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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2412G

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Superseding AMS 2412F

Submitted for recognition as an American National Standard

(R)

Plating, Silver
Copper Strike, Low Bake

1. SCOPE:

1.1 Purpose:

This specification covers the engineering requirements for silver deposited on metal parts with a copper strike between the basis metal and the silver deposit.

1.2 Application:

This process has been used typically to provide a bearing surface and to prevent galling or seizing of metal surfaces of parts made of materials where a high baking temperature may be detrimental to the properties of the basis material.

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 latest issue of SAE publications shall apply. The applicable issue of referenced documents shall be the issue in effect on the date of the purchase order.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7154 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

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

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 15248-2959.

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

2.3 ANSI Publications:

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

ASME B46.1 Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 Surface texture of surfaces to be plated other than that of nuts shall be 80 microinches (2 µm) RHR or smoother determined in accordance with ASME B46.1.

3.1.2 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:

3.2.1 Silver shall be plated over a preliminary plating of copper 0.0005 inch (13 µm) maximum. The copper strike may be omitted in plating copper and copper alloys, except for copper alloys containing zinc in quantities of 30% or more by weight. A nickel flash shall be used before the copper strike when plating corrosion-resistant steels.

3.2.2 Double plating and spotting in are prohibited.

3.3 Post Treatment:

3.3.1 Hydrogen embrittlement relief of steel parts shall be accomplished in accordance with AMS 2759/9. Thermal treatment in accordance with 3.3.2 that starts within four hours after the parts have been removed from the plating bath is an acceptable alternative.

3.3.2 Parts, except nuts shall be heated to 300 to 500 °F (149 to 260 °C) after plating, rinsing, and drying and held for not less than two hours, unless such heating would lower hardness to below drawing limits or otherwise deleteriously affect the parts, in which case heating shall be at the highest practicable temperature which will maintain specified properties. Thermal post treatment shall be in air, preferably in a circulating-air furnace.

3.4 Properties:

Plated parts shall conform to the following requirements:

3.4.1 Thickness of the deposit shall be as specified on the drawing, determined in accordance with ASTM B 487, ASTM B 499, ASTM B 568, ASTM B 748, ASTM B 504, ASTM E 376, or other method acceptable to purchaser.

3.4.1.1 Where “silver flash” is specified, plate thickness shall be approximately 0.0001 inch (2.5 µm).

3.4.2 Composition: The deposit shall be not less than 99.9% silver determined by a method acceptable to the purchaser.

3.4.3 Adhesion: The deposit shall be firmly and continuously bonded to the underlying metal as determined by the following tests:

3.4.3.1 Nuts, and other parts, shall show no blisters or other indications of poor bond.

3.4.3.2 Parts, other than nuts, shall meet the requirements of ASTM B 571.

3.4.3.3 Nuts shall show no peeling of the silver when scratched with a knife or other sharp tool.

3.4.4 Hydrogen Embrittlement after Baking: When steel parts 40 HRC or higher are plated, the process shall not cause hydrogen embrittlement, determined in accordance with ASTM F 519, Type 1, notched round bars stressed in tension under constant load. For test purposes, plating thickness shall be 0.002 inch ± 0.0002 (51 µm ± 5) measured on the smooth section of the specimen, but with visual evidence of plating in the root of the notch.

3.5 Quality:

3.5.1 Plating, as received by purchaser, which is not subsequently machined, shall be smooth, continuous, uniform in appearance, and visually free from blisters and other imperfections detrimental to the usage of the parts. Slight staining or discoloration is permissible. Selectively plated areas shall be sharply defined. There shall be no evidence of electrical arcing or local overheating. There shall be no evidence of spotting-in or double plating.

3.5.2 Silver plate which is to be machined shall be free from excessive modulation or treeing at edges. Finished parts shall be free from visible pits excessive porosity, and other imperfections detrimental to fabrication or to performance of parts.

3.5.3 Abrasion of plating on corners and edges of nuts is acceptable but plate shall be continuous on threads. Marking of the cone section of self-locking nuts, produced in offsetting the locking beams or other locking feature, is acceptable.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor shall supply all samples for processor's tests and shall be responsible for performance of all required tests. When parts are required for tests, such parts shall be supplied by the 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 (3.4.3), and quality (3.5) are acceptance tests and shall be performed on parts, or samples representing parts when permitted, from each lot.

4.2.2 Periodic Tests: Composition (3.4.2), hydrogen embrittlement (3.4.4), and tests of cleaning and plating solutions (See 8.4) are periodic tests and shall be performed at a frequency selected by the 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 production, when a significant change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmation testing necessary.

4.3 Sampling for testing shall be not less than the following; a lot shall be all parts of the same part number, plated to the same range of plate thickness in the same set of solutions in each consecutive 24 hours of operation, and presented for processor's inspection at one time.

4.3.1 Acceptance Tests: Test samples shall be randomly selected from all parts in the lot. The minimum number of samples shall be as shown in Table 1.

TABLE 1 - Sampling for Acceptance Tests

Number of Parts in Lot	Quality	Thickness and Adhesion
Up to 7	All	3
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	75	10
Over 1200	125	15

4.3.2 Sample quantities for periodic tests and preproduction tests shall be selected at the discretion of the processor, unless otherwise specified.

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. For thickness on tests, such specimens shall be panels of annealed, low-carbon steel approximately 0.032 x 1 x 4 inch (1 x 25 x 100 mm). For adhesion tests, specimens shall be panels approximately 0.032 x 1 x 4 inches (1 x 25 x 102 mm) fabricated from a material generically similar to the parts.

4.4 Approval:

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

4.4.2 The processor 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 and cleaning method
Plating bath composition and composition control limits
Plating bath temperature limits and controls
Thermal post treatment times and temperatures
Method for determining plating thickness
Stripping procedure, when applicable
Periodic test plan (See 8.4).

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 the specified requirements and that they conform to the acceptance test requirements. This report shall include the purchase order number, AMS 2412G, part number, and quantity.

4.6 Resampling and Retesting:

4.6.1 If the result of any acceptance test fails to meet specified test requirements, the parts in that lot may be stripped by a method acceptable to the 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 the purchaser that does not roughen, pit 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 specified test requirements, the process is nonconforming. No additional parts shall be plated until the process is corrected and new specimens are plated and tested. Results of all tests shall be recorded and, when requested, reported. Purchasers shall be notified of all parts plated since the last acceptable test.

5. PREPARATION FOR DELIVERY:

5.1 Parts shall be handled and packaged in such a manner as will ensure that the required physical characteristics and properties of the plating are preserved.

5.2 Packages of 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. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

6. ACKNOWLEDGMENT:

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