



Designation: B545 – 22

Standard Specification for Electrodeposited Coatings of Tin¹

This standard is issued under the fixed designation B545; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers the requirements for electrodeposited (electroplated) coatings of tin applied to metallic articles. Tin coatings are used to provide a low contact-resistance surface, to protect against corrosion (see 1.2), to facilitate soldering, to provide anti-galling properties, and to be a stopoff coating in the nitriding of high-strength steels.

1.2 Some corrosion can be expected from tin coatings exposed outdoors. In normal indoor exposure, tin is protective on iron, steel, nickel, copper, and their alloys. Corrosion can be expected at discontinuities in the coating (such as pores) due to galvanic couples formed between the tin and the underlying metal through the discontinuities, especially in humid atmospheres. Porosity increases as the coating thickness decreases, so that minimum thicknesses must be specified for each application. Parts coated with tin can be assembled safely in contact with iron and steel, tin-coated aluminum, yellow chromated zinc, cadmium, and solder coatings. (See X5.1 for oxidation and corrosion properties.)

1.3 This specification applies to electroplated coatings of not less than 99 % tin (except where deliberately alloyed for special purposes, as stated in X6.3) obtained from any of the available tin electroplating processes (see 4.3).

1.4 This specification does not apply to hot-dipped tin or other non-electrodeposited coating; it also does not apply to mill products. For mill products, refer to Specifications A623 or A623M.

1.5 *Units*—The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *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 This specification is under the jurisdiction of ASTM Committee B08 on Metallic and Inorganic Coatings and is the direct responsibility of Subcommittee B08.06 on Soft Metals.

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1.7 *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

- A623 Specification for Tin Mill Products, General Requirements
- A623M Specification for Tin Mill Products, General Requirements [Metric]
- B183 Practice for Preparation of Low-Carbon Steel for Electroplating
- B242 Guide for Preparation of High-Carbon Steel for Electroplating
- B246 Specification for Tinned Hard-Drawn and Medium-Hard-Drawn Copper Wire for Electrical Purposes
- B281 Practice for Preparation of Copper and Copper-Base Alloys for Electroplating and Conversion Coatings
- B320 Practice for Preparation of Iron Castings for Electroplating
- B322 Guide for Cleaning Metals Prior to Electroplating
- B374 Terminology Relating to Electroplating
- B487 Test Method for Measurement of Metal and Oxide 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
- B507 Practice for Design of Articles to Be Electroplated on Racks
- B542 Terminology Relating to Electrical Contacts and Their Use

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.

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

- B558** Practice for Preparation of Nickel Alloys for Electroplating
- 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
- B571** Practice for Qualitative Adhesion Testing of Metallic Coatings
- B602** Guide for Attribute Sampling of Metallic and Inorganic Coatings
- B659** Guide for Measuring Thickness of Metallic and Inorganic Coatings
- B678** Test Method for Solderability of Metallic-Coated Products
- B697** Guide for Selection of Sampling Plans for Inspection of Electrodeposited Metallic and Inorganic Coatings
- B762** Guide of Variables Sampling of Metallic and Inorganic Coatings
- B765** Guide for Selection of Porosity and Gross Defect Tests for Electrodeposits and Related Metallic Coatings
- B809** Test Method for Porosity in Metallic Coatings by Humid Sulfur Vapor (“Flowers-of-Sulfur”)
- B849** Specification for Pre-Treatments of Iron or Steel for Reducing Risk of Hydrogen Embrittlement
- B850** Guide for Post-Coating Treatments of Steel for Reducing the Risk of Hydrogen Embrittlement
- D3951** Practice for Commercial Packaging

3. Terminology

3.1 Definitions:

3.1.1 Many of the terms used in this specification are defined in Terminology **B374** or **B542**.

3.1.2 *rack-plating, n*—an electrodeposition process in which articles to be coated are mounted on racks or other fixtures during the process.

3.1.3 *significant surface, n*—that portion of the surface of a coated article at which the coating is required to meet all of the requirements of the coating specification for that article; significant surfaces are usually those that are essential to the serviceability or function of the article, or that can be a source of corrosion products or tarnish films that interfere with the function or desirable appearance of the article; significant surfaces shall be indicated on the drawings of the parts or by the provision of suitably marked samples.

3.1.4 *undercoating (see 3.1.5), n*—also called an *underplate* in the electronics industry.

3.1.5 *underplating, n*—application of a metallic coating layer between the basis metal or substrate and the topmost metallic coating or coatings. The thickness of such an undercoating is usually greater than 0.8 µm (30 µin.). This is in contrast to strikes or flashes, whose thicknesses are generally much smaller.

4. Classification

4.1 *General*—Orders for articles to be plated in accordance with this specification shall specify the service class (4.2) (and underplating, if required), indicating the severity of service

required for the coating. Other coatings variations, such as surface appearance type (4.3) or alloy composition (**Appendix X6**), are optional.

4.2 Service Class:

Class	Minimum Thickness	Typical Applications
A	2.5 µm (100 µin.)	Mild service conditions, particularly where the significant surface is shielded from the atmosphere (as in electronic connector housings). To provide corrosion and tarnish resistance where greater thicknesses may be detrimental to the mechanical operation of the product (for example, small electrical spring contacts and relays). Class A is often used for tin coatings that are not to be soldered, but must function as low-resistance electrical contact surfaces.
B	5 µm (200 µin.)	Mild service conditions with less severe requirements than Class C (below). Applications are as follows: precoating on solderable basis metals to facilitate the soldering of electrical components; as a surface preparation for protective painting; for antigalling purposes; and as a stopoff in nitriding. Also found on baking pans after reflow.
C	8 µm (320 µin.), (10 µm (400 µin.) for steel substrates)	Moderate exposure conditions, usually indoors, but more severe than Class B. Examples are electrical hardware (such as cases for relays and coils, transformer cans, screened cages, chassis, frames, and fittings) and for retention of the solderability of solderable articles during storage.
D	15 µm (600 µin.) (20 µm (800 µin.) for steel substrates)	Severe service, including exposure to dampness and mild corrosion from moderate industrial environments. Examples are fittings for gas meters, automotive accessories (such as air cleaners and oil filters), and in some electronic applications.
E	30 µm (0.0012 in.)	Very severe service conditions, including elevated temperatures, where underlying metal diffusion and intermetallic formation processes are accelerated. Thicknesses of 30 to 125 µm (0.0012 to 0.005 in.) may be required if the coating is subjected to abrasion or is exposed to slowly corrosive liquids or corrosive atmospheres or gases. Thicker coatings are used for water containers, threaded steel couplings of oil drilling strings, and seacoast atmospheres. Coatings subject to mild etchants are included.
F	1.5 µm (60 µin.)	Similar to Class A, but for shorter-term contact applications and short shelf-life requirements, subject to purchaser approval.

4.3 Surface Appearance Type (Electroplating Process):

4.3.1 *Matte Tin Electrodeposits*—Coatings with a matte appearance are obtained from tin plating baths (stannate, sulfate, methylsulfonate, and fluoborate) used without the addition of any brightening agents. However, all matte baths (except for stannate baths) do require the addition of grain-refiners, and often of other additives in order to produce the desired matte finish.

4.3.2 *Bright Tin Electrodeposits*—Bright coatings are obtained when proprietary brightening agents are used in specific bright tin plating baths.

4.3.3 *Flow-Brightened Electrodeposits*—Flow-brightened coatings are obtained by heating the matte coating above the melting point of tin for a few seconds, followed by quenching; palm oil and hydrogenated oils and fats are used as heat-transfer medium at a temperature of 240 to 260 °C (464 to