

DETONATION PROCESS
Tungsten Carbide/Cobalt Coating

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: Primarily to provide a hard, wear-resistant surface on metal parts which do not operate in service higher than 1000°F (540°C). These coatings are not recommended for surfaces with deep vee-shaped grooves, blind cavities, narrow holes or sharp corners, or where deformation of the basis 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 by nominal cobalt content as follows:
- Type A - 9% Cobalt
 - Type B - 11% Cobalt
 - Type C - 14% Cobalt
- 1.3.1 Type A coating shall be supplied unless Type B or Type C is specified by purchaser.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

- 2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

- 2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

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- 2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM C633 - Adhesion or Cohesive Strength of Flame Sprayed Coatings
ASTM E384 - Microhardness of Materials

- 2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

- 3.1 Equipment: 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 hurling them at high velocity out of the gun barrel onto the part.

- 3.2 Coating as Deposited: Shall have composition approximately as follows for the type specified:

Type A - 91% tungsten carbide - 9% cobalt
Type B - 87% tungsten carbide - 13% cobalt
Type C - 85% tungsten carbide - 15% cobalt

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 so processed prior to coating.
- 3.3.3 Parts shall be cleaned to remove water, oil, grease, dirt, scale, paint, and other foreign materials detrimental to adhesion of the coating.
- 3.3.4 Surfaces of specimens and parts to be coated shall be grit blasted to produce a uniform matte finish sufficient to provide good adhesion of the coating.
- 3.3.5 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 the designated surfaces to a sufficient thickness to permit finishing to specified dimensions. The temperature of the parts during deposition shall be controlled so as not to exceed 300°F (150°C).

3.4.2 Surface Finishing: Procedures for grinding and lapping shall be as agreed upon by purchaser and vendor.

3.5 Properties: The coating on parts and representative test specimens shall conform to the following requirements except that the test of 3.5.2 applies only to test specimens.

3.5.1 Hardness: Shall be as follows, determined in accordance with ASTM E384 as the average of not less than 10 microhardness readings taken on a cross-section of the part or representative test specimen. For hardness determinations, the coating thickness shall be greater than 0.007 in. (0.18 mm).

Type A	1200 - 1400 HV300
Type B	1050 - 1300 HV300
Type C	1000 - 1200 HV300

3.5.2 Bond Strength: Shall be not lower than 10,000 psi (6.9 MPa), determined in accordance with ASTM C633 on steel cubes nominally 3/8 in. (9.5 mm) on a side coated on one face to a thickness of 0.008 - 0.010 in. (0.20 - 0.25 mm).

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

3.5.4 Cracks and Interface Bond Separation: Shall be absent when viewed at 200X magnification.

3.6 Quality: The coating, as received by purchaser, shall be adherent to the basis metal and shall have a uniform, continuous surface free from spalling, chipping, flaking and other imperfections detrimental to usage of the coating. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.7 Tolerances: A tolerance of -0 and +0.125 in. (+3 mm) is allowed on the boundaries of areas designated to be coated.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The coating vendor shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the coating conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition of coating material (3.2), thickness (3.4.1), hardness (3.5.1), and bond strength (3.5.2) are classified as acceptance tests and shall be performed to represent each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of coated parts to a purchaser, when a change in material, processing, or both requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 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, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be not less than the following; a lot shall be all parts of essentially the same configuration coated in a continuous operation to the same thickness with powder from the same batch and presented for vendor's inspection at one time.

4.3.1 For Acceptance Tests: Not less than two sets of specimens, one coated at the beginning and one coated at the end of each lot.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Sample parts coated in accordance with this specification shall be approved by purchaser before coated parts for production are supplied, unless such approval be waived by purchaser. Results of tests on production coated 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 coated parts which are essentially the same as those used on the approved sample parts. If necessary to make any change in type of equipment, in established composition limits, or in processing parameters, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, test specimens, sample coated parts, or both. Production parts coated by the revised procedure shall not be shipped prior to receipt of reapproval.