

COATING, THIN LUBRICATING FILM, GRAPHITE
Impingement Applied

1. SCOPE:

- 1.1 Form: This specification covers a thin lubricating coating consisting of finely powdered graphite in a heat-resistant inorganic binder.
- 1.2 Application: Primarily as a coating on metal parts and selected non-metallic materials requiring less than 0.0001 in. (0.002 mm) surface thickness for reducing wear or minimizing galling.

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

- 2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

- ### 2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

AMS 6370 - Steel Bars, Forgings, and Rings; 0.95Cr - 0.20Mo (0.28 - 0.33C)

- ### 2.1.2 SAE Standards and Recommended Practices:

J403 - Chemical Compositions of SAE Carbon Steels

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

ASTM B487 - Metal and Oxide Coating Thickness by Microscopical Examination of a Cross Section

ASTM D2510 - Adhesion of Dry Solid Film Lubricants

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

- ### 2.3.1 Federal Specifications:

PPP-T-60 - Tape, Pressure-Sensitive, Adhesive, Waterproof

3. TECHNICAL REQUIREMENTS:

- 3.1 Material: Shall consist of finely powdered graphite in a heat-resistant inorganic binder; the material, properly applied, will form a lubricating film conforming to the requirements of this specification.

- ### 3.2 Procedure:

- 3.2.1 Cleaning: Before applying the coating, surfaces of the basis material shall be thoroughly cleaned with minimum abrasion or erosion. The cleaned surfaces shall be free from oxides and from foreign materials detrimental to coating adhesion.

- 3.2.2 Surface Finishing: Surfaces to be coated shall be honed with aluminum oxide powder of 240 - 400 mesh to prepare the basis material for coating.
- 3.2.3 Coating: The coating material shall be applied by spraying at high velocity (impinging) under controlled conditions to all surfaces on which it is specified.
- 3.2.4 Curing: The coating shall be cured as specified on the drawing (See 8.2).
- 3.2.5 Preservation: Unless otherwise specified, a supplementary preservative treatment, such as light machine oil, shall be applied after curing. Prior to using parts, the preservative treatment may be removed by vapor degreasing and drying in warm dry air.
- 3.3 Properties: The coating shall have the following properties; except for the test of 3.3.3, tests shall be conducted on panels approximately 4 in. (102 mm) long x 1 in. (25 mm) wide x 0.200 in. (5.08 mm) thick of the same material, condition, and surface finish as the parts they represent and which are cleaned, coated, and cured with the parts.
- 3.3.1 Adhesion: Pressure-sensitive tape conforming to PPP-T-60, type 1, class 1 shall be applied to a flat surface of a specimen, rolled in place, and then rapidly removed, in accordance with ASTM D2510, Procedure B. The lifting of flakes or particles of the coating from the specimen, exposing the surface of the specimen, shall be cause for rejection but a uniform deposit of powdery material clinging to the tape will be permitted.
- 3.3.2 Thickness: Shall be not greater than 0.0001 in. (0.002 mm), unless otherwise specified, as determined by sectioning specimens and examining them metallographically in accordance with ASTM B487. Any indication of porosity or other conditions detrimental to functional life of the coating shall be cause for rejection.
- 3.3.3 Wear Rate: The total loss in weight of two test blocks shall be not greater than 10 mg for a 500 cycle test and 40 mg for a 1000 cycle test, determined as follows:
- 3.3.3.1 The test specimens shall be two coated rectangular blocks of steel, AMS 6370 or equivalent, hardened and tempered to hardness of 40 - 45 HRC. The blocks shall be approximately 0.250 in. x 0.500 in. (6.35 mm x 12.70 mm) of any convenient length, ground prior to coating. A bar of SAE 1040 steel in accordance with SAE J403, 0.500 x 0.500 x 6.5 in. (12.70 x 12.70 x 165 mm), hardened and tempered to hardness of 45 - 50 HRC and having a ground surface shall also be provided.
- 3.3.3.2 The 0.250 x 0.500 in. (6.35 x 12.70 mm) face of the two blocks shall be rubbed on the bar, under load of 50 psi (345KPa), with an oscillating motion at a rate of 25 ft per min. (127 mm/s) through an amplitude of 4 in. (102 mm).
- 3.3.4 Thermal Stability: Test specimens shall be heated to 2000 F $\pm$ 25 (1093.3 C $\pm$ 14), held at heat for 5 min. $\pm$ 0.5, air cooled to room temperature, held at room temperature for approximately 1 hr, immersed in liquid nitrogen for approximately 1 hr, removed, warmed to room temperature, and examined. There shall be no evidence of damage to the coating.
- 3.4 Quality: The coating shall be uniform in color, smooth, and free from surface imperfections detrimental to its intended function.
4. QUALITY ASSURANCE PROVISIONS:
- 4.1 Responsibility for Inspection: The vendor shall supply all samples 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 perform such confirmatory testing as he deems necessary to assure 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 adhesion (3.3.1) requirements of this specification are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to thickness (3.3.2), wear rate (3.3.3), and thermal stability (3.3.4) requirements of this specification are classified as qualification or periodic control tests.

4.3 Sampling: Sufficient samples shall be prepared to provide for duplicate tests for conformance to each requirement of 3.3.

4.4 Approval:

4.4.1 Coated parts shall be approved by purchaser before parts for production use are supplied.

4.4.2 Vendor shall use manufacturing procedures, processes, and methods of inspection on production parts to determine conformance to this specification which are essentially the same as those used on the approved sample parts. If any change is necessary in established composition limits of the coating material or in coating and curing procedures, vendor shall submit for reapproval of the process a detailed statement of the revised operations and, when requested, sample coated parts. No production parts coated by the revised procedure shall be shipped prior to receipt of reapproval.

4.5 Reports: The vendor of coated parts shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the requirements of this specification. This report shall include the purchase order number, material specification number, and contractor or other direct supplier of coating material and basis material.

4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the parts may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the parts represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging:

5.1.1 Packaging shall be accomplished in such a manner as to ensure that coated parts, during shipment and storage, will not be permanently distorted and will be protected against damage from exposure to weather or any normal hazard. Each container shall be legibly marked with AMS 2525, purchase order number, vendor's identification, part number, and quantity.

5.1.2 Packages of coated parts shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Parts on which the coating does not conform to this specification or to authorized modifications will be subject to rejection.

8. NOTES:

8.1 Applicability: This lubricant may be applied to thoroughly cleaned surfaces of ferrous and nonferrous metals and alloys, cured thermoplastic and thermosetting polymers, and rubber (O-rings, seals, etc).