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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2423C

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Superseding AMS 2423B

Submitted for recognition as an American National Standard

PLATING, NICKEL
Hard Deposit

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: Primarily to provide good wear resistance to metal parts which may operate in service up to 450°F (232°C). Diffusion heat treatment of the deposit is not required.

1.2.1 Omission of post-plating thermal treatment may cause parts to be susceptible to hydrogen embrittlement; caution should be exercised in use of this plating on parts heat treated to tensile strength of 200 ksi (1379 MPa) or higher.

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 following publications form a part of this specification to the extent specified herein. The applicable issue of referenced publications shall be the issue in effect on the date of the purchase order.

2.1 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 487 - Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM B 504 - Measurement of Thickness of Metallic Coatings by the Coulometric Method
ASTM B 530 - Measurement of Coating Thicknesses by the Magnetic Method: Electrodeposited Nickel Coatings on Magnetic and Nonmagnetic Substrates
ASTM B 567 - Measurement of Coating Thickness by the Beta Backscatter Method
ASTM B 568 - Measurement of Coating Thickness by X-Ray Spectrometry
ASTM B 578 - Microhardness of Electroplated Coatings
ASTM B 636 - Measurement of Internal Stress of Plated Metallic Coatings with the Spiral Contractometer
ASTM E 92 - Vickers Hardness of Metallic Materials
ASTM E 290 - Semi-Guided Bend Test for Ductility of Metallic Materials

2.2 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.2.1 Military Standards:

MIL-STD-2073-1 - DOD Materiel, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 All forming, machining, heat treating, brazing, welding, and surface prestressing shall be completed before parts are plated. Ø

3.1.2 Surfaces to be plated shall be smooth and substantially free from blemishes, pits, tool marks, and other surface irregularities.

3.1.3 Steel parts, having hardness of 40 HRC or higher which have been ground after heat treatment, shall be suitably stress-relieved before plating. Temperatures to which parts are heated shall be such that maximum stress-relief is obtained without reducing hardness of parts below drawing limits.

3.1.4 Parts shall have chemically clean surfaces, prepared with minimum abrasion, erosion, or pitting, prior to immersion in the plating solution. Treatments which may produce hydrogen embrittlement shall be avoided.

3.1.5 Parts shall be within drawing limits after plating.

3.1.6 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 all over, contact points shall be located where specified or where agreed upon by purchaser and processor. 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 Nickel shall be electrodeposited from a chloride, sulfate/chloride, or sulfamate 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.

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

3.3 Properties: Plating shall conform to the following requirements;

3.3.1 Thickness: Shall be as specified, determined on representative parts or Ø test panels in accordance with ASTM B 487, ASTM B 504, ASTM B 530, ASTM E 567, ASTM B 568, or other method acceptable to purchaser.

3.3.1.1 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.

3.3.1.2 Requirements are not established for minimum plate thickness for surfaces of holes, recesses, internal threads, contact areas of parts plated all over, and other areas where a controlled deposit cannot be obtained under normal plating conditions but such areas shall not be masked to prevent plating. Unless otherwise noted on drawings, resultant thickness shall be considered only when such surfaces of parts can be touched by a sphere 0.75 inch (19.0 mm) in diameter.

3.3.2 Hardness: Shall be not lower than 400 HV or equivalent, determined in Ø accordance with ASTM E 92 or ASTM B 578, on deposits 0.004 inch (0.10 mm) and over in thickness.

3.3.3 Stress: Shall be within the range 0 - 15.0 ksi (0 - 103 MPa) in Ø compression, determined on a plate thickness of 0.0003 inch (7.5 µm) by calculation from spiral contractometer reading in accordance with ASTM B 636 or other instrument acceptable to purchaser.

3.3.4 Adhesion: Specimens as in 4.3.3 shall not show separation of the plating Ø from the basis metal, when examined at approximately 4X magnification, after being bent rapidly, in accordance with ASTM E 290, through an angle of 180 degrees around a diameter equal to the thickness of the specimen. Formation of cracks which do not result in flaking or blistering of the plating is acceptable.

3.4 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. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.4.1 Double plating and spotting-in after plating are not permitted.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The processing vendor shall supply all Ø samples for vendor's tests and shall be responsible for performing all required tests. 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: Tests for thickness (3.3.1), hardness (3.3.2), and quality (3.4) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests for stress (3.3.3) and adhesion (3.3.4) and tests of cleaning and plating solutions to ensure that the deposited metal will conform to the requirements of this specification are periodic tests and shall be performed at a frequency selected by the plating processor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests for 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.

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

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 vendor's inspection at one time:

4.3.1 For Acceptance Tests:

4.3.1.1 Thickness: Three parts for each consecutive 8 hours of operation of the same set of solutions, except as specified in 4.3.3.

4.3.1.2 Hardness: Three parts for each consecutive 8 hours of operation of the same set of solutions when minimum thickness of plate is 0.004 inch (0.10 mm) or more; otherwise, three panels as in 4.3.3.