



AEROSPACE MATERIAL SPECIFICATION

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

AMS 2417C

Superseding AMS 2417B

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NICKEL-ZINC ALLOY PLATING

1. SCOPE:

- 1.1 Purpose: This specification covers the engineering requirements for electrodeposition of a nickel-zinc alloy and the properties of the deposit.
- 1.2 Application: Primarily to prevent corrosion of steel parts which may operate at temperatures up to 900° F (482° C). No diffusion heat treatment of the coating is required.
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, Pennsylvania 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, Pennsylvania 19103.

ASTM B117 - Salt Spray (Fog) Testing

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 the Thickness of Metallic Coatings by the Coulometric Method

ASTM B529 - Measurement of Coating Thicknesses by the Eddy-Current Test Method: Nonconductive Coatings on Nonmagnetic Basis Metals

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

- 3.1.1 All brazing, forming, machining, and welding shall be completed before parts are plated.
- 3.1.2 Parts having hardness of 40 HRC or over and which have been ground after heat treatment shall be suitably stress-relieved before cleaning for plating. Temperature to which parts are heated shall be such that maximum stress relief is obtained without reducing the hardness of the parts below drawing limits.
- 3.1.3 Prior to plating, parts shall have chemically clean surfaces prepared with minimum abrasion, erosion, or pitting; treatments which may produce hydrogen embrittlement shall be avoided.

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- 3.1.4 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.
- Ø 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 Nickel Strike: Prior to electrodeposition of the alloy plate, parts shall be given an electrodeposited-nickel strike.
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- 3.2.2 Nickel-Zinc Alloy Plating: Parts shall be plated by electrodeposition, over the nickel strike, of a nickel-zinc alloy from a suitable electrolyte containing no addition agents which might have a detrimental effect on the properties of the deposited alloy or the basis metal; stress-reducing agents shall not be used unless specifically authorized by the purchaser.

- Ø 3.2.3 The plated parts shall be removed from the plating solution, thoroughly rinsed, and dried.

- 3.3 Post Treatment: Steel parts, after plating, rinsing, and drying, shall be treated as follows, to remove hydrogen embrittlement due to cleaning and plating; heating shall be in air, preferably in a circulating air furnace:

- 3.3.1 Carbon and low-alloy steel parts having hardness of 36 - 39 HRC shall be heated for not less than 3 hr at $375^{\circ}\text{F} \pm 25$ ($190.6^{\circ}\text{C} \pm 14$).

- 3.3.2 Carbon and low-alloy steel parts having hardness of 40 HRC or higher shall be heated for not less than 23 hr at $375^{\circ}\text{F} \pm 25$ ($190.6^{\circ}\text{C} \pm 14$).

- 3.3.3 All corrosion-resistant steel parts hardened by heat treatment and having hardness of 38 HRC or higher shall be heated for not less than 3 hr at $375^{\circ}\text{F} \pm 25$ ($190.6^{\circ}\text{C} \pm 14$).

- 3.3.4 Parts which would be reduced in hardness below drawing limits by heating to 375°F (190.6°C) shall be heated for not less than 23 hr at $325^{\circ}\text{F} \pm 25$ ($162.8^{\circ}\text{C} \pm 14$).

3.4 Properties:

- 3.4.1 Composition: The nickel-zinc alloy plate shall contain 16 - 30% nickel and the balance zinc, determined by a method agreed upon by purchaser and vendor.
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- 3.4.2 Thickness: Shall be as follows, unless otherwise specified, determined in accordance with ASTM B487, ASTM B499, ASTM B504, ASTM B429, or other suitable method, as agreed upon by purchaser and vendor.
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- 3.4.2.1 Nickel Strike: Shall have thickness not less than 0.00005 in. (1.3 μm).

3.4.2.2 Nickel-Zinc Alloy Plate:

- 3.4.2.2.1 Parts Other Than Washers and Parts With External Threads: Shall have plate thickness of 0.0003 - 0.0007 in. (8-18 μm).

- 3.4.2.2.2 Washers and Parts With External Threads: Shall have plate thickness of 0.0002 - 0.0004 in. (5-10 μm).

3.4.2.2.3 No requirements are 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 specified, the resultant thickness shall be considered only when such surfaces of parts can be touched by a sphere 0.75 in. (19.0 mm) in diameter.

3.4.3 Adhesion: Specimens shall not show separation of the plating from the basis metal, when examined at up to 6X magnification, after being bent at room temperature through an angle of 180 deg (3.14 rad) 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.

3.4.4 Corrosion: Parts or representative test panels, plated to a minimum thickness of 0.0002 in. (5 μ m) shall show no visual evidence of corrosion of significant surfaces after being subjected for not less than 48 hr to continuous salt spray corrosion test conducted in accordance with ASTM B117.

3.5 Quality: Plated surfaces shall be smooth, continuous, and uniform in appearance and shall be free from pin holes, porosity, blisters, nodules, pits, and other harmful imperfections. Slight staining or discoloration will not be cause for rejection.

3.5.1 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. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that processing conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance or routine control tests.

4.3 Sampling: Shall be not less than the following; a lot shall be all parts made of the same material, heat treated to essentially the same hardness or tensile strength level, plated to the same range of plate thickness in the same solutions, and presented for vendor's inspection at one time.

Ø 4.3.1 Coverage and Appearance: All parts in lot.

Ø 4.3.2 Composition: One part for each 8 hr of operation of each nickel-zinc alloy plating tank.

Ø 4.3.3 Thickness: Three parts per lot.

4.3.4 Adhesion and Corrosion: Three specimens per lot. Specimens approximately 0.032 x 4 x 1 in. or 1 x 100 x 25 mm shall be fabricated from steel strip cleaned, plated, and post treated with the parts they represent.

4.4 Approval:

4.4.1 To assure adequate performance characteristics, 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 revised plated parts, test panels, or both. No production parts plated by the revised procedure shall be shipped prior to receipt of reapproval.