

AEROSPACE MATERIAL SPECIFICATION

SAE

AMS 2426C

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Submitted for recognition as an American National Standard

Superseding AMS 2426B

(R) COATING, CADMIUM
Vacuum Deposition

1. SCOPE:

1.1 Purpose:

This specification covers the engineering requirements for vacuum deposition of cadmium and the properties of the deposit.

1.2 Application:

This process has been used typically to provide a corrosion resistant coating for high strength ferrous parts operating at not higher than 450 °F (232 °C) and requiring freedom from hydrogen embrittlement, but usage is not limited to such applications. Deposits are "line-of-sight" and may not be applicable to some internal surfaces.

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.

1.4 Warning:

Numerous scientific studies have determined that cadmium presents a health hazard to persons who are continually exposed to it.

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.

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2.1 ASTM Publications:

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

- ASTM B 117 Salt Spray (Fog) Testing
- ASTM B 487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of a Cross Section
- ASTM B 499 Measurement of Coating Thicknesses by the Magnetic Method; Nonmagnetic Coatings on Magnetic Basis Metals
- ASTM B 504 Measurement of Thickness of Metallic Coatings by the Coulometric Method
- ASTM B 568 Measurement of Coating Thickness by X-Ray Spectrometry
- ASTM B 571 Adhesion of Metallic Coatings

2.2 U.S. Government Publications:

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

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

3. TECHNICAL REQUIREMENTS:

3.1 Preparation:

- 3.1.1 All fabrication-type operations, such as brazing, welding, machining, forming, perforating, and heat treating, shall be completed before parts are coated.
- 3.1.2 Ferrous parts heat treated to a range including or exceeding a tensile strength of 240 ksi (1655 MPa) or hardness of 49 HRC shall not be exposed to processes which cause hydrogen embrittlement, such as pickling, cathodic cleaning, and etching, or to corrosive environments.
- 3.1.3 Ferrous parts heat treated to a range including or exceeding a tensile strength of 180 ksi (1241 MPa) or hardness of 40 HRC which have been exposed to processes which cause hydrogen embrittlement shall be heated to $375^{\circ}\text{F} \pm 25$ ($191^{\circ}\text{C} \pm 14$) and held at heat for not less than three hours prior to coating.
- 3.1.4 Parts shall be within specified dimensional tolerances after coating.

3.2 Procedure:

- 3.2.1 Cadmium shall be deposited directly onto the basis metal without a preliminary coating of other metal.

3.2.2 Parts shall be coated by deposition of vaporized metallic cadmium within a suitable vacuum.

3.2.2.1 The equipment and processes employed shall be adequate to ensure coverage of all external surfaces, including roots of threads, recesses, and sharp corners.

3.2.3 After coating, parts shall be conversion coated. Unless otherwise specified, a chromate conversion coating shall be used.

3.3 Properties:

The cadmium coating shall conform to the following requirements:

3.3.1 Thickness: Shall be as specified on the drawing, determined on representative parts in accordance with ASTM B 487, ASTM B 499, ASTM B 504, ASTM B 568, direct micrometer measurement, or other method acceptable to purchaser.

3.3.1.1 Coating thickness, when specified by AMS 2426 and a suffix number, shall be as specified in Table 1 for the specified suffix number and type of part or surface.

TABLE 1 - Coating Thickness and Salt Spray Corrosion Resistance Requirements

AMS 2426 Thickness Designation Specified	External Threads Thickness Inch	External Threads Thickness Micrometers	External Threads Salt Spray Resistance Hours, min	Nuts, Washers, and Unthreaded Surfaces of Parts Externally Threaded Thickness Inch	Nuts, Washers, and Unthreaded Surfaces of Parts Externally Threaded Thickness Micrometers	Nuts, Washers, and Unthreaded Surfaces of Parts Externally Threaded Salt Spray Resistance Hours, min	Parts Not Externally Threaded except Nuts and Washers Thickness Inch	Parts Not Externally Threaded except Nuts and Washers Thickness Micrometers	Parts Not Externally Threaded except Nuts and Washers Salt Spray Resistance Hours, min
2426	0.0001	2.5	100	0.0002	5.1	150	0.0003	7.6	200
	0.0004	10		0.0005	12.7		0.0005	13	
2426-1	0.0001	2.5	100	0.0002	5.1	150	0.0001	2.5	100
	0.0003	7.6		0.0004	10		0.0003	7.6	
2426-2	0.0001	2.5	100	0.0002	5.1	150	0.0002	5.1	150
	0.0004	10		0.0004	10		0.0004	10	
2426-3	0.0002	5.1	150	0.0003	7.6	200	0.0003	7.6	200
	0.0005	13		0.0005	13		0.0005	13	
2426-4	0.0003	7.6	200	0.0004	10	225	0.0004	10	225
	0.0006	15		0.0006	15		0.0006	15	
2426-5	0.0004	10	225	0.0005	13	250	0.0005	13	250
	0.0007	18		0.0007	18		0.0007	18	

Notes:

For thickness designations AMS 2426-X, where X is greater than 5, coating thickness in ten-thousandths of an inch shall be X to X+2 except on external threads where coating thickness shall be X-1 to X+2; such parts shall withstand salt spray for not less than 250 hours.

For thickness designations AMS 2426-X, where X is greater than 5, coating thickness in micrometers shall be 2.5X to 2.5 (X+2) except on external threads where coating thickness shall be 2.5 (X-1) to 2.5 (X+2); such parts shall withstand salt spray for not less than 250 hours.

- 3.3.1.2 Where "cadmium flash" is specified, coating thickness shall be approximately 0.0001 inch (2.5 μm).
- 3.3.1.3 The coating shall be substantially uniform in thickness on significant surfaces except that slight build-up on exterior corners or edges will be permitted provided finished drawing dimensions are met.
- 3.3.1.4 Requirements are not established for minimum coating thickness for surfaces of holes, recesses, internal threads except as specified in Table 1, contact areas of parts coated all over, and other areas where a controlled deposit cannot be obtained under normal coating conditions, but such areas shall not normally be masked to prevent coating. Except as specified in Table 1 for externally threaded sections, the 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 Adhesion: Shall be determined using one of the following methods:
- 3.3.2.1 Coating shall not show separation from the basis metal when tested in accordance with a method described in ASTM B 571.
- 3.3.2.2 Coating shall not show separation from the basis metal when tested using a pressure sensitive tape with 2.5 pounds per inch (446 grams per centimeter) minimum peel strength. The tape shall be applied to the coated surface, rolled into place using a rubber roller, and then rapidly removed by peeling the tape at a 90-degree angle to the coated surface.
- 3.3.3 Corrosion Resistance: Except as specified in 3.3.3.1, ferrous metal parts or representative test panels shall show no visual evidence of corrosion of the basis metal after being subjected for a time not less than specified in Table 1 to continuous salt spray corrosion test conducted in accordance with ASTM B 117. When test specimens are used, coating thickness shall be 0.0002 to 0.0004 inch (5 to 10 μm). Corrosion resistance shall not apply to parts coated to a thickness less than 0.0002 inch (5 μm).
- 3.3.3.1 Salt spray corrosion tests shall not apply to nonferrous parts, coated parts made of austenitic corrosion-resistant steels, to areas of parts made of any corrosion-resistant steel or alloy when not coated all over, and to parts made of any steel when thickness is specified as "flash".
- 3.4 Quality:
- Cadmium deposit, as received by purchaser, shall be smooth, continuous, adherent to basis metal, uniform in appearance, and essentially free from pinholes, porosity, blisters, nodules, pits, and other imperfections detrimental to usage of the coating. Slight staining or discoloration is permissible. Additional standards for acceptance may be agreed upon by purchaser and processor.
- 3.4.1 The cadmium deposit shall show no indication of contamination or improper operation of equipment used to produce the coating, such as excessively powdery or darkened coatings.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor shall supply all samples for processor's tests and shall be responsible for performing all required tests. Parts, when required for test, 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 requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Thickness (3.3.1), adhesion (3.3.2), and quality (3.4) are acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Corrosion-resistance (3.3.3) and tests of equipment and process controls to ensure that the deposited metal will conform to the specified requirements are periodic tests and shall be performed at a frequency selected by the processing vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of each part number to a purchaser, when a change in material and/or processing requires approval by the cognizant engineering organization (See 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 as follows; a lot shall be all parts of the same part number, cleaned and pretreated as applicable at the same time in the same equipment, and coated in a single pump-down, and presented for processor's inspection at one time:

4.3.1 Acceptance Tests: Number of parts sampled for acceptance testing shall be not less than shown in Table 2.

TABLE 2 - Sampling for Acceptance Testing

Number of Parts in Lot		Quality	Thickness and Adhesion
Up to	7	all	3 if available
8 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 Periodic Tests and Preproduction Tests: As agreed upon by purchaser and vendor.

4.3.2.1 For corrosion-resistance tests, specimens shall be panels of low-carbon or low-alloy steel.

4.4 Approval:

4.4.1 The process and control factors, a preproduction sample part, or any combination thereof, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 The processor shall make no significant changes to materials, processes, or control factors from those on which approval was based unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, would affect the properties or performance of the part.

4.4.3 Control factors for the process shall include, but not be limited to, the following:

- Method(s) of surface preparation
- Source and form of cadmium
- Method of cadmium vaporization
- Electrical parameters (current and/or voltage limits)
- Vacuum level
- Composition of conversion coating and parameters for application
- Fixturing techniques
- Location and orientation of parts during coating
- Temperature limits of parts during coating
- Periodic test plan