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AEROSPACE MATERIAL SPECIFICATION

SAE AMS-C-26074 | REV. C

Issued 1998-08
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Cancelled 2011-07

Superseded by AMS2404

Electroless Nickel Coatings

RATIONALE

AMS-C-26074B has been designated cancelled and superseded because equivalent technical requirements are provided by AMS2404.

CANCELLATION NOTICE

This specification has been declared “CANCELLED” by the Aerospace Materials Division, SAE, as of July 2011 and has been superseded by AMS2404. The requirements of the latest issue of AMS2404 shall be fulfilled whenever reference is made to the cancelled AMS-C-26074. By this action, this document will remain listed in the Numerical Section of the Index of Aerospace Material Specifications, noting that it has been superseded by AMS2404.

Cancelled specifications are available from SAE.

Correlation Information:

Class	
Cancelled AMS-C-26074	AMS2404 Requirement
Class 1	Class 1
Class 2	Class 2
Class 3	Class 3
Class 4	Class 4

Thickness	
Cancelled AMS-C-26074	AMS2404 Requirement
Grade A	0.0010 inch (25 µm) minimum
Grade B	0.0005 inch (13 µm) minimum
Grade C	0.0015 inch (38 µm) minimum

NOTE: A prior version of this document, AMS-C-26074A, was cancelled in favor of the reinstated MIL-C-26074E. MIL-C-26074E was superseded by MIL-DTL-26074F. MIL-DTL-26074F is available only to NAVSEA Nuclear personnel and has been superseded by AMS-C-26074 for the prior users of MIL-C-26074. AMS-C-26074B was therefore reinstated and designated as a noncurrent document. Subsequently, AMS2404 has been updated for technical equivalency, allowing supersedure of AMS-C-26074B by AMS2404. New designs should consider AMS2404, AMS2433, or other similar specifications.

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http://www.sae.org/technical/standards/AMSC26074C

NOTICE

This document has been taken directly from U.S. Military Specification MIL-C-26074E, and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-C-26074E. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualifications requirements and associated qualified products lists are mandatory to DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this technical report.

1. SCOPE:

1.1 Scope:

This specification covers the requirements for electroless (autocatalytic chemical reduction) deposition of nickel-phosphorous alloy coatings on metal and composite surfaces.

1.2 Classification:

1.2.1 Classes: The nickel coatings shall be classified in accordance with the thermal treatment applied subsequent to plating.

Class 1 - As plated, no subsequent heat treatment: A bake for hydrogen embrittlement relief is not considered a heat treatment.
Class 2 - Heat treated to obtain required hardness: May be used on all metals not affected by heating to 500 °F and above.
Class 3 - Aluminum alloys non-heat treatable, and beryllium alloys processed to improve adhesion of the nickel deposit.
Class 4 - Aluminum alloys, heat-treatable, processed to improve adhesion of the nickel deposit.

1.2.2 Grades: The nickel coatings shall be of the following grades:

Grade A - 0.0010-inch minimum thickness.
Grade B - 0.0005-inch minimum thickness.
Grade C - 0.0015-inch minimum thickness.

2. APPLICABLE DOCUMENTS:

The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

2.1 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-S-13165 Shot Peening of Metal Parts
MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117 Method of Salt Spray (Fog) Testing
ASTM B 487 Measurement of Metal and Oxide Coatings Thickness by Microscopical Examination of a Cross Section, Method for (DOD adopted)
ASTM B 499 Standard Test Method for Measurement of Coating Thickness by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals (DOD adopted)
ASTM B 567 Method for Measurement of Coating Thickness by the Beta Backscatter Method
ASTM B 568 X-Ray Spectrometry (DOD adopted)
ASTM B 571 Test Methods for Adhesion of Metallic Coatings
ASTM B 578 Test Method for Microhardness of Electroplated Coatings
ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials, Tests for (DOD adopted)
ASTM E 384 Microhardness of Materials, Test Method for
ASTM F 519 Mechanical Hydrogen Embrittlement Testing of Plating Processes and Aircraft Maintenance Chemicals (DOD adopted)

3. REQUIREMENTS:

3.1 Materials:

3.1.1 Metals and composites: Iron, copper, aluminum, nickel, cobalt, beryllium, titanium, and their alloys can be plated directly. Composites can be plated directly by using special pretreatments to prevent the basis material from contaminating the bath or to obtain adequate coating adhesion.

3.1.2 Tensile strength: All steel parts having an ultimate tensile strength of 220,000 psi, or above, shall not be coated without approval of the procuring activity.

3.2 Precoating procedures:

3.2.1 General requirements:

3.2.1.1 Unless otherwise specified, the coating shall be applied after all basis metal heat treatments and mechanical operations such as machining, brazing, welding, forming, and perforating of the part have been completed.

3.2.1.2 Parts, prior to plating, shall be degreased, abrasive and/or alkaline cleaned, and acid pickled as required to obtain maximum coating adhesion.

3.2.1.3 Hardness measurement: . Prior to coating, steel parts shall be measured for hardness in accordance with ASTM E 18.

3.2.2 Stress relief heat treatment: Prior to cleaning and coating, all steel parts having a hardness of Rockwell C40 or above, which have been machined, ground or surface hardened (includes cold worked but not shot peened surfaces), shall be given a stress-relief heat treatment at a temperature that will produce maximum stress relief without reducing the hardness to less than the specified minimum.

3.2.3 Shot peening: Prior to coating, all steel parts having a hardness of Rockwell C40 or above used in fatigue applications and/or subject to stress corrosion shall be shot peened in accordance with MIL-S-13165. Unless otherwise specified, the shot peening shall be accomplished on all surfaces for which the coating is required and all immediately adjacent surfaces when they contain notches, fillets or other abrupt changes of section size where stresses will be concentrated.

3.3 Coating properties:

3.3.1 General requirements:

3.3.1.1 Manufacturers are given latitude in the selection of specific plating bath formulations used for the chemical deposition of an amorphous nickel-phosphorous metallic compound provided the coating obtained meets the requirements of this specification.

3.3.1.2 Equipment, solutions, and process procedures shall be subject to the approval of the procuring activity.

3.3.2 Thickness: Unless otherwise specified, minimum thickness of the nickel coating shall be 0.0010 inch (0.026 mm) (Grade A) for aluminum based alloys, 0.0005 inch (0.013 mm) (grade B) for copper, nickel, cobalt, titanium and beryllium alloys, and 0.0015 inch (0.039 mm) (grade C) for iron-based alloys.

3.3.3 Adhesion on metals: The coating adhesion after completion of all processing and thermal treatments shall be such that when examined at a magnification of 4X, the coating shall not show separation from the basis metal when tested in accordance with ASTM B 571 as specified in 4.5.2. It also shall be impossible to detach any area of the coating with a sharp instrument on the outside radius of the bent-test specimen. Formation of cracks that do not result in loss of plating adhesion is acceptable.

3.3.4 Corrosion resistance: Grade A coatings on aluminum alloys and grade C coatings on iron alloys after plating and all required thermal treatments shall show no visual evidence of corrosion of the basis metal when tested in accordance with 4.5.5.

3.4 Postcoating procedures:

3.4.1 Hydrogen embrittlement relief bake: Within 4 hours after coating, coated class 1 and class 2 steel parts that have a hardness of Rockwell C40 or above shall require a hydrogen embrittlement relief bake at 375°F ± 25°F for not less than 3 hours. Parts, including carburized parts, that will decrease in hardness by heating to 375°F ± 25°F shall be heated to 275°F ± 15°F for not less than 5 hours. When tested in accordance with 4.5.4, the baked parts shall not crack or fracture.

3.4.2 Heat treatments:

3.4.2.1 Class 2 hardness coatings: Class 2 coatings shall have a minimum hardness of 800 knoop or equivalent vickers when tested in accordance with 4.5.3. Class 2 coatings on steel parts that have a hardness of Rockwell C40 or above are required to be tested in accordance with 4.5.4 without cracking or fracture. The hardness can be achieved by heating the part (see 4.5.4 and 6.3) within 4 hours after coating.

3.4.2.2 Class 3 coatings: Coated nonheat-treatable aluminum parts shall be heated for 1 to 1.5 hours at 375°F ± 15°F to improve adhesion of nickel deposit.

3.4.2.3 Class 4 coatings: Coated heat-treatable aluminum alloys shall be heated between 240°F to 260°F for 1 to 1.5 hours to improve adhesion of nickel deposit.

NOTE—These alloy types and grades may undergo microstructural changes when heated to 375°F.)

3.5 Identification marking:

When specified, the coated parts shall be marked with a fluid not affected by water, or rub off, or smear during shipment or storage; and shall carry a tag giving the following information:

a. Basis material
b. Number of this specification.
c. Class and grade of coating.

3.6 Workmanship:

3.6.1 Basis material: The basis material shall be free from defects that will be detrimental to the utility, appearance, or serviceability of the finished product or part and coating.

3.6.2 Nickel coating: The nickel coating shall be smooth, adherent, and free from visible blisters, pits, nodules, porosity, cracks and other defects. All details of workmanship shall conform to the best practices for high quality coating.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance: All items shall meet the requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility for ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the government to accept defective material.

4.2 Classification of inspection:

The inspection requirements specified herein are classified as quality conformance inspection (see 4.4).

4.3 Inspection conditions:

Unless otherwise specified, all inspections shall be performed in accordance with the methods of inspection specified in 4.5.

4.3.1 Inspection lot: A lot shall consist of coated parts of the same type and class, same basis material, and of approximately the same size and shape, coated under the same conditions and by means of the same coating process, and submitted for acceptance at one time.

4.3.2 Separate specimens: When the coated parts are of such form as to be not readily adaptable to a test specified herein, or at the discretion of the inspector for destructive tests for the sampling of small lot sizes, the test may be made by the use of separate specimens coated concurrently with the parts represented. The separate specimens shall be of a basis material equivalent (see 6.6) to that of the parts represented. For example, a cold-rolled steel surface shall not be used to represent a hot-rolled steel surface; owing to the impracticability of forging or casting separate test specimens, hot-rolled steel specimens may be used to represent forged and cast steel parts. The separate specimens shall be strips approximately 1-inch wide, 4-inches long, and 0.04-inch thick except those required for determination of embrittlement relief (see 4.5.4). These specimens shall be introduced into a lot at regular intervals prior to the cleaning operations preliminary to coating and shall not be separated therefrom until after completion of the processing.

4.4 Quality conformance inspection:

Quality conformance inspections shall consist of sampling plans A, B, C, D, and E.

4.4.1 Sampling plan A - Sampling procedures for visual examination and nondestructive tests of coating thickness: Samples shall be selected from each lot (see 4.3.1) and acceptance of the lot shall be determined in accordance with inspection level II and acceptable quality level (AQL) 1.5 of MIL-STD-105. Periodic microscopic destructive thickness and adhesion tests shall be performed as a referee method to verify comparable nondestructive tests for the purpose of process control assurance.

4.4.1.1 Visual inspection: Each of the sample parts selected in accordance with 4.4.1 shall be examined visually for conformance to requirements of 3.6.2.

4.4.1.2 Thickness (nondestructive tests): Each of the sample parts selected in accordance with 4.4.1 shall be inspected, and the coating thickness measured in several locations on each part in accordance with 4.5.1.2. The part shall be considered nonconforming if one or more measurements fail to meet the specified minimum thickness.

4.4.2 Sampling plan B - Sampling procedures for evaluating hydrogen embrittlement relief destructive test - Class 1 and 2: A hydrogen embrittlement relief test shall be run once per month on a random sample of 4 parts as specified in 4.5.4.

4.4.3 Sampling plan C - Sampling procedure for adhesion tests: A random sample of 4 parts shall be selected from each inspection lot which has more than 15 parts (see 4.3.1), or 4 separately coated specimens shall be prepared in accordance with 4.3.2 to represent each inspection lot. If the number of parts in an inspection lot is 15 or less, the number of parts in the sample shall be 2 or 3 as determined by the procuring activity.

4.4.3.1 Adhesion: Each part, or specimen shall be tested as specified in 4.5.2. Failure of one or more of the test specimens shall constitute failure of the lot.

4.4.4 Sampling plan D - Sampling procedure for hardness test - Class 2: A hardness test shall be run once a month, on four randomly selected parts representing the months production, or on four separately coated specimens as specified in 4.5.3. The amount of testing may be reduced provided the results in the consecutive months indicate a uniform product meeting the test requirements is being produced, and providing the manufacturer agrees to maintain the same manufacturing procedures or develops alternative acceptable manufacturing procedures.

4.4.5 Sampling Plan E: Sampling procedure for destructive tests of coating thickness. At least once per calendar quarter, a coated part, or a separately coated specimen prepared in accordance with 4.3.2, shall be tested in accordance with 4.5.1.1 to verify the adequacy of the nondestructive methods of thickness testing.

4.5 Methods of inspection:

4.5.1 Thickness test:

4.5.1.1 Microscopic method: The coating thickness shall be determined in accordance with ASTM B 487.

4.5.1.2 Nondestructive instrumental methods: The instrument used, its calibration, and its operation for testing given parts shall be such that the coating thickness shall be determined with ±10 percent of its true thickness, or the instrument shall be of a type approved by the procuring activity (see 6.4). The coating thickness shall be determined in accordance with ASTM B 499, ASTM B 568, and ASTM B 567. Periodic verification of the instrumental methods must be made in accordance with 4.5.1.1.

4.5.2 Adhesion test: The test specimen shall be bent 180° over a mandrel diameter 4 times the thickness (0.4 inch minimum) of the specimen.

4.5.3 Hardness tests: Vickers-hardness measurements shall be in accordance with ASTM E 384. Knoop-hardness measurements shall be in accordance with ASTM B 578.

4.5.4 Embrittlement relief: Compliance with 3.4.1 and 3.4.2.1 shall be determined with samples of plated parts. Parts--spring pins, lock rings, and so forth--that are installed in holes or rods shall be similarly assembled using the applicable parts specifications or drawing tolerances which impose the maximum sustained tensile load on the plated part. The selected samples shall be subjected to a sustained tensile load equal to 115 percent of the maximum design yield load for which the part was designed. Parts that require special fixtures, extreme loads to comply with the above requirements, or where the maximum design yield load is not known, may be represented by separate test specimens. The separate specimens shall be of a type specified in ASTM F 519 and tested as required therein. The articles, parts or test specimens shall be held under load for at least 200 hours and then examined for fracture. The lot shall be rejected if any coated article, part, or test specimen shows cracking or fracture of the basis metal.