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METRIC
MIL-H-87257
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MILITARY SPECIFICATION

HYDRAULIC FLUID, FIRE RESISTANT; LOW TEMPERATURE, SYNTHETIC HYDROCARBON BASE, AIRCRAFT AND MISSILE

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

1. SCOPE

1.1 Scope. This specification covers the general requirements for a synthetic hydrocarbon base hydraulic fluid for use in the –54° C to +135° C temperature range in aircraft and missile hydraulic systems. This hydraulic fluid is identified by NATO Code No. H–538 (see 6.5).

2. APPLICABLE DOCUMENTS

2.1 Government documents

2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: ASD/ENES, Wright–Patterson AFB OH 45433–6503 by using the self–addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 9150

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SPECIFICATIONS

FEDERAL

P-D-680	–	Dry Cleaning and Degreasing Solvent
TT-T-656	–	Tricresyl Phosphate
PPP-C-96	–	Cans, Metal, 28 Gauge and Lighter
PPP-P-420	–	Plugs and Flanges (For Drum Closures)

MILITARY

MIL-H-5606	–	Hydraulic Fluid, Petroleum Base: Aircraft, Missile, and Ordnance
MIL-H-6083	–	Hydraulic Fluid, Petroleum Base for Preservation and Operation
MIL-H-46170	–	Hydraulic Fluid, Rust Inhibited, Fire Resistant Synthetic Hydrocarbon Base
MIL-H-83282	–	Hydraulic Fluid, Fire Resistant, Synthetic Hydrocarbon Base, Aircraft, Metric, NATO Code Number H-537

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

MILITARY

MIL-STD-105	–	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-290	–	Packaging of Petroleum and Related Products
MIL-STD-1844	–	Gas Chromatography Method for Determination of Trace Chlorinated Solvents in Hydraulic Fluid

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia PA 19111-5094.)

2.1.2 Other government publications. The following other Government publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

PUBLICATIONS

CODE OF FEDERAL REGULATIONS

49 CFR	–	Transportation
FAR Clause 52.223-3		

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

DEPARTMENT OF LABOR (DOL)

OSHA 29 CFR 1910.1200 – Federal Register, Part IV, Department of Labor, OSHA Hazard Communication: Final Rule

(Guideline CPL 2-2.38 may be obtained from OSHA Publication Office, Room S-4203, 200 Constitution Avenue NW, Washington DC 20210.)

U.S. ENVIRONMENTAL PROTECTION AGENCY

Public Law 94-580 – Resource Conservation and Recovery Act of 1976

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

(Copies of specifications, standards, handbooks, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the acquisition activity or as directed by the contracting office.)

2.2 Non-Government publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents, which are DOD adopted, are those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D92 – Flash and Fire Points by Cleveland Open Cup, Standard Test Method for (DoD adopted)

ASTM D97 – Pour Point of Petroleum Oils, Standard Test Method for (DoD adopted)

ASTM D130 – Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test, Standard Method for Detection of (DoD adopted)

ASTM D445 – Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity), Standard Test Method for (DoD adopted)

ASTM D664 – Neutralization Number by Potentiometric Titration, Standard Test Method for (DoD adopted)

ASTM D892 – Foaming Characteristics of Lubricating Oils, Standard Test Method for (DoD adopted)

ASTM D1298 – Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method, Standard Test Method for

ASTM D1500 – ASTM Color of Petroleum Products (ASTM Color Scale), Standard Test Method for (DoD adopted)

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ASTM D1744 – Water in Liquid Petroleum Products by Karl Fischer Reagent, Standard Test Method for (DoD adopted)

ASTM D2532 – Viscosity and Viscosity Change After Standing at Low Temperature of Aircraft Turbine Lubricants, Standard Test Method for (DoD adopted)

ASTM D4057 – Manual Sampling of Petroleum and Petroleum Products, Standard Practice for

ASTM D4172 – Wear Preventive Characteristics of Lubricating Fluid (Four-Ball Method), Standard Test Method for

ASTM D4177 – Automatic Sampling of Petroleum and Petroleum Products, Standard Test Method for (DoD adopted)

ASTM D4636 – Corrosiveness and Oxidation Stability of Hydraulic Oils, Aircraft Turbine Engine Lubricants, and Other Highly Refined Oils, Standard Test Method for

ASTM D4898 – Insoluble Contamination of Hydraulic Fluids by Gravimetric Analysis, Standard Test Method for

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

AEROSPACE MATERIAL SPECIFICATIONS (AMS)

AMS 3217/2 – Test Slabs, Acrylonitrile Butadiene (NBR-L) Low Acrylonitrile, 65-75.

(Applications for copies should be addressed to Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale PA 15096-0001)

(Nongovernment standards and other publications are normally available from the organizations which prepare or which distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein (except for related associated detail specifications, specification sheets or MS standards), the text of this specification takes precedence. Nothing in this specification supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. The hydraulic fluids 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 4.3 and 6.3). Any change in the formulation of an approved product shall require requalification.

3.2 Materials. The materials used in formulating this hydraulic fluid shall consist of synthetic hydrogenated polyalphaolefin hydrocarbon base and shall contain additives as specified in 3.2.1. The hydraulic fluid shall contain no admixture of resins, soaps, gums, fatty oils, or oxidized hydrocarbons. The contractor shall certify that no carcinogenic or potentially carcinogenic constituents are present as

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defined under OSHA 29 CFR 1910.1200. Certification to this effect shall be made available to the contracting officer or the contracting officer's representative.

3.2.1 **Additives.** There shall be no restriction on the types of materials used as additives in the fluid except for those listed and those imposed by technical requirements of this specification. No pour point depressant materials or viscosity index improvers may be used.

3.2.1.1 **Oxidation inhibitors.** Oxidation inhibitors of the phenolic type shall not exceed a concentration of 2.0 percent by weight.

3.2.1.2 **Anti-wear agent.** Anti-wear agents, such as tricresyl phosphate (TCP) conforming to TT-T-656, shall be blended in sufficient quantity, not to exceed 3.0 weight percent, to permit the finished oil to meet the lubricity requirements specified in 3.9.10. If TCP is used, the finished fluid shall contain less than 0.03 weight percent of the ortho-isomer.

3.2.1.3 **Blending fluid.** Blending fluids, such as diesters, shall be blended in a concentration not to exceed 35 percent by weight but in sufficient quantity to meet the rubber swell, as specified in 3.3.4, and viscosity requirements at -54° C as specified in table I.

3.2.1.4 **Color.** The fluid shall contain red dye in concentration not greater than 1 part of dye per 10,000 parts of oil by weight.

3.3 **Finished fluid.** The properties of the finished fluid shall be as specified in table I and 3.3.1 through 3.3.15.

3.3.1 **Specific gravity.** The specific gravity of the hydraulic fluid shall be determined but shall not be limiting. Samples of the hydraulic fluid submitted for quality conformance tests shall not vary more than ±0.008 at 15.6° C/15.6° C from the specific gravity of the sample originally approved for qualification.

3.3.2 **Corrosiveness and oxidation stability.** When tested as specified in 4.5.2, the change in weight of steel, aluminum alloy, magnesium alloy, and cadmium-plated steel subjected to the action of the hydraulic fluid shall not be greater than ±0.2 milligrams per square centimeter of surface. The change in weight of copper under the same conditions shall be no greater than ±0.6 milligrams per square centimeter of surface. There shall be no pitting, etching, nor visible corrosion on the surface of the metals when viewed under magnification of 20 diameters. Any corrosion produced on the surface of the copper shall not be greater than No. 3 of the ASTM copper corrosion standards (ASTM D130). A slight discoloration of the cadmium shall also be permitted.

3.3.2.1 **Resistance to oxidation.** When tested as specified in 4.5.2, the fluid shall not have changed more than 10 percent from the original viscosity in centistokes at 40° C after the oxidation corrosion test. The neutralization number shall not have increased by more than 0.20 over the acid or base number of the original sample. There shall be no evidence of separation of insoluble materials nor gumming of the fluid.

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TABLE I. Properties of Finished Fluid.

Property	Requirement	Unit
Kinematic viscosity (cSt)		
@ 40° C, minimum	6.7	cSt
100° C, minimum	2.0	cSt
–40° C, maximum	550	cSt
–54° C, maximum	2500	cSt
Flash point, minimum	160	°C
Fire point, minimum	170	°C
Neutralization number, maximum	0.20	mg KOH/gm
Evaporation loss, maximum	20	wt. %
Bulk modulus (isothermal secant) 0 to		
6.9×10^4 kPa at 40° C (min)	1.379×10^6	kPa
10,000 psi at 100° F (min)	200,000	psi
Pour point, maximum	–60	°C

3.3.3 Low temperature stability. When tested as specified in 4.5.2 for 72 hours at a temperature of –54° C ± 1° C, the fluid shall show no evidence of gelling, clouding, crystallization, solidification, or separation of ingredients.

3.3.4 *Swelling of synthetic rubber.* When tested as specified in 4.5.2, the volume increase of the standard synthetic rubber NBR–L (as referenced in AMS 3217/2) by the fluid shall be within the range of 19.0 to 30.0 percent.

3.3.5 Solid particle contamination. When tested in accordance with 4.5.2, the number of solid contaminant particle per 100 ml of the fluid shall not exceed the number specified in table II, nor shall the weight of the residue exceed 0.3 mg. The filtering time for each determination shall be 15 minutes maximum.

3.3.6 Foaming characteristics. The foaming characteristics of the hydraulic fluid shall not exceed the limits indicated in table III when tested as specified in 4.5.2.

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TABLE II. Solid contaminant particle.

Particle size range (largest dimension), micrometers	Allowable number (max) each determination, automatic count
5-15	10,000
16-25	1,000
26-50	150
51-100	20
Over 100	5

TABLE III. Foaming characteristics of hydraulic fluid.

Test Temperature	Foaming tendency Foam volume, ml, at end of 5-min blowing period	Foam stability Foam volume, ml, at end of 10-min settling period
25° C	65 ml (max)	Complete collapse 1/

1/ A ring of small bubbles around the edge of the graduate may be considered complete collapse.

3.3.7 Water content. The fluid shall contain less than 100 ppm total water when tested as specified in 4.5.2.

3.3.8 Chlorine. The hydraulic fluid shall contain less than 50 ppm chlorine when determined as specified in 4.5.2.

3.3.9 Flammability

3.3.9.1 High temperature-high pressure spray ignition. If ignited, when the test flame is applied as specified in 4.5.2, the test fluid shall not continue to burn when the source of ignition is removed.

3.3.9.2 Flame propagation. When tested as specified in paragraph 4.5.5, the flame propagation rate shall be not more than 0.40 cm/sec.

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3.3.10 Lubricity. When tested in accordance with 4.5.2, wear values for hydraulic fluid shall be as specified in table IV.

TABLE IV. Wear Values.

Load (kg)	Scar diameter mm (max)
1	0.21
10	0.30
40	0.65

3.3.11 Storage stability. The fully blended product shall show no separation of ingredients nor evidence of crystallization, shall be clear and transparent when examined visually and shall conform to the requirements of section 3 after 12 months storage as specified in 4.5.2.

3.3.12 Compatibility. The hydraulic fluid shall be compatible in all concentrations with each of the fluids approved under this specification when tested as specified in 4.5.3. The hydraulic fluid shall be miscible with MIL-H-5606, MIL-H-6083, MIL-H-46170, and MIL-H-83282 fluids in all proportions from –54° C to 135° C, in that no formation of resinous gums, sludges, or insoluble materials will occur.

3.3.13 High temperature stability. When tested in accordance with 4.5.6, the change in fluid viscosity at 40° C shall not exceed five percent; neutralization number of the fluid shall not increase more than 0.1 and there shall be no formation of precipitate or insoluble material.

3.3.14 Color of finished fluid. There shall be no readily discernible difference in the color of the finished fluid and the standard color when tested as specified in 4.5.8.

3.3.15 Low temperature viscosity stability. The kinematic viscosity shall be tested at –54° C as specified in section 4, table V. The viscosity at 3 hours and at 72 hours shall not exceed 2500 cSt.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, 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 ensure supplies and services conform to prescribed requirements.

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4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspection

a. Qualification inspection (see 4.3).

b. Quality conformance inspection (see 4.4).

4.3 Qualification inspection

4.3.1 Qualification inspection sample. The qualification sample shall consist of two one-gallon containers of the finished fluid, one quart of the base stock(s) without additives, one quart of the blending fluids used, one ounce of the anti-wear additive, one ounce of the oxidation inhibitor and one ounce each of any additional additives used in the finished fluid. In the event that additives are supplied as concentrated solutions, an equivalent quantity of the solution shall be furnished.

4.3.2 Qualification tests. Qualification sample(s) shall be subjected to all the tests specified in table V.

4.3.3 Data to accompany qualification samples. The samples shall be accompanied by a test report from the manufacturer or a commercial laboratory containing complete information as to the following: source and type of base stock and additive materials used, the formulation and composition of the finished fluid, and laboratory data showing quantitative results of all the tests required by this specification except storage stability. Separate qualification inspections shall be required for each base stock used. Submission of the material safety data sheet is a requirement. One copy of the material safety data sheet shall be sent with each sample submitted for test. The samples, material safety data sheets and reports shall be forwarded to the Wright Laboratory, Materials Directorate, System Support Division (WL/MLSE), Wright-Patterson AFB OH 45433-6533. The samples shall be plainly identified by securely attached durable tags or labels marked with the following information:

Sample for Qualification Inspection
HYDRAULIC FLUID, FIRE RESISTANT; LOW TEMPERATURE, SYNTHETIC HYDROCARBON BASE, AIRCRAFT AND MISSILE METRIC, NATO CODE NUMBER H-538.
Name of ingredient (for ingredient material)
Name of manufacturer
Product code number
Date of manufacture
Submitted by (name) and (date) for qualification inspection in accordance with the requirements of MIL-H-87257 under authorization of (reference authorizing letter) (see 6.3)

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TABLE V. Quality Conformance Tests.

Inspection	Paragraph Requirement	Test Method
Pour Point	3.3	4.5.2
Flash Point	3.3	4.5.2
Fire Point	3.3	4.5.2
Neutralization number	3.3	4.5.2
Evaporation (finished fluid)	3.3	4.5.2
Viscosity (finished fluid)	3.3	4.5.2
Specific gravity	3.3.1	4.5.2
Low temperature stability	3.3.3	4.5.2
Solid particle contamination	3.3.5	4.5.7
Foaming characteristics	3.3.6	4.5.2
Water content	3.3.7	4.5.2
Chlorine content	3.3.8	4.5.2
Flame propagation	3.3.9.2	4.5.5
Lubricity	3.3.10	4.5.2
Color of finished fluid	3.3.14	4.5.8
Low temperature viscosity stability 1/	3.3.15	4.5.2
Inspection of filled containers	5.1	4.5.9

1/ The 72-hour test is not required during the quality conformance inspection. The 3-hour test is required.

4.3.3.1 Toxicity coordination. At the time of qualification submittal, the contractor shall provide the following certified materials for each ingredient to the Air Force Occupational and Environmental Health Directorate, AL/OEMB, Brooks AFB TX 78235:

Chemical Name and Formula (nomenclature of the International Union of Pure and Applied Chemistry)

NIOSH Identification number (accession or identification number referenced in the Registry of Toxic Effects of Chemical Substances, if assigned)

In addition, the range of percentages of harmful or toxic components in the finished product and any toxicological data useful in evaluating the safety of the formulation shall be furnished. The Government reserves the right to determine whether such data is adequate for the purposes of qualification under

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the provisions of this specification. The AL/OEMB personnel have 15 working days from the receipt of the contractor materials to report compliance/noncompliance to the qualifying agency.

4.3.3.2 **Formulation Sheets.** An example of a satisfactory form for the formulation sheet, indicating the percent by weight and purpose of each ingredient, is as follows:

Base stock(s) (composition and source)	percent
Blending Fluid (composition and source)	percent
Anti-wear additive (manufacturer's name and no.)	percent
Oxidation inhibitor (manufacturer's name and no.)	percent
Other additives (manufacturer's name and no.)	percent

4.3.4 **Retention of qualification.** In order to retain qualification of a product approved for listing on the Qualified Products List (QPL), the manufacturer shall verify, by certification to the qualifying activity, that the manufacturer's product complies with the requirements of this specification. The time of periodic verification by certification shall be in two-year intervals from the date of original qualification. The Government reserves the right to re-examine the qualified product whenever deemed necessary to determine that the product continues to meet any or all of the specification requirements.

4.4 **Quality conformance inspection.** The quality conformance inspection shall consist of sampling plans A, B, and C. Quality conformance inspection shall consist of examination of the sample filled containers (see 4.5.9), determination of the solid particle contamination count (see 4.5.7) and testing the sample against all requirements specified in table V. In the event of a solid particle contamination count failure, the referee method shall be the automatic particle counter method calibrated with latex spheres. Samples shall be labeled completely with information identifying the purposes of the sample, name of product, specification number, lot and batch number, date of sampling, and contract number.

4.4.1 **Inspection lots**

4.4.1.1 **Bulk lot.** A bulk lot (batch) is an indefinite quantity of homogeneous mixture of material 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 ingredient material.

4.4.1.2 **Packaged lot.** A packaged lot is an indefinite number of 55-gallon drums or smaller unit containers of identical size and type, offered for acceptance, and filled with a homogeneous mixture of material from one isolated container; or filled with a homogeneous mixture of material manufactured

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in a single plant run (not exceeding 24 hours) through the same processing equipment, with no change in ingredient material.

4.4.2 Sampling Plan A. A one-gallon bulk lot (see 4.4.1) shall be selected in accordance with ASTM D4057 or ASTM D4177 and subjected to inspection and tests specified in 4.5.2 except for corrosiveness and stability (oxidation, shear, and storage) and swelling of synthetic rubber. If the sample for tests fails any of the quality conformance tests, the inspection lot shall be rejected.

4.4.3 Sampling plan B. A random sample of filled unit containers and a sample of shipping containers fully prepared for delivery shall be selected from each packaged lot (see 4.4.2) of fluid in accordance with MIL-STD-105, Inspection Level II. The sample(s) shall be subjected to inspections specified in 4.5.9.

4.4.4 Sampling plan C. Samples of filled and sealed containers shall be taken at such periodic intervals as to be representative of each day's operation. The number of samples taken each day shall be in accordance with MIL-STD-105, Inspection Level S-3. The sample size and number of determinations shall be as specified in table VI. The sample(s) shall be subjected to inspection specified in 4.5.7.

TABLE VI. Sample for Particle Contamination.

Container	Sample Size (ml) 1/	Number of Determinations per sample
8 ounces	100	1
1 quart	100	1
1 gallon	200	2
5 gallons	300	3
55 gallons	600	6

1/ Each determination shall be made on 100 ml portions of the sample. Should the particle count on any individual determination be considered excessive, the two additional determinations on another sample from the same container may be used. The container shall be thoroughly shaken immediately prior to withdrawing each 100 ml portion for such additional determinations. The arithmetic average of the two closer particle counts shall be considered the particle count for the sample.

4.4.5 Submission of material safety data sheets. The contractor shall furnish to the contracting activity the toxicological data and formulations required to evaluate the safety of the material for the proposed use through the submission of the material safety data sheet detailed in FED-STD-313.

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4.5 Method of inspection and test

4.5.1 Inspection. Inspection shall be in accordance with Method 9601b of FED-STD-791 and 4.5.9 of this specification.

4.5.2 Tests. The hydraulic fluid properties shall be determined in accordance with the applicable methods specified in table VII and 4.5.3 through 4.5.8. Physical and chemical values specified in section 3 apply to the average of the determinations made on the samples.

TABLE VII. Test Methods for Hydraulic Fluid Properties.

Characteristic	Test Method	
	FED-STD-791	ASTM
Pour point		D97
Flash point		D92
Fire point		D92
Color (base stock)		D1500
Evaporation 1/	350	
Specific gravity		D1298
Viscosity 2/		D445
Solid particle contamination 3/	3009	
Foaming		D892
Water		D1744
Neutralization number		D664
High temperature-high pressure spray ignition	6052	
Corrosiveness and oxidation stability 4/		D4636
Swelling of synthetic rubber 5/	3606	
Low temperature stability	3458	
Storage stability	3465	
Low temperature viscosity stability		D2532
Lubricity 6/		D4172
Chlorine content 7/		

1/ Test temperature 150° C. Test time, 6.5 hours

2/ Initial viscosity reading at -54° C shall be taken at 1.5 hours.

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3/ Particulate contamination may also be measured by the use of automatic particle counters in lieu of the optical procedure detailed in method 3009. HiAC counter, Models PC–202, PC–203, PC–305, or equivalent, counting to the limits specified in table II. Directions in the manual for the respective instruments shall be followed.

4/ Bath, constant temperature, 135° C. Test time 168 hours.

5/ Use standard NBR–L (see 3.3.4 and 6.4) within 6 months of date of manufacture.

6/ A 10 ± 0.5 ml sample shall be used, and the test shall be conducted for 1 hour at each load specified in table IV.

7/ Determine using MIL–STD–1844 procedure.

4.5.3 Compatibility. Samples of candidate fluid in amounts of 20 ml, 100 ml, and 180 ml shall be mixed with samples from each of the fluids previously approved under this specification. Total volume of each mixture shall be 200 ml. Mixtures shall be prepared in 250 ml stoppered flasks. The flasks shall be thoroughly agitated and then stored in an oven at 135° C for 2 hours. At the end of this time, none of the mixtures shall show any sign of sediment, turbidity, or crystallization. The samples shall then be stored at –54° C for a period of 2 hours. Slight turbidity, at this time, which later disappears will be permitted in the samples. Compatibility tests described herein shall also be conducted with representative fluids qualified to MIL–H–5606 and MIL–H–83282.

4.5.4 Bulk modulus

4.5.4.1 Apparatus. The bulk modulus of the hydraulic fluid shall be determined using a calibrated, precision capillary pycnometer of the type shown in figure 1 (modified 21 T 50 Jerguson pressure gauge). A suitable pressure vessel and auxiliary equipment for this determination are shown in figures 2 and 3.

4.5.4.2 Procedure. The pycnometer volume to capillary diameter ratio shall be chosen to provide a precision of measurement for liquid density of ±2 parts in 10,000. The pycnometer shall be charged with candidate fluid to the top of the capillary at 40° C and atmospheric pressure, and determination made as follows: insert the pycnometer in the high–pressure pycnometer housing so that the capillary tube is visible through the window of the pressure vessel and parallel to the outside vertical surfaces of the pressure vessel. Assemble the pressure vessel containing the pycnometer, place it in a 40° C constant–temperature bath, allow equilibrium to be reached, and take volume reading at atmospheric pressure. (Since the precision of the unit depends on visual readings, care must be taken to avoid errors due to parallax and distortion in the pressure vessel window and the walls of the constant–temperature

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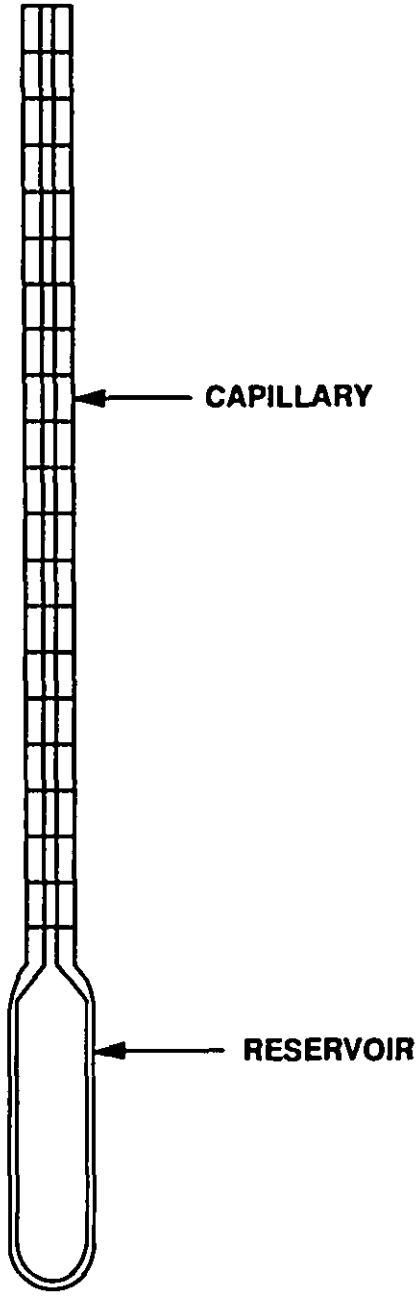

FIGURE 1. Precision capillary pycnometer.

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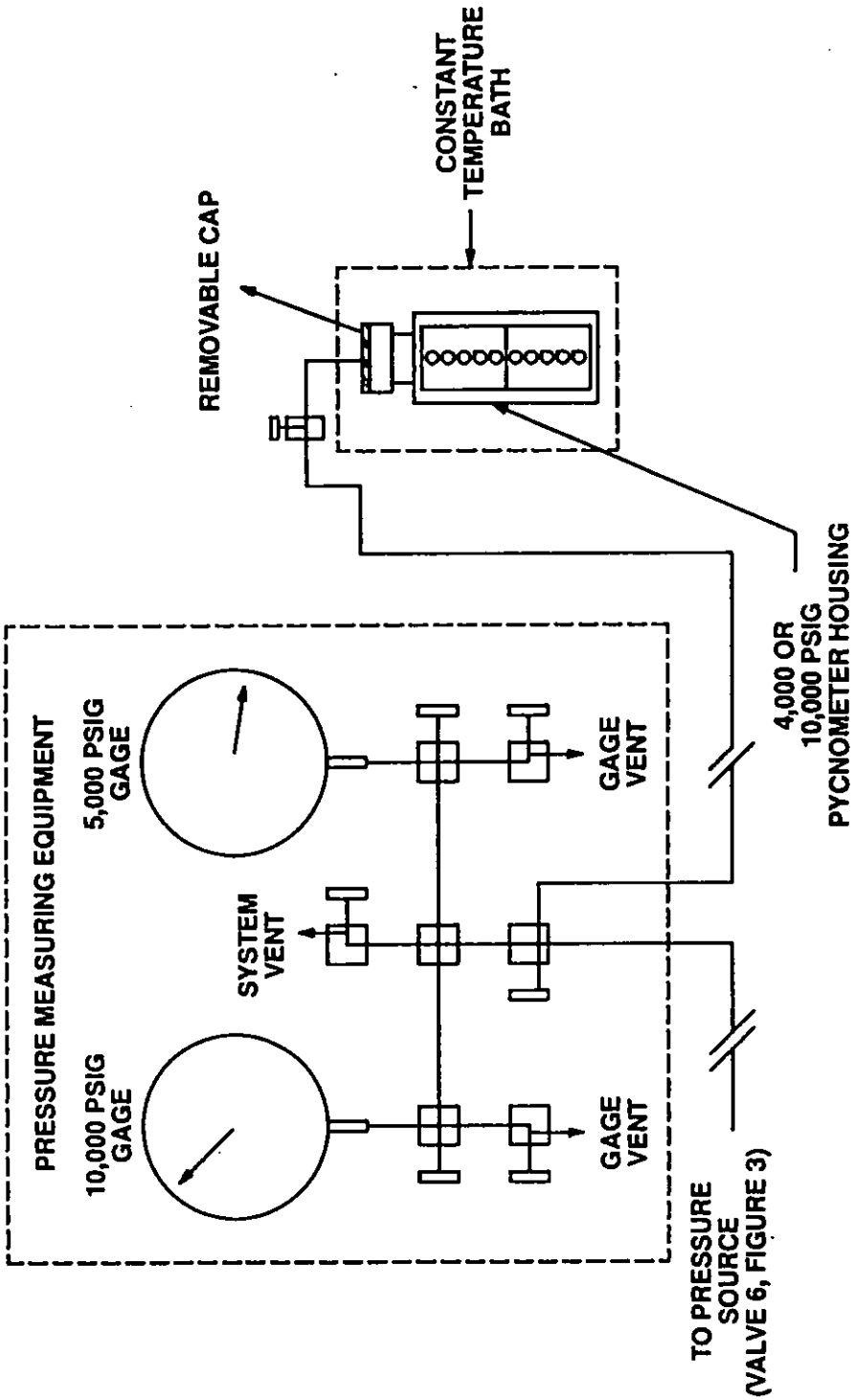

FIGURE 2. Diagram of bulk modulus equipment.

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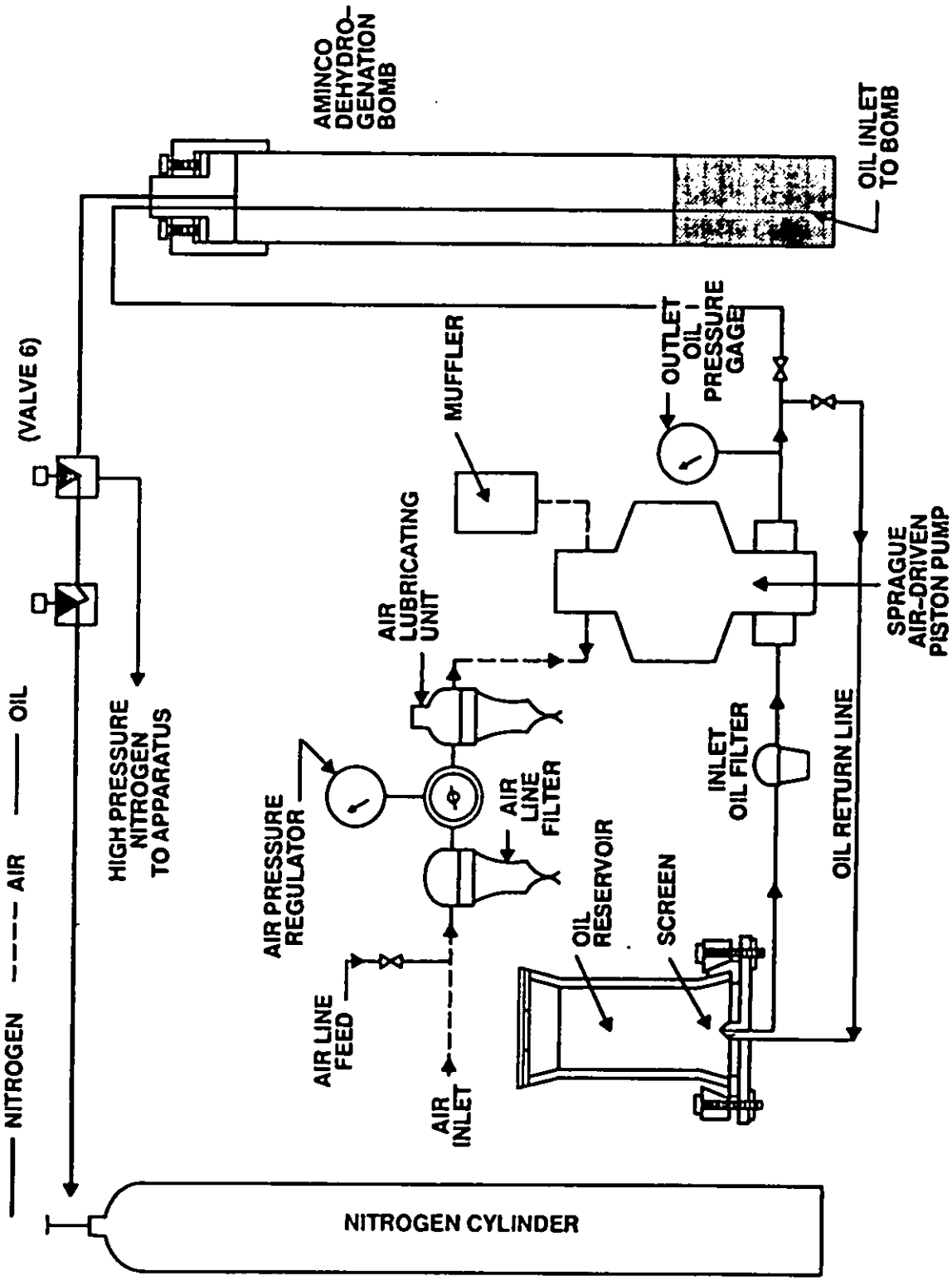

FIGURE 8. Auxiliary equipment.

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bath.) Increase nitrogen pressure to a new level and, after a 1-hour soak, take a third reading. For any pressure change, the secant bulk modulus is defined by the following equation:

$$\text{Bulk modulus} = \frac{V\Delta P}{\Delta V + \Delta V_g}$$

Where: V = the original volume of the fluid

ΔV = the observed volume change due to ΔP increase in pressure

ΔP = the pressure change between the two measurements in kPa

ΔV_g = the correction factor

The correction factor (ΔV_g) considers the bulk modulus of glass in determining the true volume of the pycnometers at pressures above atmospheric. The bulk modulus of pyrex glass is 3.28×10^7 kPa.

Therefore:

$$\Delta V_g = \frac{V\Delta P}{3.28 \times 10^7}$$

4.5.5 Flame propagation test

4.5.5.1 Flame propagation test. The flame propagation test shall be conducted according to 4.5.5 of the current revision of MIL-H-83282.

4.5.6 High temperature stability

4.5.6.1 Apparatus. Thermal stability characteristics of the hydraulic fluid shall be determined using the following test apparatus: a 50 ml round bottom flask (Ace Glass Inc., Vineland, NJ 08360 or equivalent); a 75° angle adapter (standard taper 24/40, Ace Glass or equivalent); gas inlet tube (6 mm OD pyrex tubing); and a high temperature bath capable of maintaining a temperature of 175 ± 2° C.

4.5.6.2 Procedure. Place 25 ml of candidate fluid in flask fitted with 75° angle adapter and gas inlet tube. The height of the glass inlet tube should be adjusted to within 1.0 cm above the level of the fluid. Place a 2.5 cm length of 1/4-inch OD stainless steel tubing, type 304 in the fluid. Heat the fluid for 100 hours at a temperature of 175 ± 2° C while maintaining a 1 liter per hour flow of dry nitrogen (lamp grade) on the surface of the fluid via the gas inlet tube. Upon completion of the test, the fluid shall meet the requirements of 3.3.13.

4.5.7 Solid particle examination. Particle contamination should be measured by the use of automatic particle counters employing the light interruption principle. The automatic counters shall count particles to the limits specified in table I. The operating directions in the manual for the respective instrument shall be used. A gravimetric determination shall also be made in accordance with

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ASTM D4898 using a single 0.45 micron filter membrane with the following step inserted at the end of paragraph 8.8. After removing the upper half of the filter holder, use the last 50 ml of solvent to wash the test fluid from the periphery of the filter.

4.5.8 **Color of finished fluid.** The color of the hydraulic fluid shall be compared with a standard sample prepared by adding 1 part of dye "Oil red 235" (see 6.1.4) to 10,000 parts of an oil not darker than ASTM D1500 color number 1.0.

4.5.9 **Examination of filled containers.** Each sample of filled container and shipping container shall be examined for defects of construction of the container and closure, evidence of leakage and net content. Any container in the sample having one or more defects or under required fill shall be rejected and, if the number of defective containers in any sample exceeds the acceptance number for the appropriate sampling plan of MIL-STD-105, the lot represented by the sample shall be rejected. Rejected lots may be resubmitted for quality conformance inspection provided that the contractor has removed or repaired all non-conforming containers.

5. PACKAGING

5.1 **Packaging and packing.** The packaging and packing of the hydraulic fluid shall be as specified (see 6.2.1). Unless otherwise specified, the fluid shall be furnished in 8 ounce, 1 quart, 1 gallon cans and 55 gallon drums conforming to type I of PPP-C-96. Plugs and flanges shall be in accordance with PPP-P-420. All materials used in the construction of the containers shall be such as will not affect or be affected by the contained hydraulic fluid. Just prior to filling, all containers shall be thoroughly cleaned, rinsed with clean, filtered fluid, and examined to ensure absolute absence of loose solder, dirt, fiber, lint, metal particles, seaming compound, corrosion products, water, and other foreign contaminants. The bottom seam shall show no extruded seaming compound and there shall be no seaming compound on the body immediately adjacent to the side seam. Visible seaming compound, evenly distributed and forming a fine edge at the point of contact of the seam with the body, shall not be cause for rejection. If a soldered seam is used in the fabrication of the can, residual soldering flux shall not be present on the inside seam of the container.

5.2 **Marking.** The marking of all containers shall be in accordance with MIL-STD-290 and any special marking required in the contract or purchase order (see 6.2). Manufacturers/suppliers of products under this specification shall provide a hazard warning label in accordance with OSHA 29 CFR 1910.1200. The appropriate warning shall convey the specific physical and health hazards including target organ effects of the material. This label shall be affixed to each container.

6. NOTES

6.1 **Intended use.** The hydraulic fluid covered by this specification is intended for use from –54° C to +135° C in automatic pilots, shock absorbers, brakes, flap-control mechanisms, missile hydraulic servo-controlled systems, and other hydraulic systems using synthetic sealing material.

6.1.1 **Storage conditions.** Prior to use in the intended equipment, the product may be stored under conditions of covered or uncovered storage in geographic areas ranging in temperatures from –57° C to +49° C (–70° F to +120° F).

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6.1.2 This fluid is completely compatible with MIL-H-5606, MIL-H-6083, MIL-H-83282 and MIL-H-46170 hydraulic fluids. It may be interchangeable with these fluids for some applications. The selection of the fluids to be used depends on the requirements of the operational system.

6.1.3 Cleaning agents

6.1.3.1 **Chlorinated solvents.** Chlorinated solvents should not be used for cleaning hydraulic components. Residual solvent contaminates the hydraulic fluid and may lead to corrosion.

6.1.3.2 **Recommended solvents.** The recommended solvents are P-D-680, type II (Stoddard solvent) or other petroleum distillate type solvents.

6.1.4 **Oil red dye source.** "Oil red 235" is manufactured by Passaic Color and Chemical Company.

6.2 Ordering data

6.2.1 **Acquisition requirements.** Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).

c. Type and size of containers (see 5.1).

d. Quantity.

e. Selection of applicable levels of packaging and packing with requirements in detail (see 5.1).

f. FAR Clause 52.223-3.

g. Any special marking required (see 5.1).

6.2.2 **Basis of purchase.** The fluid covered by this specification should be purchased by volume, the unit being a U.S. gallon of 231 cubic inches at 15.6° C.

6.2.3 **List of qualified products.** Products considered acceptable under this specification are listed in QPL-87257 and subsequent revisions thereto.

6.3 **Qualification.** With respect to products requiring qualification, awards will be made only for such products as have prior to the time set for opening of bids, been tested and approved for inclusion into the applicable QPL 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

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activity responsible for the QPL is WL/MLSE, Wright-Patterson AFB OH 45433-6533, and information pertaining to qualification of products may be obtained from that activity.

6.3.1 Qualification information. It is understood that the material furnished under this specification subsequent to final approval shall be of the same composition and shall be equal to products upon which approval was originally granted. In the event that the fluid furnished under contract is found to deviate from the composition of the approval product, or that the product fails to perform satisfactorily, approval of such products will be subjected to immediate withdrawal from the QPL.

6.4 Standard rubber samples. Samples of the standard synthetic rubber NBR-L (see 3.3.4) for the test specified in table VII may be obtained from either Precision Rubber Products, Phoenix AZ, or the University of Akron, Akron OH.

6.5 International standardization agreements. Certain provisions of this specification (see 1.1) are the subject of international standardization agreements, ASCC Air Standard 15/1 and NATO STANAG 1135. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international channels, including departmental standardization offices, to change the agreement or make other appropriate accommodations.

6.6 Contractual notes. In addition to Qualification and Quality Conformance Testing, the Air Force will perform final acceptance testing on each contract awarded. Specific requirements and instructions addressing this matter will be called out in each contract. Questions in regard to this action should be forwarded to: Commander, SA-ALC/SFTT Kelly AFB TX 78241.

6.7 Disposal actions

6.7.1 Background. The accumulated waste fluid shall be disposed of through a waste oil recovery program unless prohibited by local law. Otherwise the product shall be disposed of in accordance to local law and regulations promulgated by the U.S. Environmental Protection Agency under Public Law 94-580, Resource Conservation and Recovery Act of 1976.

6.7.2 Handling and safety precautions. Personnel handling the product shall wear appropriate impervious clothing to prevent repeated or prolonged skin contact. Local appraisal is required for exact health and safety implications and to prescribe precise application of protective clothing. If skin or clothing becomes moistened with the product, personnel shall promptly wash with soap or mild detergent and water. Respirators are not required unless there is an inhalation exposure to mists. Personnel shall wear protective clothing when using the product and when cleaning up spills.

6.7.3 Depot-type operations. Additionally, the used product, which has been drained from the hydraulic systems, shall be combined with unused, but contaminated fluid from partially full containers and then recycled.

6.7.4 Container disposal. Tops from one-time-use containers shall be discarded with ordinary refuse. Containers shall be made as empty as possible using gravity draining, after which they are to

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be crushed and buried in a permitted sanitary landfill or incinerated with general refuse. No special decontamination procedures are required for empty containers or their lids.

6.8 Subject term (keyword) listing

Airborne engine compressors, Hydraulic fluid for
Aircraft hydraulic fluid
Aircraft and missile hydraulic systems
Fire resistant hydraulic fluid, low temperature
Hydraulic fluid
Hydraulic fluid for aircraft and missiles
Hydraulic system
Missiles hydraulic fluid
Synthetic hydrocarbon base
Synthetic hydraulic fluid

Custodians:
Army – ME
Navy – AS
Air Force – 11

Review Activities:
Army – AV, MI, AR, EA
Navy – SH
Air Force – 68
DLA–PS, GS

User Activities:
Navy – OS
Army – AL

International Interest:
NATO (see 6.5)
ASCC

Preparing Activity:
Air Force – 11

(Project 9150–1088)

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, not to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractural requirements.

I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-H-87257	2. DOCUMENT DATE *(YYMMDD)* 920302

3. DOCUMENT TITLE: HYDRAULIC FLUID, FIRE RESISTANT, LOW TEMPERATURE, SYNTHETIC HYDROCARBON BASE, AIRCRAFT AND MISSILE

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*	b. ORGANIZATION	
c. ADDRESS *(Include Zip Code)*	d. TELEPHONE *(Include Area Code)* (1) Commercial (2) AUTOVON *(If applicable)*	7. DATE SUBMITTED *(YYMMDD)*

8. PREPARING ACTIVITY

A. NAME AF CODE 11	B. TELEPHONE *(Include Area Code)* (1) Commercial: (513) 255-6281 (2) AUTOVON *(If applicable)*: DSN 785-6281
C. ADDRESS *(Include Zip Code)* ASD/ENES WRIGHT-PATTERSON AFB OH 45433-6503	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340