

**AEROSPACE
MATERIAL
SPECIFICATION**

AMS 2422C

Issued 1-15-58
Revised 10-1-81

**GOLD PLATING
For Electronic and Electrical Applications**

1. SCOPE:

- 1.1 Purpose:** This specification covers the engineering requirements for electrodeposition of gold and the properties of the deposit.
- 1.2 Application:** Primarily to improve the solderability, electrical conductivity, corrosion resistance, performance, and appearance of electronic and electrical parts.

- 2. APPLICABLE DOCUMENTS:** The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

- 2.1 SAE Publications:** Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

- 2.2 ASTM Publications:** Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B117 - Salt Spray (Fog) Testing

ASTM B487 - Measurement of Metal and Oxide Coating Thicknesses by
Microscopical Examination of a Cross Section

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

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

ASTM E290 - Semi-Guided Bend Test for Ductility of Metallic Materials

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2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

2.4 ANSI Publications: Available from American National Standards Institute, 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

3. TECHNICAL REQUIREMENTS

3.1 Preparation:

3.1.1 All forming, machining, heat treating, brazing, and welding shall be completed before parts are plated.

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

3.1.3 Parts shall have chemically clean surfaces prepared with minimum abrasion, erosion, or pitting prior to immersion in the plating solution. Treatments which may produce hydrogen embrittlement shall be avoided.

3.1.4 Electrical contacts between the parts and the power source shall be made in such a manner as will 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.

3.2 Procedure: Parts shall be plated in the following sequence, unless otherwise agreed upon by purchaser and vendor, 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 bath, 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 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 gold cyanide solution directly onto the nickel flash or strike.
- 3.2.4 Rinsing: The plated parts shall be removed from the plating solution, thoroughly rinsed by immersion for not less than 15 min. in water at not lower than 180°F (80°C), and dried.
- 3.2.4.1 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 and within 30 min. after completion of the hot water rinse, parts shall be post treated as in 3.3.1 or 3.3.2; heating shall be in air, preferably in a circulating-air furnace.
- 3.3.1 Steel Parts:
- 3.3.1.1 Parts having hardness of 33 HRC or higher, except as specified in 3.3.1.2 and 3.3.1.3, shall be heated to $375^{\circ}\text{F} \pm 10$ ($190^{\circ}\text{C} \pm 5$) and held at heat for not less than 3 hours.
- 3.3.1.2 Parts which will decrease in hardness or be otherwise deleteriously affected by heating to $375^{\circ}\text{F} \pm 10$ ($190^{\circ}\text{C} \pm 5$) shall be heated to $275^{\circ}\text{F} \pm 10$ ($135^{\circ}\text{C} \pm 5$) and held at heat for not less than 5 hours.
- 3.3.1.3 Parts requiring special handling shall be post treated as agreed upon by purchaser and vendor.
- 3.3.2 When permitted or specified by purchaser, other methods of rinsing and embrittlement relief may be employed.
- 3.4 Properties: The deposit shall conform to the following requirements:
- 3.4.1 Thickness: Shall be as follows, unless otherwise specified, determined on representative parts or test panels as in 4.3.3 in accordance with ASTM B487, ASTM B499, ASTM B504, or other method agreed upon by purchaser and vendor:

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- 3.4.1.1 Copper or Nickel Flash or Strike: Not less than 0.0001 in. (2.5 μ m).
- 3.4.1.2 Gold Plate: Not less than 0.00005 in. (1.3 μ m) on all surfaces on which gold is functionally necessary.
- 3.4.1.3 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. Unless otherwise specified, the resultant thickness shall be considered only when such surfaces can be touched by a sphere 0.75 in. (19 mm) in diameter.
- 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 up to 6X magnification, after being bent in accordance with ASTM E290 through an angle of 180 deg 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 (175°C + 5) and holding at heat for 60 min. + 5. After heating, 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 shall be fluxed with a suitable noncorrosive flux, immersed for 3 sec in a 60Sn - 40Pb solder at 550°F + 10 (290°C + 5), removed and shaken lightly. The solder coating shall be uniform and free from lumps 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.
- 3.4.5 Corrosion Resistance: Plated parts or representative test panels shall show no visual evidence of corrosion of the basis metal after being subjected for 24 hr to continuous salt spray corrosion test conducted in accordance with ASTM B117.

3.5 Quality: Plated gold 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 plated parts. Slight staining or discoloration is permissible provided it does not affect solderability of the part. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5.1 Double plating and spotting-in after plating are not permitted, unless otherwise authorized by purchaser.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The processing vendor shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. 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 to determine conformance to requirements for thickness (3.4.1), solderability when specified (3.4.3), and quality (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for adhesion (3.4.2), purity (3.4.4), and corrosion resistance (3.4.5) and tests of cleaning and plating solutions to ensure that the deposited metal will conform to the requirements of this specification are classified as 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 to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the first article shipment of plated parts to a purchaser, when a change in bath composition or processing requires reapproval as in 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, the contracting officer, or the request for procurement.

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4.3 Sampling: Shall be not less than the following; a lot shall be all parts of one size and shape plated in one bath to the same specified plating thickness range within one 24 hr period and submitted for vendor's inspection at one time:

4.3.1 For Acceptance Tests:

4.3.1.1 Thickness: Three parts for each consecutive 8 hr of operation of the same set of solutions, except as specified in 4.3.3.

4.3.1.2 Solderability: As agreed upon by purchaser and vendor.

4.3.1.3 Quality: As agreed upon by purchaser and vendor.

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 cleaned, plated and post-treated with the parts represented may be used. Such specimens shall be panels of annealed, low-carbon steel approximately 0.032 x 1 x 4 in. (1 x 25 x 100 mm), unless otherwise specified by purchaser.

4.4 Approval:

4.4.1 Plated parts shall be approved by purchaser before parts for production use are supplied, unless such approval be waived. Results of tests on production parts shall be essentially equivalent to those on the approved sample parts.

4.4.2 Vendor shall use manufacturing procedures, processes, and methods of inspection on production parts which are essentially the same as those used on the approved sample parts. If any change is necessary in type of equipment or in established composition limits and operating conditions of process solutions, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, sample plated parts, test panels, or both. Production parts plated by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Reports: The vendor of plated parts shall furnish with each shipment three copies of a report stating that the parts have been processed and tested in accordance with the requirements of this specification and that they conform to the acceptance test requirements and, when performed, to the periodic test requirements. This report shall include the purchase order number, AMS 2422C, part number, and quantity.