

Plating, Copper

RATIONALE

AMS2418H results from a Five Year Review and update of this specification.

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:

- AMS2418H
- 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.

ChemResearch Co., Inc.
Reviewed by:



3/01/11

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on this Technical Report, please visit
<http://www.sae.org/technical/standards/AMS2418H>**

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.

AMS2759/9 Hydrogen Embrittlement Relief (Baking) of Steel Parts

AS2390 Chemical Process Test Specimen Material

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

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 678 Indentation Hardness of Aluminum Alloys by Means of a Barcol Impressor
- 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 Stress Relief Treatment

All steel parts having a hardness of 40 HRC and above and that are machined, ground, cold formed or cold straightened shall be cleaned to remove surface contamination and thermally stress relieved before plating for relief of residual tensile stresses. 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 5 hours for parts having hardness of 55 HRC or higher or not less than 375 °F (191 °C) for not less than 4 hours for other parts. Residual tensile stresses have been found to be damaging during electrofinishing.

- 3.1.1.1 For parts, excluding nitrided parts, having a hardness of 55 HRC and above, including carburized and induction hardened parts, stress relieve at 275 °F ± 25 (135 °C ± 14) for a minimum of 5 hours.
- 3.1.1.2 For steel parts having a hardness less than 55 HRC, stress relieve at 375 °F ± 25 (191 °C ± 14) for a minimum of 4 hours. Nitrided parts fall into this category. Higher temperatures shall be used only when specified or approved by the cognizant engineering organization.
- 3.1.1.3 For Peened Parts

If stress relief temperatures above 375 °F (191 °C) are elected, the stress relieve shall be performed prior to peening or the cognizant engineering organization shall be consulted and shall approve the stress relief temperature.

- 3.1.2 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.
 - 3.1.2.1 For steel 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.
- 3.1.3 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.
- 3.1.4 Aluminum alloys shall be zincate or stannate treated in accordance with ASTM B 253 or other method acceptable to the cognizant engineering organization 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 Hydrogen Embrittlement Relief

Treatment of steel parts shall be in accordance with AMS2759/9.

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 in accordance with any of the following methods as applicable: 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 the cognizant engineering organization.

3.4.1.1 Type 1 (Engineering plating)

AMS2418 shall designate plate thickness of 0.0005 to 0.0007 inch (13 to 18 μm).

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 μm). A tolerance of +0.0002 inch (+5 μm) will be allowed. Thus, AMS2418-1 designated a thickness of 0.0001 to 0.0003 inch (2.5 to 8 μm), AMS2418-6 designated a thickness of 0.0006 to 0.0008 inch (15 to 20 μm).

3.4.1.2 Type 2 (Plating for masking)

Thickness for Type 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).

3.4.1.3 Where "copper flash" is specified, the thickness of copper shall be 0.0001 inch (2.5 μm) minimum.

3.4.1.4 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 when tested in accordance with any of the following methods.

3.4.3.1 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.

3.4.3.1.1 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.

3.4.3.1.2 The burnishing test, draw test, or heat quench test of ASTM B 571.

3.4.4 Hydrogen Embrittlement

The plating process after baking shall not cause hydrogen embrittlement in steel parts 40 HRC and over, determined in accordance with 4.3.3.2.

3.4.5 Solderability

When specified by the cognizant engineering organization, 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 in accordance with 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.

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. The cognizant engineering organization 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 when specified for Type 1 (3.4.2), adhesion (3.4.3), and quality (3.5) are acceptance tests and shall be performed on parts, or specimens representing parts when permitted herein, with each lot. See 4.3.3.

4.2.2 Periodic Tests

Hydrogen 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), is a periodic test and shall be performed at least once each month that parts are plated. Tests of cleaning and plating solutions are periodic tests and shall be performed at a frequency established by the processor unless test frequency is specified by the cognizant engineering organization. See 8.6 and 4.4.3.

4.2.3 Preproduction Tests

All property verification tests (3.4) are preproduction tests and shall be performed prior to production and when the cognizant engineering organization requires confirmatory testing.

4.3 Sampling for Testing

4.3.1 Acceptance Tests

Test samples shall be randomly selected from all parts in the lot. A lot shall be all parts of the same part number, processed in a continuous series of operations (3.1 through 3.3), in not longer than 24 consecutive hours, and presented for processor's inspection at one time. Unless the cognizant engineering organization provides a sampling plan, 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 for hydrogen embrittlement, sample size is specified in ASTM F 519 unless otherwise specified by the cognizant engineering organization. See 4.3.3.2. Sample quantities for other periodic tests shall be established by the processor, unless otherwise specified by the cognizant engineering organization or herein.

4.3.3 Sample Configuration

Nondestructive testing shall be performed wherever practical. Except as noted, actual parts shall be selected as samples for tests. When representative specimens are used for acceptance testing, values so obtained shall be correlated with those of parts since properties, such as thickness, may differ between parts and representative test specimens.

4.3.3.1 Representative test specimens may be used instead of parts under any one of the following circumstances: The plated parts are of such configuration or size as to be not readily adaptable to specified tests, nondestructive testing is not practical on actual parts, or it is not economically acceptable to perform destructive tests on actual parts. Except as specified below, representative test specimens shall be made of the same generic class of alloy as the parts, established in accordance with AS2390, distributed within the lot, cleaned, plated, and post treated with the parts represented.

4.3.3.2 Hydrogen Embrittlement Test

Test shall be in accordance with the requirements of ASTM F 519 Type 1a.1 using round notched specimens, unless a different specimen is specified by the cognizant engineering organization, 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.

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 cognizant engineering organization 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.
- 4.4.3 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, AMS2418H, part number, the range of measured coating thicknesses, the average coating thickness, 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.
- 4.6.1.1 When stripping is performed, the method shall be acceptable to the cognizant engineering organization and shall not roughen, pit, or embrittle the basis metal or adversely affect part dimensions. When parts have been stripped and replated, the purchaser shall be informed.
- 4.6.2 If any periodic test fails 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.
- 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 plated parts to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT

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

7. REJECTIONS

Parts on which the plating does not conform to this specification, or to modifications authorized by the cognizant engineering organization, will be subject to rejection.

8. NOTES

- 8.1 A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.
- 8.2 Copper plating should not be specified for coverage of small holes or recesses where the depth to hole diameter ratio is greater than 1:1.
- 8.3 Part manufacturing operations performed after plating, such as heat treatment, forming, machining, welding, brazing and media finishing, could adversely affect the plate unless the plate is used as a source of copper for brazing, masking for nitriding or carburizing, or prevention of carburizing. The sequencing of these types of operations should be specified by the cognizant engineering organization and is not controlled by this specification.
- 8.4 Part manufacturer should ensure that the surface of parts supplied to the processor are free from blemishes, pits, tool marks and other irregularities that will affect the quality of the finished parts. Defects and variations in appearance that arise from surface conditions of the substrate, such as porosity, scratches or inclusions, that persist in the finished plate despite observance of industry accepted plating practices would not be considered cause for rejection.
- 8.5 An acid dip may be used for surface activation or neutralization of residual alkaline cleaners. However, the immersion time (intended to be in seconds) should be minimized to preclude pitting or hydrogen embrittlement.
- 8.6 ARP4992, Periodic Test Plan for Process Solutions, is recommended to satisfy the requirement for control of processing solutions.
- 8.7 Terms used in AMS are clarified in ARP1917. ASTM B 374 "Terminology Relating to Electroplating" should be utilized as a reference and referee document when areas of design definition or technical interpretation arise.
- 8.8 Dimensions in inch/pound units and the Fahrenheit temperatures are primary; dimensions in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

PREPARED BY AMS COMMITTEE "B"