

Submitted for recognition as an American National Standard

**(R) TUNGSTEN CARBIDE-COBALT COATING**  
Detonation Process

**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 by nominal cobalt content 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.

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#### 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 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.

- 1.4.1 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 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.

##### 2.1 ASTM Publications:

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

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

##### 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 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 vendor 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.

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. Temperature of parts, during deposition, shall be controlled so as not to exceed 300 °F (149 °C).

### 3.5 Properties:

The coating on parts of simple geometry coated at nominally 90 degrees or on process control test specimens representing the parts 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 - 1500 HV300  
Type B: 980 - 1330 HV300  
Type C: 940 - 1190 HV300

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 performing 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 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 for composition (3.2.1), thickness (3.4.1), hardness (3.5.1), bond strength (3.5.2), 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 unless otherwise specified.

4.2.2 Preproduction Tests: Tests for 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 vendor'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 coating vendor 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.

4.3.1 For Acceptance Tests: Shall be not less than one set of parts or specimens. A set shall consist of one specimen or part for each requirement, coated at the beginning of each lot.

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

#### 4.4 Approval:

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

4.4.2 The supplier shall make no significant change to materials, processes, or control factors from those on which the first article 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, could affect the properties or performance of the parts.

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

- Surface preparation
- Coating compound source and mesh distribution
- Gun-to-work distance
- Fuel gasses
- Frequency of periodic tests

#### 4.5 Reports:

The vendor of coated parts shall furnish with each shipment a report stating that parts have been processed in accordance with specified requirements and that they conform to the acceptance test requirements. The report shall include the purchase order number, lot number, AMS 2435D, coating type, part number, and quantity.

#### 4.6 Resampling and Retesting:

If any sample used in the above tests fails to meet the specified requirements, disposition of the coated parts may be based on the results of testing three additional samples from the same coating lot for each original nonconforming specimen. Failure of the retest sample to meet the acceptance test requirements shall be cause for rejection of the parts represented.