



AEROSPACE MATERIAL SPECIFICATION

AMS2411™

REV. J

Issued 1966-09
Revised 2019-07

Superseding AMS2411H

Plating, Silver
for High Temperature Applications

RATIONALE

AMS2411J results from a Five-Year Review and update of this specification with changes to Ordering Information, Stress Relief Treatment 3.1.1 and 3.1.1.3, pretreatment 3.1.2, electrical contact points 3.1.3, Hydrogen embrittlement relief 3.3.1, thickness 3.4.1.1, Adhesion warning 3.4.3, Adhesion 3.4.3.3, Hydrogen Embrittlement 3.4.4, Acceptance Tests 4.2.1, Periodic Tests 4.2.2, Sampling 4.3.1 and 4.3.2, Table 1, Adhesion Testing 4.3.3.3, Hydrogen Embrittlement Relief Test 4.3.3.4, Approval 4.4.1, and Control factors 4.4.3.

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:

- AMS2411J
- Plating thickness desired (see 3.4.1)
- Basis metal to be plated
- Tensile strength or hardness of the basis metal
- If preplate stress relief is to be performed by plating processor and if different from 3.1.1, time and temperature are to be specified.
- 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 3.4.1.4)
- Quantity of pieces to be plated
- If steel parts were machined, ground, cold formed or cold straightened after heat treat (3.1.1)
- If steel parts have been shot peened, specify if required stress relief has been completed (3.1.1.3)

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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.

1. SCOPE

- 1.1 Purpose

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

- 1.2 Application

This process has been used typically to prevent galling or seizing of surfaces of parts, such as fasteners, made of low alloy steel, corrosion and heat resistant steel, and nickel alloys for use up to 1400 °F (760 °C), but usage is not limited to such applications.

- 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 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 +1 724-776-4970 (outside USA), www.sae.org.

| | |
|-----------|---|
| AMS2430 | Shot Peening |
| AMS2750 | Pyrometry |
| AMS2759/9 | Hydrogen Embrittlement Relief (Baking) of Steel Parts |
| AMS5616 | Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 13Cr - 2.0Ni - 3.0W, Annealed |
| AMS5640 | Steel, Corrosion-Resistant, Bars, Wire, and Forgings, 18Cr - 9.0Ni, Free Machining |
| AMS5643 | Steel, Corrosion-Resistant, Bars, Wire, Forgings, Mechanical Tubing, and Rings, 16Cr - 4.0Ni - 0.30Cb (Nb) - 4.0Cu, Solution Heat Treated, Precipitation Hardenable |
| AMS5709 | Nickel Alloy, Corrosion and Heat-Resistant, Bars and Forgings, 58Ni - 19.5Cr - 13.5Co - 4.3Mo - 3.0Ti - 1.4Al - 0.05Zr - 0.006B, Consumable Electrode or Vacuum Induction Melted, 1975 °F (1079 °C) Solution, Stabilization, and Precipitation Heat Treated |

| | |
|---------|---|
| AMS5732 | Steel, Corrosion and Heat-Resistant, Bars, Wire, Forgings, Tubing, and Rings, 15Cr - 25.5Ni - 1.2Mo - 2.1Ti - 0.006B - 0.30V, Consumable Electrode Melted, 1800 °F (982 °C) Solution and Precipitation Heat Treated |
| AMS6304 | Low-Alloy Steel, Heat-Resistant, Bars, Forgings, and Tubing, 0.95Cr - 0.55Mo - 0.30V (0.40 - 0.50C) |
| ARP1917 | Clarification of Terms Used in Aerospace Metals Specifications |
| ARP4992 | Periodic Test Plan for Process Solutions |
| 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 B374 | Terminology Relating to Electroplating |
| ASTM B487 | Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of Cross Section |
| ASTM B499 | Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals |
| ASTM B504 | Measurement of the Thickness of Metallic Coatings by the Coulometric Method |
| ASTM B567 | Measurement of Coating Thickness by the Beta Backscatter Method |
| ASTM B568 | Measurement of Coating Thickness by X-Ray Spectrometry |
| ASTM B571 | Qualitative Adhesion Testing of Metallic Coatings |
| ASTM E376 | Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Testing Methods |
| ASTM F519 | Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments |

2.3 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ASME B46.1 Surface Texture (Surface Roughness, Waviness, And Lay)

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 after heat treatment shall be cleaned to remove surface contamination and thermally stress relieved before plating. (Residual tensile stresses have been found to be damaging during electroplating.) Furnaces used for stress relief shall be controlled per AMS2750; the minimum requirements shall be Class 5 and Type D Instrumentation. Temperatures to which parts are heated shall be such that stress relief is obtained while still maintaining hardness of parts within drawing limits. Unless otherwise specified, the following treatment temperatures and times shall be used:

3.1.1.1 For parts, excluding nitrided parts, having a hardness of 55 HRC and above, and for carburized and induction hardened parts, stress relieve at 275 °F ± 25 °F (135 °C ± 14 °C) for 5 to 10 hours.