

MIL-H-81019D  
 30 March 1984  
 SUPERSEDING  
 MIL-H-81019C  
 17 April 1968

## MILITARY SPECIFICATION

### HYDRAULIC FLUID, PETROLEUM BASE, ULTRA-LOW TEMPERATURE, METRIC

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 a petroleum base hydraulic fluid for use in aircraft, missile and ordnance hydraulic systems in the -70° to +100°C temperature range.

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

#### SPECIFICATIONS

##### FEDERAL

- |          |   |                                  |
|----------|---|----------------------------------|
| TT-T-656 | - | Tricresyl Phosphate.             |
| PPP-C-96 | - | Can, Metal, 28 Gage and Lighter. |

##### MILITARY

- |            |   |   |
|------------|---|---|
| MIL-H-5606 | - | Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance. |
|------------|---|---|

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733, 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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## STANDARDS

## FEDERAL

- FED-STD-313 - Material Safety Data sheets, Preparation and the Submission of
- FED-STD-791 - Lubricants, Liquid Fuel, and Related Products, Method of Testing

## MILITARY

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

2.1 2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specifications to the extent specified herein.

## PUBLICATIONS

## CODE OF FEDERAL REGULATIONS

- 49 CFR - Transportation - Hazardous Materials.

(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 contracting 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. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

## AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- ASTM D 92 - Flash and Fire Points by Cleveland Open Cup.
- ASTM D 97 - Pour Point of Petroleum Oils.
- 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 Oil.
- ASTM D 972 - Evaporation Loss of Lubricating Greases and Oils.
- ASTM D 1500 - ASTM Color of Petroleum Products (ASTM Color Scale).
- ASTM D 1744 - Water in Liquid Petroleum Products by Karl Fischer Reagent.
- ASTM D 4057 - Manual Sampling of Petroleum and Petroleum Products
- ASTM D 4172 - Wear Preventive Characteristics of Lubricating Fluid (Four-Ball Method).

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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) (continued)

- ASTM D 4177 - Automatic Sampling of Petroleum and Petroleum Products
- ASTM F 313 - Insoluble Contamination of Hydraulic Fluids by Gravimetric Method.

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI Z129.1 - American National Standard for the Precautionary Labeling of Hazardous Industrial Chemicals.

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, NY 10018.)

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

### 3 REQUIREMENTS

3.1 Qualification. The hydraulic fluid 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).

3.2 Materials. The hydraulic fluid shall be clear and transparent, consisting of petroleum products with additive materials to improve the viscosity-temperature characteristics, resistance to oxidation, corrosion and anti-wear properties of the finished product.

#### 3.3 Additives.

3.3.1 Viscosity-temperature coefficient improvers. Polymeric materials may be added to the petroleum base in quantities not to exceed 10 percent by weight of active ingredient in order to adjust the viscosity of the finished fluid to the values specified in 3.4.

3.3.2 Oxidation inhibitors. Oxidation inhibitors may be added to the petroleum base in quantities not to exceed 2 percent by weight.

3.3.3 Corrosion inhibitors. Corrosion inhibitors may be added to the petroleum base in quantities necessary to comply with the requirements of this specification.

3.3.4 Anti-wear agent. Anti-wear agents, such as tricresyl phosphate conforming to TT-T-656, shall be blended in sufficient quantity to permit the finished fluid to meet the lubricity requirements specified in table I. When tricresyl phosphate is used, it shall contain not more than 1 percent of the ortho-isomer.

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3.4 Chemical and physical properties. The chemical and physical properties of the fluid shall be as specified in table I.

3.5 Material safety data sheets. Material safety data sheets shall be prepared and submitted in accordance with FED-STD-313. Material safety data sheets shall also be forwarded as specified in 4.3.2. The grease shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the contracting activity to the appropriate departmental medical service who will act as an advisor to the contracting agency (see 4.3.2 and 6.2 1e).

3.6 Workmanship. The hydraulic fluid shall be free from oil, dirt, lint, sediment, and lumps of undissolved additives.

#### 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 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 assure supplies and services conform to prescribed requirements.

4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.3).
- b. Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall consist of a review of the test report (see 4.3.2) for approval and by testing to determine that the qualification inspection sample (see 4.3.1) complies with all the requirements for the chemical and physical properties specified in table I when tested in accordance with the inspection methods specified in table III and 4.6.3 through 4.6.4.5

4.3.1 Qualification inspection sample. The qualification sample, taken in a clean-room environment, shall consist of three 3.785 litre (1 gallon) containers of hydraulic fluid, 100 mg of the red dye, 0.237 litres (8 oz) of the additive used for improving the viscosity-temperature coefficient, 0.237 litres (8 oz) of the anti-wear agent, and 0.03 litres (1 oz) of the compounds used for improving oxidation and corrosion stability. In the event that additives are supplied as concentrated solutions, an equivalent quantity of the solution shall be furnished. The samples shall be forwarded to the Aircraft and Crew Systems Technology Directorate, Code 60612, Naval Air Development Center, Warminster, PA 18974. The sample shall be plainly identified by a securely attached durable tag or label marked with the following information:

Sample for qualification inspection.  
 HYDRAULIC FLUID, PETROLEUM BASE, ULTRA-LOW TEMPERATURE  
 Name of ingredient (for ingredient material) (see 4.3.2.1)  
 Name of manufacturer  
 Product code number  
 Date of manufacture

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Submitted by (name) (date) for qualification inspection in accordance with MIL-H-81019D under authorization of (reference authorizing letter) (see 6.3)

4.3.2 Test reports. Two copies of the manufacturer's test report, containing complete quantitative test data showing that material submitted for qualification conforms to the requirements of this specification, shall be submitted with the qualification sample. The test report shall also contain complete information as to the source of additive materials used, the formulating and composition of the finished fluid (see 4.3.2.1). Location and identity of the plant which produced the sample tested shall also be supplied. Material safety data sheets on toxicity (see 3.5) shall be prepared in accordance with FED-STD-313 and submitted to the qualifying laboratory (see 4.3.1).

4.3.2.1 Formulation sheets. An example of a satisfactory form for the formulation sheets, indicating the percentage and purpose of each ingredient, is as follows:

Viscosity -temperature coefficient improvers (composition)	percent
Corrosion inhibitors (composition)	percent
Anti-wear additive (manufacturer's name and no.)	percent
Oxidation inhibitor (manufacturer's name and no.)	percent
Other additives	percent

4.3.3 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 of the hydraulic fluid shall consist of tests of samples from 4.4.2.2 in accordance with table IV and 4.6.2, samples for determination of solid particle contamination from 4.4.2.3 in accordance with table IV and an examination of samples from 4.4.2.1 for conformance with 4.6.1. Samples shall be labeled completely with information identifying the purpose of the sample, name of product, specification number, lot and batch number, date of sampling and contract number.

4.4.1 Lot formation. A lot shall consist of all the hydraulic fluid produced by one manufacturer, at one plant, from the same materials and under essentially the same conditions, provided the operation is continuous and does not exceed a 24 hour period. In the event the process is a batch operation, each batch shall constitute a lot (see 6.4).

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4.4.2 Sampling.

4.4.2.1 For examination of filled containers. A random sample of filled unit and shipping containers, fully prepared for delivery, shall be selected from each lot of hydraulic fluid in accordance with MIL-STD-105, inspection level II with an acceptable quality level (AQL) of 2.5 percent defective.

4.4.2.2 For tests. The sample for tests shall be a composite sample of the hydraulic fluid of sufficient quantity to perform all the quality conformance tests specified in table IV. This sample shall be selected from each lot in accordance with ASTM D 4057 or ASTM D 4177. The lot shall be unacceptable if the sample fails to comply with any of the requirements for the tests specified in table IV.

4.4.2.3 Sample for determination of solid particle count. 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-4. The sample size and number of determinations shall be as specified in table V

4.5 Inspection and test conditions.

4.5.1 Inspection. Inspection shall be in accordance with method 9601 of FED-STD-791.

4.5.2 Test conditions. Test conditions shall be in accordance with 4.6 and physical and chemical values specified in section 3 apply to the average of the determinations made on the samples for those values which fall within any stated repeatability or reproducibility limits of the applicable test method

4.6 Methods of examinations and tests.

4.6.1 Examination of filled containers. Each of the filled containers selected in accordance with 4.4.2.1 shall be examined for defects of construction of the container and closure, evidence of leakage, for evidence of unsatisfactory markings, and net content to determine conformance with 5.1 and 5.2. 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.

4.6.2 Tests. Tests shall be performed in accordance with table III and 4.6.3 through 4.6.4.5 to determine conformance with requirements specified in section 3.

4.6.3 Color of finished fluid. The color of the finished hydraulic fluid shall be compared with a standard sample prepared by adding 1 part of dye "oil red 235" to 10,000 parts of an oil not darker than ASTM D 1500 color number 1.0.

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

4.6.4 Shear stability. The shear stability is determined by subjecting a convenient volume of the hydraulic fluid to irradiation by sonic oscillation for a fixed period of time and the change in viscosity is determined in accordance with ASTM D 445. A standard polymer containing oil is run frequently to assure performance of the equipment. The shear stability shall be determined as follows:

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4.6.4.1 Apparatus The apparatus shall consist of the following:

- a. Ultrasonic generator and probe (a unit made by Wave Energy Systems, Inc., Newtown PA, designated model WW201 with Titanium Horn has been found satisfactory).
- b. Laboratory platform support, "Big Jack" (Arthur H. Thomas catalog no. 8854-J40 has been found satisfactory).
- c. Sample jars, 120 ml, wide mouth (Arthur H. Thomas catalog no. 3852 or equivalent).
- d. Sound-proof box for sample treatment.
- e. Water bath, 203 mm diameter by 67 mm deep (Arthur H. Thomas catalog no. 9816-B15 or equivalent).
- f. Timer, automatic, such that irradiation times can be preset in the range from 1 to 60 minutes, (Gralab model 171, Denico Gray Company, Dayton, Ohio, is suitable)

4.6.4.2 Reference fluid. A reference fluid is necessary for calibration of equipment. ASTM reference fluid A has been used as the primary reference fluid. This fluid is a petroleum oil containing a polymer capable of being broken down by turbulence at high rates of shear. The reference fluid contains 7.8 percent by weight of polymer concentrate and the following typical properties:

<u>Temperature</u>	<u>Viscosity, m<sup>2</sup>/s</u>
99 C	11 x 10 <sup>-6</sup>
38 C	62 x 10 <sup>-6</sup>

4.6.4.3 Calibration of apparatus. The reference fluid provides a practical way of defining the performance, or level of severity, of an ultrasonic generator so that satisfactory comparisons can be made between tests run on different days with the same unit, or between tests run with different units. The procedure described below is intended to establish a repeatable performance level for a given unit

- a. With the instrument set for proper operation in accordance with the manufacturer's instructions, make three successive runs on 30 ml samples of the reference fluid using a power setting of 40 watts, but varying the time of treatment, e.g., 10 minutes, 20 minutes, 30 minutes (samples must be cooled in ice bath during irradiation). For each run, calculate the percentage loss in viscosity at 40°C. From a plot of percentage loss in viscosity versus time, find the irradiation time necessary to produce a stated loss in viscosity, for example 15 percent. Use this time setting for subsequent tests run that day. Future calibration work may be facilitated by adjusting the irradiation time as indicated by an initial run for this predetermined time period. This method of standardizing the operating severity level of the apparatus makes it possible to compare results obtained on different days.
- b. This procedure may be used to establish severity levels appropriate for the requirements of a number of specific applications. Larger sample sizes of course will require either a higher power setting or a

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longer treatment time. Once the conditions for a given level of severity has been established, it is possible to compare the shear stability of fluids at one or many irradiation times.

4.6 4.4 Test procedure. The hydraulic fluid sample shall be tested as follows:

- a. Use a syringe and transfer 30 ml of the sample to a 120 ml, wide mouth glass jar. Place the jar in an ice water bath centered on the platform of the laboratory jack inside the soundproof treatment box. Raise the jack until the probe is immersed 3 to 5 mm into the sample (see figure 1).
- b. Close the treatment box and turn on the generator unit. Adjust the total power output with the power control to 40 watts. Start the time and continue shearing for the time previously determined necessary to produce a 15 percent viscosity loss in the reference fluid.
- c. When shearing is complete, shut off the unit. Open the treatment box, lower the jack and remove the jar containing the sheared sample. Wipe off probe tip with clean tissue.
- d. Determine viscosity at 40°C and at -40°C in accordance with ASTM D 445.

4 6 4.5 Calculation. Calculate the percentage loss of viscosity as follows:

$$\text{Percent viscosity loss} = \frac{V_o - V_f}{V_o} \times 100$$

where:

$V_o$  = Viscosity, cst of oil before irradiation.

$V_f$  = Viscosity, cst of oil after irradiation.

## 5 PACKAGING

5.1 Packaging and packing. The packaging and packing of the hydraulic fluid shall be in accordance with MIL-STD-290. The levels of packaging and packing shall be as specified (see 6.2.1). Unless otherwise specified, the fluid shall be furnished in 0.946 litre (1 quart) and 3.785 litre (1 gallon) metal cans conforming to type I of PPP-C-96. All materials used in the construction of the containers shall be such as to 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 insure absolute absence of loose solder, dirt, fibers, lint, metal particles, seaming compound, corrosion products, water or 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 very 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



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5.2 Marking. The marking of the hydraulic fluid containers shall be in accordance with MIL-STD-290 and Title 49 of the Code of Federal Regulations and shall include date of delivery (month and year). Unit and intermediate containers, including unit containers that serve as shipping containers, such as pails and drums shall be marked with the applicable precautionary marking detailed in ANSI 2129.1. In addition to any special marking required in the contract or order, the unit containers shall be marked with the following information:

INSTRUCTIONS

DESTROY THIS CONTAINER WHEN EMPTY THIS FLUID IS NOT INTERCHANGEABLE WITH ANY OTHER TYPE OR GRADE OF HYDRAULIC FLUID.

## 6. NOTES

6.1 Intended use The hydraulic fluid is intended for use in automatic pilots, shock absorbers, brakes, flap-control mechanisms, missile hydraulic servo-controller 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 -60° to 50°C.

6.1.2 Fluid interchangeability This fluid is not interchangeable with any other type or grade of hydraulic fluid other than MIL-H-5606 in emergencies.

6.2 Ordering data

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this specification
- b. Type and size of containers (see 5.1).
- c. Quantity.
- d. Selection of applicable levels of packaging and packing with requirements in detail (see 5.1).
- e. Specify DAR clauses 7-104.98 and 1-323 2.

6.2.2 Purchase unit. 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.

6.3 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 Qualified Products List (QPL-81019) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, 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

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purchase orders for the products covered by this specification. The activity responsible for the qualified products list is Commander, Naval Air Systems Command, Attn: AIR-5304C, Department of the Navy, Washington, DC 20361; however, information pertaining to qualification of products and letter of authorization for submittal of sample may be obtained from the Aircraft and Crew Systems Technology Directorate, Code 60612, Naval Air Development Center, Warminster, PA 18974.

6.3.1 Qualification information. It is understood that the material furnished under this specification subsequent to final approval should 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 approved product, or that the product fails to perform satisfactorily, approval of such products will be subject to immediate withdrawal from the Qualified Products List

6.4 Batch A batch is defined as that quantity of material which has been manufactured by some unit chemical process and subjected to some physical mixing operation intended to make the final product substantially uniform

6.5 Standard rubber samples. Samples of the standard synthetic rubber NBR-L (see table I) for the test specified in table III may be obtained from the Precision Rubber Products Corp. Aerospace Division, 1217 South 26 Place, Phoenix, AZ 85035.

6.6 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - MI  
Navy - AS  
Air Force - 20

Preparing activity:

Navy - AS  
(Project No. 9150-0607)

Review activities:

Air Force - 99  
DLA - PS, GS

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TABLE I. Chemical and physical properties.

Characteristics	Requirement
Color of finished fluid <u>1/</u>	Equal to standard
Viscosity, (m <sup>2</sup> /s) at:	
100°C, minimum	2.5 x 10 <sup>-6</sup>
40°C, minimum	7.0 x 10 <sup>-6</sup>
-54°C, maximum	800 x 10 <sup>-6</sup>
-70°C, maximum	0.008
Pour point, °C, maximum	-75
Flash point, °C, minimum	95
Fire point, °C, minimum	110
Neutralization number, maximum	0.20
Evaporation, percent, weight loss, at 70° ± 1°C, maximum	12
Swelling of synthetic rubber, percent	19.0 - 28.0
Water content, parts per million, maximum	200
Corrosiveness, maximum change in weight, milligrams (mg) per square centimeter of surface: <u>2/</u>	
Steel	± 0.2
Aluminum Alloy	± 0.2
Magnesium Alloy	± 0.2
Cadmium-plated steel	± 0.2
Copper	± 0.6

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TABLE I. Chemical and physical properties. - Continued

Characteristic	Requirement
Resistance to oxidation: <u>3/</u> Viscosity, m <sup>2</sup> /s, percent change from original, at 40°C, maximum	-5 or +20
Neutralization number, change from original, maximum	0.20
Low temperature stability, at -54° ± 1°C, for 72 hours	<u>4/</u>
Shear stability: Viscosity, m <sup>2</sup> /s, percent decrease, from original at 40°C and -40°C	<u>5/</u>
Neutralization number, change from original, maximum	0.20
Copper strip corrosion	Less than number 2 of the ASTM copper strip corrosion standard
Solid particle contamination, per 100 ml of fluid: <u>6/</u> Number of solid contaminant particles	Shall not exceed the allowable number specified in table II
Weight of residue, mg, maximum	0.3
Foaming characteristics, at 25°C, foam volume, ml, at the end of: Five minute blowing period, maximum	65
Ten minute settling period <u>7/</u>	Complete collapse
Lubricity, mm, maximum	1.0
Storage stability after 12 months	<u>8/</u>

- 1/ There shall be no readily discernable difference in the color of the finished fluid and the standard color
- 2/ There shall be no pitting, etching, nor visible corrosion on the surface of the metals, when viewed under magnification of 20 diameters. Any corrosion on the copper surface shall be not greater than number 3 of the ASTM copper strip corrosion standards. A slight discoloration of the cadmium shall be permitted.
- 3/ There shall be no evidence of separation of insoluble materials nor gumming of the fluid.

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TABLE I. Chemical and physical properties. - Continued

- 4/ There shall be no evidence of gelling, crystallization, solidification or separation of the ingredients. Any turbidity shall not be greater than that shown by the turbidity standard.
- 5/ Shall be no greater than the percentage viscosity decrease of the shear stability reference fluid.
- 6/ The filtering time for each determination shall be 15 minutes maximum.
- 7/ A ring of small bubbles around the edge of the graduate shall be considered complete collapse
- 8/ There shall be no evidence of separation of the ingredients or crystallization; the fluid shall be clear and transparent; and shall conform to the requirements of section 3.

TABLE II. Solid contaminant particles.

Particle size range (largest dimension), microns	Maximum allowable number microscopic count	Each determination, automatic count
5 - 15	2,500	10,000
16 - 25	1,000	1,000
26 - 50	250	150
51 - 100	25	20
Over 100	10	5

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TABLE III. Inspection methods.

Characteristic	Test method	
	FED-STD-791	ASTM
Viscosity	-	D 445
Pour point	-	D 97
Flash point	-	D 92
Fire point	-	D 92
Neutralization number	-	D 664
Evaporation <u>4/</u>	-	D 972
Swelling of synthetic rubber <u>1/</u>	3603	-
Water	-	D 1744
Corrosiveness and oxidation stability	5308	-
Low temperature stability	3459	-
Copper strip corrosion <u>2/</u>	5325	-
Solid particle contamination <u>3/</u>	3009	-
Foaming	-	D 892
Lubricity	-	D 4172
Storage stability	3465	-

1/ Use standard rubber NBR-L (see table I and 6.5) within 6 months of date of manufacture.

2/ Three copper strips shall be tested. The copper strips shall be placed individually in test tubes or other suitable containers so that they shall be immersed in 90 ml of the hydraulic fluid. Each fluid container, equipped with an air condenser, shall be immersed in a constant temperature bath capable of maintaining the fluid temperature at  $120^{\circ} \pm 3^{\circ}\text{C}$ . After 72 hours at this test temperature, the strips shall be removed from the fluid, rinsed in sulfur-free acetone, and compared with the ASTM copper strip corrosion standards

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. A gravimetric determination shall also be made, by ASTM F 313, using a 0.45 micron filter membrane

4/ Test shall be run for 4 hours

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TABLE IV. Quality conformance tests.

Inspection	Paragraph	
	Requirement	Test method
Color of finished fluid	3.4	4.6.3
Viscosity	3.4	4.6.2
Pour point	3.4	4.6.2
Flash point	3.4	4.6.2
Fire point	3.4	4.6.2
Neutralization number	3.4	4.6.2
Evaporation	3.4	4.6.2
Water content	3.4	4.6.2
Low temperature stability	3.4	4.6.2
Copper strip corrosion	3.4	4.6.2
Solid particle contamination	3.4	4.6.2
Foaming characteristics	3.4	4.6.2
Lubricity	3.4	4.6.2
Examination of filled container	5.1 and 5.2	4.6.1

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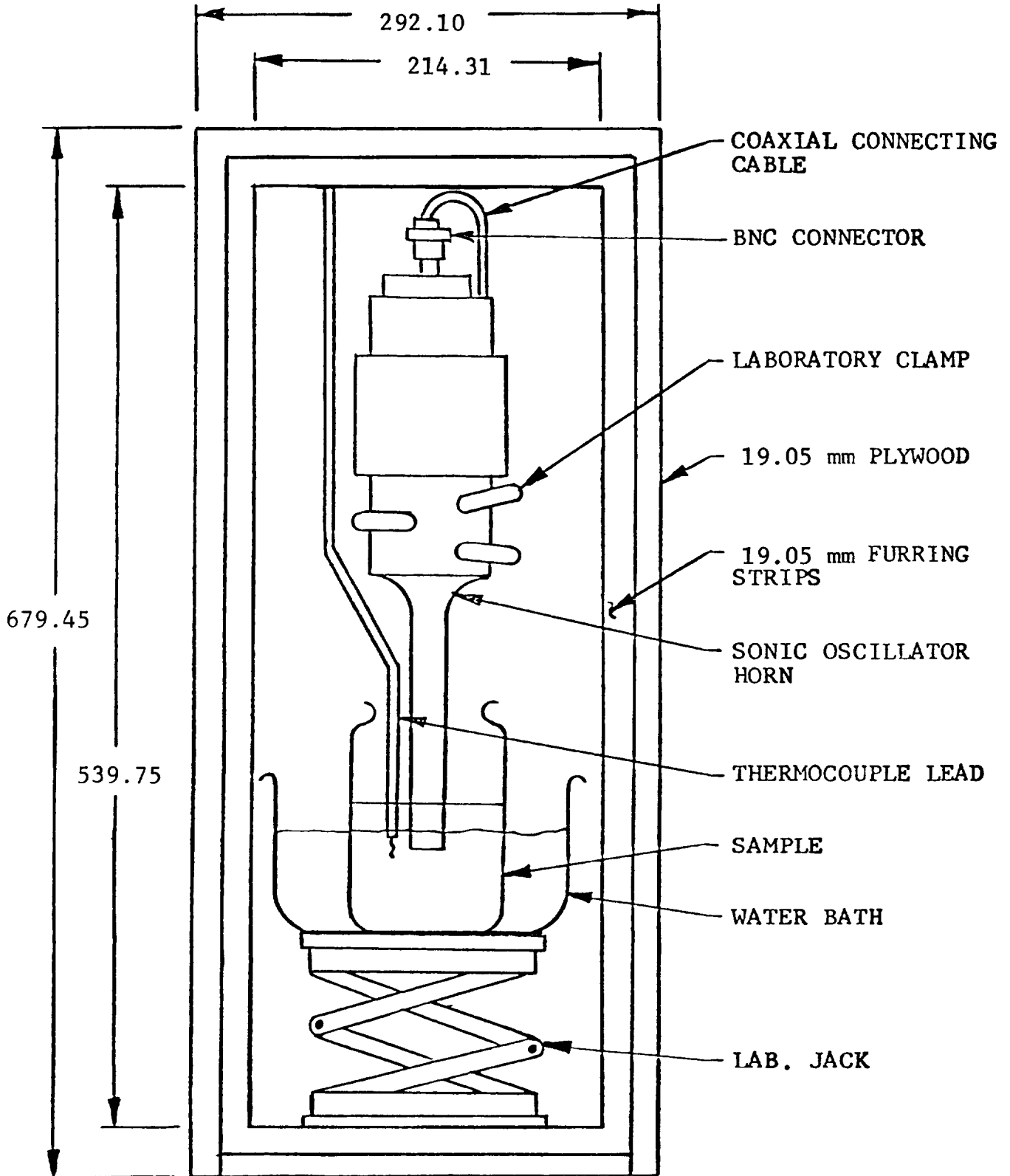
TABLE V Sample for particle contamination.

Container	Sample size, ml <u>1/</u>	Number of determinations per sample
1 quart	100	1
1 gallon	200	2
5 gallon	300	3
55 gallon	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, 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.



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## NOTES:

1. Inside of box including door, covered with 12.7mm insulation.
2. Dimensions are in millimeters.

FIGURE 1. Sonic shear test apparatus.

**INSTRUCTIONS** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the top edge (DO NOT STAPLE), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

**NOTE** This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification 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 contractual requirements.

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DEPARTMENT OF THE NAVY  
Commanding Officer  
Naval Air Engineering Center  
Engineering Specifications and Standards Department  
(ESSD), Code 93  
Lakehurst, NJ 08733



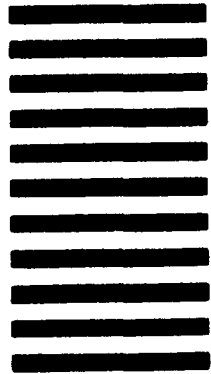
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## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

*(See Instructions - Reverse Side)*

1 DOCUMENT NUMBER MIL-H-81019D	2 DOCUMENT TITLE Hydraulic Fluid, Petroleum Base, Ultra-Low Temperature, Metric
3a. NAME OF SUBMITTING ORGANIZATION	4 TYPE OF ORGANIZATION <i>(Mark one)</i> <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER <i>(Specify)</i> _____
b ADDRESS <i>(Street, City, State, ZIP Code)</i>	
5 PROBLEM AREAS	
a. Paragraph Number and Wording	
b. Recommended Wording	
c. Reason/Rationale for Recommendation	
6 REMARKS	
7a. NAME OF SUBMITTER <i>(Last First MI)</i> - Optional	b. WORK TELEPHONE NUMBER <i>(Include Area Code)</i> - Optional
c. MAILING ADDRESS <i>(Street City State ZIP Code)</i> - Optional	8. DATE OF SUBMISSION (YYMMDD)