SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS2435 | REV. G

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Superseding AMS2435F

Coating, Tungsten Carbide-Cobalt Coating, Detonation Process

RATIONALE

AMS2435G has been reaffirmed to comply with the SAE five-year review policy.

NONCURRENT NOTICE

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of June, 2007. It is recommended, therefore, that this specification not be specified for new designs.

"NONCURRENT" refers to those specifications which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these specifications for future use in new designs. "NONCURRENT" specifications are available from SAE upon request.

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1. SCOPE:

1.1 Purpose:

This specification covers the engineering requirements for applying tungsten carbide/cobalt coatings to metal parts by the detonation process and the properties of such coatings.

1.2 Application:

This coating has been used typically to provide a hard, wear resistant surface on metal parts which do not operate in service higher than 1000 °F (538 °C) but usage is not limited to such applications. These coatings are not recommended for surfaces with deep vee-shaped grooves, blind cavities, narrow holes or sharp corners, or where deformation of the base metal may be expected. Higher cobalt content provides increased ductility for applications where impact or fretting wear is involved.

1.3 Classification:

Coatings conforming to this specification are classified as follows:

Type A: 7% Cobalt, 93% Tungsten Carbide
Type B: 11% Cobalt, 89% Tungsten Carbide
Type C: 14% Cobalt, 86% Tungsten Carbide

1.3.1 Type A coating shall be supplied unless Type B or Type C is specified.

1.4 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 that 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 the necessary precautionary measures to ensure the health and safety of all personnel involved.

1.4.1 Users who perform additional finishing operations on the coatings may produce particulate material, whether suspended in air or liquid, which requires safety-hazardous material considerations.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order form 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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 ASTM Publications:

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

ASTM C 633 Adhesion or Cohesive Strength of Flame-Sprayed Coatings
ASTM E 384 Microhardness of Materials

3. TECHNICAL REQUIREMENTS:

3.1 Equipment:

Shall consist of a specially constructed machine in which the particles of coating material are fed into the tube of a gun, suspended in a mixture of oxygen, acetylene, and nitrogen, and detonated, heating the particles to plasticity and propelling them at high velocity out of the gun barrel onto the part.

3.2 Coating as Deposited:

3.2.1 Shall have the following approximate composition by weight, determined by a method acceptable to purchaser:

Type A: 7% Cobalt, 93% Tungsten Carbide
Type B: 11% Cobalt, 89% Tungsten Carbide
Type C: 14% Cobalt, 86% Tungsten Carbide

3.2.2 Shall be well bonded with no visual lifting, cracking or separation.

3.3 Preparation:

3.3.1 Surfaces to be coated shall be machined to allow for the finished thickness of the coating.

3.3.2 Parts requiring heat treatment or shot peening shall be processed prior to coating.

3.3.3 Parts shall be supplied to coating vendor in a clean condition, except for the presence of a light oil preservative. Coating processor shall clean parts to remove surface contamination detrimental to adhesion of the coating.

3.3.4 Surfaces of specimens and parts to be coated shall be grit blasted before coating to produce a uniform matte finish sufficient to provide good adhesion of the coating. Grit blasting may be omitted when agreed to by purchaser.

3.3.5 After grit blasting, remove loose particles from the part surface using a dry, filtered air blast.

3.3.6 Parts shall be suitably masked to protect surfaces not required to be coated.

3.4 Procedure:

3.4.1 Coating: The coating material shall be deposited onto designated surfaces to a sufficient thickness to permit finishing to specified dimensions but not exceeding 0.015 inch (0.38 mm) as deposited thickness. Temperature of parts, during deposition, shall be controlled so as not to exceed 300 °F (149 °C).

3.5 Properties:

The coating on parts shall be simulated by process control samples coated at a nominal 90 degrees impingement angle and shall conform to the following requirements:

3.5.1 Hardness: Shall be as follows, determined in accordance with ASTM E 384 as the average of not less than 10 microhardness readings taken on a cross-section of the test specimen or part. For hardness determinations, the coating thickness shall be not less than 0.007 inch (0.18 mm).

Type A: 1100 to 1510 HV 300
Type B: 980 to 1370 HV 300
Type C: 900 to 1220 HV 300

3.5.2 Bond Strength: Coating shall not exhibit less than 10 ksi (68.9 MPa) bond strength, determined in accordance with ASTM C 633 or other procedure acceptable to purchaser on solid steel cylinders 1.0 inch (25 mm) in diameter coated at 90 degrees on one flat face and tested at a thickness of 0.008 to 0.012 inches (0.20 to 0.30 mm). Film type adhesives other than those specified in ASTM C 633 may be used.

3.5.3 Inclusions and Apparent Porosity: Foreign particle inclusions shall not be more than 1.5% of the coating cross-section, and apparent porosity shall not be more than 1.0%, determined by microscopic examination at 200X magnification.

3.5.4 Cracks and Interface Bond Separation: Shall not be present when viewed at 200X magnification.

3.6 Quality:

The coating on parts, as received by purchaser, shall be adherent to the base metal and shall have a uniform, continuous surface free from spalling, chipping, flaking, and other imperfections detrimental to usage of the coating.

3.7 Tolerances:

A tolerance of -0, +0.125 inch (-0 and +3 mm) is allowed on the boundaries of areas designated to be coated.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The processor shall supply all process control specimens for processor's tests and shall be responsible for the performance of all required tests. When tests are required on actual parts, such parts shall be supplied by purchaser. Purchaser reserves the right to sample and to perform any confirmatory tests deemed necessary to ensure that the coating conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Thickness (3.4.1), hardness (3.5.1), inclusions and apparent porosity (3.5.3), cracks and interface bond separation (3.5.4), and quality (3.6) are acceptance tests and shall be performed to represent each lot.

4.2.2 Periodic Tests: Bond strength (3.5.2) and composition (3.5.5) are periodic tests and shall be performed at a frequency selected by the 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 coated parts to the purchaser, when a change in materials and/or processing requires approval by the cognizant engineering organization (see 4.4.2), and whenever purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

Shall be not less than the following; a lot shall be all parts of essentially the same composition and configuration, coated to similar thicknesses in a continuous operation of one equipment set-up with powder from the same batch, and presented for processor's inspection at one time. For parts of a complex geometry or which require that the coating be applied at other than a nominal 90-degree orientation, purchaser and processor may agree on standards for the determination of acceptable coating properties. Where no such agreement exists, test results shall be based on samples coated at 90-degree orientation.