MIL-H-22072C(AS)
5 March 1984
SUPERSEDING
MIL-H-22072B(AS)
13 November 1978

MILITARY SPECIFICATION

HYDRAULIC FLUID, CATAPULT, NATO CODE NUMBER H-579

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

1 SCOPE

1 1 Scope. This specification establishes the requirements for a fire resistant water base fluid for use in catapults. This fluid is identified by NATO symbol H-579 (see 6.5)

2. APPLICABLE DOCUMENTS

2.1 Government documents

2 1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specification, 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

QQ-B-639	-	Brass, Naval, Flat Products (Plate, Bar, Sheet and Strip).
QQ-B-728	-	Bronze Manganese, Rod, Shapes, Forgings, and Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate).
QQ-C-576	-	Copper Flat Products with Slit, Slit and Edge-Rolled, Sheared, Sawed or Machined Edges (Plate, Bar, Sheet, and Strip)
QQ-S-741	-	Steel, Carbon, Structural Shape, Plate and Bar.
PPP-D-729	-	Drums, Shipping and Storage, Steel 55 Gallon (208 Liters)

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.

MILITARY

MIL-S-5059	-	Steel, Corrosion-Resistant (18-8), Plate, Sheet and Strip.
MIL-S-18729	-	Steel Plate, Sheet, and Strip, Alloy, 4130, Aircraft Quality.
MIL-H-19457	-	Hydraulic Fluid, Fire Resistant.
MIL-S-22698	-	Steel Plate and Shapes, Weldable, Ordinary Strength and Higher Strength, Hull Structure.
MIL-P-25732	-	Packing, Preformed, Petroleum, Hydraulic Fluid Resistant, Limited Service at 275°F (135°C).

STANDARDS

FEDERAL

FED-STD-313	-	Material Safety Data Sheets Preparation and Submission of.
FED-STD-601	-	Rubber, Sampling and Testing.
FED-STD-791	-	Lubricants, Liquid Fuels, 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

AIR FORCE - NAVY

AN6227	-	Packing, O Ring, Hydraulic

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

DRAWINGS

NAVAL AIR ENGINEERING CENTER

A87772	-	Packing, "V" Ring.
A88595	-	Packing.
A89791	-	Packing, Chevron Type.
A89984	-	Seal Shaft, Moulded
A92589	-	Gasket, Asbestos
A312047	-	Gasket, "O" Ring
A314255	-	Gasket, Synthetic Rubber.
A314341	-	Closure, Duplex Type.

(Application for copies should be addressed to the Naval Air Engineering Center, Code 912A1, Lakehurst, NJ 08733.)

PUBLICATIONS

CODE OF FEDERAL REGULATIONS

16 CFR - The Federal Hazardous Substances Act.
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 A 108 - Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM D 95 - Water in Petroleum Products and Bituminous Materials by Distillation
ASTM D 892 - Oils, Lubricating, Foaming Characteristics of
ASTM D 1298 - Density, Relative Density, (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method.
ASTM D 4057 - Manual Sampling of Pertoleum and Petroleum Products
ASTM D 4177 - Automatic Sampling of Petroleum and Petroleum Products
ASTM E 70 - pH of Aqueous Solutions with the Glass Electrode
Part 47 - Test Methods for Rating Motor, Diesel and Aviation Fuels.

(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 specification 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. Any change in the formulation of an approved product shall require requalification (see 3.3 2, 4 3 and 6 3)

3.2 Materials. Component materials used in the manufacture of the hydraulic fluid shall be of high quality, suitable for the purpose intended, and when finally blended shall form a fire resistant fluid meeting the requirements of this specification.

3.2.1 Additives The hydraulic fluid shall contain additive materials to provide lubrication, corrosion prevention and viscosity temperature characteristics. There shall be no other restrictions on the type of material used in the fluid except those imposed by the requirements of this specification.

3.2.2 Color. A water soluable red dye shall be added to the hydraulic fluid to improve visibility in liquid level gauges. A desirable color is obtained when 5 parts of "Pontamine Fast Red 8BNL Concentrated 175 percent" as manufactured by E I. Dupont de Nemours, Wilmington, Delaware, or an equivalent dye, is added to 100,000 parts by weight of an amber (ASTM Color Number 1-1/2 to 2) fluid.

3 3 Compatibility

3 3.1 With previously qualified fluids. When the hydraulic fluid being tested is added to all previously qualified fluids to make a mixture consisting of equal volumes of the fluid being tested and each of those previously qualified, the mixture shall not form resinous gums, sludge or insoluble solid materials and shall comply with the viscosity requirements specified in 3.4. No further efforts towards qualifying a fluid shall be conducted if the mixture does not comply with this requirement.

3.3.2 Fluid mixtures. The Government reserves the right to require that a fluid submitted for qualification comply with all of the qualification requirements of this specification when mixed with other previously qualified fluids, irrespective of the proportions of the fluid constituting the mixture.

3 4 Chemical and physical properties. The chemical and physical properties shall conform to Table I, when tested as specified in 4.6.2

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 to the qualifying activity specified in 4.3.1. The hydraulic fluid shall have no adverse effect on the health of personnel including contact dermatitis (see 4 6 15) The fluid shall contain no components which produce noxious vapors in such concentrations as to be an annoyance to personnel during formulation or use. The properties of the fluid shall be such that its use shall not require personnel protective equipment, special control procedures or special handling techniques 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 4.3.1 and 6.2.1e)

3.6 Workmanship The hydraulic fluid shall be free from oil, dirt, lint, sediment, and lumps of undissolved additives The fluid shall be filtered through a non-absorptive type of filter just prior to final packaging

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. The qualification inspection shall consist of a review for approval of the submitted manufacturer's test reports and subjecting the qualification sample (4.3.1) to examination and testing for all the requirements of this specification. Prior to completion of the storage stability test, products meeting all other requirements of this specification will be listed on the qualified products list on a tentative basis. Final approval shall only be granted after the product has passed the storage stability requirements.

4.3.1 Samples The qualification sample shall consist of six 208 litre (55-gallon) drums of hydraulic fluid for which qualification is desired The samples shall be forwarded to the Commanding Officer, Naval Air Engineering Center, Code 912A1, Lakehurst, NJ 08733. The samples shall be plainly identified by securely attached durable tags or labels marked with the following information.

Sample for qualification inspection
HYDRAULIC FLUID, CATAPULT
MIL-H-22072C(AS)
Name of manufacturer
Product code number
Date of manufacture
Submitted by (name)(date) for qualification inspection in accordance with the requirements of MIL-H-22072C(AS) under authorization of (reference authorizing letter) (see 6.3).

4.3.2 Test reports. Two copies of the manufacturer's test report, containing complete test data showing that material submitted for qualification conforms to the requirements of this specification, except for compatibility, compression ignition, effect on packings and other elastomeric components, storage stability and pump performance, shall be submitted with the qualification samples. Location and identity of the plant which produced the samples tested shall also be supplied. The test reports shall include general information as to the chemical type or tradename of the ingredients used, identifying major and minor components. Material safety data sheets on toxicity, prepared as specified in 3 5, shall also be submitted to the qualifying laboratory (see 4.3.1).

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 shall consist of an examination for acceptability of quality control methods used by the manufacturer, test of samples from 4.4.3 in accordance with Table III and an examination of samples from 4.4.4 for conformance with 4.6 1

4 4.1 Quality conformance samples. The quality conformance samples shall consist of a sample for tests (4.4.3) and samples for examination of filled containers (4 4 4) 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.

4.4.2 Lot and batch All hydraulic fluid manufactured as one batch shall be considered a lot and shall be numbered as such for purposes of inspection. A batch is defined as the end product of all raw materials mixed or blended in a single operation.

4.4.3 Sample for tests. A composite sample of hydraulic fluid in sufficient quantity to perform all the quality conformance tests specified in Table III shall be taken from each lot in accordance with ASTM D 4057 or ASTM D 4177. If the sample for tests fails any of the quality conformance inspection tests, the inspection lot represented by the composite sample shall be rejected.

4.4.4 Sample for examination of filled containers A random sample of filled containers shall be selected from each lot of fluid in accordance with MIL-STD-105, Inspection Level I and an Acceptable Quality Level (AQL) of 2 5 percent defective

4 5 Test conditions Test conditions shall be in accordance with 4.6 and the physical values specified in Table I apply to the average of determinations made on the sample

4.6 Methods of examinations and tests. Inspection shall be in accordance with Method 9601 of FED-STD-791.

4.6.1 Examinations. Each of the filled containers, selected in accordance with 4 4.4, shall be examined for defects of the container and closure, for evidence of leakage and for unsatisfactory markings to determine conformance with 5.1 Each sample container shall also be weighed to determine the amount of contents If the number of defective containers exceeds the acceptance number of the sampling plan specified in 4 4 4, the lot shall be rejected.

4.6.2 Tests. Tests shall be performed in accordance with Table IV and 4.6.3 through 4.6.14 to determine conformance with the requirements specified in 3 4.

4.6.3 High temperature stability 250 millilitres (ml) of the test fluid shall be placed in a chemically clean 355 ml (12 ounce) borosilicate glass bottle provided with a plastic cap. The stoppered bottle and contents shall be placed in an oven maintained at 70 ± 1°C (158 ± 2°F) for 168 hours. After the fluid has been examined for changes in physical appearance, it shall be allowed to stand at room temperature, 21 - 27°C (70 - 80°F) for an additional 24 hours and again examined for changes in appearance (see Table I).

4.6.4 Low temperature crystallization. A sample of the test fluid shall be placed in a number 500 Kinematic viscometer tube, and the tube then placed in a bath regulated at -12 ± 1°C (+10 ± 2°F). Drying tubes containing loosely packed granular calcium chloride or other suitable desiccant shall be connected to each leg of the tube. At intervals of 30 minutes, the fluid shall be drawn up to the mark and allowed to descend as in the determination of Kinematic viscosity. After 6 hours, a visual examination of the fluid shall be made for evidence of crystal formation (see Table I).

4.6.5 Evaporation. A microscope slide shall be immersed in the test fluid at room temperature 21 - 27°C (70 - 80°F), and shall then be removed and suspended vertically in a circulating air oven regulated at 70 ± 3°C (158 ± 5°F) for 4 hours. The slide shall then be removed, allowed to cool to room temperature and the nature of the residual film examined by touch (see Table I).

4.6.6 Volatility. Two weighing bottles, low form with flat bottom, fitted with ground glass stoppers, of uniform size and shape, shall be carefully weighed to the nearest milligram (mg). Approximately 15 ml of the test fluid shall be added to one of the weighing bottles and approximately 15 ml of distilled water shall be added to the other. The stoppers shall be immediately replaced and the weighing bottles and contents weighed. The bottles shall then be situated side by side at room temperature 21 - 27°C (70 - 80°F), in an atmospheric location free from drafts and direct sunlight. The stoppers shall be removed for a period of 30 minutes then replaced. The weighing bottles and contents shall then be reweighed. The loss in weight of the test fluid and water shall be compared directly The weighing bottle containing the test fluid shall then be returned to the previous location, the stopper removed and the test continued until at least 10 percent by weigth of the fluid has evaporated, following which, it shall be examined for separation, precipitation, or any other change in appearance (see Table I)

4.6.7 Cloud temperature. Fifty millilitres of the test fluid shall be placed in a clean, 118 ml (4 ounce) oil sample bottle. A thermometer shall be centrally located in the test fluid and shall be held in position by a suitably bored cork. The bottle and contents shall be placed in a water bath which shall be heated so that the temperature of the test fluid rises at approximately 2.8°C (5°F) per minute, to a minimum temperature of 99°C (210°F). If the fluid becomes hazy, the bottle shall be removed from the bath, inverted twice, and an attempt made to view the ruled lines of a file index card diametrically through the fluid in the bottle. The hazy fluid shall then be cooled to room temperature. If the fluid does not return fully to its initial clarity when cooled, the cloud temperature shall be regarded as the temperature at which the ruled lines are no longer visible when heated and viewed in the manner above. If the fluid returns to its initial clarity, no cloud temperature shall be recorded.

4.6.8 Compression ignition.

4.6.8.1 Compression ignition method.

4.6.8.1.1 Engine. The engine used for this test is the standard CFR cetane rating (Method 5) engine specified in ASTM Part 47, Test Methods for Rating Motor, Diesel and Aviation Fuels, modified as follows:

a. Use a variable compression plug, Waukesha Part Number 1051008, or equivalent, to extend the compression ratio range of the engine to 50·1

b. Modify the cooling systems to provide for circulation of cooling water from an external source. A thermometer, Waukesha Part Number 0105180A, or equivalent, shall be inserted into the cooling water outlet adapter attached to the cylinder head.

4.6.8.1.2 Combustion indicator. A 0 - 13800 kPa (0 - 2000 psi) range strain gage transducer shall be used as the pressure sensing element A 1.575 mm (0.062 in.) open tip thermocouple (see Figure 1) shall be used as the temperature sensing element. The pressure signal and the temperature signal are amplified and recorded on a recording oscillograph

4.6.8.1 3 Engine operating conditions. The engine operating conditions shall be as follows.

a. Speed. 900 ± 9 revolutions per minute.

b. Injection advance: 13° before top dead center.

c. Injection opening pressure: 10342 kPa ± 345 kPa (1,500 ± 50 psi).

d. Injection rate: 30 ± 0.5 ml per minute.

e. Air intake temperature· 60 ± 1°C (140° ± 2°F)

f. Water jacket temperature: 27 ± 1°C (80 ± 2°F)

g. Other engine operating conditions shall be as specified in Supplement III on operation (cetane) in ASTM Part 47.

4 6.8.1.4 Test procedure The engine shall be operated (with the fuel bypass valve open) for 45 minutes or longer at a compression ration of 50:1, until all engine operating conditions have been established. During this warm-up period, adjustments can be made to establish operating conditions and to purge the fuel injection system

4.6.8.1.4.1 With the compression ratio set at 50.1, close the fuel bypass valve. The engine shall be run under these conditions for 5 seconds continuous injection. At the end of the injection period, open the fuel bypass valve and operate the engine for 175 seconds Observe the oscillograph for indications of combustion.

4 6.8 1.4.2 To determine the lowest compression ratio for combustion, successive determinations shall be made by reducing the compression ratio two increments

per determination until no evidence of combustion is observed. This shall be followed with two additional 5 second runs, each preceded by 175 second period of operating with no injection Indication of combustion in one or more of the three 3-minute runs shall be considered evidence that the fluid is combustible for that determination. The reported compression ratio value shall be the lowest compression ratio at which ignition is observed.

4.6.8.1.5 Evidence of combustion. Any increase in pressure or temperature signals, or both, during this period of injection shall be considered as evidence that the fluid is combustible.

4.6.8.1.5.1 Indications of combustion which may occur immediately following the period of injection (fuel bypass valve open) shall not be considered as evidence that a fluid is combustible

4.6.8 1.6 Engine control fluid. Each unknown sample shall be bracketed with an engine control fluid. The fluid used shall be an approved MIL-H-19457 triaryl phosphate ester, Type I, fluid and shall be rated in the same way as the unknown sample except that the engine shall be run for 15 seconds continuous injection, followed by a 45 second engine operating period with fuel bypass valve open. Fire resistance measurements obtained on an unknown sample shall be considered valid only when the compression ratio of the engine control fluid determined during the bracketing runs exceeds the minimum compression ratio requirements of 42:1 as normally specified for Type I, MIL-H-19457 fluid. 1/

4.6.9 Effect on packings and other elastomeric components. The percentage change in volume of the packings and other elastomeric components after immersion in the fluid shall be determined in accordance with Method 6211 of FED-STD-601. The immersion period of the packings and elastomeric components specified in Table II in the fluid shall be 7 days at a temperature of 70 ± 1°C (158 ± 2°F). Volume change limits of various packings and other elastomeric components used in the catapult hydraulic system shall be in accordance with Tables I and II.

4 6 10 Static corrosion

4.6 10 1 Panel preparation Test panels measuring 25 4 by 9.5 by 1.6 mm (1 by 3/8 by 1/16 inch) having a 6 4 mm (1/4 inch) diameter circular hole located in the center of each shall be made from each of the followIng metals

Steel conforming to MIL-S-22698, Grade DH-36

Steel conforming to MIL-S-22698, Grade A

Steel conforming to ASTM A 108, UNS Designation G10200, Form - Flat

Steel conforming to MIL-S-18729, Condition A.

Steel conforming to MIL-S-5059, Type 302, Condition - Annealed.

Naval brass sheets conforming to QQ-B-639

1/ When the fire resistance of the engine control fluid does not meet the minimum requirements, engine condition shall be checked. Procedures outlined in the operating manual for cleaning and overhaul of the engine shall be followed

Manganese bronze sheets conforming to QQ-B-728, Class B.

Copper sheets conforming to QQ-C-576, Cold-Rolled, Soft-Annealed.

Immediately before being used in the test, each panel shall be abraded, polished, cleaned, and weighed as follows: The plane surface of each panel shall be abraded with a sheet of 100 mesh aluminum oxide paper or cloth which has been taped onto a machined flat steel plate. The panels shall be clamped to a suitable holder to facilitate handling, and the abrading procedure shall be carried out by slowly and uniformly rubbing the panel, in the direction of the long axis of the panel, over the abrasive. The abrasion shall be continued until a flat surface has been obtained as determined by means of an accurately machined straight edge. The final surface finish required for the test shall be obtained by using 240 mesh alumimum oxide paper or cloth and repeating the abrasion procedure until evidence of the corrosion abrasion is removed. For cleaning, the panels shall then be placed in boiling isopropyl alcohol for one minute, removed, and wiped with a clean, dry filter paper, then dipped in petroleum ether and again placed in boiling isopropyl alcohol for one minute. The cleaned panels shall then be placed in a desiccator and allowed to dry and cool to room temperature 21 - 27°C (70 - 80°F). The clean, dry panels shall then be weighed to the nearest milligram and shall then be used in the test procedure

4 6.10.2 Procedure Each weighed metal panel shall be placed in an individual screw cap culture tube of 20 mm diameter and 150 mm tall. The screw cap shall have a fluro-polymer (Teflon ® or equivalent) liner. Ten ml of the fluid shall be added to each tube. The tubes shall be tightly capped and placed in a thermostatically controlled oil bath, regulated at 70 ± 1°C (158 ± 2°F). The level of the oil in the bath shall be approximately 25 4 mm (one inch) above the level of the fluid in the tubes. After being in the hot oil bath for 720 hours (30 days), the tubes shall be removed and allowed to cool to room temperature 21 - 27°C (70 - 80°F). The metal panels shall be removed and subjected to the cleaning procedure described in 4.6.10.1 except that artgum shall be used in place of filter paper in order to remove all loosely adherent corrosion products. Each of the test panels shall then be reweighed to the nearest milligram. The change in weight of each panel shall be determined, the appearance of each panel shall be noted, and the hydraulic fluid shall be examined after standing overnight following completion of the test (see Table I)

4 6.11 Stirring corrosion

4 6.11.1 Apparatus and test panels The apparatus shall be as shown in Figure 2 The apparatus shall consist of a wide mouth, borosillicate glass bottle of 473 ml (16 ounces) capacity, equipped with a Buna-N rubber stopper The stopper shall be bored to accomodate a length of fluro-polymer tubing of approximately 9.5 mm (3/8 inch) outside diameter, which shall form a tight sleeve for a 6.4 mm (1/4 inch) diameter glass rod with just sufficient clearance to permit free rotation of the rod. Test panels having the dimensions specified in 4 6 10 1 shall be made from each of the following metals:

Copper sheet conforming to QQ-C-576, Cold-Rolled, Soft-Annealed
Manganese bronze sheet conforming to QQ-B-728, Class B

Copper sheet conforming to QQ-C-576, Cold-Rolled, Soft-Annealed
Naval brass sheet conforming to QQ-B-639, Composition 1, Soft

Copper sheet conforming to QQ-C-576, Cold-Rolled, Soft-Annealed.
Steel conforming to MIL-S-22698, Grade DH-36

Steel conforming to MIL-S-22698, Grade DH-36.
Naval brass sheet conforming to QQ-B-639, Composition 1, Soft.

Steel sheet conforming to MIL-S-18729, Condition A.
Steel conforming to MIL-S-22698, Grade DH-36.

Steel conforming to MIL-S-22698, Grade DH-36.
Manganese bronze sheet conforming to QQ-B-728, Class B

Copper sheet conforming to QQ-C-576, Cold-Rolled, Soft-Annealed
Steel sheet conforming to MIL-S-18729, Condition A.

4 6.11.2 Procedure. The test panels shall be abraded, polished, cleaned and weighed as described in 4.6 10.1 and then assembled on the lower end of the 6.4 mm (1/4 inch) glass rod in couples in the order as stated above and as shown in Figure 2. Each metal couple shall be held in electrical contract by means of a stainless steel spacing washer made from material conforming to MIL-S-5059, Type 302, Condition - Annealed. The spacing washers shall have an outside diameter of 19.1 mm (3/4 inch), an inside diameter of 6.4 mm (1/4 inch) and a thickness of approximately 0.8 mm (1/32 inch). In addition, a spacing washer of the same dimensions as above and made from fluoro-polymer (Teflon ® or equivalent) shall be placed between couples and above and below the entire assembly of couples. The position of the couples shall be such that the longitudinal axis of each couple shall be placed at right angles to the couple next to it. O-rings of Buna-N synthetic rubber forming a tight fit on the glass rod shall be situated above and below the couples assembly and shall be separated from the couples assembly by the fluoro-polymer spacing washers The entire assembly shall then be squeezed firmly together and bound with strong, clean cotton thread to prevent slippage of the panels during the test. Four-hundred millilitres of the test fluid shall be placed in the bottle and the apparatus shall be assembled as shown in Figure 2. The bottle and contents shall then be placed in a thermostatically controlled oil bath regulated at 70 ± 1°C (158 ± 2°F). The upper end of the 6.4 mm (1/4 inch) glass rod shall be connected to a motor or any other means capable of providing continuous rotation at 1750 ± 50 rpm. The test shall be continuous for 336 hours (14 days), after which time the test shall be stopped, the bottle removed and allowed to cool to room temperature 21 - 27°C (70 - 80°F) The test panels shall then be disassembled, cleaned, weighed, and examined as specified in 4.6.10.2 (see Table I).

4 6.12 Storage stability. A sample consisting of 1500 millilitres of the test fluid shall be placed, equally divided, into two tightly stoppered borosilicate glass litre (quart) containers. The containers and contents shall then be thoroughly shaken and then placed in the dark at 25 ± 6°C (77 ± 10°F) for 12 months after which time, the contents of the bottles shall be examined for resinous gums, insoluble matter, or radical changes in physical appearance. Slight discoloration of the test fluid shall not be considered cause for rejection (see Table I)

4.6 13 Pump performance. A pump identified by stock number R90NAEF41-4839-1A, a modified Vickers N746A in ready for issue condition, shall be installed in a test set-up as shown in Figure 3 A strainer identified by stock number R90NAEF 311963-3 and a thermocouple for measuring fluid temperature shall be added to the pump suction line of the test set-up The pump shall operate at 900 rpm and shall circulate 757 litres (200 gallons) of fluid in the system The fluid in the system shall be circulated during a trial period with the restrictive valve closed

and a fluid discharge pressure of 24132 ± 689 kPa (3500 ± 100 psi) shall be obtained and maintained for 45 seconds of each minute. During the remaining 15 seconds of each minute, the pump discharge shall be bypassed. The test pump is suitable for use and the test shall continue if the pump delivers at least 257.4 litres (68 gallons) per minute at 24132 kPa (3500 psi) delivery pressure and the increase is not more than 11 litres per minute (3 gpm) during the bypass portion of the cycle During the test, except for initial warm up periods, the suction line temperature shall be maintained between 49 and 54°C (120 and 130°F). Samples of the fluid shall be taken from the system at the beginning of the test, after every 50 hours of pump operation and upon completion of the test. The samples taken shall be immediately analyzed for water content, viscosity, and hydrogen ion concentration as specified in Table IV. The water content of the fluid in the system shall be adjusted at these intervals by the addition of de-ionized water sufficient to maintain a concentration of 50 ± 1.5 percent by weight of water in the fluid. The pump shall be run on an operating sequence of 112 hours on, 56 hours off; 120 hours on, 48 hours off; or 144 hours on, 24 hours off. Whenever the fluid delivery rate drops more than 11 litres per minute (3 gpm) below the initial delivery rate, while the fluid discharge pressure of 24132 kPa (3500 psi) is maintained, and excessive wear or leakage in the pump is indicated, the test shall be discontinued. A fluid sample shall be taken, the pump shall be disassembled and examined and excessively worn parts shall be replaced. When deemed necessary by the qualification testing laboratory, the system shall be drained and flushed and new 757 litres (200 gallons) of test fluid shall be placed in the system. The test shall be resumed after the cause of pump failure has been determined and a satisfactory pump has been placed in operation in the system. When pump damage is extensive, a new pump may be substituted prior to completion of the test. The test shall be considered completed when:

a. The fluid has been circulated in the system for 500 hours and the pump has not suffered excessive wear or failure of parts.

b The fluid has been circulated in the system for a sufficient time so that each pump component shall have operated for a minium of 500 consecutive hours and experienced no more than one failure or replacement due to excessive wear, discontinuing failures due to improper pump assembly or operation. (Up to 1000 hours of operation may be required to satisfy these conditions)

c. The fluid has been circulated in the system for less than the minimum time required, but failures have occurred in the pump and one component has failed and needed replacement twice due to excessive wear without having operated for 500 consecutive hours, discontinuing failures due to improper pump assembly or operation (see Table I).

4 6 14 Vapor phase corrosion.

4 6 14 1 Test panels. Three test panels each measuring 76.2 by 25.4 by 1.6 mm (3 by 1 by 1/16 in) shall be made from steel conforming to MIL-S-22698, Grade DH-36, or QQ-S-741 The panels shall be abraided, polished, and cleaned as described in 4 6 10 1

2/ Teflon® or equivalent.

4.6.14.2 Procedure. Each panel shall be placed vertically on edge in its own glass bottle. Enough fresh candidate fluid shall be added to the bottle so that the panel is half immersed and half exposed to the vapor space above the fluid. The bottle shall then be tightly capped and held at 60 ± 1°C (140 ± 2°F) for a period of 16 hours by means of a thermostatically controlled oven or oil bath. Upon completion of the 16 hours, the bottle shall be removed and allowed to cool to room temperature (21 - 27°C (70 - 80°F). The panels shall then be removed in a manner which shall not affect or obscure the surface for subsequent evaluation in accordance with Table I

4.6.15 Contact dermatitis. the fluid shall be considered as not being causative of contact dermatitis after it has passed the following tests.

a. Title 16 of the Code of Federal Regulations, Chapter II, Part 1500.42 (Acute Eye Irritation Study in Rabbits).

b. Title 16 of the Code of Federal Regulations, Chapter II, Part 1500 41 (Primary Skin Irritation Study in Rabbits).

c. Skin sensitization tests in Guinea pigs in accordance with the Landsteiner and Jacobs method.

5 PREPARATION FOR DELIVERY

5.1 Packaging and packing. The fluid shall be packaged and packed in accordance with the provisions of MIL-STD-290. Unless otherwise specified by the acquiring activity, Level A protection shall be employed and the fluid shall be furnished in 208 litres (55 gallon) metal drums conforming to PPP-D-729, Type I, except that the flanges and inside surface of the drums shall be made of uncoated steel which has not been given a phosphate treatment, the 19.1 mm (3/4 inch) plugs shall be made of polypropylene and the 50.8 mm (2 inch) plugs shall be made of polyethylene. When bulk quantitities or other packaging and packing are required, the contract or order shall specify requirements for such packaging and packing.

5.1.1 Marking. All unit, intermediate and shipping containers shall be marked in accordance with MIL-STD-290 and Title 49 of the Code of Federal Regulations and any other additional special markings specified by the acquiring activity (see 6.2.1f). 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 ordnances, 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 as a power transmission medium for hydraulic actuated systems in Naval aircraft launching catapults. The fluid may soften and remove most commonly used paints. Leakage or accidental spillage may be easily cleaned up with a wet cloth or flushed down drains with water. Normal use of the fluid should require no special handling procedures.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.

b. Quantity of the fluid in litres (gallons) required.

c. Type and capacity of containers in which the fluid is to be furnished, if other than as specified (see 5.1).

d. Applicable levels of packaging and packing with requirements in detail, if other than as specified (see 5.1).

e Specify DAR Clauses 7-104.98 and 1-323.2.

f. Any special markings required (see 5.1.1).

6 2.2 Unit of purchase. The fluid covered by this specification should be purchased by the unit being a litre or a U S. gallon of 32774 cubic mm (231 cubic inches) at 16°C (60°F).

6.3 Qualification. With respect to products requiring qualification, awards may be made only for products which are, at the time set for opening of bids, qualified for inclusion in Qualified Products List (QPL-22072) 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 activity responsible for the Qualified Products List is Commander, Naval Air Systems Command, Attn: AIR-5304C1, Washington, DC 20361; however, information pertaining to qualification of products and letter of authorization for submittal of sample may be obtained from the Commanding Officer, Naval Air Engineering Center, Code 912A1, Lakenurst, NJ 08733.

6.3.1 Qualification information It is understood that the fluid 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 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.

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, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices, to change the agreement or make other appropriate accomodations.

Review activities:
Navy - SH

Preparing activity:

Navy - AS

(Project 9150-0614)

TABLE I. Chemical and physical properties.

Characteristic	Requirement
Water content, percent by weight	50 + 1.5 - 6.5
Specific gravity at 20°C (68°F)	1.04 - 1.09
Viscosity:	
Maximum cSt(SUS) at -18°C (0°F)	1764 (8100)
Minimum cSt(SUS) at 38°C (100°F)	39.6 to 45.1 (185 to 210)
Minimum cSt(SUS) at 54°C (130°F), minimum	21.7 (105)
Foaming tendency at 24 ± 1°C (75 ± 2°F), maximum	No limit 1/
Foam, after 10 minutes of collapse, ml, maximum	10
Hydrogen ion concentration, pH	8.8 to 9.8
High temperature stability after 168 hours, at 70° ± 1°C (158 ± 2°F)	No component separation or chemical change.
Low temperature crystallization, after 6 hours, at 12° ± 1°C (10 ± 2°F) for 6 hours	No evidence of crystallization
Evaporation after 4 hours at 70 ± 3°C (158 ± 5°F)	Shall not become hard or resinous
Volatility	2/
Cloud temperature, abpve 99°C (210°F)	Above 99°C (210°F)
Compression ignition, at compression ratios of 50 to 1 and below	No indication of combustion at compression ratios of 50 to 1 below.
Effect on packings and other elastomeric components immersed in the fluid at 70 ± 1°C (158 ± 2°F) for 168 hours (7 days)	Volume change limits shall be as specified in Table II.

TABLE I. Chemical and physical properties. - Continued

Characteristic	Requirement
Static corrosion at 70 ± 1°C (158 ± 2°F) for 720 hrs (30 days):	
Change in weight, maximum	4 mg
Appearance of fluid	No change in the fundemental color, no fluid separation nor formation of sludge.
Appearance of test panels	No deep localized pitting.
Stirring corrosion at 70 ± 1°C (158 ± 2°F) for 336 hrs (14 days):	
Change in weight, maximum	7 mg
Appearance of fluid	No change in the fundamental color, no fluid separation nor formation of sludge.
Appearance of test panels	No deep localized pitting
Pump performance after 500 hours:	
Operation	Shall operate satisfactorily.
Viscosity	Shall conform to the viscosity requirements of this table.
Hydrogen ion concentration, pH	8 8 to 9.8
Vapor phase corrosion at 60 ± 1°C (140 ± 2°F) for 16 hours	No evidence of pitting, exfoliation, or corrosion on the test panels visible to the naked eye
Storage stability at 25 ± 6°C (77 ± 10°F) for 12 months	No formation of resinous gums, sludge, fluid separation or change in fundamental color of fluid.

1/ Determined as a matter of record

2/ Not more volatile than water A loss as much as 10 percent by weight shall not result in the forming of a precipitate, separation of components or radical change in appearance.

TABLE II. Volume change limits of various packings and other elastomeric components used in catapult system (see Table I and 4.6.9)

Part (Drawing) no.	Nomenclature	Volume change limits (percent)
AN6227-14 1/ (MIL-P-25732)	"O" Ring	-5
A314341-1	Garlock Klozure	-0 +15
A92589-10	Hard asbestos gasket	-0 +5
A87772-35	Hard outer flange	-0 +7 5
A87772-35	Soft core	-0 +35
A312047-10	"O" ring	-5 +10
A87772-1	Hard outer flange	-5 +5
A87772-1	Soft core	-0 +15
A88595-10	Packing cup leather	-0 +35
A89984-4	Hard outer flange	-0 +7.5
A89984-4	Soft core	-0 +15
A89791-4	Hard outer flange of Garlock chevron packing	-0 +15
A89791-4	Soft core of Garlock chevron packing	-0 +15
AN6227-32 1/	"O" ring	-5 +10
A314255-1	Gasket	+7.5

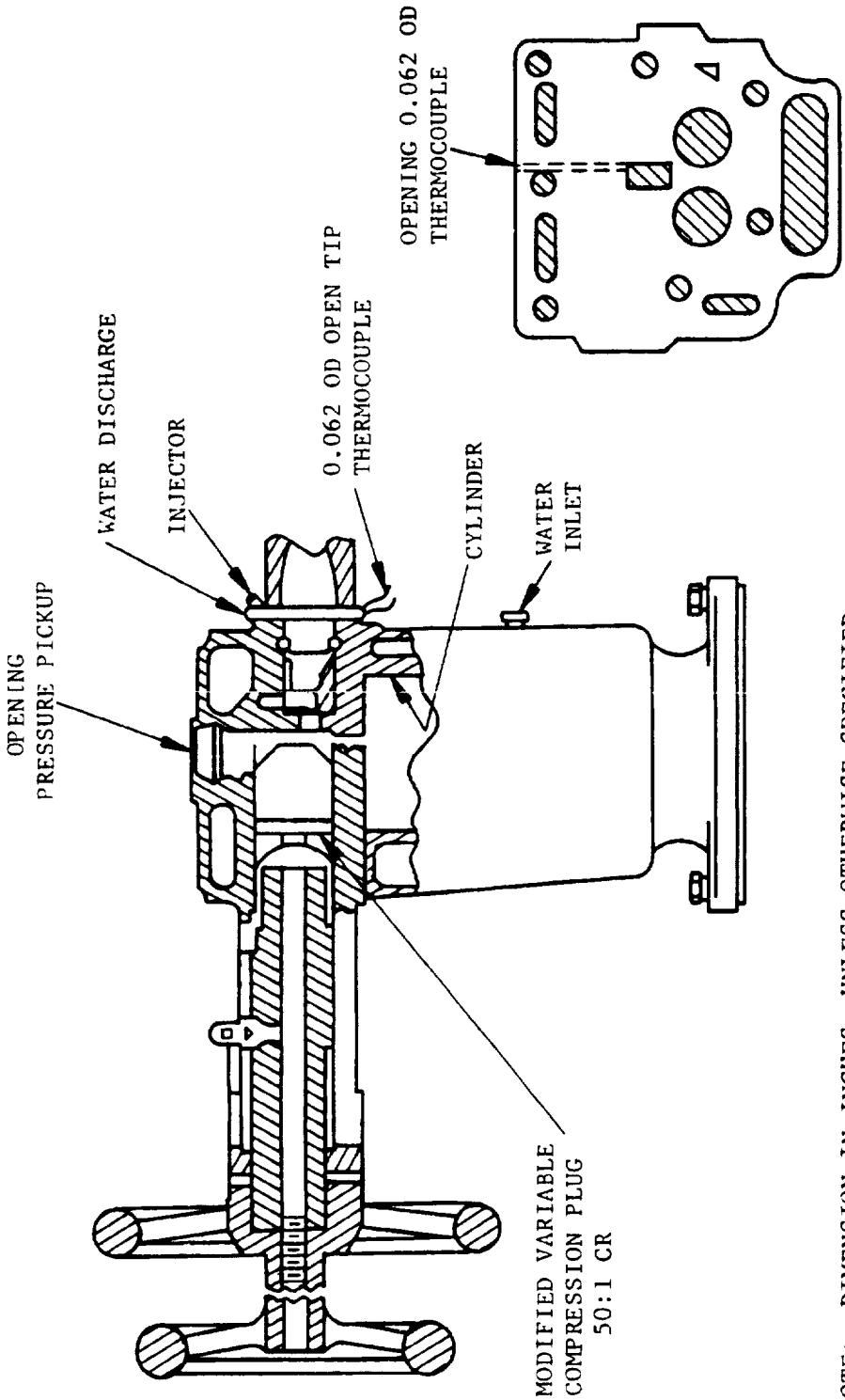
1/ Military standard.

TABLE III. Quality conformance tests.

Inspection	Paragraph	
	Requirement	Test method
Water content	Table I	Table IV
Specific gravity	Table I	Table IV
Viscosity	Table I	Table IV
Foam characteristics	Table I	Table IV
Hydrogen ion concentration, pH	Table I	Table IV
High temperature stability	Table I	4.6.3
Low temperature crystallization	Table I	4 6.4
Evaporation	Table I	4 6.5
Volatility	Table I	4 6.6
Cloud temperature	Table I	4.6.7
Vapor phase corrosion	Table I	4.6.14
Examination of filled containers	5.1	4 6.1

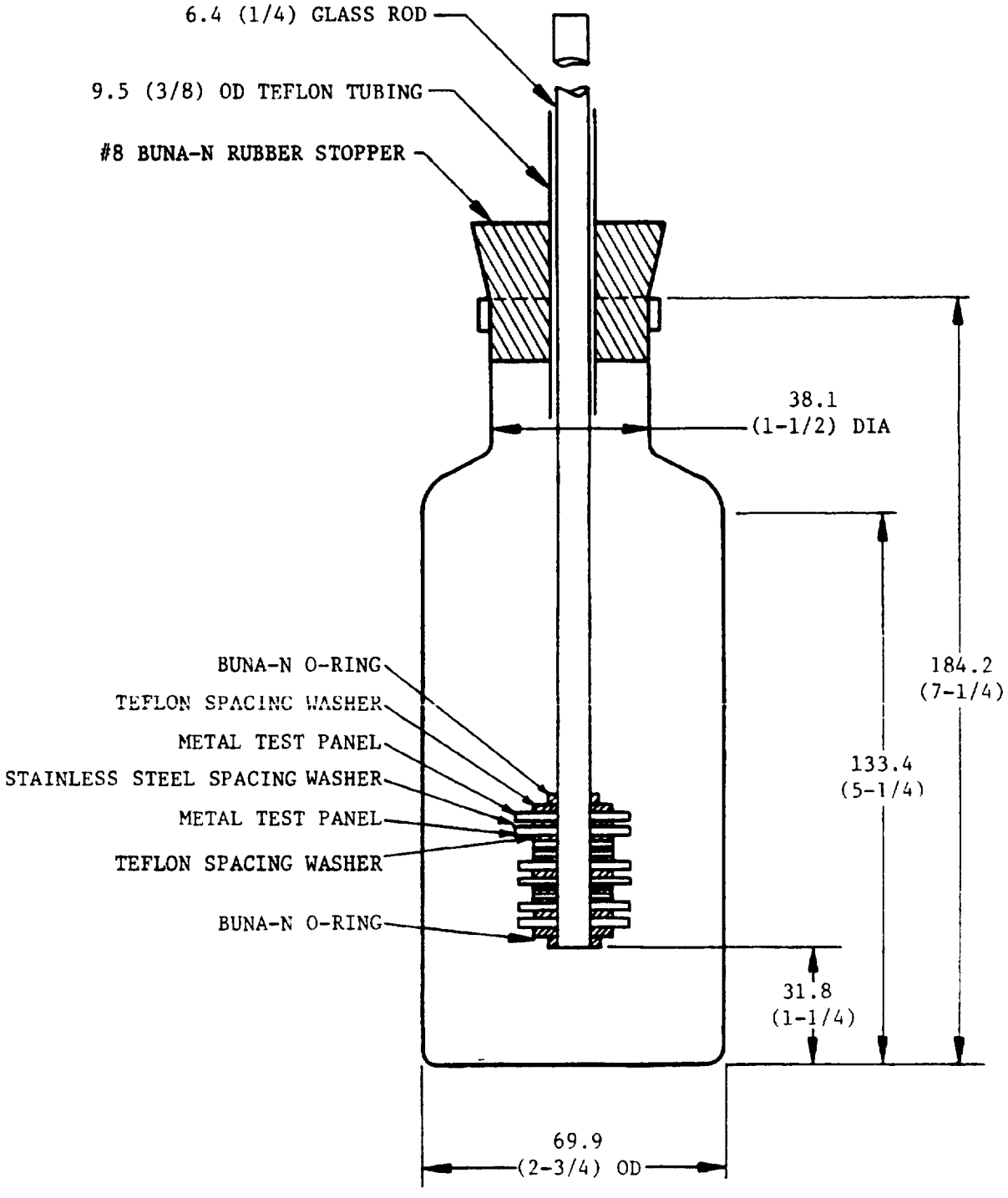
Table IV. Applicable ASTM test methods (see 4.6.2).

Test	ASTM Method
Water content	D 95
Specific gravity	D 1298
Viscosity	D 445
Foaming characteristics	D 892
Hydrogen ion concentration, pH	E 70



NOTE: DIMENSION IN INCHES, UNLESS OTHERWISE SPECIFIED.

FIGURE 1. CFR engine, details of combustion head (see 4.6.8.1.2).



NOTE: ALL DIMENSIONS ARE IN MILLIMETERS (MM) WITH INCHES SHOWN IN PARENTHESIS

FIGURE 2. Apparatus for stirring corrosion test (see 4.6.11.1).

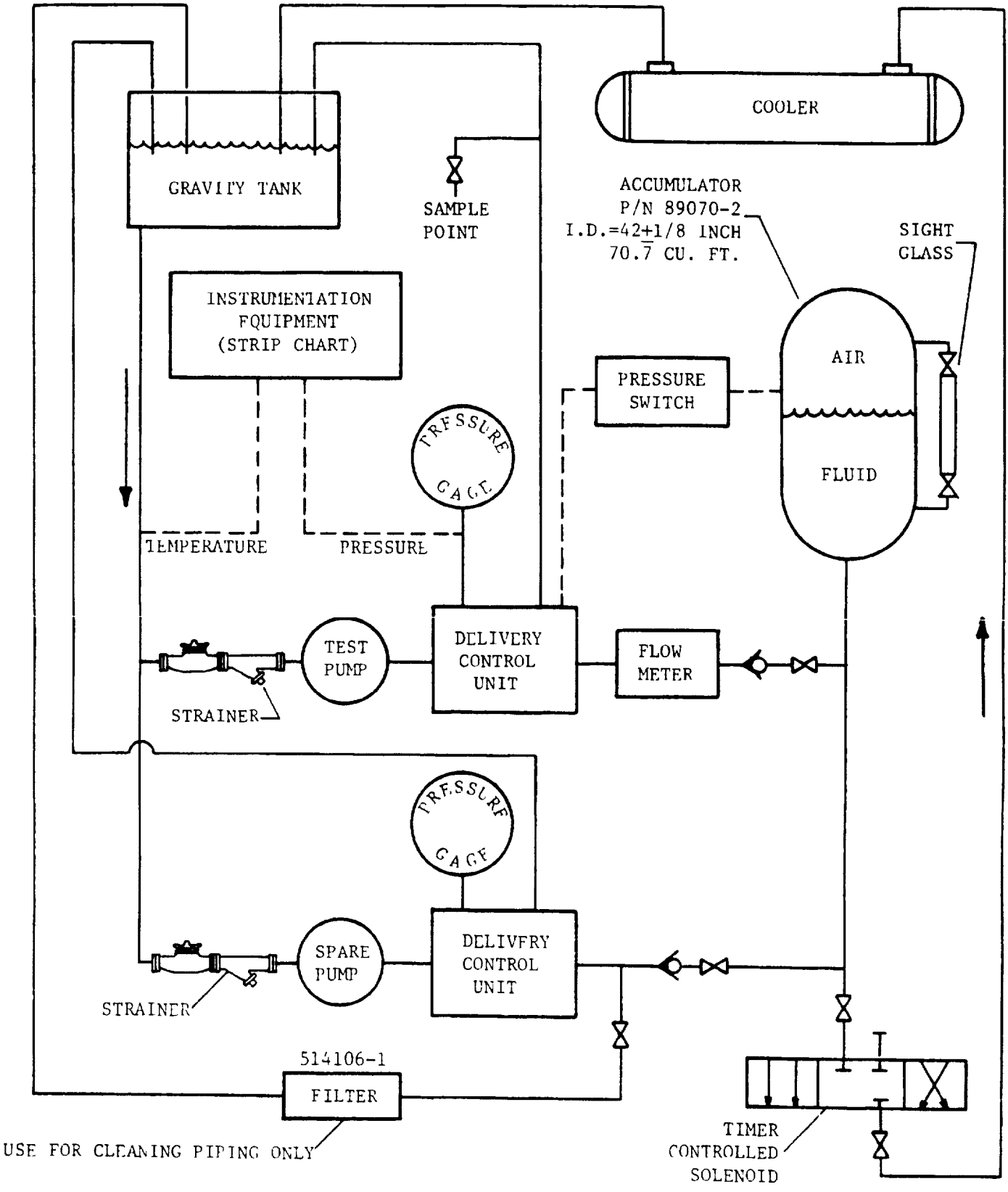


FIGURE 3. Pump test set-up (see 4.6.13).

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(See Instructions - Reverse Side)

1 DOCUMENT NUMBER	2 DOCUMENT TITLE
MIL-H-22072C(AS)	Hydraulic Fluid, Catapult, NATO Code Number H-579

3a NAME OF SUBMITTING ORGANIZATION	4 TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b ADDRESS *(Street City State ZIP Code)*	☐ 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
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