AEROSPACE STANDARD

AS6449™ REV. B

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Superseding AS6449A

Solid Film Lubricant for Fluid Fittings in Oxygen, Potable Water, Hydraulic, and Other Systems

RATIONALE

The document has been revised to change composition requirement by eliminating particle size requirement for molybdenum disulphide in 3.2.4. The film appearance and thickness requirements on the threads have also been clarified.

1. SCOPE

This document establishes the requirements for a dry film lubricant AS6449 lubricant for use on breathing oxygen system and potable water system components, for a temperature range of -90 to +300 °F. This document also establishes the Non-Destructive Test (NDT) procedures and criteria for coated production parts. This document requires qualified products and product applicators.

1.1 Application

For applications where temperatures may range from -90 to 300 °F (-68 to 149 °C), except Type IV may be used up to 400 °F (204 °C).

1.2 Type

This specification establishes the following types:

1.2.1 For use in oxygen and potable water systems

AS6449 Type I: A lubricant for use on oxygen and potable water system fittings

AS6449 Type II: A lubricant for use on potable water fittings

1.2.2 Unleaded lubricant for hydraulic and other systems

AS6449 Type III: Unleaded Lubricant in compliance with AS5272 Type I as listed in PRI-QPL-AS5272

AS6449 Type IV: Unleaded Lubricant in compliance with AS5272 Type II as listed in PRI-QPL-AS5272

NOTE: Types III and Type IV are lead free materials that are qualified to AS5272 as Types I and II respectively and are listed with other lead bearing materials in PRI-QPL-AS5272. These qualified lead free materials have been selected for inclusion in this document as AS6449 Types III and IV.

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SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AS6449B

1.3 Safety – Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve use of hazardous materials, this specification does not address the hazards which may be involved is such use. The product manufacturer shall prepare Materials Safety Data Sheets (MSDS) in accordance with ANSI Z400 and abide by MSDS requirements to ensure familiarity with the safe and proper handling of hazardous materials used and take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. REFERENCES

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS4083	Aluminum Alloy Tubing, Hydraulic, Seamless, Drawn, Round 1.0Mg - 0.60Si - 0.28Cu - 0.20Cr (6061-T6) Solution and Precipitation Heat Treated
AMS5513	Steel, Corrosion-Resistant, Sheet, Strip, and Plate 19Cr - 9.2Ni (SAE 30304) Solution Heat Treated
AMS5901	Steel, Corrosion-Resistant, Sheet, Strip, and Plate 18Cr - 8Ni (SAE 30301) Solution Heat Treated
AMS-M-7866	Molybdenum Disulfide, Technical, Lubrication Grade
AMS-QQ-A-250/12	Aluminum Alloy 7075, Plate and Sheet
AS1241	Fire Resistant Phosphate Ester Hydraulic Fluid for Aircraft
AS2094	Test Methods for Tube-Fitting Assemblies
AS5234	Nut, Coupling Flareless
AS5272	Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting, Procurement Specification
AS5528	Lubricant Application, Solid Film, Heat Cured, Corrosion Inhibiting
AS5529	Sleeve, Flareless Tube Fitting, Internally Swaged
AS6450	Lubricant Application, Solid Film, Heat Cured, Potable Water, Hydraulic, and Other Fluid Systems
AS9100	Quality Management Systems - Requirements for Aviation, Space and Defense Organizations

2.2 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS850	General Packaging Standard
NAS854	Hazardous Material Packaging and Safety Data Sheet Preparation

2.3 ANSI Accredited Publications

Available at http://webstore.ansi.org/.

ANSI Z400 Material Safety Data Sheets

2.4 ASTM Publications

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

ASTM B117 Standard Practice for Operating Salt Spray (Fog) Test Apparatus

ASTM A967 Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts

ASTM D1655 Standard Specification for Aviation Turbine Fuels

ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity

ASTM D2510 Standard Test Method for Adhesion of Solid Film Lubricants

ASTM D2512 Standard Test Method for Compatibility of Materials with Liquid Oxygen (Impact Sensitivity Threshold and Pass-Fail Techniques)

ASTM D2625 Standard Test Method for Endurance (Wear) Life and Load-Carrying Capacity of Solid Film Lubricants (Falex Pin and Vee Method)

ASTM D4080 Standard Specification for Trichloroethylene, Technical and Vapor-Degreasing Grade

2.5 ISO Publications

Available at http://webstore.ansi.org/.

ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories

2.6 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.pri-network.org.

PD2101 Aerospace Quality Assurance, Product Standards, Qualification Procedure, - Fluid Distribution Systems

PRI-QPL-AS5272 Qualified Products List (QPL) of Products Qualified Under SAE Aerospace Specification AS5272 - Lubricant, Solid Film, Heat Cured, Corrosion Inhibiting

PRI-QPL-AS6449 Qualified Products List (QPL) of Products Qualified Under SAE Aerospace Specification AS6449 - Solid Film Lubricant for Fluid Fittings in Oxygen, Potable Water, Hydraulic, and Other Systems

2.7 U.S. Government Publications

Copies of these documents are available online at http://quicksearch.dla.mil.

FED-STD-595 Colors Used in Government Procurement

MIL-A-8625 Anodic Coatings for Aluminum and Aluminum Alloys

MIL-PRF-83282 Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base

MIL-PRF-27210 Oxygen, Aviator's Breathing, Liquid and Gas

TT-N-95 Naphta, Aliphatic

2.7.1 Other Government Publications not Available under ASSIST

Available from United States Environmental Protection Agency (EPA), Web: www.epa.gov, Email: nscepEbps-limit.com, Phone: 1-800-490-9198, Mail: U.S. EPA/NSCEP, P.O. Box 42419, Cincinnati, OH 45242-0419.

OSHA 1910.1200 Hazard Communication Standard

Available from Web: www.epa.gov

RE-ADD-030 Hazard Communication Program

Available from Web: https://www.acquisition.gov/far/, Email: acquisitioncentral@gsa.gov, Mail: GSA/VIR, Attn: Regulatory Secretariat, 1800F Street, NW, Washington, DC 20405.

Title 29 CFR Code of Federal Regulations (CFP) 1910

3. REQUIREMENTS

3.1 Qualification

The lubricants furnished under this specification shall be products which are listed or approved on the applicable qualified product list, Types I and II in PRI-QPL-AS6449 and Types III and IV as lead-free in PRI-QPL-AS5272. The QPL requirement for AS6449 Type I and II may be in effect for purchase orders within 18 months following initial AS6449 release. Suppliers seeking listing on the initial QPL should contact PRI. Until the QPL is in effect, users of this standard are advised to control source approvals. No change in product formulation, raw material, basic methods of manufacturing or plant site shall be made without notification and prior approval from the Performance Review Institute (PRI). Requalification or testing and revised supplier designation may be required.

3.1.1 Manufacturer Qualification

A manufacturer producing a product in conformance to this procurement specification shall be accredited in accordance with AS9100.

3.1.2 Product Qualification

All lubricants Type I and Type II shall conform to the requirements of this specification and shall be approved in accordance with the requirements of PD2001, for listing in a PRI Qualified Products List (QPL) PRI-QPL-AS6449.

3.1.3 Qualification Testing

All qualification testing shall be conducted by a laboratory which is accredited per ISO/IEC 17025 with a relevant scope. If qualification tests are performed at the manufacturer's facility or at a test facility without ISO/IEC 17025 accreditation with a relevant scope, test shall be witnessed by a QPG member, designated QPG representative, PRI Auditor, or verified by OEM qualification test.

3.2 Material Requirements

3.2.1 General Requirements

The lubricant, applied in accordance with AS6450, shall meet the following requirements.

The material shall meet all the requirements of this specification at any time within 6 months from the date of manufacture when material is stored from 40 to 100 °F (4 to 38 °C).

The cured coating when applied to oxygen and potable water fittings shall not transfer to hands, packaging material or oxygen and potable water tubes under normal handling conditions.

3.2.2 Bonded Solid Film Requirements

Type I and Type II lubricants applied in accordance with AS6450, shall meet the requirements in 3.2 and 3.3, except Type II lubricant is not required to meet the requirements of 3.3.1. Type III and Type IV lubricants applied in accordance with AS5528 shall meet the requirements of AS5272 Type I and Type II respectively.

3.2.3 Film Appearance and Thickness

The cured dry lubricant film shall have a uniform appearance and complete coverage. No voids or buildups in excess of the film thickness tolerances of AS6450 will be permitted on contact (bearing) surfaces. The average thickness, based on six readings minimum, of the cured film of all Types shall be between 0.0003 inch (0.008 mm) and 0.0005 inch (0.013 mm). Film thickness shall be controlled on both external and internal threads by the process and by fit-check, i.e., when installed on appropriate thread gage the coated threads shall permit three quarter turn of free rotation, threads shall not exceed AS8879 MMC (Maximum Material Condition) during gage check.

3.2.4 Composition

The dry lubricant shall be composed of molybdenum disulfide, in accordance with AMS-M-7866, combined with suitable bonding agents to meet the requirements of this document. The requirements of AMS-M-7866 for molybdenum disulfide particle size shall not apply. The material manufacture shall select a grade/particle size of molybdenum disulfide that is suitable for meeting all performance requirements and material characteristics of this specification, and shall not change grade/particle size for production lots from that which was qualified. Manufacturing processes shall also be controlled to ensure the final particle size of molybdenum disulfide contained within material production lots remains consistent with that of the materials submitted for qualification. The product shall not contain lead, chrome, mercury, cadmium, antimony, or their compounds. The dry lubricant shall not contain any compounds that have a residual high vapor pressure after the cure cycle or are leachable by common industrial solvents.

3.2.5 Toxic Products, Formulations, and Health Hazard Evaluation

The dry film lubricant shall have no known adverse effect on the health of personnel when used for intended purpose. The dry film lubricant shall contain no components which produce harmful vapors during or after installation. Health hazard evaluation shall be performed for each new material qualified to this specification in accordance with RE-ADD-030 to establish its usage precautions. A Material Safety Data Sheet shall be submitted in accordance with 1.3.

3.3 Performance Requirements

3.3.1 Liquid Oxygen (LOX) and Gaseous Oxygen Compatibility (Type I Oxygen Components only)

The supplier shall submit written evidence that the cured lubricant does not react in liquid or gaseous oxygen when subjected to 98 J (72 feet-pound) impact test conducted in accordance with ASTM D2512.

NOTE: Required for Type I only, not for Type II.

3.3.2 Low Temperature Stability

The cured lubricant shall not flake, crack, or otherwise show loss of adhesion when tested in accordance with 4.6.2.

3.3.3 Fluid Resistance

When tested according to 4.6.3, the immersed portion of the test panels shall show no evidence of softening, lifting, blistering, peeling, cracking or loss of adhesion. After performing the tape adhesion test, there shall be no deposit or transfer of any coating material to the tape when viewed by the unaided eye. Exposing the substrate also indicates unsatisfactory adhesion. Test specimens shall be as shown in Table 1.

3.3.4 Corrosion Resistance

When tested according to 4.6.4, the test specimens or anodized aluminum panels shall not show discoloration, pitting, formation of white deposits or other evidence of corrosion. Test specimens shall be as shown in Table 1.

3.3.5 Odor

The cured lubricant shall contain no materials which have an objectionable odor or which will produce an objectionable odor when in contact with oxygen at 180 °F ± 10 °F for a minimum of 24 hours. A decision that the odor is objectionable to one or more of the observers, when tested according to 4.6.5, shall be cause for rejection of the lubricant. Test specimens shall be as shown in Table 1.

3.3.6 Adhesion

When tested in accordance with 4.6.6, there shall be no deposit or transfer of any coating material to the tape when viewed by the unaided eye. Exposing the substrate also indicates unsatisfactory adhesion. Specimens shall be in compliance with thickness requirement per 3.2.3 and there shall be no transfer per 3.2.1. Test specimens shall be as shown in Table 1.

3.3.7 Coefficient of Friction

When tested in accordance with 4.6.7, the average coefficient of friction shall be 0.04 ± 0.01. Test specimens shall be Falex pins and V-blocks.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The manufacturer is responsible for performing all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, and unless disapproved by the purchaser, the manufacturer's own or any other facilities suitable for the performance of the inspection requirements specified herein, may be used. The procuring activity reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to assure supplies and services conform to the prescribed requirements.

4.2 Responsibility for Compliance

All items shall meet all requirements of Sections 3 and 4. The inspection set forth in this specification shall become part of the manufacturer's overall inspection system or quality program. The absence of any inspection requirements in this specification shall not relieve the manufacturer of the responsibility of assuring that all products or supplies submitted to the procuring activity for acceptance comply with all requirements of the contract or purchase order. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the procuring activity to acceptance of defective material.

4.3 Classification of Inspections

The inspections specified herein are classified as follows:

a. Qualification Inspection (see 4.4).

b. Quality Conformance Inspection (see 4.5).

4.4 Qualification Inspection

The qualification inspection performed by the qualification laboratory and/or as noted in 3.1.3 shall consist of approval of the manufacturer's submitted test report and other data, subjecting the qualification sample, 4.4.1, to examination and testing for compliance with all the Material Requirements under 3.2 and Performance Requirements under 3.3 of this specification.

4.4.1 Qualification Samples

The qualification samples shall consist of 4 quarts (4 L) of lubricant from one batch, and two copies of the supplier's report for the product for which qualification is desired. The report shall show the product inspection results for all the requirements of this specification and shall refer specifically to the applicable paragraphs in the specification. The samples, reports and Material Safety Data Sheets (see 1.3) for the product shall be forwarded in accordance with Section 7.

4.4.1.1 Batch

A batch is defined as the end product of all the raw materials mixed or blended in a single operation.

4.4.1.2 Samples for Tests

The solid film lubricant sample for test shall consist of four separate quarts (liters) of lubricant selected at random from each batch of lubricant. The lot shall be unacceptable if a sample fails to meet any of the test requirements specified.

4.4.1.3 Sample for Examination of Filled Containers

A random solid film lubricant sample of filled containers shall be selected from each batch of lubricant. Acceptance quality shall be based on zero defectives.

4.4.2 Retention of Qualification

In order to retain qualification of a product approved for listing on the qualified products list (QPL), the manufacturer shall verify by certification to PRI that the manufacturer's product complies with the requirements of this specification. The time of periodic verification by certification shall be in 5-year intervals from the date of original qualification. The PRI in conjunction with the Qualified Products Group (QPG) reserves the right to re-examine the qualified product whenever deemed necessary to determine that the product continues to meet any or all of the specification requirements.

4.5 Quality Conformance Inspection

The quality conformance inspection shall consist of inspection of samples for tests for appearance and thickness (3.2.3), adhesion (3.3.6), and coefficient of friction (3.3.7). Samples shall be labeled completely with information identifying the purpose of the sample, name of the product, specification number, batch number, date of sampling, and contract or purchase number.

4.6 Test Methods

4.6.1 Liquid Oxygen (LOX) and Gaseous Oxygen Compatibility Test

Specimens shall be tested in accordance with ASTM D2512.

4.6.2 Low Temperature Stability Test

Use two of each of the test panels listed in Section 5.

Cool to -65 °F ± 5 °F (-54 °C ± 3 °C) and maintain at this temperature for a minimum of 3 hours.

Allow panels to return to room temperature at 72 °F ± 5 °F (22 °C ± 3 °C), then test in accordance with 4.6.6 for loss of lubrication adhesion.

4.6.3 Fluid Resistance Test

Use test panels described in Section 5.

Half immerse one of each type of coated specimen in each of the following test fluids and soak for 24 hours minimum at 160 °F ± 10 °F (71 °C ± 5 °C):

AS1241 Hydraulic Fluid

MIL-PRF-83282 Hydraulic Fluid

Turbine Engine Oil (Pratt and Whitney PWA 521 Type II)

Trichloroethylene (ASTM D4080)

ASTM D1655 Turbine Engine Oil [Conduct test at room temperature at 72 °F ± 5 °F (22 °C ± 3 °C)]

NOTE: Suspend the panels to prevent contact with the sides of the container or other panels.

Allow panels to drain off after removal. Oily panels may be dipped in TT-N-95 naphtha to remove the oil prior to drying.

Compare immerse panel section with un-immersed portion for evidence of softening, lifting, blistering, cracking, or peeling.

Determine the loss of adhesion within 24 hours after drying by conducting ASTM D2510 Procedure C.

4.6.4 Corrosion Resistance Test

Determine corrosion resistance by subjecting the specimens or anodized aluminum plates to the following tests:

4.6.4.1 Humidity Test at 120 °F (49 °C) and 100% relative humidity for a minimum of 7 days in accordance with ASTM D2247 except that temperature shall be 120 °F (49 °C).

4.6.4.2 Salt Spray (Fog) Test in accordance with ASTM B117 shall be conducted for a 14 day period.

Examine test specimens for corrosion in accordance with 3.3.4.