

**Tungsten Disulfide Coating, Thin Lubricating Film, Binder-Less
Impingement Applied**

RATIONALE

AMS2530 is a new specification covering impingement-applied binderless tungsten disulfide, thin solid film lubricant.

1. SCOPE

1.1 Form

This specification covers a coating consisting of tungsten disulfide without binders and not requiring a curing process.

1.2 Application

This product has been used typically on metal parts and selected nonmetallic materials (e.g., thermoplastic and thermosetting polymers) where a friction-reducing coating under 0.00002 inch (0.5 μm) thick is required and where wear, galling, seizure, and fretting need to be minimized, but usage is not limited to such applications.

This lubricating film has been shown to be compatible with such fluids as reagent grade water, petroleum-based hydraulic fluid, petroleum-based oils and greases, SAE phosphate ester test fluid #1, silicone fluid, unsym-dimethylhydrazine (UDMH)-compatible grease, inhibited fuming red nitric acid (IFRNA)-compatible grease, solid rocket propellants, nitrogen tetroxide, liquid oxygen and hard radiation environments.

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 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 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.

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<http://www.sae.org/technical/standards/AMS2530>**

1.1 ASTM Publications

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

ASTM B 567	Measurement of Coating Thickness by the Beta Backscatter Method
ASTM D 7901	Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals
ASTM D 2510	Adhesion of Solid Film Lubricants
ASTM D 2511	Thermal Shock Sensitivity of Solid Film Lubricants
ASTM D 2649	Corrosion Characteristics of Solid Film Lubricants
ASTM E 595	Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment

2.1 American Society for Quality Publications

Available from American Society for Quality, Quality Press, 611 East Wisconsin Ave., P.O. Box 3005, Milwaukee, WI , 53201-3005, Tel: (800) 248-1946, www.asq.org.

ANSI / ASQC Z1.4-2003 Sampling Procedures and Tables for Inspection by Attributes

3. TECHNICAL REQUIREMENTS

3.1 Coating Material

The material used for the coating shall consist tungsten disulfide in a finely powdered, lamellar form. The material shall contain no graphite, molybdenum disulfide, binders or organic constituents so as to be compatible in liquid oxygen systems and hard radiation environments. The coating material, properly applied, shall, without a curing process, form a lubricating film conforming to the requirements of 3.4

3.2 Preparation

3.2.1 Cleaning

The surfaces of the basis material shall be thoroughly cleaned with a procedure capable of removing all polar and non-polar substances including oils and greases as well as any corrosion products and scale/oxide deposits. The cleaning procedure shall not produce pitting or intergranular attack of the basis metal and shall preserve dimensional requirements. The cleaned surfaces shall be free from oils (including skin oils), greases, dirt, particulate matter or other surface contamination. All parts shall be handled in such a manner as to prevent re-contamination of any surfaces to be coated during the application process.

3.2.2 Surface Finishing

Surfaces of parts to be coated shall be honed with 5 micron aluminum oxide powder to prepare the basis material for coating. To provide the proper surface for bearing applications, all residual particles shall be removed. See 8.2.1.

3.3 Procedure

The coating material shall be applied to all specified surfaces by spraying at high velocity (impinging) under controlled conditions.

3.4 Properties

The coating shall conform to the following requirements:

3.4.1 Adhesion

A pressure-sensitive-film-backed tape with an adhesion of not less than 45 ounces per inch (0.49 N/mm), shall be applied to a flat surface of a coated specimen, rolled in place, and rapidly removed in accordance with ASTM D 2510, Procedure B. The lifting of flakes or particles of the coating from the specimen, exposing the basis metal, is not acceptable. A uniform deposit of powdery material clinging to the tape is acceptable.

3.4.2 Thickness

Thickness shall be not greater than 0.00002 inch (0.5 μ m), determined in accordance with ASTM D 7901 or ASTM B 567 or by a method acceptable to the cognizant engineering organization.

3.4.3 Thermal Stability

The coating shall be tested for thermal stability in accordance with ASTM D 2511, except that (a) the extremes of temperature exposure shall range from -188 °C or colder to 482 °C or hotter and (b) the samples shall be allowed to return to room temperature for a minimum of 5 minutes between the hot and cold exposures. After exposure, the film shall not crack, flake, blister or soften and shall then meet the adhesion requirements of 3.4.1.

3.4.4 Appearance

The film appearance shall be uniform silver gray in color and when examined under a 12-15X microscope shall show no evidence of cracks, scratches, pinholes, blisters, or surface imperfections, other than those reflected through from the underlying basis material.

3.4.5 Corrosion Resistance

The coating shall be tested for corrosion resistance in accordance with ASTM D 2649. The anodized aluminum panels shall show no signs of discoloration, pitting or formation of white deposits after not less than 500 hours of exposure.

3.4.6 Vacuum Stability

When specified by the cognizant engineering organization, the coating material shall be tested for vacuum stability in accordance with ASTM E 595. The coating material shall show a total mass loss of less than or equal to 1.0% and collected volatile condensable material measurement of less than or equal to 0.1% when tested in accordance with ASTM E 595.

3.4.7 Coefficient of Friction

Coefficient of friction tests shall be as agreed upon between purchaser and supplier. See 8.4.

3.4.8 Wear Testing

Wear performance tests shall be as agreed upon between purchaser and supplier. See 8.4.

3.5 Quality

The coating on parts, as received by purchaser, shall be uniform in color, smooth, adherent to basis material and free from surface imperfections detrimental to performance of the coating. Evidence of porosity or other conditions detrimental to performance of the coating is not acceptable.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The coating processor shall supply all samples for processor's tests and shall be responsible for the performance of all required tests. Actual parts, when 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 the coating conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Adhesion (3.4.1), appearance (3.4.4) and quality (3.5) are acceptance tests and shall be performed on parts, or specimens representing parts when permitted herein, from each lot.

4.2.2 Periodic Tests

Thickness (3.4.2) is a periodic test and shall be performed at a frequency determined by the coating processor, but not less than each time the lubricant powder in the application equipment is changed, unless a different frequency of testing is specified by the cognizant engineering organization. Wear performance (3.4.8), if required, shall be at a frequency agreed between purchaser and supplier.

4.2.3 Preproduction Tests

Testing for all technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of a coated part to a purchaser, when a change in material and/or processing requires reapproval as in 4.4.2, and when purchaser deems a confirmatory testing to be required.

4.3 Sampling for testing

4.3.1 Acceptance Tests

Acceptance test samples shall be randomly selected from all parts in the lot. A lot shall be all parts of the same material, size, and shape, coated in a continuous series of operations in not more than eight consecutive hours, and presented for processor's inspection at one time.

4.3.1.1 Adhesion

The required number of parts from each lot shown in Table 1 shall be tested for coating adhesion. When size and/or configuration prevents testing of parts, test specimens in the specified quantity (Table 1) shall be processed with each lot and tested as in 3.4.1, unless the cognizant engineering organization determines that the coating processor's periodic adhesion testing schedule is acceptable. Test specimens, approximately 0.20 x 1 x 3 inches (5 x 25 x 76 mm), shall be made from cold-rolled, low-carbon steel or CRES with a mill finish.

TABLE 1 – ADHESION SAMPLE QUANTITIES

Number of Parts in Lot	Number of samples for acceptance tests
1 to 40	All or 2*
41 to 300	3
301 to 700	4
701 and above	5

*Whichever is less

4.3.1.2 Quality

Visual inspection samples shall be selected at random in accordance with ANSI Z1.4 and subjected to Inspection Level 1, AQL 1.0.

4.3.2 Periodic Tests

Sample requirements shall be as required by the cognizant engineering organization. All samples shall conform to the specifications below for each related test.

4.3.2.1 Thickness

Two test panels, approximately 0.20 x 2 x 4 inches (5 x 51 x 102 mm), shall be made from anodized aluminum, cold-rolled low-carbon steel, or stainless steel depending upon the test method selected. The panel size may be varied to ensure suitability to the test method selected.

4.3.2.2 Corrosion Resistance

Two test panels, approximately 0.020 x 3 x 6 inches (0.5 x 76 x 152 mm), shall be made from aluminum alloy 2024, anodized as specified in ASTM D 2649.

4.3.2.3 Vacuum Stability

A bulk sample of the coating material shall be provided by the material manufacturer to the testing laboratory.

4.3.2.4 Thermal Stability

Two test panels, approximately 0.036 x 3 x 6 inches (0.9 x 76 x 152 mm), shall be made from 321 CRES with a No. 2 dull finish as specified in ASTM D 2511.

4.3.3 Preproduction Tests

Sampling for preproduction testing shall be as agreed upon by the cognizant engineering organization and processor.

4.4 Approval

4.4.1 The process and control procedures, or a preproduction sample part, or both, whichever is specified by purchaser, 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 purchaser for process reapproval unless the change is approved by the cognizant engineering organization. A significant change is one that, 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 and cleaning methods
- Coating material trade name and manufacturer
- Angle of impingement during the application process
- Air pressure during the application process
- Stripping procedure, when applicable