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AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 3150C

Issued 5-1-48
Revised 7-1-86

Superseding AMS 3150B

FLUID, HYDRAULIC
Fire Resistant

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of 10-28-68. It is recommended that this specification not be specified for new designs.

This cover sheet should be attached to the "C" revision of the subject specification.

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This specification has been delared "CANCELLED" by the Aerospace Materials Division, SAE, as of 1-15-81. By this action, subject specification number and title will be deleted from the active specification index of Aerospace Material Specifications.

This specification is under the jurisdiction of AMS Committee "B".

AERONAUTICAL
MATERIAL SPECIFICATIONS
SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York 17, N.Y.

AMS 3150C

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FLUID, HYDRAULIC
Fire Resistant

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

2. APPLICATION: For use in commercial aircraft hydraulic systems.

3. COMPOSITION: There shall be no restrictions on the type of materials used in the fluid except those imposed by the technical requirements of this specification.

4. TECHNICAL REQUIREMENTS:

4.1 Effect on Packings: The fluid shall have no deleterious effect on AMS 7277 packings as indicated by the results obtained when such packings are tested ø to the requirements of AMS 7277 using fluid to this specification in lieu of the SAE Phosphate Ester Standard Test Fluid No. 1 specified therein.

4.2 Compatibility: The fluid and currently used petroleum fluids (USAF 3580 and MIL-H-5606) shall each be compatible with at least 5% of the other, so that no malfunctioning of the system due to formation of resinous gums or sludges will occur. The fluid shall also be compatible with MIL-H-6083 fluids to the extent that there will be no deleterious effects when parts protected with MIL-H-6083 are put into service in a system containing the fire resistant fluid.

4.3 Storage: There shall be no precipitation or separation of any portion of the fluid in storage or use at temperatures from -50 F to +180 F. This does not preclude a slight cloud in the fluid at the lower temperature. A 7 day storage test is sufficient to indicate compliance with this requirement.

4.4 Toxicity: The fluid shall not burn or irritate the skin, nor shall semi-prolonged breathing of the vapors at normal ambient temperatures be toxic or injurious.

4.5 Viscosity: The upper and lower limit of viscosity at high temperature shall not be restricted except as otherwise indicated by satisfactory lubricity and hydrodynamic performance in the pumping test herein required. The viscosity limits shall be as follows when tested in accordance with ASTM D445-53T:

4.5.1 Grade 500: This fluid shall have viscosity at -40 F of not higher than ø 500 centistokes.

4.5.2 Grade 7000: This fluid shall have a viscosity at -40 F of 2000 - 7000 centistokes.

4.6 Specific Gravity: Unless otherwise agreed upon by purchaser and vendor, the specific gravity shall be not higher than 1.1 at 60 F/60 F when tested in accordance with ASTM D1298-55.

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4.7 Coefficient of Cubical Expansion: Shall not exceed 0.00053 per deg F at 68 F when calculated from density measurements made in accordance with ASTM D1217-54.

4.8 Water Content: Shall not be greater than 0.5% when determined in accordance with ASTM D1533-58T.

4.9 Autogenous Ignition Temperature: Shall be higher than 750 F, determined in accordance with ASTM D286-58T.

4.10 Flammability: Performance in all flammability tests shall be equivalent to or better than the performance of the HS-1 Reference Fluid similarly tested as follows; HS-1 Reference Fluid may be obtained from sources which will be furnished upon request of SAE office:

4.10.1 Flammability Wick Test (Pipe Cleaner Test): Arrange a means for cycling an ordinary pipe cleaner in a horizontal plane through or into the flame from a laboratory burner at a fixed rate of speed, preferably 30 - 40 cycles per minute. Soak the pipe cleaner with the test fluid and allow the excess to drain off. Adjust the burner with sufficient air to provide a non-luminous flame, but not enough to form a sharp inner cone. For best results, a flame height of approximately 4 in. is recommended. Cycle the pipe cleaner through or into the hottest part of the flame and count the number of cycles until a self-sustaining flame is achieved. The rate of cycling may be modified if necessary to allow for fluids having self-extinguishing tendencies.

4.10.2 Flammability Spray Test:

4.10.2.1 Prepare a shallow metal pan approximately 1 ft square with sides not over 2 in. high, into which is placed a platform or grid made from 1/8 - 1/4 in. mesh wire and spaced 1/2 in. from the bottom of the pan. Saturate 10 g of cotton waste with 20 g of Grade 1120 petroleum engine oil, roll the waste into a ball, and place in the center of the grid.

4.10.2.2 Place a quantity of the test fluid in a Binks Thor No. 7 paint spray gun (0.070 in. orifice). Set line pressure to 40 psi, and adjust gun to produce a dense cone shaped spray.

4.10.2.3 Ignite the oil soaked waste and allow the fire to reach maximum intensity. Aim spray gun on the fire as shown in Figure 6 and intensify fire by depressing trigger slightly (air jet only). Introduce fluid mist by fully depressing trigger in bursts. Record the results as "increase", "no increase", or "decrease" in fire when the fluid mist is introduced into fire. Spray several ounces of liquid to be certain of results.

4.10.2.4 Use new waste for each test and ensure that the pan is approximately at room temperature.

4.10.3 Flammability, High Temperature Ignition Test:

4.10.3.1 Assemble equipment for applying 1000 psi ± 50 to the test fluid. A suggested arrangement, shown in Figure 1, consists of a nitrogen bottle, a large hydraulic cylinder, and necessary lines, valves, and gages. Use a steel disc 0.063 in. thick with an orifice approximately 0.0145 in. in diameter to spray the fluid.

4.10.3.2 Charge the cylinder with the test fluid. Apply nitrogen pressure so that the gage on the fluid side reads 1000 psi ± 50. Open the valve at the orifice and attempt to ignite the spray at a point 1.5 - 12 in. from the orifice with an oxy-acetylene torch, using a No. 1 Purox tip, while maintaining the pressure at 1000 psi ± 50. Record the results as follows: "Will not ignite", "flashes with difficulty", or "flashes readily". Also indicate whether any flashing is self-extinguishing or results in a sustained fire.

4.10.3.3 If the fluid cannot be ignited in the test of 4.10.3.2, repeat the test by applying the flame at increasing distances from the orifice up to the limit of the spray. If ignition or flashing can be produced, record the minimum distance from the orifice at which such ignition or flashing is produced. Also indicate whether any flashing is self-extinguishing or results in a sustained fire.

4.10.3.4 For proper comparison with the HS-1 Reference Fluid, the tests on both fluids should be performed under identical atmospheric conditions, preferably one immediately following the other.

4.10.4 Flammability, Manifold Test:

4.10.4.1 Fabricate a simulated exhaust stack section and mount in a shield as shown in Figure 2. Opposite the steel rod, spotweld a thermocouple and insulate the leads to insure proper temperature readings. Insert a Globar element or equivalent (similar to Type AT, 31 x 12 x 1 in., 0.633 ohms, manufactured by the Carborundum Company, Niagara Falls, N.Y.) into the tube and make the necessary electrical connections. Adjust voltage so that the temperature of the tube is 1300 F ± 25. Clean the tube before each series of tests with steel wool or by sandblasting.

4.10.4.2 Slowly pour 10 ml of test fluid on the simulated exhaust stack in not less than 40 seconds.

4.10.4.3 Record the results as follows: "fluid burns on the tube", "fluid does not burn on the tube", and "burns", "flashes", or "does not burn" in the bottom of the shield.

4.11 Pumping Test: The fluid shall operate satisfactorily in a 3000 psi pump system preferably using a Vickers type PF-3911-25-ZE pump, with performance characteristics equal to or better than those of MIL-H-5606 fluid for a comparable length of time when tested as follows:

4.11.1 The pumping test shall be run continuously at a speed of 3000 - 3600 rpm at a pressure of 3000 psi and reservoir temperature of 160 F in a system such as that depicted in Figure 3. Samples should be taken to determine pH, neutralization number and viscosity changes in the fluid in accordance with the following schedule:

Schedule of Sampling

Cycles
500
1000
2000
4000
8000
14000
20000
30000

The number of cycles may be calculated by dividing the total flow of fluid through the pump (in gallons) by the quantity of fluid in the system. The total volume of fluid in the system shall not exceed 5 gallons. No fluid shall be added to the system after the test has been started in excess of the quantity required to replace that withdrawn for sampling purposes and this total quantity shall not exceed 1 quart. Additional loss of fluid in excess of 20% of the system volume shall require a retest.

4.11.2 The same system with a new pump shall be used for the referee run using MIL-H-5606 fluid.

4.11.3 The primary criterion for determining the effects of the fluid shall be the total number of running hours before failure or incipient failure. Weight loss measurements shall be made on the cylinder block, bronze thrust knuckles, and universal link assembly for comparison purposes. Observations shall also be made of corrosion or roughness of the bearings, excessive and play of piston knuckle joints, and scoring of valve plate.

4.12 Power System Performance: The power system test (see Figure 4) shall be made at 3000 psi, at a strut operating rate of 2 cycles per min., and at a reservoir temperature of 160 F. The general hydrodynamic operation of the system shall be observed and any irregularities noted. Performance shall be at least equivalent to MIL-H-5606 fluid and shall be satisfactory for the particular aircraft system for which it is intended.

4.13 Evaporation and Tackiness: Evaporation characteristics of the fluid shall be such that the fire resistance will not be materially affected in operation. Evaporation of the fluid on a polished metal surface shall not yield a sticky or tacky residue on the surface to a greater degree than for MIL-H-5606 fluid.

4.14 Corrosion and Oxidation Stability:

4.14.1 The change in weight of steel, aluminum alloy, magnesium alloy, and cadmium plated steel when subjected to the action of hydraulic fluid for 168 hr shall be not greater than ± 0.2 mg per sq cm of surface. The change in weight of copper under the same conditions shall be not greater than ± 0.6 mg per sq cm of surface. There shall be no pitting, etching, or visible corrosion on the surface of any of the metals when viewed under magnification of 20 diameters. Slight discoloration of the surface of the aluminum alloy, copper, and cadmium will be permitted.

4.14.2 The fluid shall not have changed more than -5 or +10% from the original viscosity in centistokes at 130 F after the oxidation corrosion test. The neutralization number using Brom Thymol Blue as the indicator shall not have increased by more than 0.20 over the neutralization number of the original fluid. There shall be no evidence of separation of insoluble materials or gumming of the fluid.

4.14.3 A large pyrex test tube shall be fitted with a water cooled reflux condenser preferably of the Allihn type, by means of a tight fitting shellaced cork or a ground glass connection. In the test tube shall be placed 100 ml of the fluid to be tested and weighed strips, approximately 1 in. square, of copper, AMS 4500; low carbon steel, AMS 5042 or AMS 5044; aluminum alloy, AMS 4037; magnesium alloy, AMS 4377; and steel cadmium plated in accordance with AMS 2400. The metals shall be arranged in such a way that they form a square with the magnesium specimen touching aluminum and steel but not copper as diagrammed in Figure 5. A small hole shall be bored near each of the parallel edges of each specimen and the sheets then tied together with a high grade cord previously washed with distilled water and dried. Two sets of holes may be used in each strip to give the square stability. Each specimen, except cadmium plated steel, shall be polished with 3/0 emery cloth to remove all surface oxidation, and rinsed in analytical reagent grade benzene to remove contamination. Cadmium plated steel specimens shall not be polished but shall be rinsed in analytical reagent grade benzene to remove contamination. The assembly consisting of test tube, fluid, and strips shall be weighed to 0.1 g and placed vertically in a thermostatically controlled bath maintained at 180 F. A glass tube, one end of which has been drawn down to 1/16 in. diameter orifice, shall be introduced through the condenser in such a manner that it extends to 1/4 in. from the bottom of the test tube in the center of the square, and clean moist air, obtained by bubbling through a bottle of water at room temperature, introduced at the rate of 5 liters ± 0.5 per hour. At the end of 168 hr the oil shall be examined visually for separation of insoluble material or gumming and the viscosity and neutralization number of the fluid shall be determined. Metal specimens shall be washed in c p benzene, then in acetone, and dried before reweighing. If necessary, any product remaining adherent to the metals shall be wiped or brushed off and the plates rewashed and dried before reweighing. The metal test specimens shall be reweighed to determine the change due to corrosion and shall be examined under 20 X magnification for pitting or etching. The loss of fluid for the period of test shall not be more than 8%. If the loss exceeds this value, the test shall be disregarded and a duplicate determination shall be made.

5. QUALITY: The fluid shall be entirely homogenous, and free from undissolved water, dirt, lint, and sediment. Before final packaging, the fluid shall be filtered through a blotter press or equivalent.

6. REPORTS: Unless otherwise specified, the vendor of the fluid shall furnish with each shipment three copies of a report stating that the fluid supplied conforms to the requirements of this specification. This report shall include the purchase order number, material specification number, vendor's material number, mix number, and quantity.

7. IDENTIFICATION:

7.1 Each grade of fluid shall be identified by the addition of a suitable dye as specified by the purchaser.

7.2 Each container shall be permanently and legibly marked to give the following information:

FLUID, HYDRAULIC, FIRE RESISTANT
GRADE_____
AMS 3150C
PURCHASE ORDER NUMBER_____
QUANTITY_____
MANUFACTURER'S IDENTIFICATION___
MONTH AND YEAR OF MANUFACTURE___

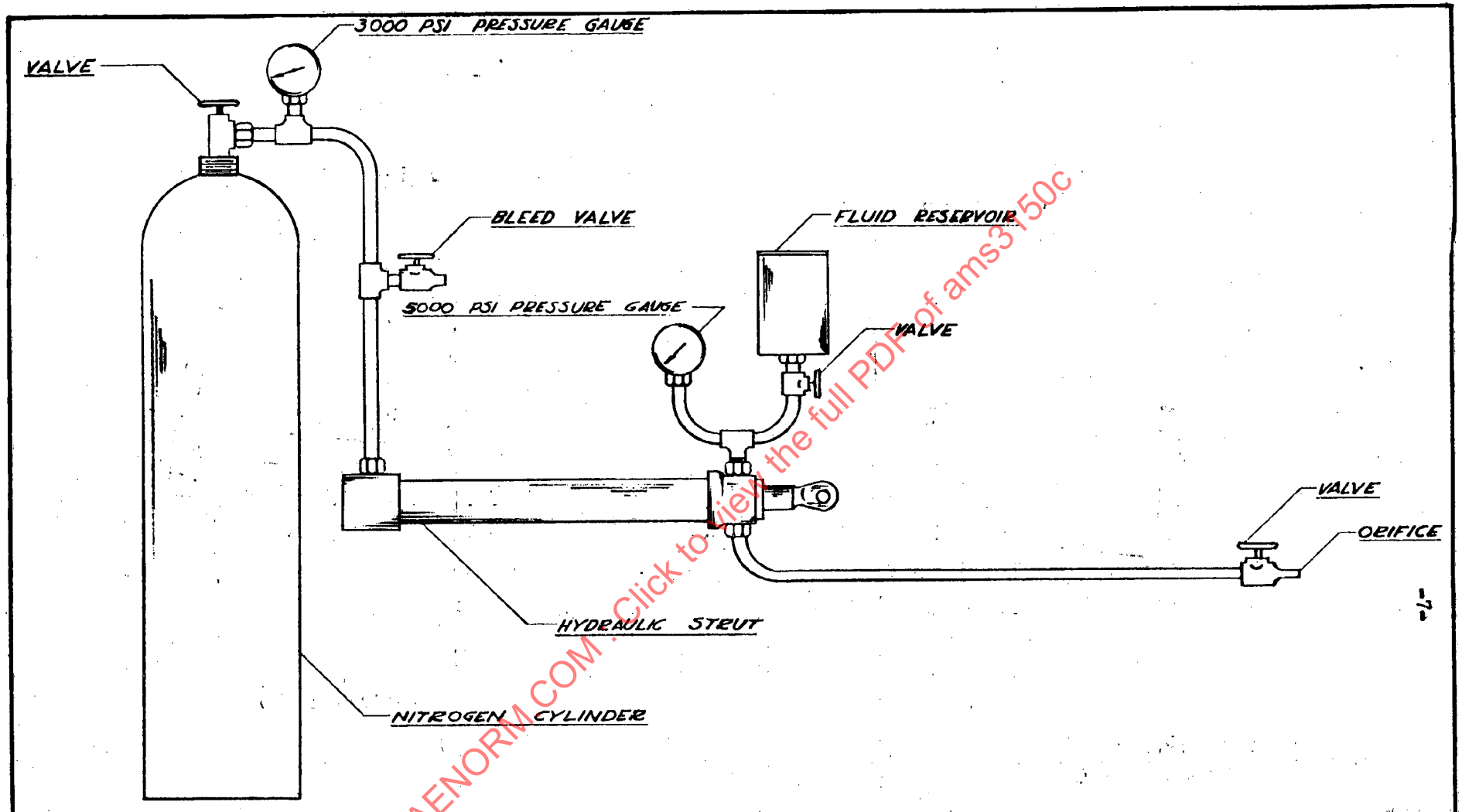
8. PACKAGING: Unless otherwise specified, material shall be supplied in 50 gal drums. The drums or containers shall be clean and not lined with material that is soluble in or might contaminate the hydraulic fluid.

9. APPROVAL:

9.1 To assure adequate performance characteristics, fluid shall be approved by purchaser before fluid for production use is supplied, unless such approval be waived. Results of tests on production fluid shall be essentially equivalent to those on the approved sample.

9.2 Vendor shall use the same ingredients and manufacturing processes for production fluid as for approved sample fluid. If necessary to make any change in ingredients or processing, vendor shall obtain permission from purchaser prior to incorporating such change.

10. REJECTIONS: Material not conforming to this specification or to authorized modifications will be subject to rejection.



— FIGURE 1 —

HIGH TEMPERATURE IGNITION TEST

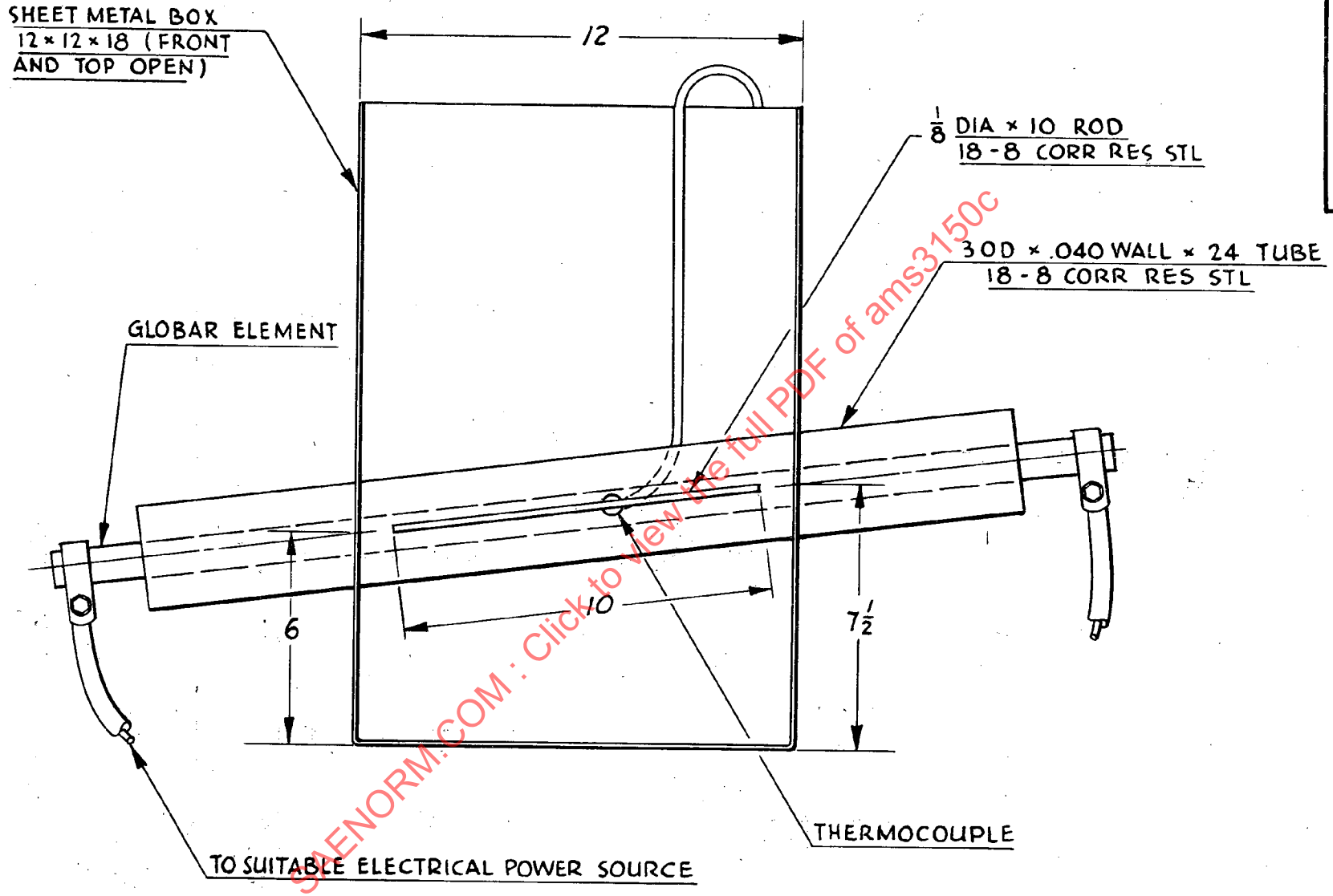
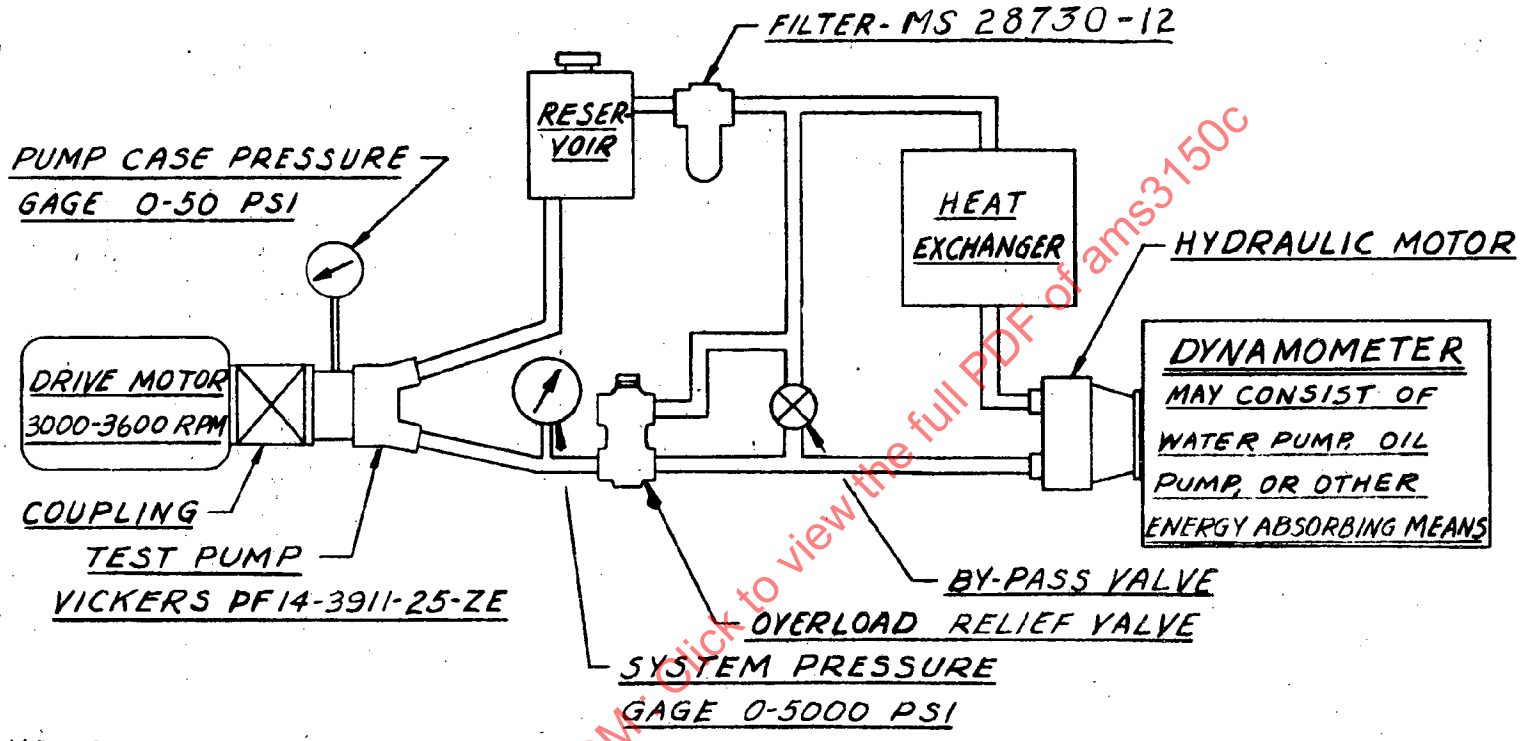


Figure 2 - EXHAUST MANIFOLD TEST



NOTES~

1. IF HEAT EXCHANGER HAS SUFFICIENT CAPACITY, RELIEF OR THROTTLE VALVE MAY BE USED FOR LOADING INSTEAD OF HYDRAULIC MOTOR AND DYNAMOMETER.
2. INCREASE IN PUMP CASE PRESSURE IS AN INDICATION OF APPROACHING PUMP FAILURE. TEST SHOULD BE STOPPED WHEN THIS OCCURS.

- FIGURE 3 -

SUGGESTED PUMPING TEST DIAGRAM