



Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners [Metric]¹

This standard is issued under the fixed designation F 2674; 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 the requirements for hot-dip zinc coating applied to carbon steel and alloy steel bolts, screws, washers, nuts, and special threaded fasteners applied by the hot-dip coating process that are manufactured in SI units (metric). Nails and rivets are not included in this specification.

NOTE 1—This specification is the metric companion of Specification F 2329.

1.2 This specification is intended to be applicable to fasteners that are centrifuged or otherwise handled to remove excess galvanizing bath metal (free zinc).

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

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:*²

A 153/A 153M Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

A 563M Specification for Carbon and Alloy Steel Nuts [Metric]

B 487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

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

F 606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets [Metric]

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

F 1789 Terminology for F16 Mechanical Fasteners

F 2329 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 Terms used in this specification are defined in Terminology **F 1789** unless otherwise defined in this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.3 *batch lot*—quantity of identical parts cleaned, pickled, fluxed, and galvanized together at one time in a galvanizing basket.

3.4 *galvanizing*—hot-dip zinc coating.

3.5 *high temperature galvanizing*—galvanizing process carried out in a ceramic vessel (kettle) at an approximate temperature ranging between 530 and 560 °C.

3.6 *hot-dip zinc coating of mechanical fasteners*—process whereby fasteners are zinc coated by immersion in a bath of molten zinc, resulting in the formation of the iron/zinc alloy coating and a zinc coating at the surface of the fastener. This process involves the removal of excess zinc by spinning the parts in a centrifuge, or brushing the threaded portion, or handling otherwise to remove the excess zinc.

3.7 *production lot*—batches of parts originating from the same manufacturing lot, processed continuously through cleaning, pickling, fluxing, dipping in molten zinc and spun in a centrifuge, or other means, without any significant change in time, temperature, and concentration of the constituents of the process.

3.8 *stress relief*—process of heating parts for a definite time at a given temperature in order to relieve stress induced by work hardening.

4. Ordering Information

4.1 Orders for zinc coating of fasteners to this specification shall include the following:

¹ This test method is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.03 on Coatings on Fasteners.

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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.

- 4.1.1 Name of product (that is, bolt, stud, nut, washers, or other);
- 4.1.2 ASTM designation and year of issue, including fastener specification number;
- 4.1.3 Hydrogen embrittlement relief, as required by the purchaser, see 7.2.3;
- 4.1.4 Quantity of fasteners to be hot-dip zinc coated;
- 4.1.5 Stress relief or tempering temperature to which the fasteners were subjected, if applicable;
- 4.1.6 Secondary processing such as chromating, phosphating, or lubrication, if applicable;
- 4.1.7 Average galvanizing temperature to which fasteners will be subjected, if required by the purchaser (see 7.2.2);
- 4.1.8 Specify baking if required (see 7.2.3); and
- 4.1.9 Certification, if required (see 14.1).

5. Materials and Manufacture

5.1 *Condition of the As-Received Fasteners*—The fasteners as received by the galvanizer shall be free from contaminants that are not readily removed in the cleaning process and would adversely affect the galvanizing.

5.2 *Process*—Unless otherwise covered in this specification, all processing parameters shall be in accordance with the requirements of Specification A 153/A 153M.

5.2.1 *Process Control*—Galvanized fasteners subjected to a process control plan based upon batch lot level shall comply with the batch lot sampling plan in Table 1, and the sampling plan for production lot (prevention process) as determined in 10.2.2 shall be applied.

5.3 *Spinning and Quenching:*

5.3.1 Parts shall be spun immediately following removal from the galvanizing bath and quenched in water. In addition, small parts shall be air cooled as needed in order to prevent the formation of zinc oxide.

5.3.2 Parts, which cannot be spun shall be brushed or handled otherwise to remove the excess zinc.

5.4 *Alteration of Threaded Fasteners:*

5.4.1 Fasteners that have been hot-dip galvanized shall not be further altered (such as subjected to a cutting, rolling, finishing-tool operation) by the galvanizer unless specifically authorized in writing by the purchaser.

5.4.2 Hot-dip galvanizing of externally threaded fasteners shall meet the thread fitting requirements of the specified product standard or specific allowance as determined by the customer.

NOTE 2—The scope of this specification does not cover the requirements regarding the overtapping of galvanized nuts. These requirements are established by the applicable product standard, such as Specification A 563M (or others), or in writing by the purchaser, if needed.

5.5 *Secondary Processing:*

5.5.1 When requested by the purchaser, treatments such as chromating or phosphating shall be applied to reduce the possibility of wet storage staining (white corrosion) or to assist subsequent painting.

5.5.2 When specified on the purchase order, the nuts, bolts, or screws shall be lubricated to enhance assembly.

6. Chemical Composition of Zinc

6.1 Unless otherwise specified in the product standard, the zinc used for the coating shall conform to the requirements of the section on Zinc of Specification A 153/A 153M.

7. Safeguards Against Alteration of Fasteners Mechanical Properties

7.1 *Stress Relief*—Fasteners subjected to severe work hardening shall be stress-relieved by the fastener manufacturer prior to hot-dip zinc coating (galvanizing).

7.2 *Hot-Dip Zinc Coating:*

7.2.1 *Effect of Temperature on Mechanical Properties:*

7.2.1.1 Galvanizing carried out at a temperature above 425 °C can adversely affect the final mechanical properties of the fasteners. Therefore, the supplier of the fasteners submitting the product to the galvanizer shall be aware of the tempering temperature of the fasteners relative to the temperature of the galvanizing bath and the potential effect it may have on the product. When requested by the purchaser, the average galvanizing temperature that the fasteners shall be subjected to shall be furnished.

7.2.1.2 Unless otherwise required by the product standard or by the purchaser, testing for mechanical properties is not necessary if the galvanizing process is carried out at a lower temperature than the stress relief or tempering temperature of the fasteners. If the galvanizing process is carried out at a higher temperature than the stress relief or the tempering temperature of the fasteners, then the purchaser shall make provision for mechanical testing.

7.2.1.3 Threaded fasteners made from carbon or alloy steel heat treated to the specified hardness of 40 HRC or above, or case hardened steel fasteners, or fasteners made to specifications which forbids zinc coatings shall not be hot-dip zinc coated.

7.2.2 *Effect of Hydrogen on the Mechanical Properties after Galvanizing*—Hydrogen has the potential of being introduced into the steel during acid pickling, prior to hot-dip galvanizing. For high strength fasteners (having a specified minimum product hardness of 33 HRC), there is a risk of internal hydrogen embrittlement. If required by the product standard or by the purchaser, mechanical descaling (with or without flash pickling) or baking shall be conducted to reduce the risk of internal hydrogen embrittlement. Baking shall be conducted after pickling and prior to hot-dip galvanizing.

7.2.3 *Effect of the Galvanizing Temperature*—Externally threaded ferrous larger than M24 with a specified minimum

TABLE 1 Process Control of Batch Lot^A

Batch Lot Size	Sample Size ^B		
	Average Coating Thickness ^C	Adhesion	Appearance ^D
5 to 25	1	1	1
26 to 50	1	1	2
51 to 150	2	1	2
151 and over	2	2	2

^AThe acceptance criterion in all cases is zero defects.

^BThe sample size is the number of specimen(s) required to be tested/inspected.

^CCoating thickness frequency of measurements: one set of specimen(s) for every five batch lots. For test method see 1.1

^DVisual inspection for conformance.