Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 2425B
Superseding AMS 2425A
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GOLD PLATING
For Thermal Control

1. SCOPE:

1.1 Purpose: This specification covers the engineering requirements for electrodeposition of gold on metals and the properties of the deposit.

1.2 Application: Primarily for passive thermal control applications where low solar absorptance, low infrared emittance, and corrosion resistance are required.

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 Society of Automotive Engineers, Inc., 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 B504 - Measurement of the Thickness of Metallic Coatings by the Coulometric Method
ASTM B567 - Measurement of Coating Thickness by the Beta Backscatter Principle
ASTM B583 - Porosity in Gold Coatings on Metal Substrates

2.3 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, Inc., 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 All machining, brazing, welding, forming, and heat treating 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 microinches (0.8 μm), determined in accordance with ANSI B46.1. Light abrasive blasting and polishing are permitted to improve surface finish to produce a high luster.

3.1.3 Parts shall have chemically clean surfaces, prepared with minimum abrasion, erosion, or pitting, prior to immersion in the plating solution.

3.1.4 Electrical contacts between the parts and 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 as specified on the part drawing or as 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:

3.2.1 Parts shall be plated in the following sequence except that aluminum alloys shall be given a zinc immersion coating treatment prior to the following cycle:

1. Copper Strike
2. Nickel Plate
3. Gold Plate

3.2.1.1 When specified, a nickel strike shall replace copper strike when the basis metal is corrosion-resisting steel or alloy.

3.2.1.2 The copper strike may be omitted when the substrate is copper or a copper alloy.

3.2.2 After the plating operation, parts shall be thoroughly rinsed.

3.3 Post Treatment:

3.3.1 After plating and rinsing, all parts shall be treated as follows, unless otherwise permitted. All parts shall be handled carefully prior to completion of the relief treatment. Plated springs shall not be flexed prior to the baking operation.

3.3.1.1 All parts, immediately after rinsing, shall be immersed for not less than 15 min. in water at a temperature not lower than 180°F (82°C). Plated springs may be removed from the plating racks after hot water treatment and prior to the following embrittlement-relief operation provided that release from the racks does not flex the springs.

3.3.1.2 Steel parts having hardness of 36 HRC or higher shall be subjected to additional embrittlement relief not more than 30 min. after completion of the hot water immersion, by heating in air, preferably in a circulating-air furnace, to 375°F ± 10 (190.6°C ± 5.6) and holding at that temperature for not less than 3 hr or to 275°F ± 10 (135°C ± 5.6) and holding at that temperature for not less than 5 hours.

3.3.2 Polishing of plated metals is permitted to improve surface finish and luster.

3.4 Properties:

3.4.1 Composition: The gold as plated shall be not less than 98% pure, but actual determination of purity shall not be required as a routine inspection procedure; the process of plating shall be controlled to produce this purity.

3.4.2 Thickness: Unless otherwise specified, gold plating thickness, determined in accordance with ASTM B487, ASTM B504, or ASTM B567, shall be not less than 0.00008 in. (2.03 μm) on all surfaces on which gold is functionally necessary; the thickness of copper shall be not greater than 0.0001 in. (2.54 μm), and the nickel thickness shall be 0.0004 - 0.0009 in. (10.2 - 22.9 μm).

3.4.3 Adhesion: The gold deposit shall meet one of the following tests; the test in 3.4.3.1 shall be used wherever practicable.

3.4.3.1 The part, or test panels representing parts, shall be bent through an angle of 100 deg (1.74 rad) around a 0.500 in. ± 0.005 (12.70 mm ± 0.13) diameter mandrel. It shall not be possible to detach any appreciable areas of deposited gold from the basis metal with a sharp instrument although fracture of the nickel plate or the basis metal is acceptable.

3.4.3.2 If the part is not readily adaptable to the test in 3.4.3.1, adhesion may be evaluated by heating the part to 350° F ± 10 (176.7° C ± 5.6) and holding at that temperature for not less than 1 hour. Following heating, no evidence of blistering shall be visible at a magnification of 4 diameters.

3.4.4 Corrosion Resistance: Parts or representative test panels shall evince no corrosion products visible to the unaided eye at normal reading distance or any corroded areas greater than 1/32 in. (0.8 mm) in diameter after being subjected for 48 hr ± 1 to continuous salt spray corrosion test conducted in accordance with ASTM B117.

3.4.4.1 The porosity test of ASTM B583 may be used in lieu of the salt spray corrosion test, when permitted by purchaser.

3.4.5 Spectral Absorptance and Emittance: The normal spectral solar absorptance integrated over a wavelength range 0.3 - 2.7 μm shall be 0.26 ± 0.04. The normal spectral emittance integrated over a wavelength range 2.0 - 27.0 μm shall be 0.04 ± 0.02.

3.4.5.1 The integrated normal spectral solar absorptance and integrated normal spectral emittance shall be determined from the equations:

$$\bar{\alpha},\ \bar{\varepsilon} = 1 - \frac{\int_a^b R_\lambda\ S_\lambda\ d\lambda}{\int_a^b S_\lambda\ d\lambda}$$

where $\bar{\alpha}$ and $\bar{\varepsilon}$ are the integrated normal spectral solar absorptance and the integrated normal spectral emittance respectively, R_λ is the normal spectral reflectance, λ is the wavelength, and

for $\bar{\alpha}$, a = 0.3 μm
b = 2.7 μm
S_λ = Solar Spectrum

and, for $\bar{\varepsilon}$, a = 2.0 μm
b = 27.0 μm
S_λ = Black body spectrum (for temperature of interest),

and R_λ is measured in an integrating-sphere reflectometer, preferably against a standard gold surface reference.

3.4.5.2 Total reflectance (specular and diffuse) shall be equal to or greater than 95% when measured at a wavelength of 0.7 μm by an integrating-sphere reflectometer.

3.5 Quality: Deposits shall be smooth, fine grained, continuous, adherent to basis metal, and of a color normally associated with high quality 24-carat gold, and shall be free from blisters, pits, nodules, indications of burning, and other imperfections detrimental to fabrication or to performance of parts. Slight discoloration resulting from rinsing or heating will be permitted provided that such discoloration does not deleteriously affect the thermal properties or corrosion resistance of the parts.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The processing vendor shall supply all samples and shall be responsible for performing all required tests except as specified in 4.2.2.1. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems 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 thickness (3.4.2), adhesion (3.4.3), corrosion resistance (3.4.4), reflectance (3.4.5.2), and quality (3.5) requirements are classified as acceptance tests.

4.2.2 Periodic Tests: Tests to determine conformance to composition (3.4.1) and spectral absorption and emittance (3.4.5) requirements are classified as periodic tests.

4.2.2.1 The plating processor is not required to perform the spectral absorptance and emittance test (3.4.5), unless otherwise agreed upon by purchaser and vendor.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests.

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.

4.3 Sampling: Shall be as follows; a lot shall be all parts of the same part number processed in a continuous operation and presented for vendor's inspection at one time. When properties are to be determined on separate specimens representing parts, test panels approximately 0.032 x 1 x 4 in. or 1 x 25 x 100 mm shall be fabricated from steel strip, cleaned, plated, and post treated with the parts they represent.

4.3.1 Acceptance Tests: Three parts from each lot.

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

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.