

# AEROSPACE MATERIAL SPECIFICATION

Issued OCT 1951  
Revised JAN 2006  
Superseding AMS 2418F

## Plating, Copper

### RATIONALE

This revision was issued to add the following notice, improve embrittlement relief instructions, ensure solderability testing occurs when appropriate, and make changes deemed necessary as part of the SAE Five Year Review process.

### NOTICE

**ORDERING INFORMATION:** The following information shall be provided to the plating processor by the purchaser.

- 1) Purchase order shall specify not less than the following:
  - AMS 2418G
  - Plating thickness desired (see 3.4.1)
  - Basis metal to be plated
  - Tensile strength or hardness of the basis metal
  - Pre-plate stress relief to be performed by plating processor (time and temperature) if different from 3.1.2
  - Special features, geometry or processing present on parts that requires special attention by the plating processor
  - Hydrogen embrittlement relief to be performed by plating processor (parameters or reference document) if different from 3.3.1
  - Minimum thickness on internal surfaces, if required (see 3.4.1.5)
  - Solderability testing, if required (see 3.4.5)
  - Quantity of pieces to be plated
- 2) Parts manufacturing operations such as heat treating, forming, joining and media finishing can affect the condition of the substrate for plating, or if performed after plating, could adversely affect the plated part. The sequencing of these types of operations should be specified by the cognizant engineering organization or purchaser and is not controlled by this specification.

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**TO PLACE A DOCUMENT ORDER:**  
Tel: 877-606-7323 (inside USA and Canada)  
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## 1. SCOPE:

## 1.1 Form:

This specification covers the requirements for electrodeposited copper.

## 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 issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

## 2.1 SAE Publications:

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS 2750 Pyrometry

## 2.2 ASTM Publications:

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 253	Preparation of Aluminum Alloys for Electroplating
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

## 2.2 (Continued):

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	Qualitative Adhesion of Metallic Coatings
ASTM B 734	Electrodeposition of Copper for Engineering Uses
ASTM B 748	Measurement of Thickness of Metallic Coatings by Measurement of Cross Section with a Scanning Electron Microscope
ASTM B 764	Simultaneous Thickness and Electrochemical Potential Determination of Individual Layers on the Multilayer Nickel Deposit (STEP Test)
ASTM E 376	Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods
ASTM F 519	Mechanical Hydrogen Embrittlement Testing of Plating/Coating Processes and Service Environments

## 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. (See 8.3).
- 3.1.2 Steel parts having a 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 all other parts.
- 3.1.3 The plating shall be applied over a surface free from water breaks. The cleaning procedure shall not produce pitting, embrittlement, or intergranular attack of the basis metal and shall preserve dimensional requirements.
- 3.1.3.1 For parts 40 HRC and over, contact time with surface activation acids such as hydrochloric, hydrofluoric, and sulfuric acids shall be minimized so as not to produce hydrogen embrittlement. (See 8.5).
- 3.1.4 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.
- 3.1.5 Aluminum alloys shall be zincate or stannate treated in accordance with ASTM B 253 or other method acceptable to purchaser prior to plating.

### 3.2 Procedure:

3.2.1 Copper shall be electrodeposited from a suitable copper plating solution onto a properly prepared surface. The copper plating shall be applied 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.

### 3.3 Post Treatment:

3.3.1 After plating, rinsing, and drying, all ferrous parts having hardness higher than 40 HRC shall be embrittlement relief baked at a set temperature of 375 °F (191 °C) for not less than 8 hours. Carburized, induction hardened and bearing steels that will decrease in hardness by heating to 375 °F (191 °C) shall be embrittlement relief baked at a temperature of 275 °F (135 °C) for not less than 23 hours. Embrittlement relief shall commence within 4 hours of plating. Pyrometry shall conform to AMS 2750 with a uniformity of  $\pm 25$  °F ( $\pm 14$  °C).

### 3.4 Properties:

Plated parts shall conform to the following requirements:

3.4.1 Thickness: Thickness of copper plating shall be as specified on the drawing, determined on representative parts, or when permitted by purchaser on test panels as in 4.3.3, in accordance with ASTM B 487, ASTM B 499, ASTM B 567, ASTM B 568, ASTM B 748, ASTM B 764, ASTM E 376, or other method acceptable to purchaser.

3.4.1.1 Type 1: AMS 2418 shall designate plate thickness of 0.0005 to 0.0007 inch (13 to 18  $\mu\text{m}$ ).

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

3.4.1.3 Type 2: Thickness for Type 2 plating shall be nominally 0.002 inch (51  $\mu\text{m}$ ) with no area having a plate thickness of less than 0.0007 inch (18  $\mu\text{m}$ ).

3.4.1.4 Where "copper flash" is specified, the thickness of copper shall be 0.0001 inch (2.5  $\mu\text{m}$ ) minimum.

3.4.1.5 All surfaces of the part, except those which cannot be touched by a sphere 0.75 inch (19 mm) in diameter, shall be plated to the specified thickness. Unless otherwise specified, surfaces such as holes, recesses, threads and other areas where a controlled deposit cannot be obtained under normal plating conditions, may be under the specified limit provided they show visual plating coverage. (See 8.2).

- 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 approximate 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 alternative, 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 Plating adhesion shall be tested on actual parts using one of the following methods, unless otherwise specified by purchaser.
- 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 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, sample specimens as specified in 4.3.3 shall 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 1a1, 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) or plated to a thickness not less than twice the maximum thickness to which the plate is to be qualified, whichever is less. Thickness shall be 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 specified by purchaser, acceptable solderability shall be determined by ASTM B 678 (steam aging does not apply). The solderability sample(s) shall show no evidence of separation of the copper plate from the basis metal when evaluated per paragraph 3.4.3 of ASTM B 678.

### 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. Spotting in is not permitted.

#### 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 the 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 specified requirements.

##### 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) is a periodic test and shall be performed at least once each month that steel parts 40 HRC and over are plated. 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 8.6) 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 production 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 as shown in Table 2.

TABLE 2 - Sampling for Acceptance Tests

Number of Parts in Lot		Quality	Porosity, Thickness, and Adhesion
1 to	6	All	All or 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

\*Whichever is less

- 4.3.2 Preproduction and Periodic Tests: Sample quantity 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 If the processor makes a significant change to any material, process, or control factor from those on which the approval was based, all preproduction tests shall be performed and results submitted to the purchaser for process reapproval 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 for process solutions (See 8.6)
- 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 2418G, part number, and quantity.
- 4.6 Resampling and Retesting:
- 4.6.1 If any acceptance test fails to meet the specified requirements, the parts in that lot may be stripped, 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, pretreated, plated, post treated as defined herein, and retested. After stripping and replating, parts shall meet drawing dimensions.