

MIL-L-45983(WC)
31 August 1976
 SUPERSEDING
 (see 6.5)

MILITARY SPECIFICATION

* LUBRICANT, SOLID FILM: HEAT CURED (TEMPERATURE
 RANGE 125° TO 250°F (51.8° TO 121°C)) CORROSION INHIBITING

This specification is approved for use by Rock Island Arsenal, Department of the Army, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers one grade of solid film lubricant which provides both lubrication and corrosion protection when applied to phosphated ferrous metals and anodized aluminum alloys (see 6.1 and 6.4).

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

<u>Federal</u>		
O-T-634	-	Trichloroethylene, Technical
QQ-A-250/12	-	Aluminum Alloy 7075, Plate and Sheet
QQ-S-634	-	Steel Bar, Carbon, Cold Finished (Standard Quality)
VV-L-800	-	Lubricating Oil, General Purpose, Preservative (Water Displacing, Low Temperature
PPP-C-96	-	Cans, Metal, 28 Gage and Lighter
<u>Military</u>		
MIL-C-372	-	Cleaning Compound, Solvent, (For Bore of Small Arms and Automatic Aircraft Weapons)
MIL-A-8625	-	Anodic Coatings for Aluminum and Aluminum Alloys

FSC 9150

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Rock Island Arsenal, ATTN: SARRI-LE-S, Rock Island, Illinois 61201 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-L-14107	-	Lubricating Oil, Weapons, Low Temperature
MIL-P-16232	-	Phosphate Coatings, Heavy, Manganese or Zinc Base (For Ferrous Metals)
MIL-L-46000	-	Lubricant, Semi-Fluid (Automatic Weapons)

STANDARDS

FEDERAL

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

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

* DRAWINGS

Rock Island Arsenal

5019316	-	Swab, Small Arms Cleaning
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(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 date of invitation for bids or request for proposal shall apply.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D270	-	Sampling Petroleum and Petroleum Products.
D2510	-	Adhesion of Dry Solid Film Lubricants.
D2511	-	Thermal Shock Sensivity of Dry Solid Film Lubricants.
D2625	-	Determining Endurance (Wear) Life and Load-Carrying Capacity of Dry Solid Film Lubricants (Falex Method).

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania, 19103.)

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Technical Society and Technical Association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal Agencies.

3. REQUIREMENTS

3.1 Qualification. 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 and Curing Requirements.

3.2.1 Materials. The lubricant shall consist of a lubricative pigment or pigments in a properly thinned resin system, with or without additives as necessary to meet the requirements of this specification. The lubricant shall be suitable for application by brushing, dipping, or spraying and shall be dry to the touch within 30 minutes from the time it is applied.

3.2.2 Cure Requirements. The manufacturer shall specify the temperature and time required to cure the lubricant film so that it will meet the requirements specified herein. The cure temperature shall not be lower than 125°F (51.8°C) nor higher than 250°F (121°C). The cure time shall not exceed two hours (see 5.1).

* 3.3 Film thickness. The lubricant shall be applied and cured to a film thickness of 0.0002 to 0.0005 inches. All film thickness measurements shall be within these limits when the cured lubricant is tested in accordance with 4.6.1.

3.4 Film Adhesion.

3.4.1 Application on Aluminum. The lubricant, when applied on anodized aluminum and on anodized and dyed aluminum panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall not be lifted to expose any anodized or dyed surface by the test tape employed. A uniform deposit of powdery material clinging to the tape shall not be cause for rejection. The test shall be performed in accordance with 4.6, 4.6¹/ (a) and 4.6¹/ (b).

3.4.2 Application on Steel. The lubricant when applied on manganese phosphated and on zinc phosphated steel panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall not be lifted to expose the phosphate surface by the test tape employed. A uniform deposit of powdery material clinging to the tape shall not be cause for rejection. The test shall be performed in accordance with 4.6, 4.6¹/ (c) and 4.6¹/ (d).

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3.5 Endurance life.

3.5.1 Application on Aluminum. The lubricant, when applied on anodized aluminum and on anodized and dyed aluminum Falex test specimens and cured to a film thickness of 0.0002 to 0.0005 inches, shall provide an average Falex endurance life of not less than 120 minutes under a 40-pound gage load. Any suspected valve rejected by the Dixon and Dean criteria should not be used to determine the average endurance life (see 6.6). The test shall be performed in accordance with 4.5, 4.6¹/ (a), 4.6¹/ (b) and 4.6²/.

3.5.2 Application on Steel. The lubricant, when applied on manganese phosphated and on zinc phosphated steel Falex test specimens and cured to a film thickness of 0.0002 to 0.0005 inches, shall provide an average Falex endurance life of not less than 60 minutes under a 1000-pound gage load. The test shall be performed in accordance with 4.6, 4.6¹/ (c) and 4.6¹/ (d).

3.6 Corrosion Protection.

* 3.6.1 Application on Aluminum. The lubricant, when applied on anodized aluminum and on anodized and dyed aluminum test panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall show no more than three corrosion spots per panel, none of which exceeds one millimeter in length, width, or diameter after 500 hours exposure in a 5-percent salt spray solution in a salt fog cabinet. Corrosion on the outer 1/4 inch of the panels or within 1/4 inch of the hole in the panel shall not be cause for rejection. The test shall be performed in accordance with 4.6, 4.6¹/ (a), 4.6¹/ (b), and 4.6⁵/.

3.6.2 Application on Steel. The lubricant, when applied on manganese phosphated and on zinc phosphated steel test panels and cured to a film thickness of 0.0002 to 0.0005 inches, 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 in a 5-percent salt spray solution in a salt fog cabinet. Rust on the outer 1/4 inch of the panels or within 1/4 inch of the hole in the panel shall not be cause for rejection. The test shall be performed in accordance with 4.6, 4.6¹/ (c), 4.6¹/ (d), and 4.6⁵/.

3.7 Thermal Shock Sensitivity.

3.7.1 Application on Aluminum. The lubricant, when applied on anodized aluminum and anodized and dyed aluminum test panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall not flake, crack, or soften and shall pass the film adhesion requirement (3.4.1) after being exposed to a temperature of 250° ± 1°F (121° ± 0.5°C) followed by exposure to a temperature of -65° ± 1°F (-54° ± 0.5°C). The test shall be performed in accordance with 4.6, 4.6¹/ (a), 4.6¹/ (b) and 4.6³/.

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3.7.2 Application on Steel. The lubricant, when applied on manganese phosphated and on zinc phosphated steel test panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall not flake, crack, or soften and shall pass the film adhesion requirement (3.4.2) after being exposed to a temperature of $250^{\circ} + 10^{\circ}\text{F}$ ($121^{\circ} + 0.5^{\circ}\text{C}$) followed by exposure to a temperature of $-65^{\circ} + 10^{\circ}\text{F}$ ($-54^{\circ} + 0.5^{\circ}\text{C}$). The test shall be performed in accordance with 4.6, 4.6¹/_(c), 4.6¹/_(d) and 4.6³/_.

3.8 Removability.

3.8.1 Mechanically rubbed.

3.8.1.1 Application on Aluminum. The lubricant, when applied on anodized aluminum and on anodized and dyed aluminum test panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall withstand a minimum of 500 strokes before any anodized or dyed surface of the test panel is exposed. The lubricant shall be rubbed in the presence of each of the fluids specified in Table I. The test shall be performed in accordance with 4.6.2.2.1.

3.8.1.2 Application on Steel. The lubricant, when applied on manganese phosphated and on zinc phosphated steel panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall withstand a minimum of 500 strokes before any of the phosphate surface of the test panels is exposed. The lubricant shall be rubbed in the presence of each of the fluids specified in Table I. The test shall be performed in accordance with 4.6.2.2.1.

3.8.2 Hand rubbed.

3.8.2.1 Application on Aluminum. The lubricant, when applied on anodized aluminum and on anodized and dyed aluminum test panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall withstand a minimum of 120 hand rubbed strokes in the presence of semi-fluid lubricant meeting the requirements of specification MIL-L-46000 before any anodized or dyed surface of the test panel is exposed. The test shall be performed in accordance with 4.6.2.2.2.

3.8.2.2 Application on Steel. The lubricant, when applied on manganese phosphated and on zinc phosphated steel test panels and cured to a film thickness of 0.0002 to 0.0005 inches, shall withstand a minimum of 120 hand rubbed strokes in the presence of semi-fluid lubricant meeting the requirements of specification MIL-L-46000 before any of the phosphate surface of the test panel is exposed. The test shall be performed in accordance with 4.6.2.2.2.

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Table I. Fluids for Removability Test

Fluid	Specification No.
Trichloroethylene	O-T-634
Lubricating Oil, General Purpose, Preservative	VV-L-800
Cleaning Compound, Solvent (For Bore of Small Arms Weapons)	MIL-C-372
Lubricating Oil, Weapons, Low Temperature	MIL-L-14107
Lubricating Oil, Semi-Fluid (Automatic Weapons)	MIL-L-46000

3.9 Total solids. The lubricant shall contain a minimum of 25 percent by weight of solid material. The test shall be performed in accordance with 4.6.3.

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

3.11 Storage stability. The bulk lubricant, after being stored at 6 months \pm 5 days at $77^{\circ} \pm 5^{\circ}\text{F}$ ($25^{\circ} \pm 3^{\circ}\text{C}$) and applied on applicable test specimens and cured as specified by the lubricant manufacturer, shall meet all the requirements specified in 3.2 through 3.8. The test shall be performed in accordance with 4.6.5.

3.12 Workmanship. The lubricant ingredients shall be processed in such a manner as to insure that the lubricant, when applied by brushing, dipping, or spraying, will produce a bonded solid film which shall, upon visual examination, appear uniform in color, smooth, free from cracks, scratches, blisters, foreign matter, bubbles or other surface imperfections. The lubricant film shall show no evidence of separation of material ingredients.

* 3.13 End Item Application. The lubricant, when applied to an end item to a film thickness of 0.0002 to 0.0005 inches and cured in accordance with 3.2.2, shall meet the requirements specified in Table II. This requirement is not applicable to the qualification of materials under this specification. The intent is to insure that qualified solid film lubricants are properly processed on end items in order that the full efficiency of the solid film lubricant coating is utilized.

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* Table II. End Item Requirements and Quality Assurance Provisions

Requirement	Paragraph number for application on		Quality Assurance paragraph number <u>1</u> /
	aluminum	steel	
Film Adhesion	3.4.1	3.4.2	4.6 ⁴ / ₁
Corrosion Protection	3.6.1 ⁶ / ₁	3.6.2 ⁶ / ₁	4.6 ² / ₅
Thermal Shock Sensitivity	3.7.1	3.7.2	4.6 ³ / ₄
Removability, hand rubbed	3.8.2.1	3.8.2.2	4.6.2.2.2
Workmanship	3.12	3.12	Visual examination

1/ Make all tests on the coated and cured end items.

2/ The salt spray solution shall contain 5 percent sodium chloride by weight.

3/ Use an oven temperature of $250^{\circ} \pm 1^{\circ}\text{F}$ ($121^{\circ} \pm 0.5^{\circ}\text{C}$) in place of the 500°F specified oven temperature.

* 4/ Test should be run on any flat surface regardless of area. Scribe lines should be eliminated and tape pressed on by finger pressure instead of roller.

* 5/ Corrosion of edges, sharp corners, or voids and holes that retain and collect condensate shall not be cause for rejection.

* 6/ There shall be no corrosion on the parts except in those areas described in footnote 5/.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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.

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. A random sample of filled containers shall be selected from each lot in accordance with MIL-STD-105 at Inspection Level II. The Acceptable Quality Level (AQL) shall be 2.5 percent defective.

4.3.2 Sampling for Quality Conformance Tests. Quality conformance test samples shall be in accordance with ASTM method D 270.

4.4 Inspection. Perform inspection in accordance with Method 9601 of Federal Test Method Standard 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 or 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.

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4.5 Classification of Tests. Tests are classified as follows:

- (a) Qualification tests.
- (b) Quality Conformance tests.

4.5.1 Qualification tests. Qualification tests shall consist of tests for all the requirements specified in Section 3., except 3.13.

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

- (a) Endurance Life (3.5)
- (b) Corrosion Protection (3.6)
- (c) Removability (3.8)
- (d) Total Solids (3.9)

4.6 Test Methods. Perform tests in accordance with Table III and 4.6.1 through 4.6.5 as applicable.

Table III. Test Methods

Test	Fed. Test Method Std. No. 791, Method No.	ASTM Designation
Film Adhesion		D 2510 Procedure A ₁ /
Endurance Life		D 2625 Procedure A _{1/2} /
Corrosion Protection, salt fog	4001 <u>1/4/5/</u>	
Thermal Shock Sensitivity		D 2511 <u>1/3/</u>

1/ Perform these tests with the following exceptions:

- (a) Anodized aluminum specimens shall be made from aluminum alloy in accordance with QQ-A-250/12, Temper T6 anodized in accordance with MIL-A-8625, Type III, Class 1, to a film thickness of 0.001 ± 0.0002 inches.

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- (b) Anodized and dyed aluminum specimens shall be made from aluminum alloy in accordance with QQ-A-250/12, Temper T6 anodized in accordance with MIL-A-8625, Type III, Class 2, to a film thickness of 0.001 ± 0.0002 inches.
- (c) Manganese phosphated steel specimens shall be made from cold rolled SAE 1009 steel in accordance with QQ-S-63⁴ and manganese phosphated in accordance with MIL-P-16232, Type M, Class 3, to a minimum phosphate coating weight of 1500 milligrams per square foot.
- (d) Zinc phosphated steel specimens shall be made from cold rolled SAE 1009 steel in accordance with QQ-S-63⁴ and zinc phosphated in accordance with MIL-P-16232, Type Z, Class 3, to a minimum phosphate coating weight of 1000 milligrams per square foot.
- (e) The lubricant shall be applied to a film thickness of 0.0002 to 0.0005 inches and cured at the temperature and time specified by the lubricant manufacturer.

2/ Use a direct jaw load of 40 pounds on a 200 pound gage for tests on anodized and anodized and dyed aluminum alloy specimens.

3/ Use an oven temperature of $250^{\circ} \pm 1^{\circ}\text{F}$ ($121^{\circ} \pm 0.5^{\circ}\text{C}$) in place of the 500°F specified oven temperature.

4/ The salt spray solution shall contain 5 percent sodium chloride by weight.

5/ All panels for the salt spray test shall be 2" by 3" by 1/8" in size.

4.6.1 Film thickness. Determine the thickness of the cured lubricant film in accordance with method 3816, Fed. Test Method Std. No. 791 or any other suitable means such as the eddy current principle (Magnegage type) after baking the coated and air dried panel at the cure temperature and cure time specified by the lubricant manufacturer.

4.6.2 Removability.

4.6.2.1 Description of Apparatus. The apparatus for determining the removability of the cured lubricant film is shown in Figure 1. The essential part of this apparatus is the rubbing component. This component shall consist of a tube (metal or glass) with a 10mm inside diameter and a minimum of 6 inches long containing a 100 percent wool felt plug (190 ounces per square yard). The plug shall be approximately 0.75 inches in length and shall be placed in the lower end of the tube so that it extends approximately 0.125 inch outside 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 across the surface of the solid film lubricant

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coated panel by a drive mechanism consisting of a motor, speed reducer, and eccentric wheel. The drive mechanism shall be capable of producing a reciprocating motion 2 inches \pm 1/8 inches in length at a reciprocating speed of 30 \pm 1 strokes per minute.

4.6.2.2 Test Procedures.

4.6.2.2.1 Mechanically Rubbed. Prepare a total of 20 panels 2" by 3" by 1/8" in size of the material and surface treatment as follows:

- Group 1. Five anodized aluminum alloy panels in accordance with Table III, footnote 1/(a).
- Group 2. Five anodized and dyed aluminum alloy panels in accordance with Table III, footnote 1/(b).
- Group 3. Five manganese phosphated steel panels in accordance with Table III, footnote 1/(c).
- Group 4. Five zinc phosphated steel panels in accordance with Table III, footnote 1/(d).

Apply the solid film lubricant by brush, dip or spray to a film thickness of 0.0002 to 0.0005 inches and cure at the temperature and time specified by the lubricant manufacturer. Immerse one panel from each of the above groups in each of the five fluids specified in Table I. The fluid shall completely cover the panel. Permit the panels to remain in the fluids for a period of 24 \pm 1 hours at 77° \pm 5°F (25° \pm 3°C). Test each panel for lubricant removability as follows: Clamp the panel to the platen of the removability apparatus, removing as little of the test fluid as possible. Operate the apparatus (which has been previously adjusted to apply a stroke of 2 \pm 1/8 inches at a rate of 30 \pm 1 strokes per minute) for 500 strokes. The panels shall be covered with the test fluid throughout the test period (500 strokes). If necessary, add test fluid to the panels during the test period to maintain this condition. The wool felt plug shall be replaced after each individual test. At the conclusion of the rubbing period, examine the panels for conformance with 3.7.1.

* 4.6.2.2.2 Hand rubbed. Prepare a total of 4 panels 3" by 6" by 0.020" in size of the material and surface treatment as follows:

- 1 anodized aluminum alloy panel in accordance with Table III, footnote 1/ (a).
- 1 anodized and dyed aluminum alloy panel in accordance with Table III, footnote 1/ (b).
- 1 manganese phosphated steel panel in accordance with Table III, footnote 1/ (c).
- 1 zinc phosphated steel panel in accordance with Table III, footnote 1/ (d).

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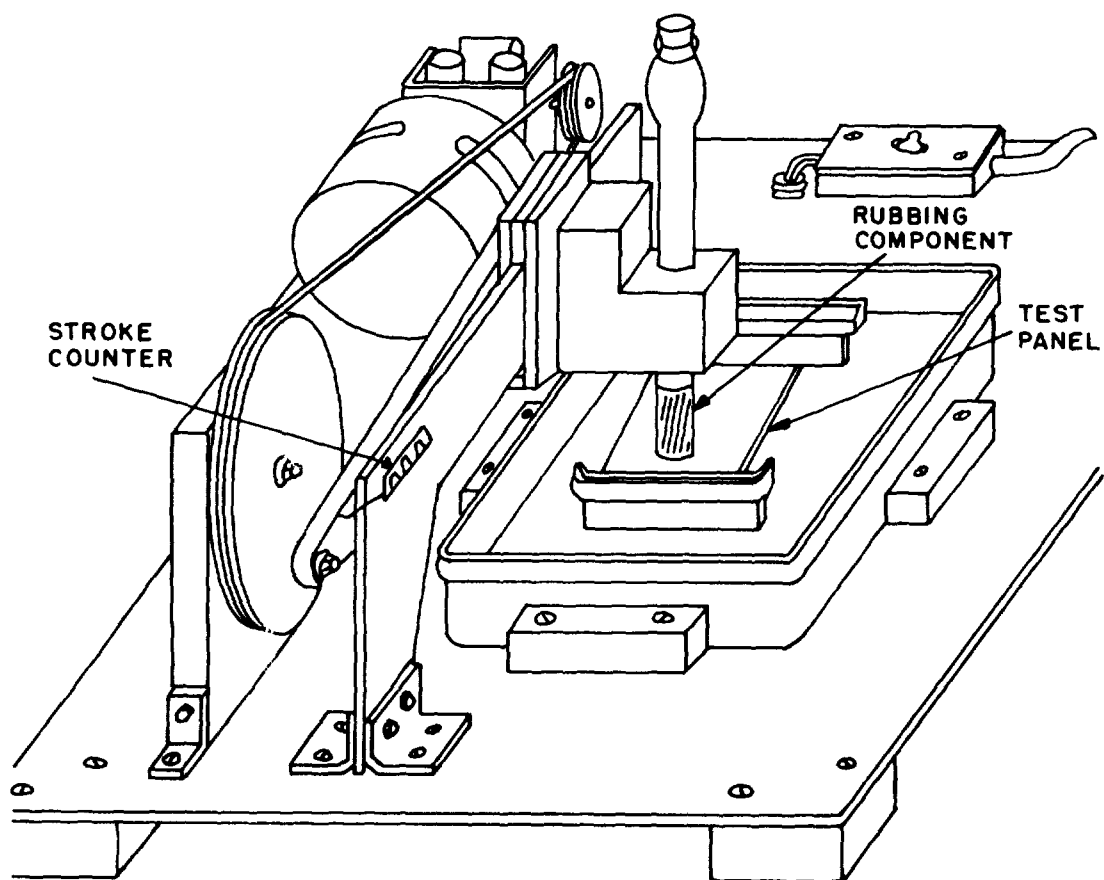


Figure 1. Apparatus for Determining Removability

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Apply the solid film lubricant to a film thickness of 0.0002 to 0.0005 inches and cure at the temperature and time specified by the lubricant manufacturer. Immerse each panel in lubricating oil meeting the requirements of MIL-L-46000 for a period of 24 hours \pm 15 minutes at $77^{\circ} \pm 5^{\circ}\text{F}$ ($25^{\circ} \pm 3^{\circ}\text{C}$). Fasten, with a rubber band, a small arms cleaning swab per Drawing 5019316 to the end of a steel cylinder $2'' \pm 1/16''$ in diameter by $4'' \pm 1/16''$ long. The nap surface of the swab shall be exposed. Remove each panel from the lubricating oil, place it on a flat surface. Saturate the swab with the lubricating oil and place the cylinder, swab end down, on the panel. Hold the cylinder with the fingers and move it longitudinally across the surface of the panel in such a manner that the cylinder does not rock nor do the fingers contribute to the weight of the cylinder. Rub for a period of 2 minutes \pm 15 seconds at a rate of 60 ± 10 strokes per minute. Examine each panel at the conclusion of the rubbing period for conformance with 3.7.2. Use a new swab for each test.

4.6.3 Total Solids. Shake the lubricant on a mechanical paint shaker (Red Devil or equivalent) for a period of 5 minutes \pm 15 seconds to provide a uniform dispersion. To insure uniform dispersion, stir the solid film lubricant formulation with a spatula until no lumps of pigment are present in the container. Immediately after shaking, weight 5 ± 0.5 grams of the lubricant into a tared weighing dish approximately $2 \frac{1}{2}$ inches in diameter (Fisher Scientific Company, Cat. No. 7-732 has been found to be satisfactory). Place the dish and contents in a forced draft oven maintained at $120^{\circ} \pm 5^{\circ}\text{F}$ ($49^{\circ} \pm 3^{\circ}\text{C}$) for a period of 18 ± 1 hours. Raise the temperature of the oven to the lubricant manufacturer's recommended cure temperature and maintain this temperature for a period of time equal to the lubricant manufacturer's cure time. Remove the weighing dish from the oven and place it in a desiccator and weigh it. From the weight of the sample prior to heating and the weight of the residue after heating, calculate the percent by weight of solid material in the fluid lubricant from the formula:

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

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

4.6.5 Storage Stability. Shake the lubricant on a mechanical paint shaker (Red Devil or equivalent) for a period of 5 minutes \pm 15 seconds and immediately fill a 1 quart can conforming to PPP-C-96, Type V, Class 2, with the lubricant to approximately 0.25 inches from the top. Tightly seal the can and place it in storage at a temperature of $77^{\circ} \pm 5^{\circ}\text{F}$ ($25^{\circ} \pm 3^{\circ}\text{C}$) for a period of 6 months \pm 3 days. At the end of the storage period, test the lubricant for conformance with the requirements in 3.11.

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5. PACKAGING

5.1 Packaging, Packing and Marking. Unless otherwise specified in the contract or purchase order (see 6.2), packaging, packing and marking shall be in accordance with MIL-STD-290. In addition, each unit package, intermediate package and external package shall be marked as follows:

- (a) To show the manufacturer's recommended cure temperature and cure time.
- (b) To show the date of manufacture.
- (c) To include the following information: CAUTION! Use only in a well ventilated area or in a hood where no flames or other ignition sources are present.

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

6. NOTES

* 6.1 Intended Use. The solid film lubricant covered by this specification is intended for use in applications where a cure temperature above 250°F (121°C) may adversely affect the metallurgical or the corrosion protective properties of the part to be coated with the lubricant. This lubricant is useful under the following conditions:

- a. Where conventional lubricants are difficult to apply or retain.
- b. Where dust or dirt contamination on lubricated surfaces is deleterious.
- c. Where operating temperature may range from -90° to 250°F (68°C to 121°C).
- d. In mechanisms operated at infrequent intervals.
- e. In mechanisms which are lubricated for life.
- f. Where long term corrosion protection is required.
- g. Where a dull dark gray nonreflective surface is required.
- h. Where a coating resistant to nearly every fluid, including diester lubricants, is required.

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- 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 or less, where contamination with conventional fluid lubricants is probable.
- k. It is generally suitable for sliding motion applications such as plain and spherical bearings, flap tracks, hinges, threads, and cam surfaces.

This lubricant should not be used under the following conditions:

- a. On materials which will be adversely affected by the curing temperature.
- b. 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.
- c. 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 inches. Where maximum corrosion protection on steel is desired, the lubricant should be applied over phosphated steel to a thickness of 0.001 inches. 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 desired.
- c. Type and size of containers (see 5.1).
- d. Level of packaging and packing (see 5.1).
- e. Special marking, if required (see 5.1).

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* 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 suppliers 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 U.S. Army Armament Command, General Thomas J Rodman Laboratory at Rock Island Arsenal, ATTN: SARRI-LR, Rock Island, Illinois 61201, and information pertaining to qualification of products may be obtained from that activity.

6.4 Application on aluminum and aluminum alloys. For maximum endurance life and maximum corrosion protection, the surface of aluminum and aluminum alloys must be anodized prior to the application of this lubricant. At the present time, there is no information available as to the endurance life or corrosion protective properties provided by this lubricant when it is applied on aluminum and aluminum alloys which have been chemically treated with materials conforming to MIL-C-5541.

* 6.5 Supersession data. This specification includes the requirements of U.S. Army Weapons Command Purchase Description USAWECOM PD 42, dated 1 October 1970.

* 6.6 The Falex test results shall be analyzed using the Dixon and Dean criteria given in the article "Simplified Statistics for Small Samples", Analytical Chemistry, Vol 23, p. 636 (1951). If the suspect valve is out of line it shall be rejected and the average endurance life determined from the remaining valves. The rejection factor is given in the Table V below.

Table V - Rejection Factors

Number of Observations	Confidence Factors				Deviation Factor kw	Rejection Factor Q .90
	Students "t"		Range			
	t .95	t .99	tw .95	tw .99		
2	12.7	64.0	6.40	31.83	0.83	
3	4.3	10.0	1.30	3.01	0.59	0.94
4	3.2	5.8	0.72	1.32	0.49	0.76
5	2.8	4.6	0.51	0.84	0.43	0.64
6	2.6	4.0	0.40	0.63	0.40	0.56
7	2.5	3.7	0.33	0.51	0.37	0.51

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Table V - Rejection Factors (cont)

Number of Observations	Confidence Factors				Deviation Factor kw	Rejection Factor Q .90
	Students "t"		Range			
	t .95	t .99	tw .95	tw .99		
8	2.4	3.5	0.29	0.43	0.35	0.47
9	2.3	3.4	0.26	0.37	0.34	0.44
10	2.26	3.2	0.23	0.33	0.33	0.41
∞	1.96	2.57	0.00	0.00	0.00	0.00

Equations

$w = \text{range} = X_n - X_1$ (value arranged in order of magnitude)

S_w (standard deviation) = WKw

Shortest Probability Interval Range = $X + Wtw$

Rejection $Q = \frac{X_2 - X_1}{X_n - X_1}$ = Distance between doubtful value and nearest neighbor

NOTE: If Q exceeds table value, then doubtful member is extraneous.

6.7 The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue have been made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army - WC

Preparing Activity:

Army - WC

Review Activities:

Army - AT, AV, ME, MI, MR, MU
DSA - PS

Project No:

9150-A403

User Activities:

Army - PA, WV
DSA - GS

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APPENDIX

INSTRUCTIONS FOR APPLYING LUBRICANT
 SOLID-FILM: HEAT-CURED (TEMPERATURE
 RANGE 125° TO 250°F), CORROSION INHIBITING

10. SCOPE

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

20. APPLICABLE DOCUMENTS

20.1 Issues of documents. 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

<u>FEDERAL</u> QQ-P-35	-	Passivation Treatments For Austenitic, Ferritic, and Martensitic Corrosion-Resisting Steel (Fastening Devices)
TT-N-95	-	Naphtha, Aliphatic
<u>MILITARY</u> 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

<u>MILITARY</u> MIL-STD-171	-	Finishing of Metal and Wood Surfaces
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30. REQUIREMENTS

30.1 Application on aluminum and aluminum alloys. Vapor degrease the surfaces to be coated with aliphatic naphtha meeting the requirements of TT-N-95, Type II. Anodize and seal the surface in accordance with finish number 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 inches and permit the coated parts to air-dry for at least 30 minutes to assure complete solvent removal. Bake according to schedule given by the manufacturer. The coated surface of

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the piece must remain at the cure temperature for the specified time. This may require that the coated piece remain in the oven for a period longer than that specified to assure compliance with this requirement. The use of a thermocouple attached to the coated surface to indicate the temperature of the coating has been found to be satisfactory for determining the beginning of the timed baking period.

30.2 Application on copper and copper alloys. Vapor degrease the surfaces to be coated with aliphatic naphtha meeting the requirements of TT-N-95, Type II. Sandblast the surfaces with 130 mesh clean, dry sand. Form a black oxide finish on the surfaces in accordance with MIL-F-495. Do not touch the pretreated surfaces with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inches and permit the coated parts to air-dry for at least 30 minutes to assure complete solvent removal. Bake according to schedule given by the manufacturer. The coated surface of the piece must remain at the cure temperature for the specified time. This may require that the coated piece remain in the oven for a period longer than that specified to assure compliance with this requirement. The use of a thermocouple attached to the coated surface to indicate the temperature of the coating has been found to be satisfactory for determining the beginning of the timed baking period.

30.3 Application on magnesium and magnesium alloys. Vapor degrease the surfaces to be coated with aliphatic naphtha meeting the requirements of TT-N-95, Type II. Anodize the surface in accordance with MIL-M-45202, Type I, class A, B, or C. Do not touch the pretreated surfaces with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inches and permit the coated parts to air-dry for at least 30 minutes to assure complete solvent removal. Bake according to schedule given by the manufacturer. The coated surface of the piece must remain at the cure temperature for the specified time. This may require that the coated piece remain in the oven for a period longer than that specified to assure compliance with this requirement. The use of a thermocouple attached to the coated surface to indicate the temperature of the coating has been found to be satisfactory for determining the beginning of the timed baking period.

30.4 Application on steel. Vapor degrease the surfaces to be coated with aliphatic naphtha meeting the requirements of TT-N-95, Type II. Sandblast the surfaces with 120 mesh clean, dry sand or steel grit. Phosphate in accordance with MIL-P-16232, type M, class 3 or type Z, class 3. Do not touch the pretreated surfaces with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inches and permit the parts to air-dry for at least 30 minutes to assure complete solvent removal. Bake according to schedule given by the manufacturer. The coated surface of the piece must remain at the cure temperature for one hour. This may require that the coated piece remain in the oven for a period longer than that specified to assure compliance

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with this requirement. The use of a thermocouple attached to the coated surface to indicate the temperature of the coating has been found to be satisfactory for determining the beginning of the timed baking period.

30.5 Application on stainless steels. Vapor degrease the surfaces to be coated with aliphatic naphtha meeting the requirements of TT-N-95, Type II. Sandblast the surfaces with 120 mesh clean, dry sand. Passivate the surfaces in accordance with QQ-P-35, Types I, II, or III, as applicable. Do not touch the pretreated surfaces with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inches and permit the coated parts to air-dry for at least 30 minutes to assure complete solvent removal. Bake according to the schedule given by the manufacturer. The coated surfaces of the piece must remain at the cure temperature for one hour. This may require that the coated piece remain in the oven for a period longer than that specified to assure compliance with this requirement. The use of a thermocouple attached to the coated surface to indicate the temperature of the coating has been found to be satisfactory for determining the beginning of the timed baking period.

30.6 Application on titanium and titanium alloys. Degrease the surfaces to be coated with aliphatic naphtha meeting the requirements of TT-N-95, type II. Sandblast the surface with 120 mesh clean, dry sand or steel grit and alkaline anodize. Do not touch the pretreated surfaces with the fingers. Apply the lubricant by brushing, dipping, or spraying to a film thickness of 0.0002 to 0.0005 inches and permit the coated parts to air-dry for at least 30 minutes to assure complete solvent removal. Bake according to the schedule given by the manufacturer. The coated surface of the part must remain at the cure temperature for one hour. This may require that the coated part remain in the oven for a period longer than that specified to assure compliance with this requirement. The use of thermocouple attached to the coated surface to indicate the temperature of the coating has been found to be satisfactory for determining the beginning of the timed baking period.

30.7 Engineering tolerances. The operating thickness of this lubricant ranges from 0.0002 to 0.0005 inches per lubricated surface. This thickness seldom requires alteration of established clearances between moving parts. There is one exception. The lubricant coating thickness must be considered in the case of small parts which normally operate with very little clearance. The cured lubricant film is relatively soft and any interference produced by the thickness of the lubricant will cause rapid wear of the lubricant film to the point where interference is eliminated.

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