

AEROSPACE MATERIAL SPECIFICATION

SAE

AMS 3185A

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Superseding AMS 3185

Hydraulic Fluid, Nonflammable
Chlorotrifluoroethylene (CTFE) Base

CANCELLATION NOTICE

This specification has been declared "CANCELLED" by the Aerospace Materials Division, SAE, as of September 1999, and has been superseded by MIL-H-53119. The requirements of the latest issue of MIL-H-53119 shall be fulfilled whenever reference is made to the cancelled AMS 3185A. By this action, this document will remain listed in the Numerical Section of the Index of Aerospace Material Specifications noting that it is superseded by MIL-H-53119.

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1. SCOPE:

1.1 Purpose:

This specification covers a nonflammable hydraulic fluid, composed with a chlorotrifluoroethylene (CTFE) base, in the form of a liquid.

1.2 Application:

This fluid has been used typically for hydraulic systems of aircraft and selected armored vehicles for usage in the temperature range -65 to +275 °F (-54 to +135 °C), but usage is not limited to such applications.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measure to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2825	Material Safety Data Sheets
AMS 3217/4	Test Slab, Fluoroelastomer (FKM), 65 - 75

AS4707	Test Methods, Evaluation of Nonflammable, Chlorotrifluoroethylene Base Hydraulic Fluid
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2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 97	Pour Point of Petroleum Oils
ASTM D 130	Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test
ASTM D 240	Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter
ASTM D 445	Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D 664	Neutralization Number by Potentiometric Titration
ASTM D 892	Foaming Characteristics of Lubricating Oils
ASTM D 1405	Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D 1744	Water in Liquid Petroleum Products by Karl Fischer Reagent
ASTM D 2382	Heat of Combustion of Hydrocarbon Fuels by Bomb Calorimeter (High -Precision Method)
ASTM D 4057	Manual Sampling of Petroleum and Petroleum Products
ASTM D 4172	Wear Preventive Characteristics of Lubricating Fluid (Four-Ball Method)

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-R-83485	Rubber, Fluorocarbon Elastomer, Improved Performance at Low Temperatures
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-290	Packaging of Petroleum and Related Products
PPP-C-96	Can, Metal, 28 Gage & Lighter
FED-STD-791	Lubricants, Liquid Fuels, and Related Products; Method of Testing
HSC 29CFR1910.1200	Hazard Communication Standard

3. TECHNICAL REQUIREMENTS:

3.1 Material:

- 3.1.1 Hydraulic fluid shall consist of chlorotrifluoroethylene (CTFE) base fluid with additives to improve lubricity and anti-rust characteristics.
- 3.1.2 Recycled CTFE may be used as base fluid provided it meets all properties shown in Table 1.

TABLE 1 - Properties of CTFE Base Fluid

Property	Value	AS4707 Test Method
Unsaturation, min	60 Minutes	Method 1
Capillary gas chromatography, elution before trimer, max	11%	Method 2

3.1.3 Additives that improve low temperature flow and viscosity-temperature characteristics (pour point depressants and viscosity index improvers) are not permitted.

3.2 Properties:

3.2.1 Base Fluid without Additives: Shall conform to the properties shown in Table 1, determined in accordance with methods and procedures specified in AS4707.

3.2.2 Hydraulic Fluid with Additives: Shall conform to Table 2 and the following; testing shall be performed in accordance with specified test methods:

TABLE 2 - Properties of Hydraulic Fluid

Property	Requirement	FED-STD-791 Test Method	Test Method
3.2.2.1 Viscosity, max			ASTM D 445
At -65 °F (-54 °C)	1200 centistokes		
At 100 °F (37.8 °C)	2.9 centistokes		
At 275 °F (135 °C)	0.60 centistokes		
3.2.2.2 Total Acid Number, oil, max	0.6 mg KOH/g oil		ASTM D 664
3.2.2.3 Lubricity, 4-Ball Wear Scar, max	0.8 mm		ASTM D 4172
3.2.2.4 Vapor Pressure, 250 °F (121 °C), max	13.3	Method 3480	
3.2.2.5 Pour Point, max	-76 °F (-60 °C)		ASTM D 97
3.2.2.6 Corrosion of Copper, max	3A		ASTM D 130
3.2.2.7 Heat of Combustion, max	2750 Kcal/kg		ASTM D 240, ASTM D 1405, ASTM D 2382
3.2.2.8 Hot Manifold Ignition, min	925 °F (496 °C)	Method 6053	
3.2.2.9 Low-Temperature Stability	Pass	Method 3458	
3.2.2.10 Water, max	200 ppm		ASTM D 1744
3.2.2.11 Storage Stability	Pass	Method 3465	

3.2.3 Corrosiveness and Oxidation Stability:

3.2.3.1 Corrosiveness: Shall be as shown in Table 3 after immersion in hydraulic fluid and tested in accordance with FED-STD-791, Method 5308.

TABLE 3 - Corrosion Test Weight Change

Material	Permissible Change
Steel or Aluminum	±0.2 mg/cm ² surface area
Magnesium	±0.2 mg/cm ² surface area
Cadmium	±0.2 mg/cm ² surface area
Copper	±0.6 mg/cm ² surface area

3.2.3.1.1 Test alloys, excluding copper, shall exhibit no pitting, etching, or visible corrosion when viewed at 20X magnification. Corrosion on any one surface of copper specimens shall be no greater than that noted in ASTM D 130. Copper Corrosion Standard 3a.

- 3.2.3.2 Oxidation: Shall be as follows when tested in accordance with FED-STD 791, Method 5308. Fluid shall not have changed more than 5% from the original viscosity at 104 °F (40 °C) after the test of 3.2.3.1. Total acid number shall not have increased more than 0.20 from the original sample. No evidence of separation of insoluble materials or gumming of the fluid shall be present.
- 3.2.4 Swelling: Volume increase of MIL-R-83485, AM. 1, Type II synthetic rubber (fluorocarbon elastomer) or AMS 3217/4, caused by fluid exposure, shall be within the range of 25 to 45 percent, determined in accordance with FED-STD 791, Method 3603.
- 3.2.5 Solid Particle Contamination: Shall not be greater than shown in Table 4, when tested in a clean, dust-free atmosphere using an automatic particle counter.

TABLE 4 - Solid Contaminant Particles per 100 mL

Particle Size Range Largest Dimension µm	Maximum Allowable Number Each Determination Automatic Count
5 to 15	10000
16 to 25	1000
26 to 50	150
51 to 100	20
Over 100	5

- 3.2.5.1 Directions shall be followed as noted in the manual for the particle counter actually used.
- 3.2.6 Foaming Characteristics: Foam volume at end of five-minute blowing period shall be no greater than 65 mL, determined at 77 °F (25 °C) in accordance with ASTM D 892. Foam shall have completely collapsed after 10 minutes settling period. Complete collapse is observed as a ring of small bubbles around the edge of the graduate.
- 3.2.7 Compatibility: Hydraulic fluid shall be miscible in all proportions with each AS4707 approved fluid when tested in accordance with 4.5.1. Compatibility is evidenced when no formation of resinous gums, sludges, or insoluble materials are noted.
- 3.2.8 Thermal Stability: Changes from the original values of fresh fluid shall not exceed the values shown in Table 5, determined in accordance with AS4707, Method 3.

TABLE 5 - Thermal Stability

Property	Maximum Change
Change from original viscosity centistokes, 104 °F (40 °C)	5%
Total Acid Number	0.20 mg KOH/g
Change in weight of steel balls	±0.2 mg/cm ² of surface area
Change in weight of naval bronze	±0.5 mg/cm ² of surface area

- 3.2.8.1 No pitting, etching, or visible corrosion on the steel balls is permitted. Presence of black particles in the post test fluid shall cause the fluid to be subject to rejection. Bomb weight loss of greater than 0.500 gram shall cause the test to be declared invalid.
- 3.2.9 Corrosion Protection: Test panels immersed in hydraulic fluid shall show no more visible corrosion and no greater weight change than the referenced panels immersed in Standard Reference Fluid A, determined in accordance with AS4707, Method 4.
- 3.2.10 Bulk Modulus: Isothermal secant bulk modulus of the finished fluid at 104 °F (40 °C) and 4.0 ksi (28 MPa) shall be not less than 180 ksi (1241 MPa), determined in accordance with AS4707, Method 5.
- 3.2.11 Examination of Filled Containers: Shall be in accordance with MIL-STD-290 with regard to fill, closure, sealing, leakage, packaging, packing, and marking. Any container with one or more defects shall be rejected. Defective or underfilled containers exceeding the acceptance number for the appropriate sampling plan of MIL-STD-105 shall be cause for rejection of all samples.
- 3.2.12 500-Hour Pump Endurance Tests: Pump and fluid shall meet the requirements shown in Table 6, determined in accordance with AS4707, Method 6.

TABLE 6 - Fluid Sample Criteria

Determination	Limit
Fluid Appearance	No observed cloudiness
Kinematic Viscosity Change, max	10 % cSt at 104 °F (40 °C)
Total Acid Number max	1.5 mg KOH/g
Capillary Gas Chromatography, max	2 % New Peaks
Water, change, max	500 ppm
Metal Analysis	Report

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The manufacturer of hydraulic fluid shall supply all samples when required for manufacturer's tests and shall be responsible for performing all required tests. Parts, if required for tests, shall be supplied by purchaser. Manufacturer may utilize his own or any other inspection facilities and services acceptable to purchaser. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the hydraulic fluid conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Requirements shown in Table 7 are acceptance tests and shall be performed on each lot.

TABLE 7 - Acceptance Tests

Requirement	Paragraph Reference
Saturation (base fluid)	3.2.1
Viscosity	3.2.2.1
Total Acid Number	3.2.2.2
Lubricity	3.2.2.3
Low-Temperature Stability	3.2.2.9
Water Content	3.2.2.10
Solid Particle Contamination	3.2.5
Foaming Characteristics	3.2.6

4.2.2 Preproduction Tests: All technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of the fluid to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing:

Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient fluid shall be taken in accordance with ASTM D 4057 from each lot to perform all required tests. Except as otherwise specified, the number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.