements of the Fastener Quality Act, the following sections are used to determine rejection and retesting.

9.2 When partial inspection of materials to determine conformity with visual requirements of Section **5** warrants rejection of a lot, the galvanizer is not prohibited from sorting the lot and submitting it once again for inspection.

9.3 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.

9.4 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.

9.5 Materials that have been rejected for reasons other than embrittlement are not prohibited from being stripped, regalvanized, and resubmitted for test and inspection. They shall then conform to the requirements of this specification.

NOTE 6—Conformance to this specification does not guarantee “zero defects.” Depending on the size and configuration of the parts (small diameter threaded parts and small washers as examples), a small amount of “fall out” may exist in an inspection lot that is not detected during a sample inspection. Issues include, but are not limited to, zinc build up in the threads or bonded washers. Handling of these types of issues need to be negotiated between the purchaser and supplier.

## **10. Packaging**

10.1 The supplier shall employ such methods of packaging zinc-coated articles as shall 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.

## **11. Certification**

11.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each inspection 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.

## **12. Keywords**

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



**SUMMARY OF CHANGES**

Committee A05 has identified the location of selected changes to this standard since the last issue, A153/A153M – 16a, that may impact the use of this standard. (April 1, 2023)

(1) Added clarifying language to **Note 3** in **5.2**.

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