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METRIC

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PERFORMANCE SPECIFICATION

LUBRICATING OIL, HELICOPTER TRANSMISSION SYSTEM, SYNTHETIC BASE

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

1. SCOPE

1.1 Scope. This specification covers the requirements for one grade of a synthetic base helicopter transmission system lubricating oil.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

Comments, suggestions, or questions on this document should be addressed to: Commander, Naval Air Systems Command, AIR-4.4.5, 22229 Elmer Road, Unit 4, Patuxent River MD 20670-1534, or e-mailed to Douglas.Mearns@navy.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://dodssp.daps.mil.

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SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-7808 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-PRF-23699 - Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO Code Number O-156

STANDARDS

FEDERAL

FED-STD-313 - Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD-791 - Lubricants, Liquid Fuels, and Related Products; Methods of Testing

(Copies of these documents are available online at http://www.assist.daps.mil/quicksearch or http://www.dodssp.daps.dla.mil or from the Standardization Documents Order Desk, Bldg. 4D, 700 Robins Avenue, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation or contract (see 6.2).

DEPARTMENT OF DEFENSE TECHNICAL MANUALS

DEPARTMENT OF THE NAVY

NAVAIR 17-15BF-62 - Fluid Analysis Spectrometer, Atomic Emission, Operation Instructions and Maintenance Instructions

(Application for copies should be addressed to the Navy Inventory Point, Code 03334 (Publications/Forms Branch), 700 Robbins Avenue, Philadelphia, PA 19111-5098. Their customer service telephone is (215) 697-5632).

CODE OF FEDERAL REGULATIONS

DEPARTMENT OF LABOR

29 CFR 1910.1200 - Occupational Safety and Health Standards - Hazard Communications

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(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM-D92 - Flash and Fire Points by Cleveland Open Cup. (DoD Adopted)
ASTM-D97 - Pour Point of Petroleum Oils. (DoD Adopted)
ASTM-D445 - Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity). (DoD Adopted)
ASTM-D892 - Foaming Characteristics of Lubricating Oils.(DoD Adopted)
ASTM-D972 - Evaporation Loss of Lubricating Greases and Oils.(DoD Adopted)
ASTM-D2532 - Viscosity and Viscosity Change After Standing at Low Temperature of Aircraft Turbine Lubricants. (DoD Adopted)
ASTM-D2603 - Sonic Shear Stability of Polymer-Containing Oils. (DoD Adopted)
ASTM-D4057 - Manual Sampling of Petroleum and Petroleum Products. (DoD Adopted)
ASTM-D4177 - Automatic Sampling of Petroleum and Petroleum Products. (DoD Adopted)
ASTM-E1 - ASTM Thermometers. (DoD Adopted)

(Copies of these documents are available from the American Society for Testing and Materials International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959; (610) 832-9500; or through their website at http://www.astm.org.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

ASQ-Z1.4 - Sampling Procedures and Tables for Inspection by Attributes. (DoD Adopted)

(Copies of ASQ-Z1.4 are available from the American Society for Quality, P.O. Box 3005, 611 East Wisconsin Avenue, Milwaukee, WI 53201-4606, or through their website at http://www.asq.org.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)
AEROSPACE MATERIAL SPECIFICATIONS (AMS)

SAE AMS 3217/1 - Test Slabs, Acrylonitrile Butadiene (NBR-H), Medium-High Acrylonitrile, 65-75 (DoD Adopted)
SAE AMS 3217/4 - Test Slabs, Fluoroelastomer (FKM), 65-75 (DoD Adopted)

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SAE AMS-T-9046 - Titanium and Titanium Alloy, Sheet, Strip, and Plate (DoD Adopted)

AEROSPACE RECOMMENDED PRACTICE (ARP)

SAE ARP 5088 - Test Method for the Determination of Total Acidity in Polyol Ester and Diester Gas Turbine Engine Lubricants by Automatic Potentiometric Titration

(Copies of SAE documents are available from the Society of Automotive Engineers, SAE World Headquarters, 400 Commonwealth Drive, Warrendale, PA 15096-0001, or through their website at http://www.sae.org.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the 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.

3. REQUIREMENTS

3.1 Qualification. The lubricating oil furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Materials. The composition of the lubricating oil is not limited; however, materials containing barium, organic compounds of titanium, and known or suspected human carcinogens (as specified by the Occupational Safety and Health Standards – Hazard Communications, 29 CFR 1910.1200) are prohibited. Recycled basestocks are permitted; however, each batch must be fully tested in accordance with the qualification requirements of this specification. If a tricresyl phosphate (TCP) additive is used, it shall not contain more than one (1) percent of the ortho-isomer of tricresyl phosphate.

3.2.1 Acid assay. The acid components, in mole-percent, of the finished oil submitted as the qualification test sample shall be determined in accordance with FED-STD-791, method 3500, “Monobasic Acid Components of Synthetic Ester Lubricants by Gas Chromatography.” The manufacturer shall then select a range of 10 mole-percent for each acid component to bracket the values measured on the qualification sample by the qualifying laboratory. The major acid components (10 mole-percent or greater) of the oil shall fall within the stated range for each acid. The minor acid components shall not exceed 10 mole-percent. The manufacturer may use alternate methods to determine the acid components as described in Table I, footnote 1.

3.3 Chemical and physical requirements. The lubricating oil shall conform to table I.

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TABLE I. Physical, chemical, and performance requirements.

Characteristic	Requirement	Test method	
		ASTM or SAE	FED-STD-791
Acid assay	Report (see 3.2.1)	---	1/ 3500
Viscosity, mm^2/s (cSt), at -40°C (-40°F), maximum Percent change after 72 hours at -40°C (-40°F), maximum 2/	13,000 ±6	ASTM-D2532	---
Viscosity, mm^2/s (cSt), at 100°C (212°F) at 40°C (104°F), minimum	4.90 - 5.40 23.0	ASTM-D445	---
Flash point, °C (°F), minimum	246 (475)	ASTM-D92	---
Pour point, °C (°F), maximum	-54 (-65)	ASTM-D97	---
Total acid number, mg KOH/g, maximum	0.75	SAE-ARP5088	---
Evaporation loss, percent by weight, 6.5 hours at 204°C (400°F), maximum 3/	10	ASTM-D972	---
Foaming, foam volume, ml, maximum 4/		ASTM-D892	---
5 minutes aeration at 24°C (75°F)	25		
1 minute settling at 24°C (75°F)	none		
5 minutes aeration at 93.5°C (200°F)	25		
1 minute settling at 93.5°C (200°F)	none		
5 minutes aeration at 24°C (75°F) (after test at 93.5°C, above)	25		
1 minute settling at 24°C (75°F)	none		
Rubber compatibility		---	5/ 3604 and 3433
Rubber swell, percent			
SAE-AMS3217/1, 72 hours at 70°C (158°F)	5 – 25		
SAE-AMS3217/4, 72 hours at 204°C (400°F)	5 – 25		
Standard silicone rubber, 96 hours at 110°C (230°F)	0 – 25		
Tensile strength loss of standard silicone rubber, percent, maximum	60		
Compatibility	Compatible	---	6/ 3403
Turbidity	None		
Sediment, mg/l, maximum	10		

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TABLE I. Physical, chemical, and performance requirements - Continued.

Characteristic	Requirement	Test method	
		ASTM or SAE	FED-STD-791
Storage stability			
Low temperature, 6 weeks at -18°C (0°F)	No crystallization, separation or gelling.	---	7/
Qualification sample Stored for three years at -40 to +60°C (-40 to +140°F)	Conform to 3.3 and 3.4. 9/	---	8/
First production qualification sample Stored for 12 months at 24° ±5°C (75° ±10°F)	Pass the conformance inspection. 9/	---	8/
Thermal stability and corrosivity at 274°C (525°F)			3411
Viscosity change, percent, maximum 10/	5.0	---	
Total acid number change from original, maximum, 11/	6.0	---	
Metal weight change, mg/cm^2, maximum	4.0	---	
Sediment 12/		---	3010
Visual undissolved water	None		
Sediment through 1.2 micron filter, mg/l maximum 13/	10		
Total ash content, mg/l, maximum	1		
Shear stability, viscosity loss at 40°C (104°F), percent, maximum	4	ASTM-D2603 14/	---
Trace metal content, parts per million (ppm), maximum		15/	---
Aluminum (Al)	2		
Iron (Fe)	2		
Chromium (Cr)	2		
Silver (Ag)	1		
Copper (Cu)	1		
Tin (Sn)	11		
Magnesium (Mg)	2		
Nickel (Ni)	2		
Titanium (Ti)	2		
Silicon (Si)	10		
Zinc (Zn)	2		
Lead (Pb)	2		
Molybdenum (Mo)	3		
Sodium (Na)	2		
Boron (B)	2		

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TABLE I. Physical, chemical, and performance requirements - Continued.

Characteristic	Requirement	Test method	
		ASTM or SAE	FED-STD-791
Corrosion and oxidative stability		---	16/ 5308
a) 72 hours at 175°C (347°F)			
Viscosity, percent change 10/	-5 to +15		
Total acid number change, maximum 11/	2.0		
Metal weight change, mg/cm^2, maximum			
Steel	±0.2		
Silver (Ag)	±0.2		
Aluminum (Al)	±0.2		
Magnesium (Mg)	±0.2		
Copper (Cu)	±0.4		
Titanium (Ti)	---		
Sludge content (filtered through 10 µm), mg/100 ml of oil, maximum	50		
Corrosion and oxidative stability		---	16/ 5308
b) 72 hours at 204°C (400°F)			
Viscosity, percent change 10/	0 to +30		
Total acid number change, maximum 11/	3.0		
Metal weight change, mg/cm^2, maximum			
Steel	±0.2		
Silver (Ag)	±0.2		
Aluminum (Al)	±0.2		
Magnesium (Mg)	±0.2		
Copper (Cu)	±0.4		
Titanium (Ti)	---		
Sludge content, (filtered through 10 µm), mg/100 ml of oil, maximum	50		

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TABLE I. Physical, chemical, and performance requirements - Continued.

Characteristic	Requirement	Test method	
		ASTM or SAE	FED-STD-791
Corrosion and oxidative stability		---	16/ 5308
c) 72 hours at 218 °C (425 °F)			
Viscosity, percent change, maximum 10/	150		
Total acid number change, maximum 11/	10.0		
Metal weight change, mg/cm^2, maximum			
Steel	±0.2		
Silver (Ag)	±0.2		
Aluminum (Al)	±0.2		
Magnesium (Mg)	---		
Copper (Cu)	---		
Titanium (Ti)	±0.2		
Sludge content (filtered through 10 µm), mg/100 ml of oil, maximum	50		

1/ Alternate methods may be used if approved by the qualifying activity; however, only FED-STD-791, method 3500, "Monobasic Acid Components of Synthetic Ester Lubricants by Gas Chromatography," shall be used for referee tests.

2/ The initial viscosity shall be determined 35 ±1 minutes after the viscometer is placed in the bath maintained at -40° ±1°C (-40° ±2°F) and again at 72 hours ±5 minutes after completion of initial viscosity.

3/ Bath temperature shall be maintained at 204°C ±1°C (400°F ±2°F), for a 6.5 hour test period. ASTM-E1, Thermometer 80F shall be used. Air temperature shall be maintained at 204°C ±1°C (400°F ±2°F), using a preheater, if necessary.

4/ Complete foam collapse is that point at which no more than a single row of bubbles remain around the cylinder wall and air inlet tube. If this ring of bubbles around the cylinder wall contains segments having two or more layers of bubbles and the difference in height of the foam in the ring is not greater than 10 milliliters (ml), complete foam collapse is the point at which a break occurs in the ring of bubbles without subsequent reforming of the ring.

5/ SAE-AMS3217/1 and SAE-AMS3217/4 shall be tested in accordance with FED-STD-791, method 3604, "Swelling of Synthetic Rubber by Aircraft Turbine Lubricants." Standard silicone rubber shall be tested in accordance with FED-STD-791, method 3433, "Compatibility of Synthetic Aircraft Turbine Lubricants with Silicone Rubber."

6/ See paragraph 4.4.1 for test method details.

7/ See paragraph 4.4.2 for test method.

8/ See paragraph 4.4.3 for test method.

9/ Tentative qualification approval shall be given to products meeting all other tests of the qualification inspection (see 4.2). Final qualification approval will be awarded upon successful completion of the extended storage stability tests. Failure to pass the extended storage stability tests is cause for withdrawal of qualification approval (see 4.4.3).

10/ Compared with viscosity of new oil samples tested at 40°C (104°F).

11/ The total acid number shall be determined in accordance with SAE-ARP 5088.

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12/ Sediment measurement may be made using a silver membrane filter.
13/ If the total sediment does not exceed 1 mg/l, the ash content does not need to be determined.
14/ Use an irradiation period of 30 minutes on a 30 ml oil sample at a power setting which causes 11.5 ±0.5 percent viscosity loss to a 30 ml sample of ASTM Reference Fluid A, when irradiated for five minutes. ASTM Reference Fluid A is a petroleum oil containing a polymer capable of being broken down by turbulence at high rates of shear; typical viscosities are 10.7 mm^2/s (cSt) at 100°C (212°F) and 57 mm^2/s (cSt) at 40°C (104°F). ASTM Reference Fluid A may be obtained from the RohMax USA, Inc. 723 Electronic Drive, Horsham, PA 19044-2228.
15/ See paragraph 4.4.6 for test method details.
16/ See paragraph 4.4.4 for test method details.

3.4 Bench performance requirements. Bench performance requirements shall be as specified in table II and 3.4.1 through 3.4.2.

TABLE II. Bench performance requirements.

Requirement	Limit	Test method FED-STD-791
Gear load carrying ability	1/	6508
Bearing deposits	2/	3410, severity level 1½

1/ See 3.4.1.
2/ See 3.4.

3.4.1 Gear load carrying ability. The average of six determinations run on the oil shall be not less than 145 percent of the reference oil (Hercolube A, see 6.2.1) when tested in accordance with FED-STD-791, method 6508, "Load Carrying Ability of Lubricating Oils (Ryder Gear Machine)". All six determinations shall be made on the same machine. The reference oil average rating used to obtain the relative ratings shall also be reported.

3.4.2. Bearing deposits. The overall deposit demerit rating shall be less than 80 after a 100 hour bearing test in accordance with FED-STD-791, Method 3410, "High Temperature Deposit and Oil Degradation Characteristics of Aviation Turbine Oils," severity level 1½. The weight of filter deposits shall not exceed 3 grams and the total oil consumption shall not exceed 2,000 ml. The viscosity of the lubricating oil shall not have changed more than 0 to +35 percent from the original viscosity at 40°C (104°F) and the change in total acid number shall not exceed 2.0 mg KOH/g, during test and at the end of the l00 hour test period.

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3.5 Full-scale performance requirements.

3.5.1 Turboshaft engine. The oil shall be tested in a full-scale turboshaft engine in accordance with 4.4.5 to evaluate its serviceability and to ensure that engine components are compatible with the lubricating oil. The post-test condition of the engine shall not indicate excessive or unusual deposits, wear or corrosion which are attributed to the test oil.

3.5.2 Service evaluation. The oil shall be rated as satisfactory after the model type test evaluation and flight evaluation of 4.4.7.

4. VERIFICATION

4.1 Classification of inspections. The inspection and testing of lubricating oil shall be classified as follows:

a. Qualification inspection (see 4.2)
b. Conformance inspection (see 4.3)

4.2 Qualification inspection. Qualification inspection shall consist of testing to all the requirements specified in section 3. When required by the qualification activity, additional evaluations (engine and flight test service evaluation) shall be conducted on candidate formulations. The extended storage stability tests (see 4.4.3) shall be performed after the candidate product has passed all other qualification tests. Tentative qualification approval shall be granted to products undergoing the extended storage stability tests. Upon successful completion of the extended storage stability test, full qualification approval shall be granted. Failure to pass the extended storage stability tests is cause for withdrawal of qualification approval.

4.2.1 Requalification. Requalification shall be required when any reformulation or change is made in source of manufacture, purity, or composition of the lubricating oil base stocks or additives. Requalification is also required for any changes in the manufacturing process or plant locations of the finished product, it's additives or basestock(s). A minor change in the oil formulation shall not be made unless approved by the qualification activity (see 6.3).

4.3 Conformance inspection. Conformance inspection shall consist of all of the tests specified in table III. Failure to pass any conformance test shall be cause for rejection of the lot.

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Table III. Conformance tests.

Characteristic	Test method		
	Test paragraph	ASTM or SAE	FED-STD-791
Acid assay (see table I and 3.2.1)	---	---	3500
Viscosity (see table I) at 40°C (104°F) at 100°C (212°F)	 --- ---	 ASTM-D445 ASTM-D445	 --- ---
Flash point, °C (see table I)	---	ASTM-D92	---
Pour point, (see table I)	---	ASTM-D97	---
Total acid number, (see table I)	---	SAE-ARP5088	---
Foaming, foam volume (see table I)	---	ASTM-D892	---
Thermal stability and corrosivity at 274°C (525°F) (see table I)	---	---	3411
Sediment (see table I)	---	---	3010
Corrosion and oxidative stability, 72 hours at 204°C (400°F) (see table I)	4.4.4	---	5308
Trace metal content (see table I)	4.4.6	---	---

4.3.1 Sampling and inspection. Each lot (see 6.6) of material for conformance inspection shall be sampled at random in accordance with ASTM-D4057 or ASTM-D4177. Inspections shall be conducted in accordance with FED-STD-791, method 9601, "Inspection Requirements." A sample of five cases of 1 quart containers (120 containers) of material from the first production lot supplied to the procuring agency after qualification, and one case of every production lot supplied to the procuring activity thereafter, shall be forwarded to the Naval Air Station Receiving Officer, HAZMART Bldg. 2385, Sample (AIR-4.4.5), 22680 Hammond Road, Patuxent River, MD 20670.

4.3.2 Examination of filled containers. A random sample of filled containers from each lot (see 6.6), taken in accordance with ASQ-Z1.4, shall be examined with regard to fill, closure, sealing and leakage. Reject any container having one or more defects or for being under the required fill. If the number of defective or underfilled containers exceeds the acceptance number for the appropriate sampling plan of ASQ-Z1.4, reject the lot represented by the sample.

4.3.3 Conformance test inspection report. A copy of the conformance inspection report on each lot of oil produced for U.S. Government use shall be forwarded to the qualification activity (see 6.3).

4.4 Test methods. All tests shall be performed in accordance with tables I and II, and 4.4.1 through 4.4.7.

4.4.1 Compatibility. The compatibility test shall be performed in accordance with FED-STD-791, method 3403, "Compatibility of Turbine Lubricating Oils," with the exception

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that petroleum ether (with a boiling range of 30° to 60°C), n-heptane, or hexane, shall be used in place of 1,1,1-trichloroethane. Upon completion of the 168 hour oven period, the test flasks shall be stored in the dark at room temperature (24° ±5°C (75° ±10°F)) for 21 days before visual inspection for turbidity. Sediment shall be determined in accordance with FED-STD-791, method 3010, "Solid Particle Contamination in Aircraft Turbine Engine Lubricants (Gravimetric Procedure)." If the amount of sediment collected after the exposure period is greater than the limit specified in table I additional testing shall be performed on the mixture to determine that its performance meets the requirements of this specification. The additional testing shall include all of the tests in this specification. Referee lubricating oils shall consist of selected oils qualified under this specification, MIL-PRF-7808, and MIL-PRF-23699.

4.4.2 Low temperature storage stability. Three one quart samples of oil shall be stored in a cold chamber maintained at -18° ±2.5°C (0° ±5°F) for 6 weeks. At the end of the storage period the oil shall be visually inspected for evidence of crystallization, additive separation, and gelling.

4.4.3 Extended storage stability.

a. Qualification sample. Ten one-gallon cans of the qualification sample shall be stored at -40 to +60°C (-40 to +140°F), for three years. If at any time during the storage period the lubricating oil fails to conform to 3.3 and 3.4, qualification approval will be withdrawn.
b. First production sample. Five cases of one quart containers (120 containers) from the first production batch of the tentatively qualified oil (original qualification, reblend, or rebrand) shall be stored at 24° ±5°C (75° ±10°F) for 12 months. At the end of the storage period, the lubricating oil shall pass the conformance inspection (see 4.3).

4.4.4 Corrosion and oxidation stability. The corrosion and oxidation stability test shall be performed in accordance with FED-STD-791, method 5308, "Corrosiveness and Oxidation Stability of Light Oils (Metal Squares)," with the following modifications:

a. Three separate tests, each conducted for 72 hours, shall be conducted with bath temperatures of 175°±2.5°C (347° ±5°F), 204° ±2.5°C (400° ±5°F), and 218° ±2.5°C (425° ±5°F);
b. A liquid-medium or fluidized sand bath heating apparatus may be used in place of an aluminum block heater;
c. Metal Coupons: An electrolytic-grade, silver test square shall be substituted for the cadmium plated steel square. In the 218°C test, in place of copper and magnesium, substitute titanium conforming to SAE AMS-T-9046, type I, composition C. The weight loss for titanium shall be reported as the average of the two squares. Stainless steel or nickel-chrome wire may be used to tie the metal coupons together at all test conditions.
d. Condenser water temperature shall be maintained at 18° ±2.5°C (65° ±5°F).
e. The total acid number shall be determined in accordance with SAE-ARP 5088.

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The post-test sludge content shall be determined as follows:

a. Decant oil from the test tube through a preweighed l0.0 micron polytetrafluoroethylene (Teflon) filter (Militec LCWP 047-00 or equivalent) and measure filtrate volume;
b. Set filtrate aside for viscosity and acid number tests;
c. Remove all sludge from test equipment with rubber policeman, wash equipment and filtered sludge with petroleum ether, oven dry sludge sample, and weigh and compute sludge weight per 100 ml of oil.
d. Do not add the petroleum ether washings to the oil filtrate used for viscosity and acid number measurements. Petroleum ether, with a boiling range of 30°C to 60°C (104°F to 140°F), n-heptane, or hexane shall be used in place of 1,1,1-trichloroethane.

4.4.5 Turboshaft engine. The lubricating oil shall be subjected to an accelerated endurance test in a turboshaft engine for a period sufficient to determine its performance characteristics. Engine components shall be inspected for lubricant related defects upon completion of the endurance test run. Any such defects found in the components of the engine which are attributable to the oil shall be cause for disqualification. Engine test conditions and test period shall be specified by the activity responsible for qualification (see 6.3).

4.4.6 Trace metal content. The trace metal content of the lubricating oil shall be determined with a Joint Oil Analysis Program (JOAP) approved atomic emission spectrometer. Using JOAP spectrometric calibration standards, the spectrometer shall be standardized as specified in NAVAIR 17-15BF-62. Immediately after standardizing the spectrometer, five determinations of the oil for trace metal content shall be performed. The average of the five determinations shall be reported. Samples requiring trace metal content determinations may be sent to: Department of Defense, Joint Oil Analysis Program Technical Support Center, 85 Millington Avenue, Bldg. 3887, Pensacola, FL 32508-5010.

4.4.7 Service evaluation. When candidate lubricants that are the result of unique or unusual formulation or manufacturing technologies are submitted for qualification testing, the qualification activity (see 6.3) may require ground and flight test gearbox evaluations. The evaluations shall be conducted by the qualifying activity, or its designated representative, and will consist of the following:

a. Model type test. A 150 hour, test cell operated, evaluation will be conducted on a minimum of two different models of helicopter transmission systems used by the U.S. Military.
b. Flight evaluation. A 500 hour flight evaluation will be conducted in a Government owned aircraft having the same transmission system model as used in the model type test, above.

4.4.7.1 Evaluation criteria. The rating criteria for both the model type test and the flight evaluation will be reported as satisfactory or unsatisfactory. The satisfactory rating is contingent upon the successful completion of the test duration without a lubricant-related discrepancy and

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the satisfactory condition of the lubricant-wetted parts upon post-test transmission disassembly and inspection. The post-test condition of the candidate lubricant shall not have changed from the original new oil value beyond the following limits: viscosity change at 40°C: -5 percent to +15 percent, Total Acid Number Change: +2.0 mg KOH/g.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. These lubricating oils are intended for use in helicopter transmissions and gearboxes for air, sea, and ground mobility equipment. These oils are designed for operation within the approximate bulk oil temperature range of -40 to 175 °C (-40 to 350 °F). This specification fulfills the military unique requirement for a high performance aviation transmission lubricant certified for use in the gearboxes and transmissions of all type/model/series helicopters designed to operate on a 5cS lubricant.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. If certification of conformance to material prohibitions is required (see 3.2).
c. Submittal of conformance test results (see 4.3.3).
d. Packaging requirements (See 5.1).
e. Quantity desired, type, and size of container required (see 5.1).

6.2.1 Source for standard reference oil for Ryder Gear Test (see 3.4.1 and table II). Standard reference oil may be obtained from: Fuels and Lubricants Division, AIR-4.4.5, Bldg. 2360, Naval Air Systems Command, 22229 Elmer Road, Unit 4, Patuxent River, MD 20670.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in the applicable Qualified Products List, QPL-85734, whether or not such products have actually been so listed by that date. The attention of the contractors is called to this requirement, and

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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. Information pertaining to qualification of products may be obtained from the Fuels and Lubricants Division, AIR-4.4.5, Bldg. 2360, Naval Air Systems Command, 22229 Elmer Road, Unit 4, Patuxent River, MD 20670.

6.3.1 Data. To initiate the qualification process, forward a written request, including general information on the proposed candidate material, to the above address. Written response to this will be a "letter of authorization," which will provide detailed instructions for the submission of product samples and test data. A test report, containing data showing the results of all tests required by this specification, with the exception of compatibility, low temperature storage, extended storage stability, bearing test, shear stability, and full scale engine tests must be submitted to the qualification activity prior submittal of the qualification test sample. The test report must include complete formulation data, including the chemical name, the manufacturer, the trade name, and the percentage of each ingredient. The mole-percent of each acid of the base ester must be provided (see 3.2.1). The MSDS of the candidate product and each additive used in the formulation must be included.

6.3.2 Sample. The qualification test sample consists of 208 liters (55 gallons) of finished lubricating oil and 19 liters (5 gallons) of the base oil without additives. A minimum of 100 grams of each additive ingredient used in the manufacture of the qualification test sample must be submitted prior to qualification testing. Each sample is to be identified by a securely attached, durable tag or label marked with the following information:

QUALIFICATION INSPECTION SAMPLE
LUBRICATING OIL, HELICOPTER TRANSMISSION SYSTEM,
DOD-PRF-85734

Type of sample: *(basestock, additive, or finished oil)*
Name of manufacturer: _____
Product code number: _____
Batch number: _____
Date of manufacture: _____
Submitted by *(name)* on *(date)* for qualification inspection in accordance with DOD-PRF-85734 under authorization of *(reference authorizing letter, see 6.3)*.

6.3.3 Reblend lubricating oil qualification. A reblend lubricating oil is an original qualified product, as specified in 4.2, in which one or more ingredients have been blended by a manufacturer other than the manufacturer of the original formulation. At the discretion of the qualification activity, the turboshaft engine performance test requirements (see 3.5.1 and 4.4.5) may be waived, if the other test results indicate equivalence to the original formulation. Candidates for reblend approval are required to undergo qualification inspection (see 4.2) and may be initiated by the process described in 6.3.

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6.3.4 Rebrand lubricating oil qualification. A rebrand lubricating oil is a lubricating oil which has successfully passed the qualification tests (see 4.2) and is manufactured by the original formulator at the original manufacturing site but is packaged/distributed using a second party identifying trade name. Rebrand approvals may be initiated by the process described in 6.3.

6.4 Subject term (key word) listing.

Lubricant
Helicopter transmission lubricant
Helicopter gearbox lubricant
Helicopter gearbox oil
Synthetic base lubricant

6.5 Material Safety Data Sheets. Contracting officers will identify those activities requiring copies of completed Material Safety Data Sheets prepared in accordance with FED-STD-313.

6.6 Toxicity. The lubricating oil shall have no adverse effect on the health of personnel when used for its intended purpose. Material safety data sheets (MSDS) must be prepared and submitted in accordance with FED-STD-313 (see 6.5).

6.7 Definitions.

Bulk lot - A bulk lot is defined as an indefinite quantity of homogeneous mixture of material offered for acceptance in a single isolated container or manufactured by a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

Packaged lot - A packaged lot is defined as an indefinite number of 208 liter (55 gallon) drums or smaller unit packages of identical size and type offered for acceptance and filled with a homogeneous mixture of material manufactured by a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

6.8 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

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CONCLUDING MATERIAL

Custodians:
Army - AT
Navy - AS
Air Force - 11
DLA - GS

Preparing activity:
Navy - AS
(Project 9150-1300)

Review Activities:
Army - AR, AV
Navy - SH
Air Force - 68

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at www.dodssp.daps.mil.