

MIL-T-10727B

2 April 1980

SUPERSEDING

MIL-T-10727A

20 May 1959

MILITARY SPECIFICATION

TIN PLATING; ELECTRODEPOSITED OR HOT-DIPPED,
FOR FERROUS AND NONFERROUS METALS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers the requirements for electrodeposited tin and hot-dipped tin coatings on ferrous and nonferrous metals.

1.2 Classification. The tin plating covered by this specification shall be of the following types, as specified (see 6.1):

Type I - Electrodeposited. Use ASTM B 545 Standard Specification for Electrodeposited Coatings of Tin

Type II - Hot-dipped

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-S-571 - Solder, Tin Alloy: Tin-Lead Alloy; and Lead Alloy

QQ-T-371 - Tin; Pig

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MIL-F-14256 - Flux, Soldering, Liquid (Rosin Base)

Area MFFP

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Army Materials and Mechanics Research Center, Watertown, MA 02172 by using the self-addressed Standardization Documents Improvement Proposal (DD Form 1426 appearing at the end of this document or by letter.

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STANDARD

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS

- ASTM B 117 - Method of Salt Spray (Fog) Testing
- ASTM B 242 - Preparation of High Carbon Steel for Electroplating
- ASTM B 487 - Measurement of Coating Thicknesses by Microscopical Examination of a Cross Section
- ASTM B 499 - Measurement of Coating Thickness by the Magnetic Method
- ASTM B 504 - Measurement of Thickness of Metallic Coatings by the Coulometric Method
- ASTM B 545 - Electrodeposited Coatings of Tin
- ASTM B 567 - Measurement of Coating Thickness by the Beta Back Scatter Method
- ASTM B 568 - Measurement of Coating Thickness by X-Ray Spectrometry

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 Tin coating. Coating shall be either electrodeposited (type I) or hot-dipped (type II) as specified. The hot-dip tin bath shall be prepared using tin having a 99.8 percent minimum tin content in accordance with QQ-T-371. Electrodeposited tin (type I) shall adhere to those physical requirements set forth in paragraph 5 of the American Society for Testing and Materials (ASTM) specification designation: B 545, Electrodeposited Coatings of Tin.

3.2 Basis metal. The basis metal shall be substantially free from flaws or defects that will be detrimental to the appearance or the protective value of the coating. It shall be subjected to such cleaning, pickling, and plating procedures as are necessary to yield adherent deposits.

3.2.1 Preparation of basis metal.

3.2.1.1 Type I (electrodeposited coatings). All basis metal shall be subjected to appropriate cleaning and oxide removal procedures to ensure deposition of adherent deposits. Clean as outlined in ASTM B 545.

3.2.1.2 Type II (hot-dip coatings). All basis metal shall be given a 2 to 5 minute treatment in a cold 15 percent (by volume) aqueous sulfuric acid solution containing 2 percent (by volume) nitric acid. After pickling and rinsing, all items shall be dipped in a flux solution composed of 3 pounds of zinc chloride and 0.3 pound of ammonium chloride per gallon of water.

3.2.1.3 Brass or bronze basis metal. In the case of brass or bronze basis metal, all stains shall be thoroughly removed with an acid dip or warm cyanide solution prior to coating.

3.3 Minimum thickness of coating. The minimum thickness of electro-deposited (see ASTM B 545, section 5.1) or hot-dipped tin on significant surfaces of the finished items after final finishing operation shall be as specified on the drawings, or in the contract or purchase order. Unless otherwise specified, significant surfaces are those visible surfaces or parts of the surface which can be touched with a sphere 0.75 inch (19.1mm) in diameter. The plating on all other surfaces shall be of sufficient thickness to ensure plating continuity which is essential to the appearance or serviceability of the article when assembled in normal position; or which can be the source of corrosion products that deface visible surfaces on the assembled article (see 6.1 and 6.2).

3.4 Adhesion of coating. The adhesion of coating shall be such that when examined at a magnification of 4 diameters it does not show separation from the basis metal at the common interface when subjected to the test specified in 4.6.2. The interface between the tin and basis metal is the surface of the basis metal. The formation of cracks in the basis metal or plate which do not result in flaking, peeling, or blistering of the plate shall not be considered as nonconformance with this requirement.

3.5 Solderability. When specified that the item is to be soldered later, the hot-dipped plate shall be easily coated with solder when tested as specified in 4.6.3. The solder shall adhere to the hot-dipped plate evenly without lump formation; and firmly, so that it cannot be lifted with sharp-edged instrument.

3.6 Salt spray resistance. When specified in the contract or order (see 6.2), coatings required for corrosion protection shall be subjected to the salt spray test in accordance with 4.6.4. At completion of the test, the coating shall show no more corrosion of the basis metal than specified in 3.6.1.

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3.6.1 Appearance. The appearance of more than six corroded areas that are visible to the unaided eye per square foot of surface, or of any corroded areas larger than 0.063 inch (1.59mm) in diameter, shall be cause for rejection. For purpose of this requirement, a corroded area is defined as exposure or corrosion of the basis metal.

3.7 Workmanship. The coating shall be lustrous, smooth, fine-grained, adherent, and free from blisters, pits, nodules, indications of burning and other defects.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements. Inspection records of the examinations and tests shall be kept complete and available to the Government if specified in the contract or order.

4.2 Classification of inspections. The inspection requirements specified herein are classified as quality conformance inspection (see 4.3).

4.3 Quality conformance inspection.

4.3.1 Lot. A lot shall consist of plated articles of the same type and of approximately the same size, form and shape, of the same specified thickness of coating, plated under similar conditions, and submitted for inspection at one time.

4.4 Sampling.

4.4.1 Separate specimens. When plated articles are of such form as to be not readily adaptable to the tests described in 4.6, separate specimens plated concurrently with articles represented may be used. Sheet, strip, or wire test specimens shall be essentially of the same composition basis metal, heat treatment, condition, and surface finish of the articles represented, prior to plating. For type I (electrodeposited) tin plating, specimens shall be introduced into a lot at regular intervals prior to the cleaning operations preliminary to plating, and shall not be separated therefrom until after completion of the processing. Conditions affecting the plating of the specimens, including the spacing and positioning with respect to anodes and to other objects being plated, shall correspond as nearly as possible to those affecting the significant surfaces of the articles represented. Type II (hot-dipped plating) specimens shall be securely attached to the articles prior

to the cleaning operations preliminary to coating and shall not be separated therefrom until after completion of the processing. Separate specimens shall not be used for thickness measurements, however, unless the necessity for their use has been demonstrated. Separate specimens may be strips approximately 25mm wide, 100mm long and 1mm thick (1 inch x 4 inches x 0.04 inches).

4.4.2 Sampling for visual examination and nondestructive tests. Sampling for visual examination and nondestructive tests shall be conducted in accordance with MIL-STD-105. A sample of coated parts or articles shall be selected at random from each lot in accordance with MIL-STD-105. The lot shall be accepted or rejected according to the procedures in 4.4.2.1 for visual examination and 4.4.2.2 for plating thickness (nondestructive tests) at the acceptable quality level (AQL) of 2.5 percent defective.

4.4.2.1 Visual examination. Samples selected in accordance with 4.4.2 shall be examined for compliance with the requirements of 3.7 after plating. If the number of nonconforming articles exceeds the acceptance number for the sample, the lot represented by the sample shall be rejected.

4.4.2.2 Thickness of plating (nondestructive tests). Samples selected in accordance with 4.4.2 shall be inspected and the plating thickness measured by the applicable tests detailed in 4.6.1. The part or article shall be considered nonconforming if one or more measurements fail to meet the specified minimum thickness. If the number of defective items in any sample exceeds the acceptance number for the specified sample, the lot represented by the sample shall be rejected. Separate specimens (see 4.4.1) shall not be used for thickness measurements unless a need has been demonstrated.

4.4.3 Sampling for destructive tests (thickness, adhesion, solderability and salt spray resistance). A sample of four items shall be selected at random from each lot or four separately plated specimens shall be prepared as specified in 4.4.1 to represent the lot. If the items in a lot are four or less, the number of items in the sample shall be determined by the procuring activity. Specimens may be used for more than one test where applicable.

4.5 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the applicable paragraphs in sections 3 and 4.

4.5.1 Examination for compliance with 3.1 and 3.2. The process and parts shall be examined for compliance with the requirements of 3.1 and 3.2. Should the process or parts fail to meet the requirements specified, acceptance of the final product shall be discontinued until corrective action has been taken.

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4.5.2 Examination of finished items. Samples selected as specified in 4.4.2 shall be examined for compliance with 3.7 and 5.1. Any item in the sample having any defects shall be considered defective, and if the number of defective items in any sample exceeds the acceptance number of the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected. Rejected lots may be resubmitted for acceptance tests provided the contractor has removed or reworked all nonconforming products.

4.5.3 Testing. Unless otherwise specified, sampling shall be in accordance with 4.4.3 and the items shall be tested in accordance with 4.6. If any item in the sample fails to pass any test, the lot which the sample represents shall be considered defective, and shall be cause for rejection of the lot. Rejected lots may be resubmitted for acceptance tests provided the contractor has removed or reworked all nonconforming products.

4.6 Tests.

4.6.1 Thickness. Separate specimens (see 4.4.1) shall not be used for thickness measurements unless a need for such specimens has been shown. Thickness measurements may be made by any suitable method provided the specific method and equipment used shall be such that the coating thickness will be determined within plus or minus 10 percent of its true thickness. The following test methods for thickness may be used as applicable: ASTM B 487 (microscopical), ASTM B 504 (coulometric), ASTM B 499 (magnetic), ASTM B 567 (beta radiation backscatter), or ASTM B 568 (X-ray spectrometry). Measurements on threaded fasteners shall be made on the shank or other smooth surface as close to the threads as possible. The method or instrument used for determining the coating thickness shall be of a type approved by the procuring activity.

4.6.1.1 Nondestructive tests for thickness. Each item in the sample selected in accordance with 4.4.2 shall be measured for plating thickness. The measurements shall be made in representative locations on each item and the item shall be considered defective if one or more of the measurements fail to meet the specified minimum thickness.

4.6.1.2 Destructive tests for thickness. Each item selected in accordance with 4.4.3 shall be tested in several locations by one of the destructive test methods for thickness. If the plating thickness at any one place on any one item is less than the specified minimum, the lot shall be rejected.

4.6.2 Adhesion. Each item selected in accordance with 4.4.3 shall be tested for adhesion. The items used for the thickness test of 4.6.1 may be used for the adhesion test if the items are of suitable size and form. When specified (see 6.2), an alternate adhesion test may be used.

4.6.2.1 Method of test. The test specimens shall be bent repeatedly through an angle of 180 degrees on a diameter equal to the thickness of the specimen until fracture of the basis metal occurs. Following fracture of the basis metal, it shall not be possible to detach any areas of the coatings with a sharp instrument. When the plated articles are not readily adaptable to the bend test, adhesion may be determined on the plated article by cutting the plating from the basis metal at the interface in a continuous path, and examining at four diameters magnification to determine whether removal has been caused by the cutting away of an adherent plate or by the lifting of a nonadherent plate.

4.6.3 Solderability. When solderability is required each item in the sample of 4.4.3 shall be tested for solderability. The items used for the thickness and adhesion tests of 4.6.1 and 4.6.2 may be used for the solderability test if the items are of suitable size and form.

4.6.3.1 Method of test. Test specimens shall be suitably fluxed with a noncorrosive flux conforming to MIL-F-14256, type R (or as outlined in ASTM B 545, paragraph A 6.2.2.3), and then immersed in a solder conforming to QQ-S-571. Unless otherwise specified by the procuring activity, the solder shall conform to Sn60, Sn62 or Sn63 of QQ-S-571, recommended on the basis of its wide use in electronics. Specimens shall be immersed for 4 ± 1 second at a solder-pot temperature of 450 ± 20 F (232 ± 11 C), removed and shaken lightly to remove excess of solder. The solder coating shall be examined for compliance with 3.5.

4.6.4 Salt spray test. When specified (see 3.6 and 6.2), coated items shall be subjected to a 24 hour, 5 percent sodium chloride solution, salt spray test in accordance with ASTM B 117, Salt Spray (Fog) Testing. After removal from the salt spray (fog) cabinet examine the items for compliance with 3.6.

5. PACKAGING

5.1 Preservation. All tin plated parts specified as being used for electrical terminals which are to be soldered shall be given a protective coating or dip composed of 1 ounce of stearic acid (commercial) dissolved in 1 gallon of xylol (commercial). Parts shall be dipped or coated immediately after plating at room temperature 70 F (21 C) and then spun dried.

5.2 Packaging and packing. The parts shall be packaged and packed in accordance with the applicable item specification.

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6. NOTES

6.1 Intended use. The following applications of various thicknesses of coating are submitted for information purposes only and are not to be construed as mandatory requirements in the use of this specification:

- a. ASTM B 545 outlines thicknesses for various service conditions in section 5, paragraph 5.2.2.
- b. 0.0001 to 0.00025 inch (2.5 to 6.4 μm) for "tin flashing" of articles to be soldered.
- c. 0.0002 to 0.0004 inch (5 to 10 μm) for articles to prevent galling or seizing.
- d. 0.0003 inch (5.1 to 15 μm) minimum for articles generally plated to prevent corrosion of basis metals.
- e. 0.0002 to 0.0006 inch for articles to prevent formation of case during nitriding.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- a. Title, number, and date of this specification.
- b. Type of tin plating (see 1.2).
- c. Thickness of tin plating (see 3.3 and 6.1).
- d. Whether salt spray tests are required (see 3.6).
- e. Whether the item is to be soldered (see 3.5).
- f. Administrative provisions for inspection records (see 4.1).
- g. Supplementary preservative coating if required (see 5.1).
- h. Other tests, including any of those specified in accordance with ASTM B 545.

6.3 The manufacturer of the basis metal parts shall provide the plating facility with the following data:

- a. Hardness of steel parts.
- b. Whether heat treatment for stress relief has been performed or is required (ASTM B 242, Preparation of High-Carbon Steel for Electroplating).

6.4 Significant surfaces. Significant surfaces (3.3) are those surfaces that are visible and subject to wear and corrosion.

6.5 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

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Army - MR
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Air Force - 99

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