SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2422E

Issued JAN 1958
Revised JUL 2002
Reaffirmed APR 2007

Superseding AMS 2422D

(R)

Plating, Gold

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

1. SCOPE:

1.1 Form:

This specification covers the engineering requirements for electrodeposition of gold and the properties of the deposit.

1.2 Application:

This plating has been used typically to improve the solderability, electrical conductivity, corrosion resistance, performance, and appearance of electronic and electrical parts, but usage is not limited to such applications.

1.3 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 which 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 necessary precautionary measures to ensure the health and safety of all personnel involved.

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

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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2759/9 Hydrogen Embrittlement Relief (Baking) of Steel Parts

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or http://www.astm.org/cgi-bin/SoftCart.exe/index.shtml?E+mystore

ASTM B 117 Operating Salt Spray (Fog) Testing Apparatus
ASTM B 253 Preparation of Aluminum Alloys for Electroplating
ASTM B 487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM B 499 Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
ASTM B 504 Measurement of Thickness of Metallic Coatings by the Coulometric Method
ASTM B 567 Measurement of Coating Thickness by the Beta Backscatter Method
ASTM B 568 Measurement of Coating Thickness by X-Ray Spectrometry
ASTM B 571 Adhesion of Metallic Coatings
ASTM E 376 Measuring Coating Thickness by Magnetic-Field or Eddy-current (Electromagnetic) Test Methods
ASTM F 519 Mechanical Hydrogen Embrittlement Evaluation of Plating Processes and Service Environments

2.3 ANSI Publications:

Available from American National Standards Institute, Inc., 25 West 43rd Street, New York, NY 10036 or http://www.web.ansi.org/public/std_info.html.

ANSI B46.1 Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 Finish of surfaces to be plated, prior to cleaning, shall be not rougher than 32 microinches (0.8 µm), determined in accordance with ANSI B46.1.

3.1.2 Steel parts having a hardness higher than 40 HRC and which have been ground after heat treatment shall be cleaned to remove surface contamination and suitably stress relieved before preparation for plating. Temperatures to which parts are heated shall be such that maximum stress relief is obtained without reducing hardness of parts below drawing limits but, unless otherwise specified not less than 275 °F (135 °C) for not less than five hours for parts having hardness of 55 HRC of higher or not less than 375 °F (191 °C) for not less four hours for other parts.

3.1.3 Parts shall have clean surfaces free of waterbreak prior to immersion in the plating solution.

3.1.4 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.

3.2 Procedure:

Parts shall be plated in the following sequence using the solution specified; parts shall be immersed in each plating solution with the current on.

3.2.1 Copper Flash or Copper Strike: A copper flash or copper strike shall be electrodeposited from a suitable plating solution, except as exempted in 3.2.1.1.

3.2.1.1 When parts to be plated are made of copper or copper alloy containing less than 15% zinc, the copper flash or copper strike may be omitted.

3.2.2 Nickel Flash or Nickel Strike: A nickel flash or nickel strike shall be electrodeposited from a suitable nickel plating solution over the copper, copper alloy containing less than 15% zinc, copper flash, or copper strike as applicable.

3.2.3 Aluminum alloys may be zincate treated in accordance with ASTM B 253.

3.2.4 Gold Plating: Parts shall be plated by electrodeposition of gold from a suitable solution directly onto the nickel strike.

3.2.5 Plated springs may be removed from the plating racks after rinsing provided they are not flexed prior to embrittlement relief.

3.2.6 Spotting-in is not permitted.

3.3 Hydrogen Embrittlement Relief:

Treatment of steel parts shall be in accordance with AMS 2759/9.

3.4 Properties:

The deposit shall conform to the following requirements:

3.4.1 Thickness: Shall be as follows, determined on representative parts or test panels as in 4.3.1.1 in accordance with ASTM B 487, ASTM B 499, ASTM B 504, ASTM B 567, ASTM B 568, ASTM E 376, or other method acceptable to purchaser.

3.4.1.1 Copper Flash or Strike: Not less than 0.0001 inch (2.5 µm).

3.4.1.2 Nickel Strike: Not less than 0.0001 inch (2.5 µm).

3.4.1.3 Gold Plate: Not less than 0.00005 inch (1.27 µm) on all surfaces on which gold plating is specified (See 8.2).

3.4.1.4 Thickness requirements apply to surfaces that can be touched by a sphere 0.75 inch (19 mm) in diameter. Other areas, such as surfaces of holes, recesses, internal threads, or contact areas of parts plated all over, where a controlled deposit cannot be obtained under normal plating conditions, shall show evidence of plating.

3.4.2 Adhesion: Plate shall be firmly and continuously bonded and shall not show separation from the basis metal or internal delamination of the plating, determined on representative parts or specimens in accordance with the heat quench method described in ASTM B 571.

3.4.3 Solderability: When specified, sample parts or representative test panels as in 4.3.3 shall be cleaned to remove surface contamination, fluxed with a suitable noncorrosive rosin flux (RA), immersed for three to five seconds in a molten solderbath containing 60Sn - 40Pb solder at 550 °F ± 10 (288 °C ± 6), removed and shaken lightly. The solder coating shall be uniform and free from lumps, and dewetted areas, and shall not flake or peel when tested in accordance with 3.4.2.

3.4.4 Purity: Gold, as plated, shall be not less than 99.0% pure, determined by a method acceptable to purchaser.

3.4.5 Corrosion Resistance: Plated parts or representative test panels as in 4.3.3 shall show no visual evidence of corrosion of the basis metal after being subjected for 24 hours to continuous salt spray corrosion test conducted in accordance with ASTM B 117.

3.4.6 Hydrogen Embrittlement: The plating shall not cause hydrogen embrittlement in ferrous metals. Testing in accordance with ASTM F 519 Type 1a using notched specimens, unless a different specimen is specified by the purchaser, stressed in tension under constant load, is required only when parts 36 HRC or higher are plated. For test purposes, plating thickness shall be 0.0005 to 0.0007 inch (13 to 18 µm), measured on the smooth section of the specimen, but with visual plating in the root of the notch.

3.5 Quality:

Plating shall be smooth, continuous, free of delaminations 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.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor shall supply all samples and shall be responsible for the performance of all required tests. When parts are to be tested, such parts shall be supplied by purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Thickness (3.4.1), adhesion (3.4.2), solderability, when specified (3.4.3), and quality (3.5) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Purity (3.4.4), corrosion resistance (3.4.5), hydrogen embrittlement (3.4.6) and tests of cleaning and plating solutions to ensure that deposited metal will conform to specified requirements are periodic tests (See 8.6) and shall be performed at a frequency selected by the plating processor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of plated parts to a purchaser, and when a change in material and/or processing requires reapproval by the cognizant engineering organization (See 4.4.2), and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

Shall be not less than the following; a lot shall be all parts of the same part number, made of the same basis metal, plated in the same set of solutions to the same specified plating thickness range within a consecutive 24 hours, and presented for processor's inspection at one time:

4.3.1 Sample Configuration: Nondestructive testing shall be performed wherever practical and authorized herein; except as noted, actual parts shall be selected as samples for test.

4.3.2 For Acceptance Tests: Test samples shall be randomly selected from all parts in the lot. Unless purchaser specifies a sampling plan, the minimum number of samples shall be as shown in Table 1.

TABLE 1 – Sampling for Acceptance Testing

Number of Parts in Lot	Quality	Thickness and Adhesion	Solderability, When Specified
Up to 7	All	3	1
8 to 15	7	4	2
16 to 40	10	4	2
41 to 110	15	5	3
111 to 300	25	6	3
301 to 500	35	7	4
501 to 700	50	8	4
701 to 1200	75		6

4.3.2.1 A statistical sampling plan, acceptable to purchaser, may be used by purchaser in lieu of sampling in accordance with 4.3.1.

4.3.3 Periodic Tests: Sample quantity and test frequency shall be at the discretion of the processor unless a test frequency is specified by purchaser. Hydrogen embrittlement testing is required only when ferrous alloys 36 HRC or higher are being plated.

4.3.3.1 When plated parts are of such configuration or size as to be not readily adaptable to the specified tests, separate test specimens made of the same generic class of alloy as the parts, cleaned, plated, and post-treated with the parts represented may be used. Specimens shall be panels approximately 0.032 x 1 x 4 inches (0.81 x 25 x 102 mm). For corrosion resistance testing, the specimens shall be made from low carbon steel.

4.4 Approval:

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

4.4.2 The processor of plated parts shall make no significant change to materials, processes, or control factors from those on which the approval was based, unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgement of the cognizant engineering organization, could affect the properties or performance of the parts.

4.4.3 Control factors shall include, but not be limited to, the following:

Surface preparation or activation as applicable
Location and method of attaching electrical contacts
Composition and composition limits of nickel flash bath
Composition and composition limits of gold plating bath
Current limits (amperes/square foot) of gold plating procedure
Method used for determining plate thickness
Frequency and method of analysis of plating baths
Periodic test plan

4.5 Reports:

The processor of plated parts shall furnish with each shipment a report stating that the parts have been processed and tested in accordance with specified requirements and that the plated parts conform to the other technical requirements. This report shall include the purchase order number, lot number, AMS 2422E, part number, and quantity.

4.6 Resampling and Retesting:

4.6.1 If the result of any acceptance test fails to meet the specified requirements, the parts in that lot may be stripped by a method acceptable to purchaser that does not roughen, pit, or embrittle the basis metal, pretreated, plated, and post treated as defined herein and tested. Alternatively, all parts in the lot may be inspected for the nonconforming attribute, and the nonconforming parts may be stripped by a method acceptable to purchaser that does not pit, roughen, or embrittle the basis metal, pretreated, plated, post treated as defined herein, and tested.

4.6.2 If the result of any periodic test fails to meet the specified requirements, the process will be declared nonconforming. No additional parts shall be plated until the process is corrected and new specimens are plated and retested. Results of all tests shall be recorded and, when requested reported. Purchaser shall be notified of all parts plated since the last acceptable test.

5. PREPARATION FOR DELIVERY:

5.1 Plated parts shall be handled and packaged to ensure that the required physical characteristics and properties of the plating are preserved.

5.2 Packages of processed parts shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the parts to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT:

Processor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.