Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 2406F
Superseding AMS 2406E
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CHROMIUM PLATING
Hard Deposit

1. SCOPE:

1.1 Purpose: This specification covers the engineering requirements for electrodeposition of a hard chromium plate and the properties of the deposit.

1.2 Application: Primarily for use on ferrous parts for increasing abrasion resistance, increasing tool and die life, maintaining accuracy of gages, reconditioning worn or undersized parts, and increasing corrosion resistance. Plated high strength parts may require special treatments to reduce the embrittling effects of hydrogen pickup.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications

AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B487 - Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
ASTM B499 - Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals
ASTM B504 - Measurement of Thickness of Metallic Coatings by the Coulometric Method
ASTM B578 - Measurement of Microhardness of Electroplated Coatings

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

2.4 ANSI Publications: Available from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

3.1.1 Surfaces of parts to be plated shall be substantially free from blemishes, pits, tool marks, and other irregularities.

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3.1.2 Unless otherwise specified, parts to be finished after plating shall, before plating, have a surface texture not rougher than 10 microin. (0.3 μm), determined in accordance with ANSI B46.1. Parts not to be finished after plating shall have a surface finish before plating that is smoother than that required on the parts after plating.

3.1.3 Parts having hardness higher than 40 HRC and which have been ground after heat treatment shall be suitably stress-relieved before cleaning for plating. Temperatures to which parts are heated and time at heat shall be such that maximum stress-relief is obtained without reducing mechanical properties of parts below specified limits.

3.1.4 When magnetic particle inspection is required, parts shall be so inspected before plating except as permitted in 3.1.4.1, and shall be so inspected after plating and complete finishing.

3.1.4.1 Parts having specified maximum hardness of 40 HRC or lower need not be magnetic particle inspected before plating if the specified maximum plate thickness is 0.0015 in. (0.038 mm) or less.

3.1.5 Parts, prior to immersion in the plating solution, shall have chemically clean surfaces prepared with minimum abrasion, erosion, or pitting. Except as specified in 3.1.5.1 and 3.1.5.2, the final step in cleaning shall consist of anodically cleaning the parts in a chromic acid solution of concentration approximately equal to that of the chromic acid solution used in plating or in the plating bath.

3.1.5.1 For plating nickel alloys, and for plating other alloys on which a deposit of nickel is used as an undercoating for chromium, the final step in cleaning shall consist of anodically cleaning the parts in a sulfuric-hydrofluoric acid solution (25% by volume H_2SO_4 and 4.5% by volume HF) or in a 40% (by volume) solution of sulfuric acid.

3.1.5.2 Other methods of cleaning may be used when agreed upon by purchaser and vendor.

3.1.6 Electrical contacts between the parts and power source shall be made in such a manner as will 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 vendor. 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 Parts shall be plated by electrodeposition of chromium from a chromic acid solution containing added sulfate or fluoride ions. The chromium shall be deposited directly on the basis metal without a coating of other metal underneath, except in the case of parts made of maraging steels, corrosion-resistant steels, or aluminum alloys, on which a preliminary deposit of nickel or other suitable metal is permissible.

3.2.1.1 The size and shape of parts and the thickness of plate should be considered in providing adequate racks and anodes for plating.

3.2.2 After plating, parts shall be rinsed in cold water and dried.

3.2.3 Steel parts, after being dried, shall be heated as follows, unless otherwise specified, to minimize the embrittling effects of cleaning and plating; heating shall be at 375°F ± 10 (190°C ± 5) in air, preferably in a circulating-air furnace:

3.2.3.1 Parts having specified minimum tensile strength lower than 220,000 psi (1517 MPa) shall be heated for not less than 3 hours.

3.2.3.2 Parts having specified minimum tensile strength of 220,000 psi (1517 MPa) or higher shall be heated for not less than 23 hours.

3.2.4 Grinding after plating should be done with proper coolant, never dry, and never with a very heavy cut.

3.3 Properties: The deposit shall conform to the following requirements:

3.3.1 Thickness: The finished thickness shall be as specified on the drawing, determined on representative parts or test panels in accordance with ASTM B487, ASTM B499, ASTM B504, or other method agreed upon by purchaser and vendor. Recommended maximum thickness of chromium is 0.015 in. (0.38 mm) except on tools and die. Recommended minimum thickness of chromium, when used for protection against corrosion, is 0.002 in. (0.05 mm).

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 No requirements are established for minimum thickness of plate for surfaces of holes, recesses, contact areas of parts plated all over, and other areas on which a controlled deposit cannot be obtained under normal plating conditions but such areas shall not be masked to prevent plating unless otherwise specified on the drawing. Unless otherwise noted on drawings, the resulting thickness shall be considered only when such surfaces of parts can be touched by a sphere 0.75 in. (19 mm) in diameter.

3.3.1.2.1 If internal surfaces as defined in 3.3.1.2 are required to be plated to a specified thickness, notes on the part drawing will so specify.

3.3.2 Hardness: Shall be not lower than 700 HV or equivalent.

3.4 Quality: Plate shall be firmly bonded to the basis metal, and shall be smooth and uniform in appearance and, except as noted in 3.4.1, shall be free from frosty areas, pinholes, nodules, blisters, and other imperfections detrimental to performance of the deposit. The method of determining satisfactory adhesion shall be as agreed upon by purchaser and vendor. Visual inspection may be aided my magnification of not greater than 5 diameters.

3.4.1 Pin holes and other imperfections which can be shown to be the result of failure of the deposit to bridge or fill imperfections, such as porosity, in the surface of the basis metal are acceptable.

3.4.2 Double plating and spotting-in after plating are not permitted, unless otherwise specified.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The processing vendor shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform such confirmatory testing as he deems necessary to ensure that processing conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the initial shipment of a plated part to a purchaser, when a change in material or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 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, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be not less than the following; a lot shall be all parts of the same part number processed in a continuous operation to the same thickness range and presented for vendor's inspection at one time:

Ø 4.3.1 Coverage and Appearance: All parts in each lot.

Ø 4.3.2 Thickness: Three parts from each lot.

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 cleaned and plated with the parts they represent may be used. For adhesion tests, such specimens shall be panels of annealed, low-carbon steel approximately 0.032 x 4 x 1 in. (1 x 100 x 25 mm) and for thickness, hardness, and quality tests shall be panels of the same size and type or shall be bars approximately 0.5 in. (10 mm) in diameter and 4 in. (100 mm) long.

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4.4 Approval:

4.4.1 Plated parts shall be approved by purchaser before parts for production use are supplied, unless such approval be waived. Results of tests on production parts shall be essentially equivalent to those on the approved sample parts.

4.4.2 Vendor shall use manufacturing procedures, processes, and methods of inspection on production parts which are essentially the same as those used on the approved sample parts. If any change is necessary in type of equipment or in established composition limits and operating conditions of process solutions, vendor shall submit for reapproval of the process a statement of the proposed changes in processing and, when requested, sample parts, test panels, or both. Production parts plated by the revised procedure shall not be shipped prior to receipt of reapproval.

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4.5 Reports: The processing vendor shall furnish with each shipment three copies of a report stating that the parts have been processed and tested in conformance with the requirements of this specification and that they conform to the technical requirements. This report shall include the purchase order number, AMS 2406F, part number, and quantity.

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4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the parts may be based on the results of testing three additional specimens for each original nonconforming specimen. Except as permitted by 4.6.1, failure of any retest specimen to meet the specified requirements shall be cause for rejection of the parts represented and no additional testing shall be permitted. Results of all tests shall be reported.

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4.6.1 If any part fails to meet the specified requirements, either on the original sampling as in 4.3 or upon resampling as in 4.6, the parts in that lot may be stripped by a method approved by purchaser which does not roughen, pit, or embrittle the basis metal, replated, and retested.

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4.6.1.1 Parts rejected for defective plating (as noted in 3.4) shall be stripped before replating. Parts having hardness higher than 40 HRC which have been stripped for replating shall be embrittlement relieved at 375°F ± 10°F (190°C ± 5) for not less than 3 hr providing such temperature is not detrimental to the part before plating. Carburized parts shall be baked at 275°F ± 10 (135°C ± 5) for not less than 5 hours.

5. PREPARATION FOR DELIVERY

5.1 Plated parts shall be handled and packaged in such a manner as will ensure that the required physical characteristics and properties of the plating and parts are preserved.

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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 parts to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

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