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25 March 1986
SUPERSEDING
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10 February 1982

MILITARY SPECIFICATION

HYDRAULIC FLUID, FIRE RESISTANT, SYNTHETIC HYDROCARBON BASE, AIRCRAFT, METRIC, NATO CODE NUMBER H-537

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 general requirements for a synthetic hydrocarbon base hydraulic fluid for use in the -40°to +205°C temperature range in aircraft and missile hydraulic systems. The fluid is also used in airborne engine compressors and related equipment. This hydraulic fluid is identified by NATO Code Number H-537 (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 solication.

SPECIFICATIONS

FEDERAL

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Systems Engineering and Standardization Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733-5100, 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

SPECIFICATIONS (continued)

MILITARY

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

STANDARDS

FEDERAL

FED-STD-313	-	Material Safety Data Sheets, Preparation and Submission of
FED-STD-791	-	Lubricant, Liquid Fuel 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.

* 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.

(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 officer)

* 2 2 Other 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 shall be those listed in the issue of the DODISS specified in the solication Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solication.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

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

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

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 Oils
ASTM D 1298	-	Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
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 4172	-	Wear Preventive Characteristics of Lubricating Oil (Four-Ball Method)
ASTM D 4057	-	Manual Sampling of Petroleum and Petroleum Products
ASTM D 4177	-	Automatic Sampling of Petroleum and Petroleum Products
ASTM E 659	-	Autoignition Temperature of Liquid Chemicals
ASTM F 313	-	Insoluble Contamination of Hydraulic Fluids by Gravimetric Analysis

(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, 400 Commonwealth Dr , Warrendale, PA. 15096)

* (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 associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained

3 REQUIREMENTS

3 1 Qualification The hydraulic fluid furnished under this specificaton 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 the hydraulic fluid shall consist of a synthetic hydrocarbon base stock (see 3 2 1), and shall contain additives as specified in 3 2 2 The hydraulic fluid shall contain no admixture of resins, soaps, gums, fatty oils or oxidized hydrocarbons

* 3 2 1 Base stock requirements. The properties of the synthetic hydrocarbon base stock used in formulating the finished fluid, before the addition of any other ingredients required herein, shall be as designated in Table I when tested as specified in 4.5.

3 2 2 Additives There shall be no restriction on the types of materials used as additives in the fluid except those listed and those imposed by the technical requirements of this specification No pour point depressant materials or viscosity index improvers may be used.

3 2 2 1 Oxidation inhibitors. Oxidation inhibitors of the phenolic type shall be added to the base oil in quantities not to exceed 2 0 percent by weight

* 3.2 2 2 Anti-wear agent Anti-wear agents, such as tricresyl phosphate (TCP) conforming to TT-T-656, shall be blended in sufficient quantity to permit the finished oil to meet the lubricity requirements specified in 3.3 9. When tricresyl phosphate is used, it shall contain not more than three percent total weight TCP and not more than one percent of the ortho-isomer

3 2 2 3 Blending fluid Blending fluids, such as diesters, shall be blended in a quantity not to exceed 33 percent by weight to permit the finished fluid to meet the rubber swell requirements, as specified in 3.3 4, and the viscosity requirements in centistokes at -40°C as specified in Table II.

3.2.2 4 Red dye The fluid shall contain red dye in a concentration not greater than one 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 II and 3 3.1 through 3 3 13

3.3 1 Specific gravity The specific gravity of the hydraulic fluid shall be determined as specified in 4 5 2, but shall not be limited Samples of 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.

3 3.2.1 Corrosiveness 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 be not greater than ± 0.2 milligrams per square centimeter of surface The change in weight of copper under the same conditions shall be not 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 be not greater than No. 3 of the ASTM copper corrosion standards. A slight discoloration of the cadmium shall be permitted.

3.3.2.2 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.

3.3.3 Low temperature stability. When tested as specified in 4.5.2 for 72 hours at a temperature of -40 ± 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 18.0 to 30.0 percent.

3.3.5 Solid particle contamination. When tested in accordance with 4.5.2, the number of solid contaminant particles per 100 ml of the fluid shall not exceed the number specified in Table III, 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 IV when tested as specified in 4.5.2.

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

3.3.8 Flammability.

3.3.8.1 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 8.2 Flame propagation. When tested as specified in 4.5.5, the flame propagation rate shall be not more than 0.30 cm/sec.

3.3.8.3 Effect of evaporation on flammability - wick ignition. When tested as specified in 4.5.2, a minimum of 10 cycles shall be required to produce a self-sustaining flame on the wick.

3.3.9 Lubricity. When tested in accordance with 4 5.2, wear values for hydraulic fluid shall be as specified in Table V.

3.3.10 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.

3.3.11 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 fluids in all proportions from -40°C to 135°C, in that no formation of resinous gums, sludges or insoluble materials will occur.

3.3.12 High temperature stability. When tested in accordance with 4.5.6, the change in fluid viscosity at 40°C shall not exceed 5 percent; neutralization number of the fluid shall not increase more than 0.1 and there shall be no formation of precipitate or insoluble material.

3.3.13 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 4.5.7.

* 3 4 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 4.3.1. Questions pertinent to the effect of MIL-H-83282 hydraulic fluid on the health of personnel, when used for its intended purpose, shall be referred by the acquiring activity to the appropriate medical service who will act as adviser to the acquiring activity (see 4.4.6 and 6.2 le).

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

* 4.1.1 Responsibility for Compliance. All items must 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 assuring that all products of supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material

4 2 Classification of inspection. The inspection requirements specified herein are classified as follows

a. Qualifcation inspection (see 4 3)

b. Quality conformance inspection (see 4.4).

4 3 Qualification inspection. Qualification inspection shall consist of a review for approval of the submitted manufacturer's test report and subjecting the qualification samples (see 4.3 1) to examination and testing for all the requirements of this specification

* 4.3.1 Qualification samples. The qualification sample shall consist of two 1-gallon containers of the finished fluid, two quarts of the base stock without additives, two quarts of the blending fluids used, eight ounces 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. The samples shall be accompanied by a test report from the manufacturer or a commercial laboratory containing complete information as to the 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. When the material safety data sheet is a requirement, one copy shall accompany the samples being submitted for test. The samples, material safety data sheets and reports shall be forwarded to the Aircraft and Crew Systems Technology Directorate, Code 60612, Naval Air Development Center, Warminster, PA 18974 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, SYNTHETIC HYDROCARBON BASE, AIRCRAFT, METRIC, NATO CODE NUMBER H-537
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-83282C under authorization of (reference authorizing letter) (see 6.3)

4.3.1.1 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 (composition)	percent
Blending fluid (composition)	percent
Anti-wear additive (manufacturer's name and no.)	percent
Oxidation inhibitor (manufacturer's name and no.)	percent
Other additives	percent

4.3 2 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 a sample for tests (see 4.4.3), samples for examination of filled containers (see 4.4.4), samples for determination of solid particle count (see 4.4 5), and the tests specified in Table VI. 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. Unless otherwise specified, sampling of the hydraulic fluid shall be in accordance with MIL-STD-105.

4.4.1 Bulk lot. A bulk lot (batch) is an indefinite quantity of a 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.

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

* 4.4.3 Sample for tests. Take samples for tests in accordance with ASTM D 4057 or ASTM D 4177. This sample shall be subjected to all the applicable quality conformance tests. If the sample for tests fails any of the quality conformance tests, the inspection lot shall be rejected. In addition, a random sample of base oil shall be selected for each lot of the finished fluid and shall be subjected to all the applicable quality conformance tests for base oil.

4.4.4 Sample for examination of filled containers. A random sample of filled unit containers and a sample of shipping containers fully prepared for delivery shall be selected from each lot of fluid in accordance with MIL-STD-105, Inspection Level II and an Acceptable Quality Level (AQL) of 2.5 percent defective.

4.4.5 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-3. The sample size and number of determinations shall be as specified in Table VII.

* 4 4.6 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.

4.5 Method of inspection and test.

4.5.1 Inspection. Inspection shall be in accordance with Method 9601 of FED-STD-791 and 4.5.8 of this specification.

4.5.2 Tests. The hydraulic fluid properties shall be determined in accordance with the applicable methods specified in Table VIII and 4.5.3 through 4.5.7. 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.

4.5.3 Compatibility. Samples of candidate hydraulic 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 205°C for 2 hours. At the end of this time, none of the mixtures shall show any signs of sediment, turbidity or crystallization. The samples shall then be stored at -40°C for a period of 2 hours. Slight turbidity, at this time, that later disappears will be permitted in the samples. Compatibility tests described herein shall also be conducted with a representative fluid qualified to MIL-H-5606. Temperature extremes for these latter tests shall be 135°C and -40°C .

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

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

Where:

V is the original volume of the fluid,
ΔV is the observed volume change due to [P increase in pressure,
ΔP is the pressure change between the two measurements in kPa, and
ΔV_g is 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 x 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 Apparatus. Flame propagation rate shall be determined using the apparatus shown schematically in Figure 4. The following additional equipment will be required·

4.5.5.1.1 Recorder. A zero centered fast response strip chart recorder with a ± 5 mv range and a 0 5 second full scale deflection capability has been found to be satisfactory. Chart speed of 7.5 mm per minute is desirable.

4.5.5.1.2 Pair of differential thermocouples. A pair of differential thermocouples, 24 gauge, with bare junctions and fiberglass wrap insulation, ISA Type J (see Figure 4) are required.

4.5.5.1.3 Fume hood A draft free fume hood shall be used so that when the ventilation system is not operative, no draft will occur

4.5.5 1.4 Weights. Two 50 gram weights with attached hooks are required.

4.5.5.1.5 Stainless steel tube or rod. A stainless steel tube or rod, approximately 1.3 cm in diameter and 38 cm in length, shall be used

4.5.5.1.6 Evaporating dish. An evaporating dish, 100 mm diameter, (approximately 125 ml capacity) shall be used.

4.5.5.1.7 Ceramic fiber cord. Ceramic fiber cord, 0.13 cm in diameter, Nextel 312-390, 415, 2 7 TPI, as manufactured by Minnesota Mining Manufacturing Company, St. Paul, MN 55101, or equivalent, shall be used.

4.5.5.1.8 Absorbent paper wipers. Absorbent papers wipers, 38 by 21.6 cm shall be used.

4.5 5.1.9 Matches. A commercially available kind of matches shall be used.

4 5 5.2 Procedure. Assemble the apparatus as shown in Figure 4, and place it in a suitable fume hood. Support the stainless steel rod on a ring stand in a horizontal position, about 60 cm above the table surface Carefully wrap an absorbent paper wiper around the steel rod and secure it to the rod with a small piece of 2 5 cm masking tape. Leave about 10 cm of the rod uncovered by the wiper.

4.5 5.2.1 Tie small loops in each end of a 50 cm section of the ceramic string. Place 50 ml of the hydraulic fluid sample into the evaporating dish. Place string in fluid taking care not to immerse the loops at the ends of the string.

4 5 5.2.2 Allow the string to remain in the fluid for at least 3 minutes.

4.5 5.2.3 Remove the string from the fluid and attach a 50 gram weight to the loop at each end. Hang the soaked string with attached weights over the unwrapped section of the steel rod. Pull down gently on the uppermost weight to cause the soaked string to pass over the bare rod, flexing it gently as it moves When the lower weight has been drawn up to the rod, reverse the process until the first weight has again been drawn up to the rod Repeat the cycle four times to work the sample thoroughly into the string

4.5.5.2.4 Transfer the string to the covered portion of the rod. Pass the string over the absorbent paper in the same manner described in 4.5.5.2.3. After each double cycle, lift the string and rotate it through 180 degrees while it is held taut in a vertical position, and replace it on a fresh area of the absorbent paper. Repeat until four double cycles have been completed.

4.5 5.2.5 Place the prepared string on the test apparatus, with the weights in place to provide tension in the strings Adjust the differential thermocouple junctions so that they are exactly 2 mm above the string

4.5.5 2.6 Start the recorder chart With a match, ignite the sample on the string near its support at one end of the apparatus. Permit the flame to advance along the string past each thermocouple until it extinguishes itself upon reaching the opposite string support Stop the recorder and start the hood to exhaust combustion products Recorder display should be similar to that shown in Figure 5

4 5.5.2 7 Measure the interval between peak maxima on the recorder chart. From the measured interval, the chart speed of the recorder and the known distance between thermocouples in the test apparatus, calculate the linear flame propagation rate in cm/sec. Triplicate runs should be made for each sample Report the average of the three runs as the flame propagation rate for the sample.

$$\text{Linear propagation rate} = \frac{D\ v}{T}$$

Where:

D is the distance between thermocouples in centimeters (see Figure 4)
v is the chart speed in cm/sec.
T is the distance measured from peak to peak (see Figure 5).

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 degree angle adapter (24/40) (Ace Glass Inc , or equivalent); gas inlet tube (6 mm OD pyrex tubing); a high temperature bath, capable of maintaining temperature of 205 ± 2°C.

4.5.6.2 Procedure Place 25 ml of candidate fluid in flask fitted with 75 degrees angle adapter and gas inlet tube. The height of the gas inlet tube should be adjusted to within 1.0 cm above the level of the fluid. Place a 2.5 cm length of .635cm OD stainless steel tubing, Type 304, in the fluid. Heat the fluid for 100 hours at a temperature of 205 ± 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 3.12.

4.5 7 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" to 10,000 parts of an oil not darker than ASTM D 1500 Color Number 1.0.

4.5 7.1 Oil red dye source. "Oil Red 235" is manufactued by Passaic Color and Chemical Company.

4.5 8 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 Preservation and packing The preservation and packing of the hydraulic fluid shall be in accordance with MIL-STD-290. The levels of preservation and packing shall be as specified (see 6.2.1) Unless otherwise specified, the fluid shall be furnished in 1-quart and 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 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 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.

* 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 any other special markings specified by the acquiring activity (see 6.2.1). All unit and intermediate packs of toxic and hazardous chemicals and materials shall also be labeled in accordance with the applicable laws, statutes, regulations or ordinances, including Federal, State and Municipal requirements. In addition unit and intermediate containers, including unit containers that serve as shipping containers, such as pails and drums, shall be marked with the applicable precautionary information detailed in ANSI Z129.1.

6. NOTES

6.1 Intended use. The hydraulic fluid covered by this specification is intended for use from -40°to +205°C in automatic pilots, shock absorbers, air compressor gear boxes, 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 temperature from -40°to +50°C.

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 preservation and packing with requirements in detail (see 5.1).

e. Specify FAR Clauses 52 223-3.

f. Any special markings required (see 5 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 Qualified Products List (QPL-83282) 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 purchase orders for the products covered by this specification. The actvity responsible for the Qualified Products List is the Commander, Naval Air Systems Command, Attn AIR-5304C2, Department of the Navy, Washington, DC 20361; however, information pertaining to qualification of products and letter of authorization 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 Standard rubber samples Samples of the standard synthetic rubber NBR-L (see 3.3.4) for the test specified in Table VIII may be obtained from the Precision Rubber Products Corp. Aerospace Division, 1217 South 26 Place, Phoenix, AZ 85035.

6.5 International standardization agreements. Certain provisions of this specification (see 1.1) are the subject of international standardization agreement, ASCC Air Standard 15/1, NATO STANAG NAT-STD-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 standardization channels, including departmental standardization offices, to change the agreement or make other appropriate accomodations.

* 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, San Antonio ALC, Attn· SFTT, Kelly AFB, TX 78241.

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

* 6.8 Subject term (Keyword) listing.

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

Custodians:
Army - ME
Navy - AS
Air Force - 20

Preparing activity:
Navy - AS

(Project 9150-0741)

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

User:
Navy - OS

International Interest:
NATO (see 6.5)

TABLE I. Properties of synthetic hydrocarbon base stock.

Characteristic	Requirement
Viscosity in centistokes at 100°C minimum	3.5
Viscosity in centistokes at 40°C	Report
Viscosity in centistokes at -40°C maximum	2,600
Flash point,°C minimum	205
Fire point,°C minimum	245
Evaporation, weight percent, maximum	14.0
Neutralization number, maximum	0.10
Specific gravity at 15 6°C/15.6°C	Report
Color number, ASTM, maximum	1.0
Pour point,°C maximum	-55

TABLE II. Properties of the finished fluid.

Characteristic	Requirement
Viscosity in centistokes at 205°C, minimum	1.0
Viscosity in centistokes at 100°C, minimum	3.45
Viscosity in centistokes at 40°C, minimum	14.0
Viscosity in centistokes at -40°C, maximum	2,200
Flash point,°C minimum	205
Fire point,°C minimum	245
Auto-ignition temperature, °C, minimum	345
Neutralization number, maximum	0.10
Evaporation, weight percent, maximum	20.0
Bulk modulus (isothermal secant 0 to 6.9 x 10^4 kP_a) at 40°C kP_a minimum	1.379 x 10^6
Pour point,°C maximum	-55

TABLE III. Solid contaminant particles.

Particle size range (largest dimension), microns	Allowable number (max) 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

TABLE IV Foaming characteristics of hydraulic fluid.

Test	Foaming tendency	Foam stability
	Foam volume, ml, at end of 5 minute blowing period	Foam volume, ml, at 10 minute settling period
at 25°C	65 ml, maximum	Complete collapse 1/

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

TABLE V Wear values.

Load (kg)	Scar diameter mm (max)
1	0 21
10	0 30
40	0 65

TABLE VI 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	4.5.2
Foaming characteristics	3.3.6	4 5.2
Water	3.3.7	4 5.2
Effect of evaporation on flammability	3 3.8.3	4.5.2
Lubricity	3 3.9	4 5 2
Color of finished fluid	3.3.13	4.5.7
Inspection of filled containers	5.1	4.5.8

TABLE VII. Sample for particle contamination

Container	Sample size (ml) 1/	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

TABLE VIII. Test methods for hydraulic fluid properties.

Characteristic	Test method	
	FED-STD-791	ASTM
Pour point		D 97
Flash point		D 92
Fire point		D 92
Color (base stock)		D 1500
Evaporation 1/	350	
Specific gravity		D 1298
Viscosity		D 445
Solid particle contamination 2/	3009	
Foaming		D 892
Water		D 1744
Neutralization number		D 664
High temperature-high pressure spray ignition	6052	
Auto-ignition temperature		E 659
Corrosiveness and oxidation stability 3/	5308	
Swelling of synthetic rubber 4/	3603	
Low temperature stability	3458	
Storage stability	3465	
Lubricity 5/		D 4172
Effect of evaporation on flammability 6/	352	

1/ Test temperature 205°C Test time, 6.5 hours.

TABLE VIII Hydraulic fluid properties (continued)

2/ Particulate contamination may also be measured by the use of automatic particle counters in lieu of the optical procedure detailed in Method 3009 of FED-STD-791. HiAc counter, Models PC-202, PC-203, PC-305, or equivalent, counting to the limits specified in Table III Directions in the manual for the respective instruments shall be followed A gravimetric determination shall also be made, by ASTM F 313, using a single 0 45 micron filter membrane.

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

4/ Use standard rubber NBR-L (see 3.3 4 and 6.4) within 6 months of date of manufacture.

5/ A 10 ± 0.5 ml sample shall be used, and the test shall be conducted for 1 hour at each load specified in Table V

6/ Eliminate oven storage and recheck

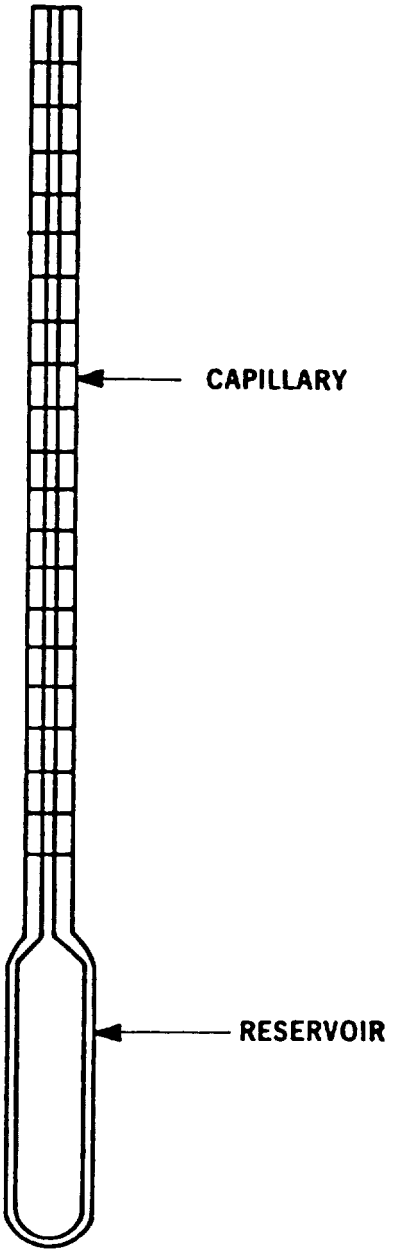

FIGURE 1. Precision capillary pycnometer.

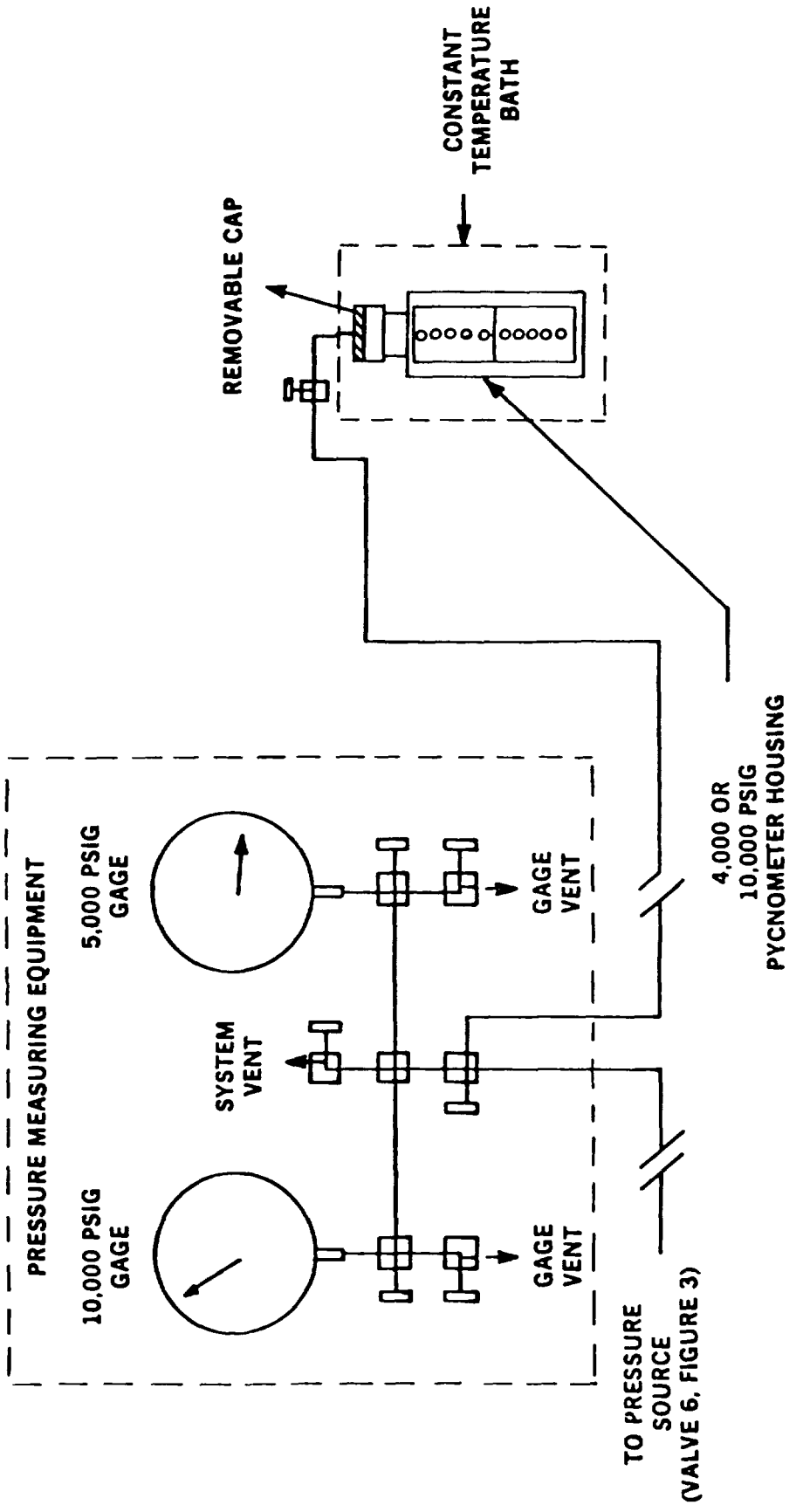

FIGURE 2. Diagram of bulk modulus equipment.

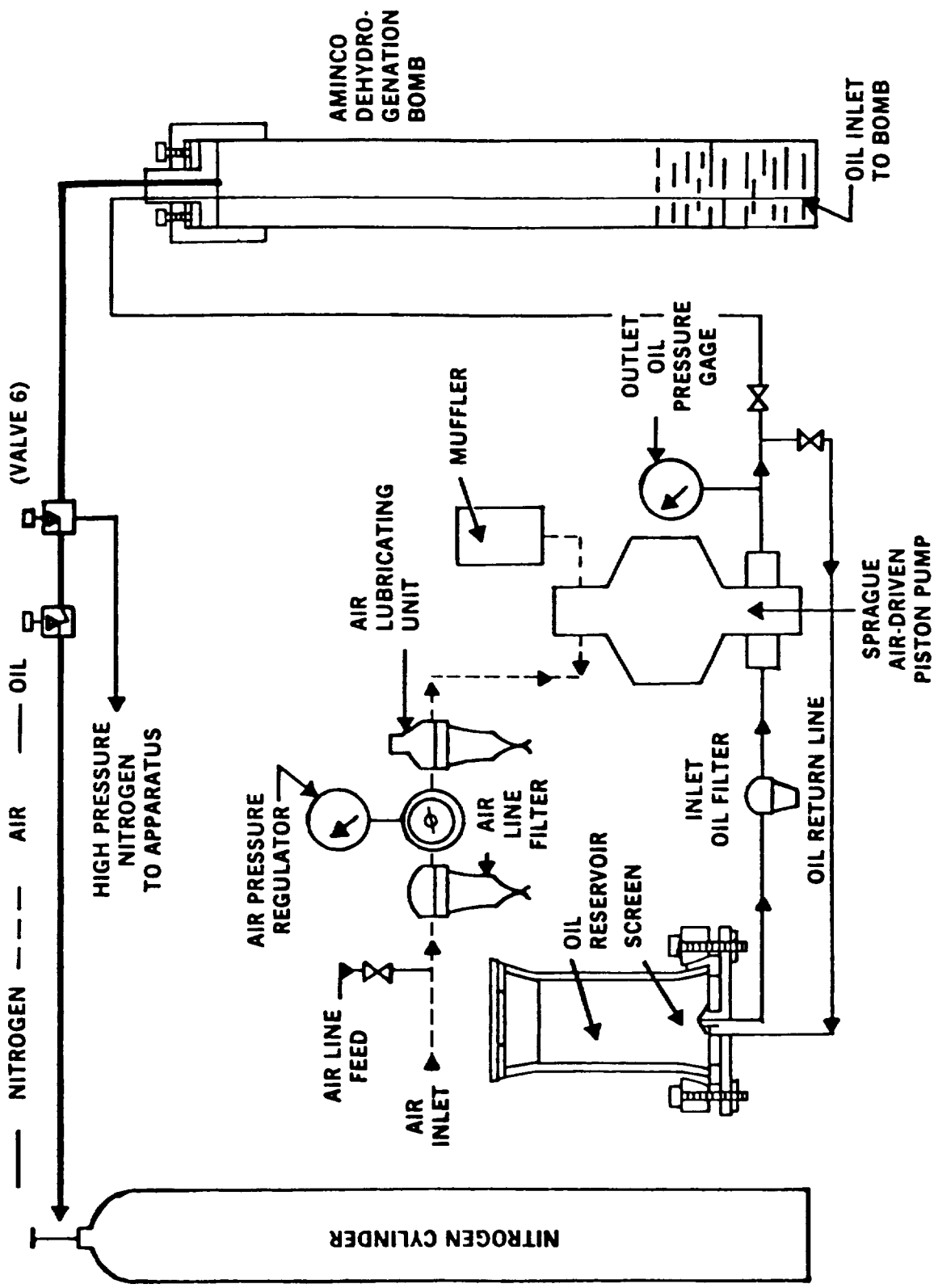

FIGURE 3. Auxiliary equipment

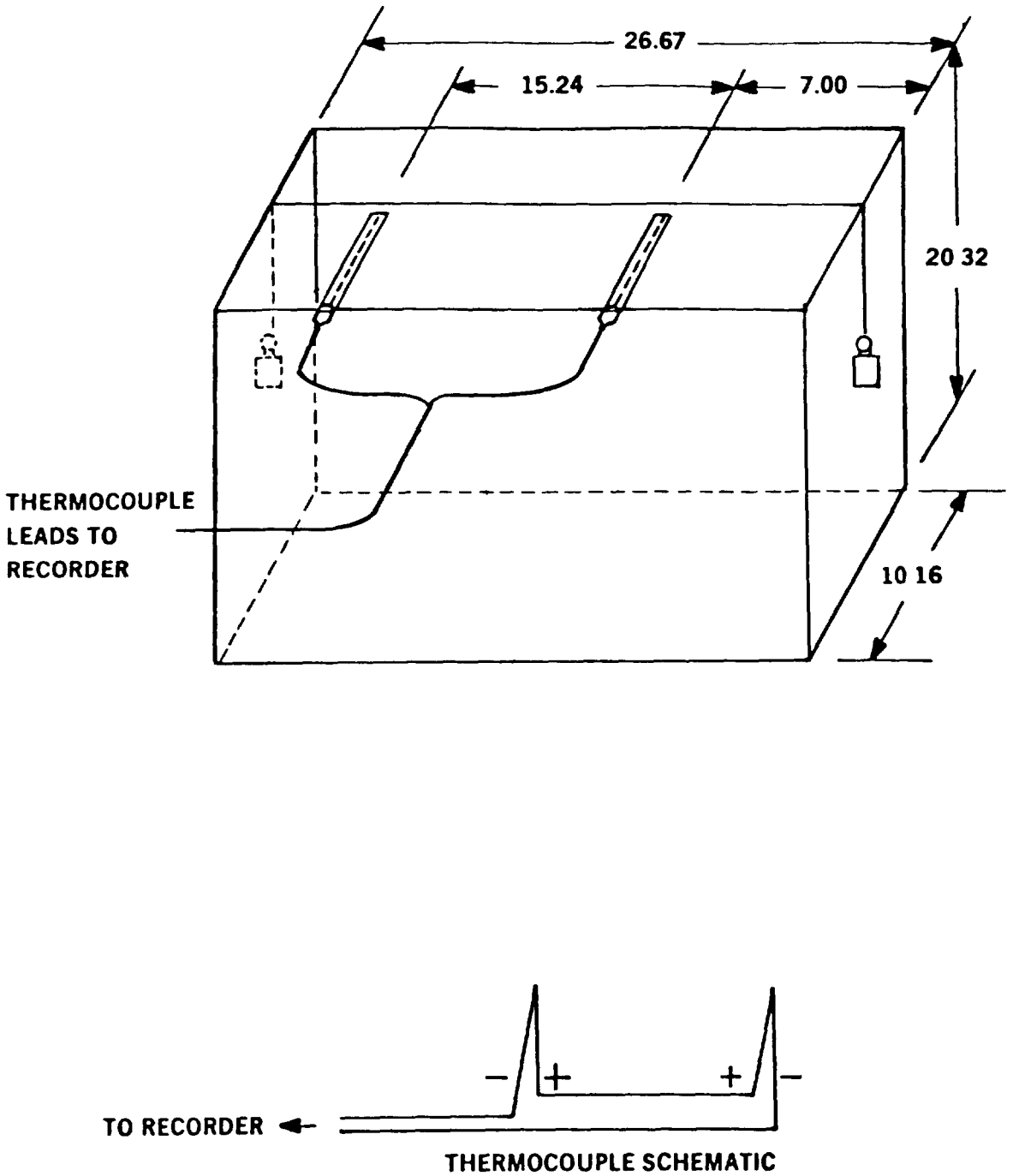

FIGURE 4. Apparatus for the determination of linear flame propagation rates.

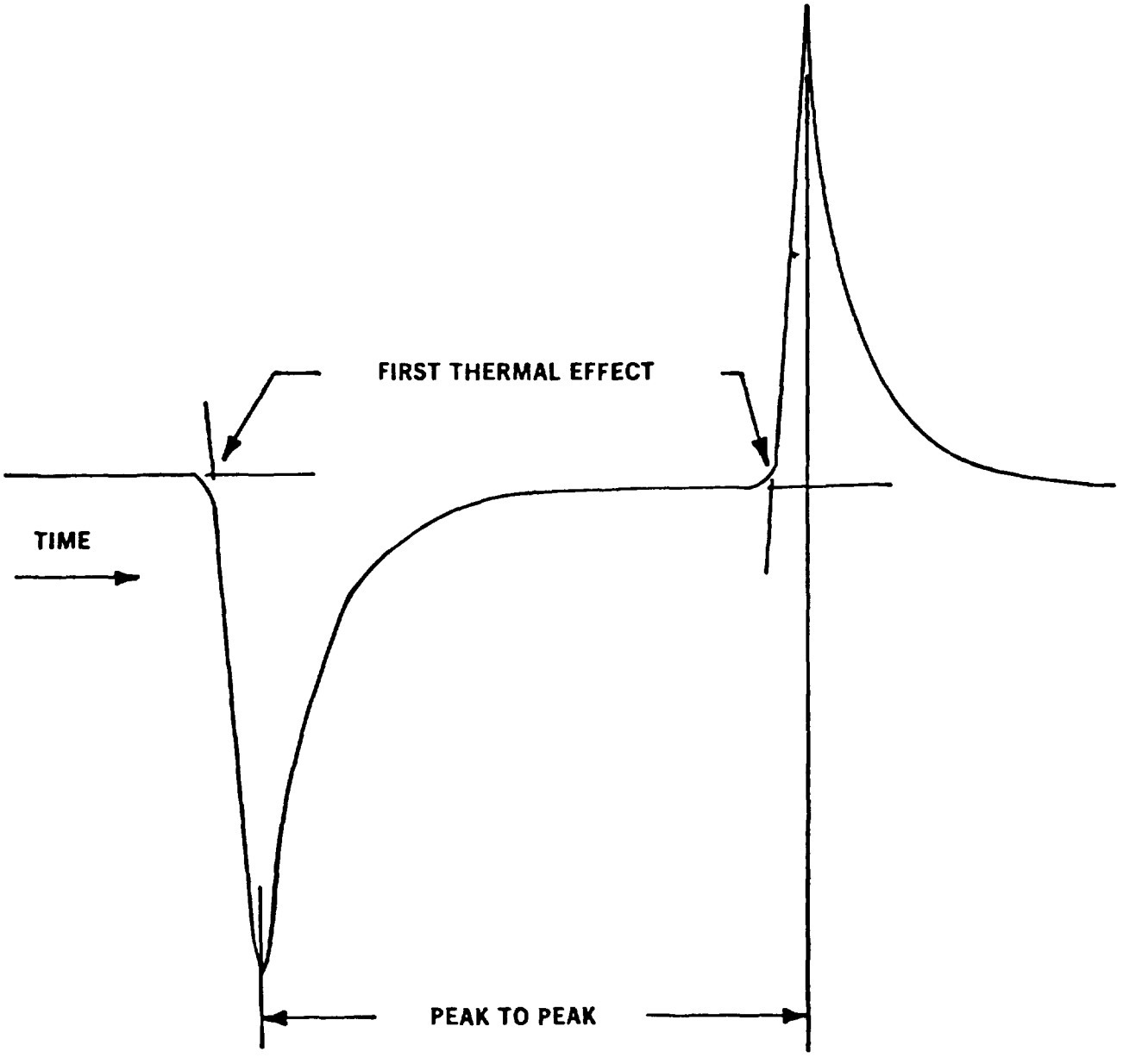

FIGURE 5. Determination of linear flame propagation rates: typical strip-chart record.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1 DOCUMENT NUMBER	2 DOCUMENT TITLE
MIL-H-83282C	HYDRAULIC FLUID, FIRE RESISTANT, SYNTHETIC HYDROCARBON BASE

3a. NAME OF SUBMITTING ORGANIZATION

b. ADDRESS *(Street, City, State, ZIP Code)*

4 TYPE OF ORGANIZATION *(Mark one)*

- ☐ VENDOR
- ☐ USER
- ☐ MANUFACTURER
- ☐ OTHER *(Specify)* _____

5 PROBLEM AREAS

a. Paragraph Number and Wording

b. Recommended Wording

c. Reason/Rationale for Recommendation

6 REMARKS

7a NAME OF SUBMITTER *(Last, First, MI)* – Optional	b WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8 DATE OF SUBMISSION *(YYMMDD)*

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