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INTERNATIONAL
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AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 2422D

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Superseding AMS 2422C

(R) PLATING, GOLD

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.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The applicable issue of referenced publications shall be the issue in effect on the date of the purchase order.

2.1 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 117 Salt Spray (Fog) Testing
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 568 Measurement of Coating Thickness by X-Ray Spectrometry
ASTM E 290 Semi-Guided Bend Test for Ductility of Metallic Materials
ASTM E 376 Measuring Coating Thickness by Magnetic-Field or Eddy-current (Electromagnetic) Test Methods

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2073-1 DoD Materiel, Procedures for Development and Application of Packaging Requirements

2.3 ANSI Publications:

Available from American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036.

ANSI B46.1 Surface Texture

3. TECHNICAL REQUIREMENTS

3.1 Preparation:

3.1.1 All fabrication type operations, such as forming, machining, heat treating, brazing, and welding, shall be completed before parts are plated.

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

3.1.3 Parts shall have clean surfaces free of waterbreak prior to immersion in the plating solution. Treatments which may produce hydrogen embrittlement shall be avoided.

3.1.4 Electrical contacts between parts and power source shall be made to ensure that neither chemical or immersion deposition nor electrical arcing or overheating will occur. If parts are to be plated all over, contact points shall be located where specified or where agreed upon by purchaser and vendor. If parts are not required to be plated all over, contact points shall be located in areas on which plating is not required or is optional. Barrel plated parts shall be sufficiently agitated during plating to ensure coverage of parts.

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 copper cyanide, alkaline noncyanide, or other plating solution acceptable to purchaser, 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 or are copper plated, 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 Watt's type nickel solution or from a nickel chloride or nickel sulfamate solution over the copper, copper alloy containing less than 15% zinc, copper plate, copper flash, or copper strike as applicable.

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

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

3.3 Post Treatment:

After plating, rinsing, and drying, steel parts shall be treated as in 3.3.1 3.3.2, or 3.3.3 as applicable to remove hydrogen embrittlement; heating shall be in air, preferably in a circulating-air oven. Post-treatment shall follow the plating operation with a maximum delay of four hours.

3.3.1 Parts having a specified hardness of 33 to 45 HRC shall be heated to 375 °F ± 25 (191 °C ± 14) and held at heat for not less than three hours. Parts having hardness of 46 HRC or higher shall be held at heat for 23 hours.

3.3.2 Parts, including carburized parts, which will decrease in hardness or be otherwise deleteriously affected by heating to 375 °F (191 °C) shall be heated to 275 °F ± 25 (135 °C ± 14) and held at heat for five hours. Parts having a hardness of 46 HRC or higher shall be held at heat for not less than 23 hours.

3.3.3 Parts requiring special handling shall be post treated as specified by purchaser.

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 4.3.3 in accordance with ASTM B 487, ASTM B 499, ASTM B 504, ASTM B 568, ASTM E 376, or other method acceptable to purchaser.

3.4.1.1 Copper 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 No requirements are established for minimum plate thickness on surfaces of holes, recesses, internal threads, contact areas of parts plated all over, and other areas where a controlled deposit cannot be obtained under normal plating conditions but such areas shall not be masked to prevent plating. The resultant thickness shall be considered only when such surfaces can be touched by a sphere 0.75 inch (19.0 mm) in diameter; however, such surfaces shall show visual evidence of coverage.

3.4.2 Adhesion: Parts or specimens as in 4.3.3 shall not show separation of the plating from the basis metal, when examined at approximately 4X magnification, after being bent in accordance with ASTM E 290 through an angle of 180 degrees around a diameter equal to the nominal thickness of the specimen. Formation of cracks which do not result in flaking or blistering of the plating is acceptable.

3.4.2.1 If parts are not suitable for bend testing, adhesion may be determined, prior to hydrogen embrittlement relief, by heating parts to 350 °F ± 10 (177 °C ± 6), holding at heat for 60 minutes ± 5, and quenching in water. After heating and quenching, there shall be no evidence of blistering of the plating visible under 4X magnification.

3.4.3 Solderability: When specified, sample parts or representative test panels as in 4.3.3 shall be fluxed with a suitable noncorrosive rosin flux, (RA) immersed for three seconds in a 60Sn - 40Pb solder at 550 °F ± 10 (288 °C ± 6), removed and shaken lightly. The solder coating shall be uniform and free from lumps, 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.

3.5 Quality:

Plating, as received by purchaser, shall be smooth, fine grained, continuous, adherent to basis metal, bright, of a color normally associated with high quality 24-carat gold, and uniform in appearance and shall be essentially free from pin holes, porosity, blisters, nodules, pits, indications of burning, and other imperfections detrimental to usage of plating. Slight staining or discoloration is permissible provided it does not affect solderability of the part. There shall be no evidence of double plating or spotting-in.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor shall supply all samples and shall be responsible for performing 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: Tests for 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: Tests for purity (3.4.4) and corrosion resistance (3.4.5) and tests of cleaning and plating solutions to ensure that deposited metal will conform to specified requirements are periodic tests 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: Tests for 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.

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

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 solution to the same specified plating thickness range within a consecutive 24 hours, and presented for processor's inspection at one time:

4.3.1 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.

(R) TABLE 1 - Sampling for Acceptance Testing

Number of Parts in Lot	Quality	Thickness and Adhesion	Solderability, When Specified
Up to 6	All	3	1
7 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
1201 and over	125	15	10

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

4.3.2 For Periodic Tests and Preproduction Tests: As agreed upon by purchaser and vendor.

4.3.3 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).

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

4.4.3.1 Any of the above control factors for which parameters are considered proprietary by the process or may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

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 technical requirements. This report shall include the purchase order number, lot number, AMS 2422D, 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, re pretreated, replated, and re-post treated as defined herein and retested. 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, re-pretreated, replated, re-post treated as defined herein, and retested.

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.