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 SUPERSEDING
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MILITARY SPECIFICATION

LUBRICANT, SOLID FILM; AIR-CURED (CORROSION-INHIBITING)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers two types of an air-curing solid film lubricant (see 6.1) identified by Military Symbol SFD. The lubricant provides both lubrication and corrosion protection and can be applied by dipping, by brushing, or by spraying from gas-pressurized (aerosol) cans.

1.2 Classification. The solid film lubricant shall be furnished in the following types, as specified (see 6.2):

- Type I - Bulk dispersion
- Type II - Aerosol propelled

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

- TT-N-95 - Naphtha, Aliphatic
- TT-S-735 - Standard Test Fluid; Hydrocarbon
- VV-D-001078 - Damping Fluid, Silicone Base (Dimethyl Polysiloxane)
- VV-L-800 - Lubricating Oil, General Purpose, Preservative
(Water-Displacing, Low Temperature)
- PPP-C-96 - Cans, Metal, 28 Gage and Lighter

FSC 9150

Official comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Army Materials and Mechanics Research Center, Watertown, MA 02172 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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- MIL-C-372 - Cleaning Compound, Solvent (For Bore of Small Arms and Automatic Aircraft Weapons)
- MIL-G-3056 - Gasoline, Automotive, Combat
- MIL-H-5606 - Hydraulic Fluid, Petroleum Base, Aircraft, Missile and Ordnance
- MIL-T-5624 - Turbine Fuel, Aviation, Grades JP-4 and JP-5
- MIL-L-6082 - Lubricating Oil, Aircraft Reciprocating Engine (Piston)
- MIL-L-7808 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
- MIL-A-8625 - Anodic Coatings for Aluminum and Aluminum Alloys
- MIL-L-14107 - Lubricating Oil, Low Temperature, Weapons
- MIL-P-16232 - Phosphate Coatings, Heavy, Manganese or Zinc Base (For Ferrous Metals)
- MIL-L-46000 - Lubricating Oil, Semi-Fluid (Automatic Weapons)

STANDARDS

FEDERAL

- Fed. Test Method Std. No. 791 - Lubricants, Liquid Fuels, and Related Products; Methods of Testing

MILITARY

- MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes
- MIL-STD-290 - Packaging, Packing, and Marking of Petroleum and Related Products

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposals shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) TEST METHODS

- D 270 - Sampling Petroleum and Petroleum Products
- D 2510 - Adhesion of Dry Solid Film Lubricants
- D 2511 - Thermal Shock Sensitivity of Dry Solid Film Lubricants
- D 2625 - Determining Endurance (Wear) Life and Load-Carrying Capacity of Dry Solid Film Lubricants (Falex Method)

(The ASTM test methods listed above are included in Parts 23 and 24 of the Annual Book of ASTM Standards and are also available separately. Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

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Specifications and standards of technical societies are generally available for reference from libraries. They are also distributed among using Federal agencies.

3. REQUIREMENTS

3.1 Qualification. Solid film lubricants furnished under this specification shall be products which are qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.5.1 and 6.3).

3.2 Materials. The lubricant shall be of the following composition:

- a. A suitable, fast-drying vehicle such that the applied film shall dry to the touch in a maximum of 30 minutes at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$) and shall cure fully in a maximum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).
- b. A suitable lubricative pigment or mixture of lubricative pigments.
- c. Additives, if necessary.
- d. For lubricant in gas-pressurized cans only, a pressure-producing agent to expel the contents of the container.

3.3 Film adhesion. The lubricant, when applied to anodized aluminum panels, cured to a film thickness of 0.0002 to 0.0005 inches (approximately 0.005 to 0.013 mm) and tested with tape in accordance with table II (ASTM D 2510) shall not be lifted to expose any bare surface. A uniform deposit of powdery material clinging to the tape shall not be considered as cause for rejection.

3.4 Endurance life. The lubricant, when applied to phosphated steel specimens and cured to a film thickness of 0.0002 to 0.0005 inches (approximately 0.005 to 0.013 mm), shall have an average Falex endurance life of not less than 120 minutes under a gage load of 1000 lbf (4480 N). The test shall be performed in accordance with table II (ASTM D 2625). No test result shall be less than 56 minutes.

3.5 Load-carrying capacity. The lubricant, when applied to phosphated steel specimens and cured to a film thickness of 0.0002 to 0.0005 inches (approximately 0.005 to 0.013 mm), shall have an average Falex load-carrying capacity of not less than 2500 lbf (11,200 N) with no single test result less than 2000 lbf (8950 N). The test shall be performed in accordance with table II (ASTM D 2625).

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3.6 Corrosion protection (salt spray). The lubricant, when applied to phosphated steel panels and cured to a film thickness of 0.0002 to 0.0005 inches (approximately 0.005 to 0.013 mm), shall show no more than three rust spots per panel, none of which exceeds one millimeter in length, width, or diameter after 100 hours exposure to a 5-percent salt spray solution in a salt fog cabinet. The test shall be performed in accordance with table II (Fed. Test Method Std. No. 791, method 4001).

3.7 Thermal shock sensitivity. The lubricant, when applied to aluminum panels and cured to a film thickness of 0.0002 to 0.0005 inches (approximately 0.005 to 0.013 mm), shall not flake, crack, or soften and shall pass the film adhesion requirement (3.3). The test shall be performed in accordance with table II (ASTM D 2511), except that the high temperature shall be $375^{\circ} \pm 5^{\circ}\text{F}$ ($191^{\circ} \pm 3^{\circ}\text{C}$).

3.8 Fluid resistance. The lubricant, when applied to aluminum panels and cured to a film thickness of 0.0002 to 0.0005 inches (approximately 0.005 to 0.013 mm), shall not flake or peel and shall pass the film adhesion requirement (3.3) after being immersed in the test fluids specified in table I. The test shall be performed in accordance with table II (ASTM D 2510).

Table I. Immersion fluids

| Fluid | Specification designation |
|---|---------------------------|
| Standard Test Fluid, Hydrocarbon | TT-S-735, type II |
| Silicone Damping Fluid | VV-D-001078 |
| Cleaning Compound, Solvent (for Bore of Small Arms and Automatic Weapons) | MIL-C-372 |
| Gasoline, Automotive | MIL-G-3056 |
| Hydraulic Fluid, Petroleum | MIL-H-5606 |
| Turbine Fuel, Aviation | MIL-T-5624, grade JP-4 |
| Lubricating Oil, Aircraft | MIL-L-6082, grade 1100 |
| Lubricating Oil, Aircraft Turbine | MIL-L-7808 |
| Lubricating Oil, Semi-Fluid, (Automatic Weapons) | MIL-L-46000 |

3.9 Removability. The lubricant, when applied to an anodized aluminum panel and cured to a film thickness of 0.0002 to 0.0005 inches (approximately 0.005 to 0.013 mm), shall withstand a minimum of 500 strokes before any bare metal surface of the test panels is exposed. The lubricant shall be rubbed in the presence of fluid lubricants conforming to the following specifications: VV-L-800, MIL-L-14107, and MIL-L-46000. The test procedures shall be performed in accordance with 4.6.1.

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3.10 Spray pattern and duration (lubricant in gas-pressurized containers only). The spray pattern shall be a minimum of 1.5 inches (38 mm) wide and shall be uniform in color, smooth, and free from bubbles. The spray shall be effective for a minimum of 290 seconds. (The effective spray is one that carries the pigment together with the resin required for bonding.) The test shall be performed in accordance with 4.6.2.

3.11 Total solids.

3.11.1 Lubricant in non-pressurized cans. Lubricant supplied in non-pressurized cans shall contain a minimum of 24 percent by weight of total solids. The test shall be performed in accordance with 4.6.3.1.

3.11.2 Lubricant in gas-pressurized cans. Each gas-pressurized can shall contain a minimum of 30 grams of total solids. The test shall be performed in accordance with 4.6.3.2.

3.12 Graphite and powdered metals. The lubricant shall contain no graphite or powdered metals. The test shall be performed in accordance with 4.6.4.

3.13 Storage stability. The lubricant, after being stored for 365 ± 7 days at $77^\circ \pm 5^\circ\text{F}$ ($25^\circ \pm 3^\circ\text{C}$) shall be readily dispersed by moderate shaking or stirring and shall meet all the requirements in section 3 except total solids (3.11) and graphite and powdered metals (3.12). The test shall be performed in accordance with 4.6.5.

3.14 Workmanship. The lubricant ingredients shall be processed in such a manner as to insure that the lubricant will produce a bonded solid film which shall, upon visual examination, appear uniform in color, smooth, free from cracks, scratches, blisters, foreign matter, grit, rough particles, bubbles, pin holes, runs, sags, or other surface imperfections. The lubricant film shall show no evidence of separation of ingredient materials.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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4.2 Lot.

4.2.1 Bulk lot. An indefinite quantity of a homogeneous mixture of lubricant, offered for acceptance in a single, isolated container; or manufactured in a single plant run (not exceeding 24 hours), through the same processing equipment, with no change in the ingredient materials.

4.2.2 Packaged lot. An indefinite number of unit containers of identical size and type offered for acceptance and filled with a homogeneous mixture of lubricant from a single isolated container; or filled with a homogeneous mixture of lubricant manufactured in a single plant run (not exceeding 24 hours); through the same processing equipment, with no change in the ingredient materials.

4.3 Sampling.

4.3.1 Sampling for examination of filled containers. Take a random sample of filled containers from each lot in accordance with MIL-STD-105 at inspection level II and acceptable quality level (AQL) = 2.5 percent defective.

4.3.2 Sampling for quality conformance tests. Take samples for tests in accordance with ASTM Method D 270.

4.4 Inspection. Perform inspection in accordance with method 9601 of Fed. Test Method Std. No. 791.

4.4.1 Examination of filled containers. Examine samples taken in accordance with 4.3.1 for compliance with MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing and marking of the containers. Reject any container having one or more defects and under the required fill. If the number of defective or underfilled containers exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, reject the lot represented by the sample.

4.5 Classification of tests. Tests are classified as follows:

- a. Qualification tests.
- b. Quality conformance tests.

4.5.1 Qualification tests. Qualification tests consist of tests for all of the requirements specified in section 3.

4.5.2 Quality conformance tests. Quality conformance tests consist of tests for the following requirements specified in section 3:

- a. Endurance life (3.4).
- b. Corrosion protection (salt-spray) (3.6).
- c. Total solids (3.11).
- d. Film adhesion (3.3).

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4.6 Test methods. Perform tests in accordance with table II and 4.6.1 through 4.6.5 on specimens which have been coated with the solid film lubricant and cured at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$) for a minimum of 18 hours. The specimens prepared for tests shall be prepared either by dipping or spraying. Where a cleaning procedure specifies the use of trichloroethylene, substitute the use of naphtha conforming to TT-N-95.

Table II. Test methods

| Test | Test method No., Fed. Std. 791 | Test method No., ASTM |
|-----------------------------------|-----------------------------------|-----------------------------------|
| Film adhesion | | D 2510, procedure A ^{1/} |
| Endurance life | | D 2625, procedure A ^{2/} |
| Load carrying capacity | | D 2625, procedure B ^{2/} |
| Corrosion protection (salt spray) | 4001 ^{3/} | |
| Thermal shock sensitivity | | D 2511 ^{4/} |
| Fluid resistance | | D 2510, procedure C |

^{1/} Make two parallel scratches one hour after drying.

^{2/} Type 2, class 3 phosphate coating conforming to MIL-P-16232 may also be used. The applied solid film lubricant shall dry to the touch in a maximum of 30 minutes at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$) and shall cure fully in a maximum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).

^{3/} Determine the solid film lubricant coating thickness in accordance with method 3816, Fed. Test Method Std. No. 791.

^{4/} Perform this test with the following exceptions:

Use anodized aluminum panels as prescribed in ASTM D 2510 and an oven temperature of $375^{\circ} \pm 5^{\circ}\text{F}$ ($191^{\circ} \pm 3^{\circ}\text{C}$).

4.6.1 Removability.

4.6.1.1 Description of apparatus. A satisfactory apparatus for determining the removability of the dried lubricant film is illustrated in figure 1. The essential part of this apparatus is the rubbing component. This component shall consist of a tube (metal or glass), with an inside diameter of 0.394 inch (10 mm), and a length of at least six inches (152 mm) containing a 100 percent wool felt plug (weighing 109 ounce per square yard or 3.7 kg per square meter). The plug shall be approximately 0.75 inch (19 mm) long and shall be placed in, and extend approximately 0.125 inch (3 mm) below, the lower end of the tube. The total weight of this component shall be 65 ± 0.5 grams. Lead shot or sand may be placed inside the tube to provide the required weight. The rubbing component shall be driven back and forth

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across the surface of the coated panel by a drive mechanism consisting of a motor, speed reducer, and an eccentric wheel. The drive mechanism shall be capable of producing a reciprocating motion of 2 ± 0.125 (51 ± 3 mm) inches in length at a reciprocating speed of 30 ± 1 strokes per minute.

4.6.1.2 Test procedure. Anodize three 2024 aluminum alloy panels measuring 0.020 by 3 by 6 inches (0.51 by 76 by 152 mm) in accordance with MIL-A-8625, type I. Clean the panels in hot naphtha meeting the requirements of TT-N-95 and dry them in air. Apply the solid lubricant to the test panels by means of spraying or dipping to produce a dry film thickness between 0.0002 and 0.0005 inches (approximately 0.005 and 0.013 mm) as determined by method 3816, Fed. Test Method Std. No. 791. Permit the film to cure in air at $77^\circ \pm 3^\circ\text{F}$ ($25^\circ \pm 2^\circ\text{C}$) for a minimum of 18 hours. Immerse one panel in lubricating oil meeting the requirements of VV-L-800. Immerse the second panel in lubricating oil meeting the requirements of MIL-L-14107. Immerse the third panel in lubricating oil meeting the requirements of MIL-L-46000. Permit the panels to remain in the lubricating oils for a period of 24 ± 0.25 hours at $77^\circ \pm 5^\circ\text{F}$ ($25^\circ \pm 3^\circ\text{C}$). Test each oil-coated panel for removability as follows: Clamp the oil-coated panel to the platen of the tester, removing as little of the lubricating oil as possible. Adjust the length of the wiping stroke to 2 ± 0.125 inches (51 ± 3 mm). Adjust the speed to 30 ± 1 strokes per minute. Operate the tester for 500 ± 10 strokes. Examine the panels for conformance to 3.9.

4.6.2 Spray pattern and duration (material in gas-pressurized cans only). Select a new, unused spray container. The temperature of the spray container and the ambient air shall be $77^\circ \pm 3^\circ\text{F}$ ($25 \pm 2^\circ\text{C}$). In a vertical position, fasten either a sheet of white paper on which two parallel lines have been drawn 1.5 inch (38 mm) apart, or a sheet of rectangular coordinate graph paper containing lines 1.5 inch (38 mm) apart. Position the spray container 10 ± 0.5 inches (25.5 ± 1.25 cm) from the paper. Open the valve fully and, with a stop watch, determine the time required to exhaust the container. Measure the width of the spray pattern using the parallel lines on the sheet of paper. Agitate the can frequently during the spray procedure.

4.6.3 Total solids.

4.6.3.1 Bulk material. Stir the lubricant thoroughly to provide a uniform dispersion. Weigh 5 ± 0.5 grams of the lubricant into a weighing dish with a diameter of approximately 2.5 inches (approximately 64 mm) (Fisher Scientific Co. Catalog No. 7-732 or equal). Place the dish and contents in a force-draft oven maintained at $120^\circ \pm 5^\circ\text{F}$ ($49^\circ \pm 3^\circ\text{C}$) for 18 ± 1 hours. Remove the dish and contents from the oven, place them in a desiccator, and allow them to cool to $77^\circ \pm 5^\circ\text{F}$ ($25^\circ \pm 3^\circ\text{C}$). Remove the dish and contents from the desiccator and weigh them. Repeat the procedure to constant weight. Calculate the percent by weight of the solid material in the fluid lubricant from the formula:

$$\frac{\text{Weight of solid material (in grams)}}{\text{Weight of sample (in grams)}} \times 100 = \text{Percent total solids}$$

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4.6.3.2 Lubricant in gas-pressurized cans. Select a new, unused spray container for the total solids test (3.11.2). Place it in an upright position in a solid carbon dioxide cabinet (dry ice cabinet) overnight to reduce the internal pressure. Remove the container from the cold cabinet and immediately pierce a small hole in the top of the container with a sharp punch. Permit the container to warm to $77^{\circ} \pm 5^{\circ}\text{F}$ ($25^{\circ} \pm 3^{\circ}\text{C}$) in an upright position, in a well-ventilated area. When all the gas has escaped from the container, remove the top of the container with a can opener. Transfer quantitatively the contents of the container to a 600-ml beaker previously weighed to the nearest 0.1 gram. Rinse the container twice with methylene chloride, ACS Grade and add the rinsings to the 600-ml beaker. Remove the agitator (usually a glass marble or a small steel ball) from the beaker, rinse it with methylene chloride and return it to the empty container. Add the methylene chloride rinsing to the 600 ml beaker. Place the beaker in an explosion-proof oven operated at $120^{\circ} \pm 5^{\circ}\text{F}$ ($49^{\circ} \pm 3^{\circ}\text{C}$). Permit the 600-ml beaker to remain in the oven overnight at $120^{\circ} \pm 5^{\circ}\text{F}$ ($59^{\circ} \pm 3^{\circ}\text{C}$). Remove the beaker, permit it to cool to $77^{\circ} \pm 5^{\circ}\text{F}$ ($25^{\circ} \pm 3^{\circ}\text{C}$) and weigh to a constant weight. Calculate the weight of total solids in grams from the following formula:

$$\text{Weight beaker and total solids (in grams)} - \text{weight beaker (in grams)} = \text{Weight total solids (in grams)}$$

4.6.4 Graphite and powdered metals. The manufacturer shall submit a notarized certification, signed by a responsible officer in its management, attesting that no graphite or powdered metals are present in the product furnished under this specification.

4.6.5 Storage stability.

4.6.5.1 Lubrication in non-pressurized cans. Fill a one-quart (0.946 liter) can conforming to PPP-C-96, type V, class 2 with thoroughly-mixed lubricant to within approximately 0.25 inch (6 mm) of the top. Seal the can tightly and place it in storage at $77^{\circ} \pm 5^{\circ}\text{F}$ ($25^{\circ} \pm 3^{\circ}\text{C}$) for 365 ± 7 days. At the end of the storage period, test the lubricant for conformity to all the requirements of section 3 except total solids (3.11).

4.6.5.2 Lubricant in gas-pressurized cans. Select two new, unused spray cans and place them in storage at $77^{\circ} \pm 5^{\circ}\text{F}$ ($25^{\circ} \pm 3^{\circ}\text{C}$) for 365 ± 7 days. At the end of the storage period, test the lubricant for conformity to all of the requirements of section 3 except total solids (3.11).

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5. PACKAGING

5.1 Preservation-packaging, packing, and marking.

5.1.1 Lubricant in non-pressurized cans. Unless otherwise specified in the contract (6.2), packaging, packing, and marking shall be level A, B or commercial, as specified in accordance with MIL-STD-290. In addition, each unit package, intermediate package, and external package shall be marked as follows:

CAUTION: FLAMMABLE. Use only in a well-ventilated area or in a hood where no flames or other ignition sources are present. HARMFUL IF INHALED.

WARNING: Do not use this lubricant in food-processing or food-handling equipment on surfaces that may contact food. Do not allow the lubricant to contaminate foodstuffs.

5.1.2 Lubricant in gas-pressurized cans. Unless otherwise specified in the contract (6.2), packaging, packing, and marking shall be level A, B, or commercial, as specified in accordance with MIL-STD-290. The lubricant shall be packaged in 16-ounce (0.473-liter) cans conforming to PPP-C-96, type IX, class 2. Each can shall contain a stirring device such as a marble or a steel ball. In addition, each unit package, intermediate package, and external package shall be marked as follows:

CAUTION: FLAMMABLE. Use only in a well-ventilated area or in a hood where no flames or other ignition sources are present. HARMFUL IF INHALED.

WARNING: Do not use this lubricant in food-processing or food-handling equipment on surfaces that may contact food. Do not allow the lubricant to contaminate foodstuffs.

WARNING PRESSURIZED CONTAINER: Do not store at a temperature above 120°F (49°C). Keep away from direct sunlight, radiators, stoves, hot water or other heat sources. Do not puncture this can nor place it in an incinerator.

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6. NOTES

6.1 Intended use. The solid film lubricant covered by this specification is intended for use on aluminum, aluminum alloys, copper and copper alloys, steel, stainless steel, titanium, and chromium and nickel bearing surfaces. It is useful under the following conditions:

- a. Where conventional lubricants are difficult to apply or retain.
- b. Where dust and dirt contamination on lubricated surfaces is deleterious.
- c. Where temperatures may range from -90° to $+200^{\circ}$ F (-67° to $+93^{\circ}$ C).
- d. In mechanisms operated at infrequent intervals.
- e. In mechanisms that are lubricated for life.
- f. Where long-term corrosion protection is required.
- g. Where a dull dark gray non-reflective surface is required.
- h. Where a coating resistant to nearly every common solvent, including diester lubricants, is required.
- i. Where a sacrificial lubricant is necessary to carry extremely heavy loads developed in the initial start-up of heavily loaded mechanisms designed for fluid lubrication.
- j. In operations consisting of reciprocating motion, loaded to 15 psi (103 kPa) or less, where contamination with conventional fluid lubricants is probable.
- k. To touch up worn surfaces originally coated with lubricant conforming to MIL-L-46010.
- l. For sliding motion applications such as plain and spherical bearings, flap tracks, hinges, threads, and cam surfaces.

The lubricant should not be used under the following conditions:

- a. In operations consisting of rotary motion above 100 rpm under heavy loads where the possibility of conventional fluid lubricant contamination exists. The cured lubricant film is highly resistant to conventional fluid lubricants, but the high fluid pressures developed in heavily loaded sleeve type bearings drastically reduces the wear life provided by the solid film lubricant film.

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- b. On bearings containing rolling elements.

This lubricant can be expected to provide corrosion protection for five years in indoor storage and approximately two years protection in outdoor storage when the lubricant is applied over phosphated steel to a thickness of 0.0005 inch (0.013 mm). Where maximum corrosion protection of steel is desired, the lubricant should be applied over phosphated steel to a thickness of 0.001 inch (0.025 mm). This heavier coating can be expected to provide outdoor corrosion protection for approximately four years.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number, and date of this specification.
- b. Quantity of lubricant required.
- c. Type of container required (pressurized or non-pressurized cans (see 5.1)).
- d. Size of container required (see 5.1).
- e. Level of packaging and packing (see 5.1).
- f. Special marking, if required (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List whether or not such products have actually been so listed by that date. The attention of the contractor is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the US Army Mobility Equipment Research and Development Command, ATTN: DRDME-GL, Fort Belvoir, VA 22060, and information pertaining to qualification of products may be obtained from that activity.

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6.4 Units of measure. In sections of this specification where U. S. customary units are given first with metric units in parenthesis, the U. S. customary units should be considered as the standard. Metric units have been rounded off and are not, in many instances, precise equivalents of the U. S. units.

Custodians:

Army - MR
Navy - AS
Air Force - 68

Preparing activity:

Army - MR

Project No. 9150-0412

Review activities:

Army - AT, MD, MI, ME
Navy - AS
Air Force - 11
DLA - GS, PS

User activities:

Army - AV
Navy - OS

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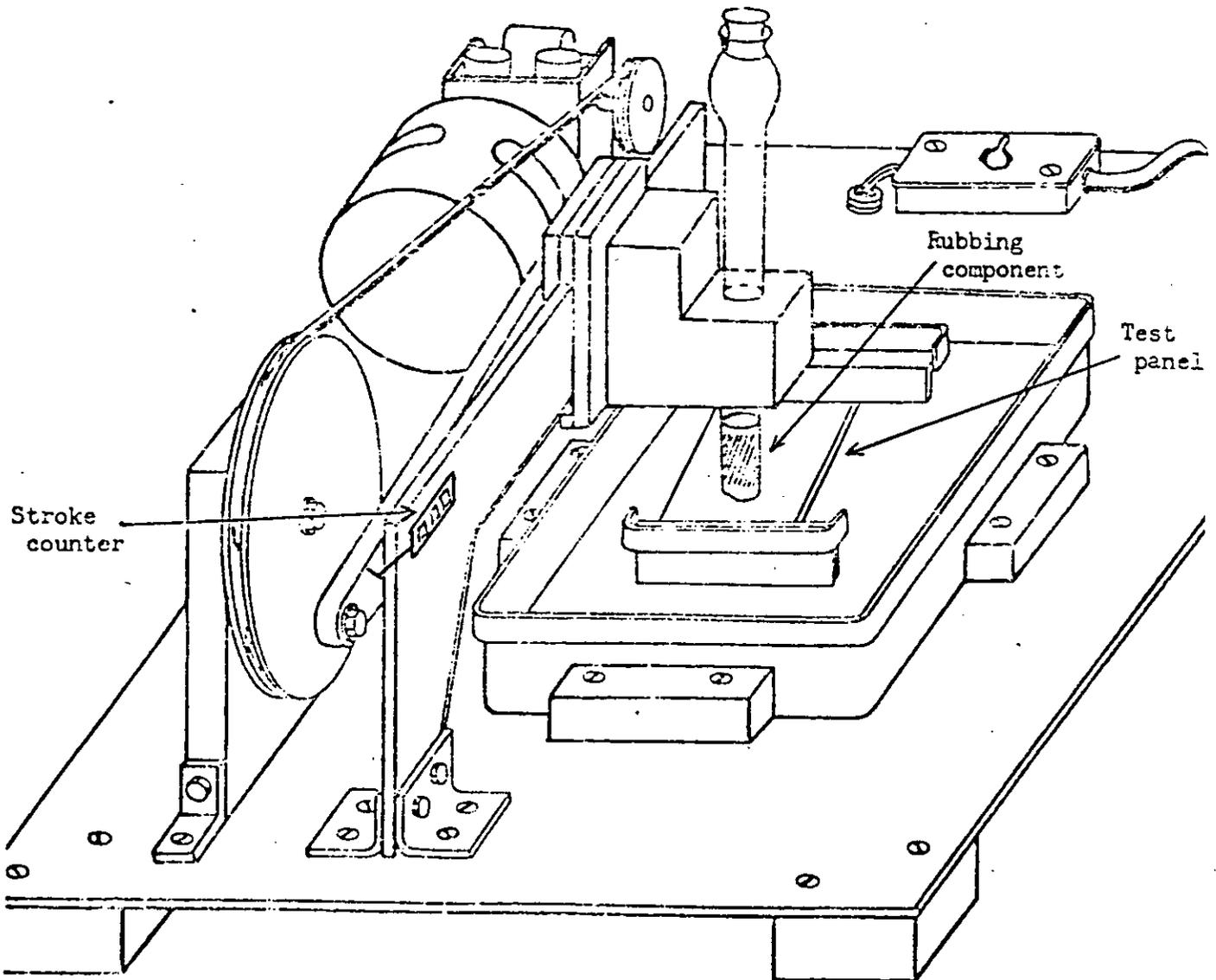


Figure 1. Apparatus for determining removability

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APPENDIX

INSTRUCTIONS FOR APPLYING LUBRICANT,
SOLID FILM: AIR-CURED (CORROSION-INHIBITING)

10. SCOPE

10.1 This appendix covers in detail the surface pretreatment, temperature, and time required to cure the solid film lubricant when it is applied over the bearing surfaces of various metals.

20. APPLICABLE DOCUMENTS

20.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this appendix to the extent specified herein.

SPECIFICATIONS

FEDERAL

- QQ-P-35 - Passivation Treatments for Austenitic, Ferritic, and
Martensitic Corrosion-Resisting Steel (Fastening Devices)
TT-N-95 - Naphtha, Aliphatic

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- MIL-F-495 - Finish, Chemical, Black, for Copper Alloys
MIL-P-16232 - Phosphate Coatings, Heavy Manganese or Zinc Base
(for Ferrous Metals)
MIL-M-45202 - Magnesium Alloys, Anodic Treatment of

STANDARDS

MILITARY

- MIL-STD-171 - Finishing of Metal and Wood Surfaces

30. REQUIREMENTS

30.1 Application on aluminum and aluminum alloys. Degrease the surface to be coated with aliphatic naphtha conforming to TT-N-95. Anodize and seal the surface in accordance with the requirements for 7.2.1 of MIL-STD-171. Do not touch the sealed surface with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inch (approximately 0.005 to 0.013 mm). Permit the coated part to air-cure for a minimum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).

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30.2 Application on copper and copper alloys. Degrease the surface to be coated with aliphatic naphtha conforming to TT-N-95. Sandblast the surface with 130-mesh, clean, dry sand. Form a black oxide finish on the surface in accordance with the requirements of MIL-F-495. Do not touch the pretreated surface with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inch (approximately 0.005 to 0.013 mm). Permit the coated part to air-cure for a minimum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).

30.3 Application on magnesium and magnesium alloys. Degrease the surface to be coated with aliphatic naphtha conforming to TT-N-95. Anodize the surface in accordance with the requirements of MIL-M-45202 for type I, class A, B, or C. Do not touch the pretreated surface with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inch (approximately 0.005 to 0.013 mm). Permit the coated part to air-cure for a minimum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).

30.4 Application on steel. Degrease the surface to be coated with aliphatic naphtha conforming to TT-N-95. Sandblast the surface with 120-mesh, clean, dry sand or steel grit. Phosphate the surface in accordance with the requirements of MIL-P-16232 for type M, class 3 or for type Z, class 3. Do not touch the pretreated surface with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inch (approximately 0.005 to 0.013 mm). Permit the coated part to air-cure for a minimum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).

30.5 Application on stainless steels. Degrease the surface to be coated with aliphatic naphtha conforming to TT-N-95. Sandblast the surface with 120-mesh, clean, dry sand. Passivate the surface in accordance with the requirements of QQ-P-35 for type I, II, or III, as applicable. Do not touch the pretreated surface with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inch (approximately 0.005 to 0.013 mm). Permit the coated part to air-cure for a minimum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).

30.6 Application on titanium and titanium alloys. Degrease the surface to be coated with aliphatic naphtha conforming to TT-N-95. Alkaline anodize the surface. Do not touch the pretreated surface with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inch (approximately 0.005 to 0.013 mm). Permit the coated part to air cure for a minimum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).

30.7 Engineering tolerances. The operating thickness of this lubricant varies from 0.0002 to 0.0005 inch (approximately 0.005 to 0.013 mm) on each lubricated surface. This thickness seldom requires alteration of established clearances between moving parts. There is one exception: The lubricant coating thickness must be considered with small parts which normally function with very little clearance. The cured lubricant film is rather soft and any interference produced by its thickness will cause rapid wear of the film until the interference is eliminated.

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30.8 Application on surfaces previously coated with a solid film lubricant. Scrub the surface vigorously and rinse it with naphtha conforming to TT-N-95. Do not touch the cleaned surface with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inch (approximately 0.005 to 0.013 mm). Permit the coated part to air-cure for a minimum of 18 hours at $77^{\circ} \pm 3^{\circ}\text{F}$ ($25^{\circ} \pm 2^{\circ}\text{C}$).