AEROSPACE MATERIAL SPECIFICATION

AMS2423	REV. E

Issued 1962-06
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Revised 2015-01

Superseding AMS2423D

(R) Plating, Nickel Hard Deposit

RATIONALE

AMS2423E 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:

   - AMS2423E
   - Plating thickness desired (See 3.4.1)
   - Basis metal to be plated
   - Tensile strength or hardness of the basis metal
   - Preplate stress relief to be performed by plating processor (time and temperature) if different from 3.1.1
   - 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
   - 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.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

1. SCOPE

1.1 Purpose

This specification covers the engineering requirements for electrodeposition of a hard nickel and the properties of the deposit.

1.2 Application

This process has been used typically to provide good wear resistance to metal parts which may operate in service up to 450 °F (232 °C), but usage is not limited to such applications. Diffusion heat treatment of the deposit is not required.

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

AMS2750 Pyrometry

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

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 B253 Preparation of Aluminum Alloys for Electroplating

ASTM B487 Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section

ASTM B504 Measurement of Thickness of Metallic Coatings by the Coulometric Method

ASTM B530 Measurement of Coating Thicknesses by the Magnetic Method: Electrodeposited Nickel Coatings on Magnetic and Nonmagnetic Substrates

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 B636 Measurement of Internal Stress of Plated Metallic Coatings with the Spiral Contractometer

ASTM E376 Measuring Coating Thickness by Magnetic or Eddy Current (Electromagnetic) Testing Methods

ASTM E384 Knoop and Vickers Hardness of Materials

3. TECHNICAL REQUIREMENTS

3.1 Preparation

3.1.1 Stress Relief Treatment

3.1.1.1 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, with 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:

3.1.1.1.1 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 (135 °C ± 14) for 5 to 10 hours.

3.1.1.1.2 For parts having a hardness less than 55 HRC, and for nitrided parts, stress relieve at 375 °F ± 25 (191 °C ± 14) for a minimum of 4 hours. Higher temperatures shall be used only when specified or approved by the cognizant engineering organization.

3.1.1.1.3 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 Parts shall have clean surfaces, free of water break, prior to immersion in the plating solution.

3.1.2.1 Alkaline cleaning of steel parts may be done with anodic current, but steel part shall not be cathodically cleaned.

3.1.3 Parts shall be within drawing limits after plating and machining.

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.

3.2 Procedure

3.2.1 Nickel shall be electrodeposited from a chloride, sulfate/chloride, sulfamate or other suitable plating solution containing addition agents to produce the specified hardness. Nickel shall be deposited directly on the basis metal without a prior flash coating of metal other than nickel, except that a preliminary chemical coating, immersion plate, and/or metal flash is permissible on aluminum, magnesium, and their alloys.

3.2.1.1 Aluminum alloys may be zincate treated in accordance with ASTM B253 before plating.

3.2.2 The plated parts shall be removed from the plating solution, thoroughly rinsed, and dried.

3.3 Post Treatment

Hydrogen embrittlement relief of steel parts shall be in accordance with AMS2759/9.

3.4 Properties

Plating shall conform to the following requirements:

3.4.1 Thickness

Shall be as specified, determined on representative parts or test panels in accordance with ASTM B487, ASTM B504, ASTM B530, ASTM E567, ASTM B568, ASTM E376, or other method acceptable to purchaser.

3.4.1.1 The plate shall be substantially uniform in thickness on significant surfaces except that slight build-up at exterior corners or edges will be permitted provided finished drawing dimensions are met.

3.4.1.2 Thickness requirements apply to surfaces that can be touched by a sphere 0.75 inch (19 mm) in diameter. Other areas such as surfaces of holes, recesses, internal threads, or contact areas of parts plated all over, where a controlled deposit cannot be obtained under normal plating conditions, shall show evidence of plating.

3.4.2 Hardness

Shall be not lower than 400 HV or equivalent, determined in accordance with ASTM E384 , on deposits 0.004 inch (0.10 mm) and over in thickness.

3.4.3 Stress

Shall be within the range 0 to 15.0 ksi (0 to 103 MPa) in compression, determined on a plate thickness of 0.0003 inch (7.6 µm) by calculation from spiral contractometer reading in accordance with ASTM B636 or other instrument acceptable to purchaser.

3.4.4 Adhesion

Specimens as in 4.3.3 shall not show separation of the plating from the basis metal, when examined at approximately 4X magnification, after being bent rapidly, in accordance with ASTM B571. Formation of cracks which do not result in flaking or blistering of the plating is acceptable.

3.4.4.1 When acceptable to purchaser, adhesion of plating after final machining of the plating will be considered acceptable evidence of plating adhesion.

3.4.5 Hydrogen Embrittlement

The plating process shall not cause hydrogen embrittlement in ferrous metals. Testing shall be in accordance with the requirements of ASTM F519 Type 1A using notched round specimens, unless a different specimen type is specified by the purchaser, stressed in tension under sustained load. For test purposes, plating thickness shall be 0.005 inch (0.13 mm) minimum measured on the smooth section of the specimen, but with visual plating at the root of the notch. Testing beyond the 200 hour test period is not required.

3.5 Quality

Plated surfaces, as received by purchaser, shall be smooth, continuous, uniform in appearance, and essentially free from frosty areas, pin holes, porosity, blisters, nodules, pits, and other imperfections detrimental to usage of nickel plate. Slight staining or discoloration is acceptable. Double plating and spotting-in after plating are not permitted.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The processor shall supply all samples for processor's tests and shall be responsible for the performance of all required tests. Where actual 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 specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Thickness (3.4.1), hardness (3.4.2), and quality (3.5) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests

Stress (3.4.3), hydrogen embrittlement (3.4.5) and tests of cleaning and plating solutions (See 8.8) to ensure that the deposited metal will conform to the requirements of this specification are periodic tests and shall be performed at least monthly unless frequency of testing is specified by the cognizant engineering organization. Adhesion (3.4.4) is a periodic test that shall be performed no less than daily for each generic class of alloy as defined by AS2390 processed during that day.

4.2.3 Preproduction Tests

All technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of plated parts to a purchaser, when a change in bath composition and/or processing requires reapproval as in 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 of one size and shape plated in one bath to the same specified plating thickness range within one 24 hour period and presented for processor's inspection at one time:

4.3.1 For Acceptance Tests

Shall be as shown in Table 1. Test samples shall be randomly selected from all parts in the lot.

Table 1 - Sampling for acceptance tests

Number of Parts in Lot	Quality	Thickness
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 For Periodic Tests

Frequency of testing shall be at the discretion of the processor unless a test frequency is specified by purchaser. Tests for hydrogen embrittlement are applicable only when parts having a hardness of 36 HRC or higher are plated. For adhesion tests, four test specimens of each generic class of alloy, as defined by AS2390, that have been be processed through the same cleaning and plating operations as the parts that they represent. These adhesion test specimens shall be processed prior to the first production lot of parts or with the first production lot of parts.

4.3.3 Sample Configuration

Nondestructive testing shall be performed wherever practical and authorized herein. Except as noted, actual parts shall be selected as samples for tests.