AEROSPACE MATERIAL SPECIFICATION

AMS2427™	REV. E

Issued 1981-01
Reaffirmed 2018-08
Revised 2023-12

Superseding AMS2427D

Aluminum Coating
Ion Vapor Deposition

RATIONALE

AMS2427E results from a Five-Year Review and update of this specification with changes to preparation (see 3.1.2) allowing other types of masking, blasting (see 3.2.4.1) clarification of requirements, and deletion of 3.4.1.2.1.

NOTICE

ORDERING INFORMATION: The following information shall be provided to the coating processor by the purchaser:

1. Purchase order shall specify not less than the following:
    - AMS2427E
    - Coating thickness desired (see 3.4.1). If more than one thickness is required (see 3.2.2). If internal surfaces need coating (see 3.4.1.2.1).
    - Optional: Acceptance standards (see 3.5).
    - Optional: Sample quantity and frequency of periodic testing (see 4.2.2 and 4.3.2).
    - Optional: Statistical sampling plan (see 4.3.1.1).
    - Optional: Corrosion test panel alloy (see 4.3.3.2).
    - Whether approval is based on approval of process/control factors or sample part or both (see 4.4.1).
    - Quantity of pieces to be coated.
2. Parts manufacturing operations such as heat treating, forming, joining, and media finishing can adversely affect the coated part. The sequencing of these types of operations should be specified by the cognizant engineering organization or purchaser and is not controlled by this specification.

1. SCOPE

1.1 Purpose

This specification covers the requirements for ion vapor deposited (IVD) aluminum on steel, titanium, and aluminum alloys.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS2427E

1.2 Application

This process has been used typically to improve corrosion resistance of ferrous parts operating at service temperatures up to 925 °F (496 °C) without the risk of hydrogen embrittlement and solid metal embrittlement, but usage is not limited to such applications.

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 issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2430 Shot Peening

AMS2473 Chemical Film Treatment for Aluminum Alloys, General Purpose Coating

AS2390 Chemical Process Test Specimen Material

AS7766 Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B117 Operating Salt Spray (Fog) Testing Apparatus

ASTM B487 Measurement of Metal and Oxide Coating Thicknesses by Microscopical Examination of Cross Section

ASTM B499 Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals

ASTM B567 Measurement of Coating Thickness by the Beta Backscatter Method

ASTM B568 Measurement of Coating Thickness by X-Ray Spectrometry

ASTM B571 Qualitative Adhesion of Metallic Coatings

ASTM B748 Measurement of Thickness of Metallic Coatings by Measurement of Cross Section with a Scanning Electron Microscope

ASTM E376 Measuring Coating Thickness by Magnetic-Field or Eddy Current (Electromagnetic) Testing Methods

2.3 Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Preparation

3.1.1 Ferrous parts having a tensile strength of 220 ksi (1517 MPa) or greater shall not be subjected to any hydrogen embrittling process, such as exposure to an acid, cathodic cleaning, etching, or to a corrosive environment.

3.1.2 Aluminum or corrosion-resistant steel foil or specially configured aluminum or corrosion-resistant steel masking or plugs shall be used to mask areas where the coating is not desired. Aluminum tape may be used where it is not practical to use foil. The quantity of aluminum tape used shall be minimized. Other types of masking that do not outgas in the vacuum may be used such as silicone tapes and plugs.

3.1.3 The coating shall be deposited over a dry surface free from water breaks.

3.2 Procedure

3.2.1 The coating shall be applied directly to the basis metal by the deposition of vaporized metallic aluminum, from wire of 99.0% minimum purity, on parts which are made the cathode of a high voltage system within a suitable low pressure gas (vacuum) environment.

3.2.2 When more than one coating thickness is required on a part, the application procedure shall be acceptable to the cognizant engineering organization.

3.2.3 The temperature of the parts during deposition of the coating shall be controlled so as not to reduce hardness of titanium and aluminum alloy parts by more than two points HRB and of steel parts to below the minimum of the specified hardness (see 8.2).

3.2.4 The IVD coating shall be compacted by glass or ceramic bead peening to obtain a coating essentially free from porosity. Interconnected porosity results from under-peening while over-peening can reduce the thickness or remove the IVD coating from the substrate. Process controls shall ensure a coherent coating is produced with no cuts or gouges or embedded media from broken or shattered beads (see 8.5).

3.2.4.1 Appropriate glass or ceramic bead size, blast pressure, and nozzle working distance shall be established prior to production.

3.2.5 Application of IVD aluminum coating over IVD aluminum coating is prohibited.

3.3 Post-Treatment

Coated parts shall receive a supplementary chromate treatment in accordance with AMS2473.

3.4 Properties

The deposited aluminum shall conform to the following requirements:

3.4.1 Thickness

Thickness shall be as specified, determined, on representative parts or test panels, in accordance with any of the following methods, as applicable: ASTM B487, ASTM B499, ASTM B567, ASTM B568, ASTM B748, ASTM E376, micrometer measurements, or other method acceptable to the cognizant engineering organization.

3.4.1.1 Coating thickness may be specified by AMS2427 and a suffix number normally designating the minimum thickness in ten-thousandths of an inch (2.5 µm) as shown in Table 1. The maximum thickness shall be 0.0005 inch (13 µm) greater than the minimum.

Table 1 - Coating thickness and salt spray corrosion resistance requirements

AMS Thickness Designation	Thickness[1] Inches	Thickness[1] Micrometers	Salt Spray Resistance[2] Hours
-3	0.0003 to 0.0008	8 to 20	336
-5	0.0005 to 0.0010	13 to 25	504
-10	0.0010 to 0.0015	25 to 38	672

(1) A part having coating thickness exceeding the applicable range above shall not be rejected unless the thickness causes a part dimension to violate a specified requirement.

(2) Salt spray resistance requirements are for coated ferrous parts with supplementary chromate treatment.

3.4.1.2 All surfaces of the part, except those that cannot be touched by a sphere 0.75 inch (19 mm) in diameter, shall be coated to the specified thickness. Unless otherwise specified, surfaces such as holes, recesses, internal threads, and other areas where a controlled deposit cannot be obtained, may be under the specified limit provided they show visual plating coverage to a depth at least the diameter of the hole or recess.

3.4.2 Adhesion

Adhesion shall meet the requirements of ASTM B571 by the bend test method using a mandrel equal in diameter to the nominal thickness of the specimen. Testing for adhesion shall be accomplished after all processing including compaction in accordance with 3.2.4.

3.4.3 Corrosion Resistance of Ferrous Parts

Ferrous metal parts coated all over to a thickness range in Table 1, 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 B117 (see 4.3.3.2).

3.4.4 Porosity

No interconnected porosity is allowed when metallographic cross section examined at 400 to 600X magnification.

3.5 Quality

Coating, as received by the purchaser, shall be smooth, continuous, adherent to basis metal, uniform in appearance, and essentially free from pin holes, porosity, blisters, nodules, pits, and other imperfections detrimental to performance of the coating. Slight staining or discoloration is permissible. Standards for acceptance shall be acceptable to the cognizant engineering organization.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The processor shall supply all samples for the processor's tests and shall be responsible for the performance of all required tests. Parts, if required for tests, shall be supplied by the purchaser. The cognizant engineering organization reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that processing conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Reduction of hardness (see 3.2.3), thickness (see 3.4.1), adhesion (see 3.4.2), and quality (see 3.5) are acceptance tests and shall be performed on parts, or samples representing parts when permitted, from each lot.

4.2.2 Periodic Test

Corrosion resistance (see 3.4.3), porosity (see 3.4.4), and verification of blasting parameters (see 3.2.4.1) are periodic tests and shall be performed monthly unless frequency of testing is specified by the cognizant engineering organization.

4.2.3 Preproduction Tests

All property verification tests (see 3.4), and establishment of blasting parameters (see 3.2.4.1) are preproduction requirements and shall be performed prior to or on the initial shipment of coated parts to a purchaser and when the cognizant engineering organization deems confirmatory testing to be required.

4.3 Sampling and Testing

Sampling and testing shall be not less than the following: a lot shall be all parts of essentially the same size, shape, and basis metal, heat treated to the same hardness or tensile strength level, processed in a single pump down to the same coating thickness, and presented for the processor's inspection at one time.

4.3.1 Acceptance Tests

Test samples shall be randomly selected from all parts in the lot. The minimum number of samples shall be three parts from each lot or all parts, whichever is less.

4.3.1.1 A statistical sampling plan, acceptable to the cognizant engineering organization, may be in used lieu of sampling as in 4.3.1.

4.3.2 Periodic Tests

Sample quantity shall be selected at the discretion of the processor, unless otherwise specified by the cognizant engineering organization.

4.3.3 Sample Configuration

4.3.3.1 Separate test specimens may be used under any one of the following circumstances: The coated parts are of such configuration or size as to be not readily adaptable to the specified tests, when nondestructive testing is not practical on actual parts, or it is not economically acceptable to perform destructive tests on actual parts. Separate test specimens shall be made of the alloy specified in AS2390, distributed within the lot, cleaned, coated, and post-treated with the parts they represent.

4.3.3.2 Corrosion test panels shall be made of the predominant generic class of alloy as the parts in the month approximately 0.062 to 0.125 inch (1.57 to 3.18) thick and not less than 4 inches (102 mm) long by 3 inches (76 mm) wide. Alternative alloy or configuration may be used when acceptable to the cognizant engineering organization.

4.3.3.3 Adhesion test specimens shall be approximately 0.032 x 1 x 4 inches (0.81 x 25 x 102 mm).

4.3.3.4 Thickness test specimens shall be approximately 0.032 x 1 x 4 inches (0.81 x 25 x 102 mm) or shall be bars approximately 0.5 inch (13 mm) in diameter and 4 inches (102 mm) long.

4.4 Approval

4.4.1 The process and control factors, a preproduction sample, or both, whichever is specified by the cognizant engineering organization, shall be approved by the cognizant engineering organization before production parts are supplied.

4.4.2 If the processor makes a significant change to any material, process, or control factor from that which was used for process approval, all preproduction tests shall be performed, and the results submitted to the cognizant engineering organization for process reapproval unless the change is approved by the cognizant engineering organization. A significant change is one which, in the judgment of the cognizant engineering organization, could affect the properties or performance of the parts.