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INTERNATIONAL
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2418F

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Superseding AMS 2418E

Submitted for recognition as an American National Standard

Plating, Copper

1. SCOPE:

1.1 Form:

This specification covers the requirements for electrodeposition of copper on metals and the properties of the deposit.

1.2 Application:

This process has been used typically to provide an anti-seize surface, to prevent carburizing of surfaces on which carburizing is neither required or permitted, to prevent decarburization, to enhance solderability, or to provide a source of copper for furnace brazing, but usage is not limited to such applications.

1.3 Classification:

Plating covered by this specification is classified as follows:

Type 1 Engineering plating
Type 2 Plating for masking

1.3.1 Type 1 shall be supplied if no class is specified.

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 other publications shall be the issue in effect on the date of the purchase order.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 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 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

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 Beta Backscatter Method
ASTM B 568	Measurement of Coating Thickness by X-Ray Spectrometry
ASTM B 571	Adhesion of Metallic Coatings
ASTM B 734	Electrodeposition of Copper for Engineering Uses
ASTM E 376	Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods
ASTM F 519	Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals

2.2 U.S. Government Publications:

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

MIL-F-14256	Flux, Soldering, Liquid (Rosin Base)
QQ-S-571	Solder, Tin Alloy, Lead-Tin Alloy and Lead Alloy

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 All fabrication-type operations, such as forming, machining, welding, or brazing, shall be completed before parts are plated, except when plating is used as a source for copper for brazing, masking for nitriding or carburizing, or prevention of carburizing.

3.1.2 Steel parts having hardness higher than 40 HRC and which have been ground after heat treatment shall be cleaned to remove surface contamination and 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 with hardness of 55 HRC or over, or not less than 375 °F (191 °C) for not less than four hours for other parts.

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

3.1.3.1 Care must be used if parts are to be cleaned with acids which may pit the surface or induce hydrogen embrittlement in ferrous alloys. This includes, but, is not limited to, hydrochloric and sulfuric acids. In general, a momentary dip in such acids for surface activation or neutralization after alkaline cleaning is permissible, but immersion for an extended time is prohibited.

3.1.4 Except for barrel plating, electrical contacts between the 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 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:

3.2.1 Copper shall be electrodeposited from a suitable copper plating solution directly onto the metal part, or from a high speed copper plating solution following a "copper strike", except that a preliminary flash of nickel or other suitable metal is permissible on parts made from corrosion-resistant and heat-resistant steels or alloys.

3.2.2 Aluminum alloy may be zincate or stannate treated before plating.

3.3 Post Treatment:

3.3.1 After plating, rinsing, and drying, all parts having hardness higher than 40 HRC that are not to be subsequently carburized, heat treated, or brazed within four hours of completion of plating, shall be suitably heated within that time to relieve possible embrittlement. Temperatures to which parts are heated shall be such that maximum embrittlement relief is obtained without reducing the hardness of parts below drawing limits but shall be not lower than 300 °F (191 °C) for not less than one hour.

3.3.2 When localized stripping is used for removal of copper plating, it shall be performed by a method acceptable to the purchaser, that does not pit, roughen or embrittle the basis metal.

3.4 Properties:

Plated parts shall conform to the following requirements:

3.4.1 Thickness: Shall be as specified on the drawing or as follows, determined on representative parts, or when permitted by purchaser on test panels as in 4.3.2, in accordance with ASTM B 487, ASTM B 499, ASTM B 567, ASTM B 568, ASTM E 376, or other method acceptable to purchaser.

3.4.1.1 AMS 2418 shall designate plate thickness of 0.0005 to 0.0007 inch (13 to 18 µm).

3.4.1.2 Other plate thicknesses may be specified by this specification number and a suffix number designating the minimum thickness in ten thousandths of an inch (2.5 µm). A tolerance of +0.0002 inch (+5 µm) will be allowed. Thus, AMS 2418-1 designated a thickness of 0.0001 to 0.0003 inch (2.5 to 8 µm), AMS 2418-6 designated a thickness of 0.0006 to 0.0008 inch (15 to 20 µm).

3.4.1.3 Thickness for Class 2 plating shall be nominally 0.002 inch (51 µm) with no area having a plate thickness of less than 0.0007 inch (18 µm).

3.4.1.4 Where “copper flash” is specified, the thickness of copper shall be approximately 0.0001 inch (2.5 µm).

3.4.1.5 If internal surfaces or surfaces of small holes and deep recesses are required to be plated, notes on drawings will so specify but minimum plate thickness requirements will be waived except when such surfaces can be touched by a sphere 0.75 inch (19.0 mm) in diameter. When plating of such surfaces is specified, external surfaces may have plate thickness greater than that specified, but this will not be cause for rejection if dimensions of parts are within specified tolerances. However, such surfaces shall show visual evidence of coverage.

3.4.2 Porosity: For Type 2, and when specified, for Type 1, copper plate shall be nonporous so as not to give a blue color when tested for five minutes with potassium ferricyanide solution of the composition shown in Table 1.

TABLE 1 - Potassium Ferricyanide Test Solution

Ingredient	Quantity
Potassium ferricyanide	10 grams
Sodium chloride	5 grams
Water	100 mL

3.4.2.1 As an alternate test, the modified ferroxyl test of ASTM B 734 may be used.

3.4.3 Adhesion: Plating shall be firmly bonded to the basis metal.

3.4.3.1 Whenever possible, plating adhesion shall be tested on actual parts, using one of the following methods:

3.4.3.1.1 The plating shall be scraped through to the basis metal with a sharp knife or awl to expose the basis metal and examined at approximately 5X magnification for evidence of flaking or separation.

3.4.3.1.2 The basis metal shall be bent or deformed as required to cause it to crack, and examined at approximately 5X magnification for evidence of flaking or separation of the plating.

3.4.3.1.3 Test adhesion, using the burnishing test, draw test, or heat quench test of ASTM B 571.

3.4.3.2 Where testing of actual parts is impractical or not permitted by purchaser, specimens as in 4.3.3 may be used.

3.4.4 Hydrogen Embrittlement: When parts with hardness of 40 HRC or higher are plated, the process used shall not cause hydrogen embrittlement, determined in accordance with ASTM F 519, Type 1, using notched round bars stressed in tension under constant load. For test purposes, plating thickness shall be not less than 0.002 inch (0.5 mm), measured on the smooth section of the specimen, but with visual evidence of plating at the root of the notch.

3.4.5 Solderability: When required by purchaser, solderability shall be determined by coating a copper plated part or, when permitted by purchaser, a copper plated test specimen (See 4.3.5), with a flux conforming to MIL-F-14256, type R, and then partially immersing in solder conforming to QQ-S-571, Sn60 or Sn63, for approximately three seconds at a solder temperature of 450 °F ± 25 (232 °C ± 14). After shaking off excess solder, the scraping test of 3.4.2.1.1 or bending test of 3.4.3.1.2 shall show no evidence of separation from the basis metal. The solder coating shall be uniform, with no bubbles or dewetted areas, although occasional drips of excess solder are permissible.

3.5 Quality:

Copper plate, as received by purchaser, shall be smooth, continuous, adherent to basis metal, uniform in appearance, and not coarsely crystalline, and shall be free from pin holes, porosity, blisters, nodules, pits, and other imperfections detrimental to usage of the plate. Slight staining or discoloration is permissible. 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 test specimens for processor's tests and shall be responsible for performance of all required tests. Where 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), porosity, for Type 2 and for Type 1 when specified (3.4.2), adhesion (3.4.3), and quality (3.5) are acceptance tests and shall be performed with each lot.

4.2.2 Periodic Tests: Embrittlement (3.4.4) and solderability, when specified (3.4.5), and tests of cleaning and plating solutions to ensure that the deposited metal will conform to specified requirements (see 8.3) are periodic tests and shall be performed at a frequency selected by the processor unless test frequency 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, when a change in materials and/or processing requires approval 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 made 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 or fraction thereof, and presented for processor's inspection at one time.

4.3.1 Acceptance Tests: Test samples shall be selected randomly from all parts in the lot. THe minimum number of samples shall be shown in Table 2.

TABLE 2 - Sampling for Acceptance Tests

Number of Parts in Lot	Quality	Porosity Thickness and Adhesion
1 to 6	All	3
7 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 Preproduction and Periodic Tests: Sample quantity and frequency of sampling 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 of the same generic class of alloy as the parts represented, cleaned, plated, and post-treated with the parts represented may be used.

4.4 Approval:

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

4.4.2 The processor of plated part 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 judgment of the cognizant engineering organization, could affect the properties or performance of the plated parts.

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

Surface preparation and cleaning procedures
Surface activation procedures
Plating bath composition and composition control limits
Plating bath temperature limits and controls
Current/voltage limits and controls
Post treatment times and temperatures (when required)
Method for determining plating thickness
Method for testing plate adhesion
Method for stripping plating (when required)
Method of porosity testing (when required)
Periodic test plan

4.5 Reports:

The processor shall furnish with each shipment a report stating that the parts have been processed and tested in accordance with specified requirements and that they conform to the technical requirements. This report shall include the purchase order number, lot number, AMS 2418F, part number, and quantity.

4.6 Resampling and Retesting:

4.6.1 If the results of any acceptance test fail 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, 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, pretreated, plated, post treated as defined herein, and retested.

4.6.2 If the results of any periodic test fail to meet the specified requirements, the process is 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.