AEROSPACE MATERIAL SPECIFICATION

AMS2434™	REV. E

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Reaffirmed 2022-01

Superseding AMS2434D

Plating, Tin-Zinc Alloy

RATIONALE

AMS2434E results from a Five-Year Review and update of this specification with technical changes to Ordering Information, classification (1.3, 1.3.1, 1.3.2), stress relief treatment (3.1.2, 3.1.2.1, 3.1.2.2, 3.1.2.3), activating treatment (3.1.7), type 2 treatments (3.3.2, 3.3.2.1, 3.3.2.2, 3.3.2.3), thickness (3.4.1, 3.4.1.3), hydrogen embrittlement (3.4.5), solderabilty (3.4.6), acceptance tests (4.2.1), periodic tests (4.2.2), sampling for acceptance tests (Table 2), sampling for periodic tests (4.3.2), hydrogen embrittlement test and specimens (4.3.3.3) and adhesion test specimens (4.3.3.4).

NOTICE

ORDERING INFORMATION: The following information shall be provided to the plating processor by the purchaser.

1. Purchase order shall specify not less than the following:
   - AMS2434E and plating Type and Grade (see 1.3).
   - Plating thickness desired (see 3.4.1).
   - Basis metal to be plated.
   - Copper underplating, if required for soft soldering (see 8.7).
   - Tensile strength or hardness of the basis metal.
   - Pre-plate stress relief to be performed by plating processor (time and temperature) if different from 3.1.2.
   - Special features, geometry or processing present on parts that requires special attention by the plating processor.
   - Permissible electrical contact locations, if not specified
   - Hydrogen embrittlement relief to be performed by plating processor (parameters or reference document) if different from 3.3.
   - Minimum thickness on internal surfaces, if required (see 3.4.1.1).
   - Solderability, if required (see 3.4.6).
   - Optional: Periodic testing frequency (see 4.2.2) and sample quantity (see 4.3.2).
   - Quantity of pieces to be plated.

2. Parts manufacturing operations such as heat treating, forming, joining and media finishing can affect the condition of the substrate for plating, or if performed after plating, could adversely affect the plated part. The sequencing of these types of operations should be specified by the cognizant engineering organization or purchaser and is not controlled by this specification.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS2434E/

1. SCOPE

1.1 Purpose

This specification covers the requirements for electrodeposited tin-zinc alloy plating.

1.2 Application

This plating has been used typically as a corrosion resistant plating where cadmium cannot be used, as a replacement for tin plating where tin whisker growth is a concern, a coating for fasteners where thread lubricity is desirable, and for parts which are to be joined using tin-lead solders, but usage is not limited to such applications.

1.3 Classification

Plating covered by this specification is classified as follows:

Type 1 - As plated

Type 2 - With supplementary chromate treatment.

Grade A - Hexavalent chromate treatment, service temperature 250 °F (121 °C) maximum.

Grade B - Trivalent chromium treatment, service temperature 375 °F (191 °C) maximum.

1.3.1 Unless a Type is specified, Type 2 shall be supplied.

1.3.2 For Type 2 plating, if no grade is specified, Grade A shall be supplied. Processors have the option of using Grade B if permitted by the cognizant engineering organization.

1.4 Safety - Hazardous Materials

While the materials, methods, applications and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards that may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take the necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2418 Plating, Copper

AMS4751 Tin - Lead Eutectic 63Sn - 37Pb

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

AS2390 Chemical Process Test Specimen Material

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B32 Solder Metal

ASTM B117 Operating Salt Spray (Fog) Apparatus

ASTM B253 Preparation of Aluminum Alloys for Electroplating

ASTM B374 Terminology Relating to Electroplating

ASTM B487 Measurement of Metal and Oxide Coating Thickness by Microscopic Examination of Cross-Section

ASTM B499 Measurement of Coating Thickness by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals

ASTM B504 Measurement of Thickness of Metallic Coatings by the Coulometric Method

ASTM B567 Measurement of Coating Thickness by the Beta Backscatter Method

ASTM B568 Measurement of Coating Thickness by X-Ray Spectrometry

ASTM B571 Qualitative Adhesion Testing of Metallic Coatings

ASTM F519 Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments

3. TECHNICAL REQUIREMENTS

3.1 Preparation

3.1.1 Unless otherwise specified, parts shall be within drawing dimensions before plating, except as specified in 3.1.1.1.

3.1.1.1 All engine and propeller utility parts having numbers with prefix AN, AS, or MS, required to be plated in accordance with this specification, shall be made to such dimensions that parts will be within drawing limits after plating. Undercutting before plating shall not be permitted unless authorized by purchaser.

3.1.2 Stress Relief Treatment

All steel parts having a hardness of 40 HRC and above and that are machined, ground, cold formed or cold straightened after heat treatment shall be cleaned to remove surface contamination and thermally stress relieved before plating. (Residual tensile stresses have been found to be damaging during electroplating.) Furnaces used for stress relief shall be controlled per AMS2750; the minimum requirements shall be Class 5 and Type D Instrumentation. Temperatures to which parts are heated shall be such that stress relief is obtained while still maintaining hardness of parts within drawing limits. Unless otherwise specified, the following treatment temperatures and times shall be used:

3.1.2.1 For parts, excluding nitrided parts, having a hardness of 55 HRC and above, and for carburized and induction hardened parts, stress relieve at 275 °F ± 25 (135 °C ± 14) for 5 to 10 hours.

3.1.2.2 For parts having a hardness less than 55 HRC, and for nitrided parts, stress relieve at 375 °F ± 25 (191 °C ± 14) for a minimum of 4 hours. Higher temperatures shall be used only when specified or approved by the cognizant engineering organization.

3.1.2.3 For peened parts: If stress relief temperatures above 375 °F (191 °C) are elected, the stress relieve shall be performed prior to peening or the cognizant engineering organization shall be consulted and shall approve the stress relief temperature.

3.1.3 The plating shall be applied over a surface free from water breaks. The cleaning procedure shall not produce pitting or intergranular attack of the basis metal and shall preserve dimensional requirements.

3.1.4 Unless otherwise specified, a wet or dry abrasive cleaning that does not change dimensions of the part may be used to assist adhesion of the plate.

3.1.5 Except for barrel plating, electrical contact points shall be as follows. For parts which are to be plated all over, locations shall be acceptable to purchaser. For parts which are not to be plated all over, locations shall be in areas on which plating is not required.

3.1.6 Aluminum alloys shall be zincate or stannate treated in accordance with ASTM B253 or other method acceptable to the cognizant engineering organization prior to plating.

3.1.7 Nickel or cobalt alloys and corrosion resistant steels shall be given an activating treatment, such as nickel strike, prior to tin-zinc plating.

3.2 Procedure

3.2.1 Except as noted or otherwise specified, tin-zinc shall be electrodeposited directly on the basis metal from a suitable tin-zinc solution. See 8.7 if soft soldering is required.

3.2.2 Spotting-in and double plating are not permitted.

3.3 Post Treatment

3.3.1 Parts shall be given a hydrogen embrittlement relief or adhesion enhancement treatment in a circulating air furnace in accordance with Table 1 (see 8.2). Treatment shall begin within four hours of the completion of the plating operation.

Table 1 - Post plating baking conditions

Material	Temperature	Time, Hours Minimum
Carburized parts	275 °F ± 25 °F (135 °C ± 14 °C)	23
Other steels over 55 HRC	275 °F ± 25 °F (135 °C ± 14 °C)	23
Steel parts 40 HRC and higher	340 °F ± 25 °F (171 °C ± 14 °C)	12
Threaded fasteners 31 HRC and higher	340 °F ± 25 °F (171 °C ± 14 °C)	12
PH steels and aged below 1000 °F (538 °C)	340 °F ± 25 °F (171 °C ± 14 °C)	12
Adhesion enhancement, Aluminum Alloy parts (see 8.7)	225 °F ± 25 °F (107 °C ± 14 °C)	1
Adhesion enhancement, other alloys (optional)	225 °F ± 25 °F (107 °C ± 14 °C)	1

3.3.2 Type 2 Treatments

3.3.2.1 Type 2 parts shall be subjected to a chemical conversion process that retards the formation of white corrosion product sufficiently to meet the requirements of 3.4.4.2. Waxes, oils, or other water repellant systems shall not be used for this purpose.

3.3.2.2 Grade A parts shall receive a hexavalent chromate conversion treatment. When hydrogen embrittlement relief baking is required by Table 1, the treatment shall be applied after baking and surface reactivation.

3.3.2.3 Grade B parts shall receive a trivalent chromium conversion treatment. When hydrogen embrittlement relief baking is required by Table 1, the treatment shall be applied prior to baking.

3.4 Properties

3.4.1 Thickness

Thickness of the plated deposit shall be as specified on the engineering drawing, determined by a dimensional gaging method (see 3.4.1.3) or in accordance with any of the following methods as applicable: ASTM B487, ASTM B499, ASTM B504, ASTM B567, ASTM B568 or other method acceptable to purchaser.

3.4.1.1 All surfaces of the part, except those which cannot be touched by a sphere 0.75 inch (19 mm) in diameter, shall be plated to the specified thickness. Unless otherwise specified, surfaces such as holes, recesses, threads and other areas where a controlled deposit cannot be obtained under normal plating conditions, may be under the specified limit provided they show visual plating coverage.

3.4.1.2 Where a tin-zinc flash plate is specified, plate thickness shall be approximately 0.0001 inch (2.5 µm).

3.4.1.3 Dimensional gauging (micrometers, verniers, pin gages, dial bore gages, height gages, or coordinated measuring machines, as examples) shall be maintained in accordance with ANSI/NCSL Z540.3. Resolution of the calibrated measuring instrument used, shall be not less than ten times more precise than the attribute being measured.

3.4.2 Composition

The plated deposit shall have a composition of 70 to 90% tin and 10 to 30% zinc, as determined by a method acceptable to the cognizant engineering organization (see 8.8). In case of dispute, one or more of the parts may be stripped of coating, and the resultant solution analyzed by conventional wet chemical methods for relative proportions of tin and zinc.

3.4.3 Adhesion

Adhesion shall meet the requirements of the heat quench method described in ASTM B571 for tin plating.

3.4.4 Corrosion Resistance

3.4.4.1 Type 1

Parts or specimens having a plate thickness of 0.0003 to 0.0005 inch (8 to 13 µm) shall not show basis metal corrosion after 96 hours of continuous salt spray test, conducted in accordance with ASTM B117.

3.4.4.2 Type 2

Parts or specimens having a plate thickness of 0.0003 to 0.0005 inch (8 to 13 µm) shall show neither white corrosion product after 96 hours of continuous salt spray test nor basis metal corrosion after 500 hours of continuous salt spray test conducted in accordance with ASTM B117. The presence of white corrosion product within 0.25 inch (6.4 mm) from the edges of the specimen shall not constitute failure.

3.4.5 Hydrogen Embrittlement

The plating process after baking (see 8.2) shall not cause hydrogen embrittlement in steel parts 36 HRC and over determined in accordance with ASTM F519, Type 1a.1.

3.4.6 Solderability

When specified, Type 1 deposits shall demonstrate acceptable solderability using tin-lead solder in accordance with AMS4751, or ASTM B32 Grade SN63 or solder material as approved by the cognizant engineering organization, and using a mildly reactive rosin (RMA) flux. The solder shall flow uniformly and shall show no evidence of dewetted areas.

3.5 Quality

Plating shall be smooth, continuous, free of delamination within the plating, uniform in appearance, and free of imperfections detrimental to usage of the plating. Plating shall be visually free from frosty areas, pinholes, porosity, blisters, nodules, and pits. Slight discoloration or staining is permitted.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The processor shall supply all specimens for processor's tests and shall be responsible for the performance of all required tests. Parts, if required for tests, shall be supplied by purchaser. The cognizant engineering organization reserves the right to sample and to perform any confirmatory tests deemed necessary to ensure that processing conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Thickness (3.4.1), solderability, when specified, (3.4.6) and quality (3.5) are acceptance tests and shall be performed on parts, or specimens representing parts when permitted herein from each lot (see 4.3.3).

4.2.2 Periodic Tests

Composition (3.4.2) and corrosion resistance (3.4.4) are periodic tests and shall be performed at least monthly that parts are processed unless frequency of testing is specified by the cognizant engineering organization. Adhesion (3.4.3) is a periodic test that shall be performed no less than daily for each generic class of alloy as defined by AS2390 processed during that day.Tests of cleaning and plating solutions are periodic tests and shall be performed at a frequency established by the processor unless frequency is specified by the cognizant engineering organization (see 8.6 and 4.4.3).

Hydrogen embrittlement (3.4.5) is a periodic test and shall be performed in accordance with 4.3.3.3 at least once in each month that steel parts 36 HRC and over are plated unless frequency of testing is specified by the cognizant engineering organization.

4.2.3 Preproduction Tests

All property verification test (3.4) are preproduction tests and shall be performed prior to or on the initial shipment of plated parts to a purchaser and when the cognizant engineering organization requires confirmatory testing to be required.

4.3 Sampling for Testing

4.3.1 Acceptance Tests

Test samples shall be randomly selected from all parts in the lot. A lot shall be all parts of the same part number, processed in a continuous series of operations (3.1 through 3.3), in not longer than 8 consecutive hours, and presented for processor's inspection at one time. Unless the cognizant engineering organization provides a sampling plan, the minimum number of samples shall be as shown in Table 2.

Table 2 - Sampling for acceptance tests

Number of Parts in Lot	Quality	Thickness and Solderability, when specified
Up to 7	all	3 or all*
8 to 15	7	4
16 to 40	10	4
41 to 110	15	5
111 to 300	25	6
301 to 500	35	7
501 to 700	50	8
701 to 1200	125	15

*Whichever is less.

4.3.2 Periodic Tests

Sample quantity shall be four for corrosion resistance. For hydrogen embrittlement, sample size shall be as specified in ASTM F519 unless otherwise specified by the cognizant engineering organization (see 4.3.3.3). For adhesion tests, four test specimens of each generic class of alloy, as defined by AS2390, that have been be processed through the same cleaning and plating operations as the parts that they represent. These adhesion test specimens shall be processed prior to the first production lot of parts or with the first production lot of parts. Sample quantity for other periodic tests shall be at the discretion of the processor unless otherwise specified by the cognizant engineering organization or herein.

4.3.3 Sample Configuration

Nondestructive testing shall be performed wherever practical. Except as noted, actual parts shall be selected as samples for tests. When representative specimens are used for acceptance testing, values so obtained shall be correlated with those of parts since properties, such as thickness, may differ between parts and representative test specimens.

4.3.3.1 Representative test specimens may be used in lieu of parts under any one of the following circumstances: The plated parts are of such configuration or size as to be not readily adaptable to specified tests, nondestructive testing is not practical on actual parts, or it is not economically acceptable to perform destructive tests on actual parts. Except as specified below, representative test specimens shall be made of the same generic class of alloy as the parts, established in accordance with AS2390, distributed within the lot, cleaned, plated, and post treated with the parts represented.

4.3.3.2 Corrosion Test Specimens

When ferrous alloy parts are processed within the test month, representative test specimens shall be low carbon or low alloy steel 0.025 inch (0.63 mm) minimum thickness and not less than 4 x 6 inches (102 x 152 mm) or bars approximately 0.5 inch (13 mm) in diameter and 4 inches (102 mm) long having a surface roughness not to exceed 40 µin (1 µm) AA. Representative test specimens for aluminum alloy parts (same specimen size as for steel) made of either 2024-T3 or the same generic class of alloy as the parts processed within the test period when aluminum alloy parts are plated. Representative test specimens, made of the predominant generic class of alloy as the parts and plated within the test period may be used when acceptable to the cognizant engineering organization. Alternative alloy or configuration may be used when acceptable to the cognizant engineering organization. Plating thickness shall be 0.0005 inch (13 µm) maximum.

4.3.3.3 Hydrogen Embrittlement Test and Specimens

Test shall be in accordance with the requirements of ASTM F519 Type 1a.1 using round notched specimens, unless a different specimen is specified by the cognizant engineering organization, stressed in tension under sustained load. For test purposes, the plating thickness shall be 0.0005 inch ± 0.0002 (51 µm ± 5) measured on the smooth section of the test specimen, but with visual evidence of plating in the root and flanks of the notch. Testing beyond the 200 hour test period is not required. The test samples shall be exposed to all steps of the documented plating process including surface preparation (reagent, electro-cleaning or abrasive blasting as applicable), any flash, strike or underplate, and the prescribed baking schedule per AMS2759/9.

4.3.3.4 Adhesion Test Specimens

Test specimens for adhesion testing shall be made of the same generic class of alloy processed as defined by AS2390. The test specimens shall be 0.025 inch (0.6 mm) minimum thickness and not less than 1 x 4 inches (25 x 102 mm).

4.4 Approval

4.4.1 The process and control factors, or a preproduction part, or both, whichever is specified, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 If the processor makes a significant change to any material, process, or control factor from that which was used for process approval, all preproduction tests shall be performed and the results submitted to the cognizant engineering organization for process reapproval unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect the properties or performance of the parts.