



Designation: F1941/F1941M – 16 (Reapproved 2025)

Standard Specification for Electrodeposited Coatings on Mechanical Fasteners, Inch and Metric¹

This standard is issued under the fixed designation F1941/F1941M; 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.

INTRODUCTION

This specification covers the coating of steel unified inch and metric mechanical fasteners by electrodeposition. The properties of the coatings shall conform to the ASTM standards for the individual finishes. This standard shall be used in place of ASTM B633 for mechanical fasteners.

Coating thickness values are based on standard tolerances for inch and metric external threads. The coating must not cause the basic thread size to be transgressed by either the internal or external threads. The method of designating inch coated threads shall comply with ASME B1.1 and ISO 965-1, ISO 965-2, and ISO 965-3 for ISO metric coated threads.

With normal methods for depositing metallic coatings from aqueous solutions, there is a risk of delayed failure due to hydrogen embrittlement for case hardened fasteners and fasteners having a hardness above 39 HRC. Although this risk can be managed by selecting raw materials suitable for the application of electrodeposited coatings and by using modern methods of surface treatment and post heat-treatment (baking), the risk of hydrogen embrittlement cannot be completely eliminated. Therefore, the application of a metallic coating by electrodeposition is not recommended for such fasteners.

1. Scope

1.1 This specification covers application, performance and dimensional requirements for electrodeposited coatings on threaded fasteners with unified inch and metric screw threads, but it may also be applied to other threaded parts and non-threaded parts such as washers and pins. It specifies coating thickness, supplementary hexavalent chromate or non-hexavalent conversion coatings, corrosion resistance, precautions for managing the risk of hydrogen embrittlement and hydrogen embrittlement relief for high-strength and surface-hardened fasteners. It also highlights the differences between barrel and rack plating and makes recommendations as to the applicability of each process.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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

Current edition approved Jan. 1, 2025. Published January 2025. Originally approved in 1998. Last previous edition approved in 2016 as F1941/F1941M – 16. DOI: 10.1520/F1941_F1941M-16R25.

1.3 Terms used in this specification are defined in Terminology F1789.

1.4 The following precautionary statement pertains to the test method portion only, Section 9, of this specification: *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.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization 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.*

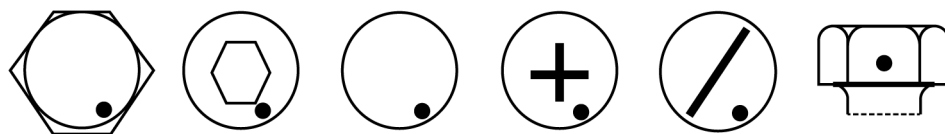
2. Referenced Documents

2.1 *ASTM Standards:*²

B117 Practice for Operating Salt Spray (Fog) Apparatus

B487 Test Method for Measurement of Metal and Oxide

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.



NOTE 1—Black dot (•) indicates test surface.

FIG. 1 Significant Surfaces on Externally Threaded Fasteners

Coating Thickness by Microscopical Examination of Cross Section

B499 Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals

B504 Test Method for Measurement of Thickness of Metallic Coatings by the Coulometric Method

B567 Test Method for Measurement of Coating Thickness by the Beta Backscatter Method

B568 Test Method for Measurement of Coating Thickness by X-Ray Spectrometry

B633 Specification for Electrodeposited Coatings of Zinc on Iron and Steel

B659 Guide for Measuring Thickness of Metallic and Inorganic Coatings

D6492 Practice for Detection of Hexavalent Chromium On Zinc and Zinc/Aluminum Alloy Coated Steel

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

F519 Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments

F606/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

F788/F788M Specification for Surface Discontinuities of Bolts, Screws, Studs, and Rivets, Inch and Metric Series

F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

F1624 Test Method for Measurement of Hydrogen Embrittlement Threshold in Steel by the Incremental Step Loading Technique

F1789 Terminology for F16 Mechanical Fasteners

F1940 Test Method for Process Control Verification to Prevent Hydrogen Embrittlement in Plated or Coated Fasteners

F2078 Terminology Relating to Hydrogen Embrittlement Testing

2.2 *ASME Standards*:³

B1.1 Unified Inch Screw Threads (UN and UNR Thread Form)

B1.2 Gages and Gaging for Unified Inch Screw Threads

B1.16M Gages and Gaging for Metric M Screw Threads

B18.6.3 Machine Screws, Tapping Screws, and Metallic Drive Screws (Inch Series)

2.3 *National Aerospace Standard (AIA)*:⁴

NASM-1312-5 Fast Test Method – Method 5: Stress Durability

2.4 *IFI Standard*:⁵

IFI-142 Hydrogen Embrittlement Risk Management

2.5 *ISO Standards*:⁶

ISO 965-1 ISO General Purpose Metric Screw Threads – Tolerances – Part 1: Principles and Basic Data

ISO 965-2 ISO General Purpose Metric Screw Threads – Tolerances – Part 2: Limits of Sizes for General Purpose External and Internal Screw Threads

ISO 965-3 ISO General Purpose Metric Screw Threads – Tolerances – Part 3: Deviations for Construction Screw Threads

ISO 4042 Electroplated Coatings

3. Terminology

3.1 *Definitions*:

3.1.1 *reference area*—the area within which a specified number of single measurements are required to be made.

3.1.2 *sealant*—chemical with or without integral lubricant applied on the substrate which forms a composite layer with a conversion coating in order to improve chemical resistance, corrosion protection, UV resistance, etc.

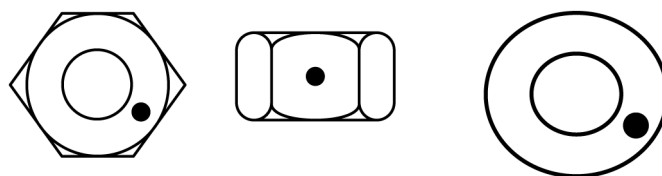
3.1.3 *significant surface*—**Figs. 1 and 2** illustrate significant surfaces on standard externally and internally threaded fasteners and washers.

3.1.4 *top coat*—additional layer with or without integral lubricant applied on a substrate in order to achieve functional properties such as torque-tension control, color, chemical resistance, etc.

⁴ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

⁵ Available from Industrial Fasteners Institute (IFI), 1717 East 9th Street, Suite 1105, Cleveland, OH 44114-2879.

⁶ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.



NOTE 1—Black dot (•) indicates test surface.

FIG. 2 Significant Surfaces on Internally Threaded Fasteners and Washers

³ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.