AERONAUTICAL MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
29 West 39th Street
New York City

AMS3150A

Issued 5-1-48
Revised 6-1-49

F L U I D - H Y D R A U L I C
Interim-Nonflammable Type

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

2. APPLICATION: For tentative use in commercial aircraft hydraulic systems after any necessary minor mechanical alterations have been made as approved by the aircraft manufacturer concerned.

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 currently used packing materials. Excessive volumetric swell or softening of standard packings or elastomer components as described in applicable specifications such as AN-HH-P-114 Packing, AN-P-79 Packings and Gaskets, AN-R-22 Rings, AN-H-24 Hose and AN-H-28 Hose Assemblies shall not be considered deleterious if power system tests indicate no excessive loss of packing life expectancy. "O" ring grooves normally will not accommodate more than 20% volumetric swell.

4.2 Compatibility: The fluid and currently used petroleum fluids (AAF-3580 and AN-VV-O-366b) 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 AN-O-7 fluids to the extent that there will be no deleterious effects when parts protected with AN-O-7 are put into service in a system containing the nonflammable 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 low temperatures. Generally 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:

4.5.1 Grade 2000: This fluid shall have viscosity at -40 F of 2000 centistokes, maximum and is the preferred fluid, satisfactory for all commercial aircraft.

4.5.2 Grade 7000: This fluid shall have a viscosity at -40 F of 2000 to 7000 centistokes and may be restricted to certain types of aircraft.

4.6 Specific Gravity: Unless otherwise agreed, the specific gravity shall be 1.1 max at 60 F/60 F. Fluids of higher specific gravity will be considered if proper system performance can be demonstrated.

4.7 Coefficient of Expansion: The coefficient of expansion shall be determined and should preferably not exceed that of petroleum base fluids.

4.8 Autogenous Ignition Temperature: The Autogenous Ignition Temperature shall preferably be above 750 F determined by A. S. T. M. method D286-30.

4.9 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:

4.9.1 Flammability Wick Test:

4.9.1.1 Pipe Cleaner: 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 to 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" 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.

4.9.2 Flammability Spray Test:

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

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

4.9.2.3 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.

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

4.9.3 Flammability, High Temperature Ignition Test (See Figure 1):

4.9.3.1 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 0.064 inch thick with an orifice approximately 0.0145 inch in diameter to spray the fluid.

4.9.3.2 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 1-1/2 to 12 inches 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.

4.9.3.3 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.

4.9.3.4 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.

4.9.4 Flammability, Manifold Test (See Figure 2):

4.9.4.1 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, 31x12x1, 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. Clean the tube before each series of tests with steel wool or by sandblasting.

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

4.9.4.3 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.

4.10 Pumping Test (See Figure 3): The fluid shall operate satisfactorily in a 3000 psi pump system, preferably using a Vickers type PF-3911-25 pump, with performance characteristics equal to or better than those of AN-VV-O-366b fluid for a comparable length of time when tested as follows:

4.10.1 The pumping test shall be run continuously at a speed of 3000 - 3600 rmp 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

500 cycles
1000 cycles
2000 cycles
4000 cycles
8000 cycles
14000 cycles
20000 cycles
30000 cycles

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 five 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 one quart. Additional loss of fluid in excess of 20% of the system volume shall require a retest.

4.10.2 The same system with a new pump shall be used for the referee run using AN-VV-O-366b fluid.

4.10.3 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 end play of piston knuckle joints, and scoring of the valve plate.

4.11 Power System Performance (See Figure 4): The power system test shall be made at 3000 psi, at a strut operating rate of 2 cycles per minute, 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 AN-VV-O-366b fluid and shall be satisfactory for the particular aircraft system for which it is intended.

4.12 Evaporation and Tackiness: Evaporation characteristics of the fluid shall be such that the nonflammability 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 AN-VV-O-366b fluid.

4.13 Corrosion and Oxidation Stability:

4.13.1 The change in weight of steel, aluminum alloy, magnesium alloy and cadmium plated steel when subjected to the action of hydraulic fluid for 168 hours shall not be greater than ± 0.2 mg per squarecentimeter of surface. The change in weight of copper under the same conditions shall be no greater than ± 0.6 mg per square centimeter 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.

4.13.2 The fluid shall not have changed more than -5 or +10% from the original viscosity in centipoises 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.

4.13.3 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 shellacked 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 one inch square of copper, AMS 4500B; low carbon steel, AMS 5042D or AMS 5044B; aluminum alloy, AMS 4037B; magnesium alloy AMS 4370; and steel cadmium plated in accordance with AMS 2400G. 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 which had been 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 gram 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 inch diameter orifice shall be introduced through the condenser in such a manner that it extends 1/4 inch from the bottom of the test tube in the center of the square and clean moist air obtained by bubbling through a room temperature bottle of water introduced at the rate of 5 + 0.5 liters per hour. At the end of 168 hours 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 CP 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 they shall be examined under 20 X magnification to discover pitting or etching if it exists. The loss of the 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 or 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 notarized report stating that the material 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: Each grade of fluid shall be identified by the addition of a suitable dye designated by the testing agency.

8. PACKAGING:

8.1 Unless otherwise specified, shipment shall be in 50-gallon drums. The drums or containers shall be clean and not lined with material that is soluble in or might contaminate the hydraulic fluid.

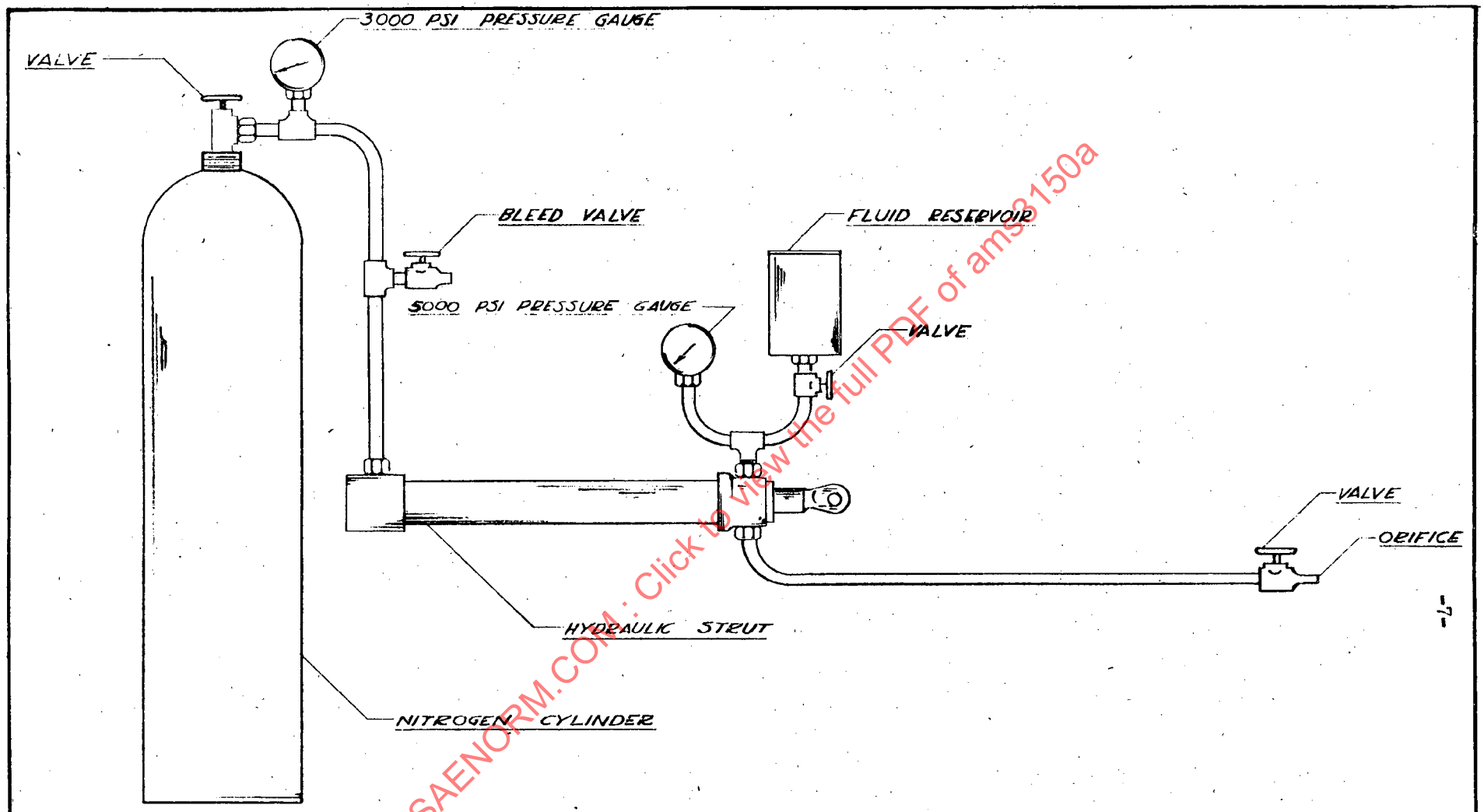
8.2 Each container shall be permanently and legibly marked to give the following information:

FLUID - HYDRAULIC - NONFLAMMABLE
GRADE -
MATERIAL SPECIFICATION AMS_____
PURCHASE ORDER NUMBER -
QUANTITY -
MANUFACTURER'S IDENTIFICATION -
MONTH AND YEAR OF MANUFACTURE -

9. APPROVAL: A vendor shall not begin to supply fluid to this specification until samples are approved by the purchaser, and after approval, the ingredients and method of compounding shall not be changed without notification to the purchaser. Results of test on incoming shipments shall be essentially equal to those obtained on approved samples.

10. REJECTIONS: Material not conforming to this specification or to authorized modifications will be subject to rejection. Unless otherwise stipulated, rejected material will be returned to vendor at vendor's expense, unless purchaser receives within three weeks of notification of rejection other instructions for disposition.

NOTE. SIMILAR SPECIFICATIONS: This specification is based on the requirements developed and proposed by the Aircraft Industries Association - Aircraft Research and Testing Committee.



— FIGURE 1 —

HIGH TEMPERATURE IGNITION TEST

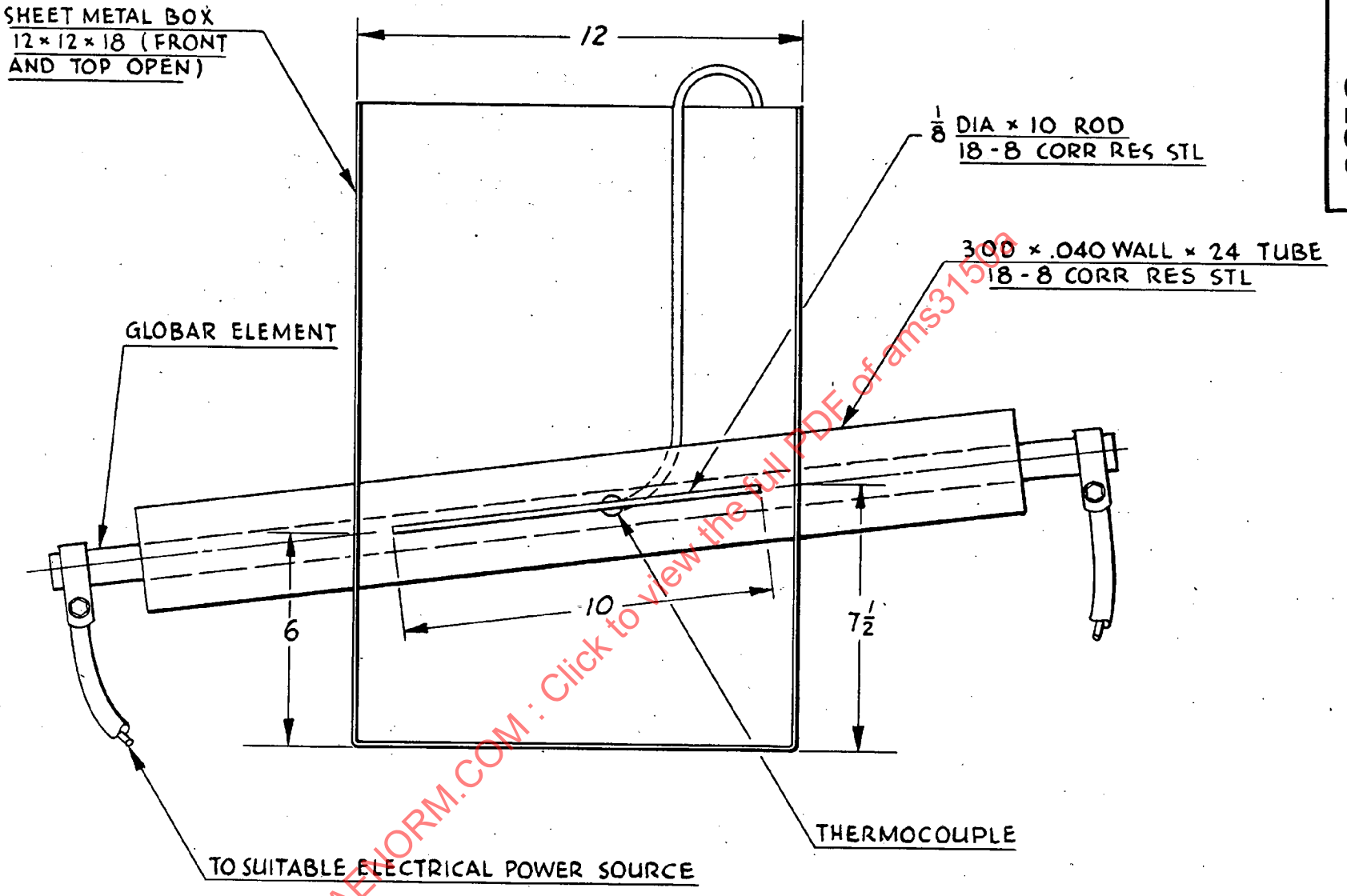
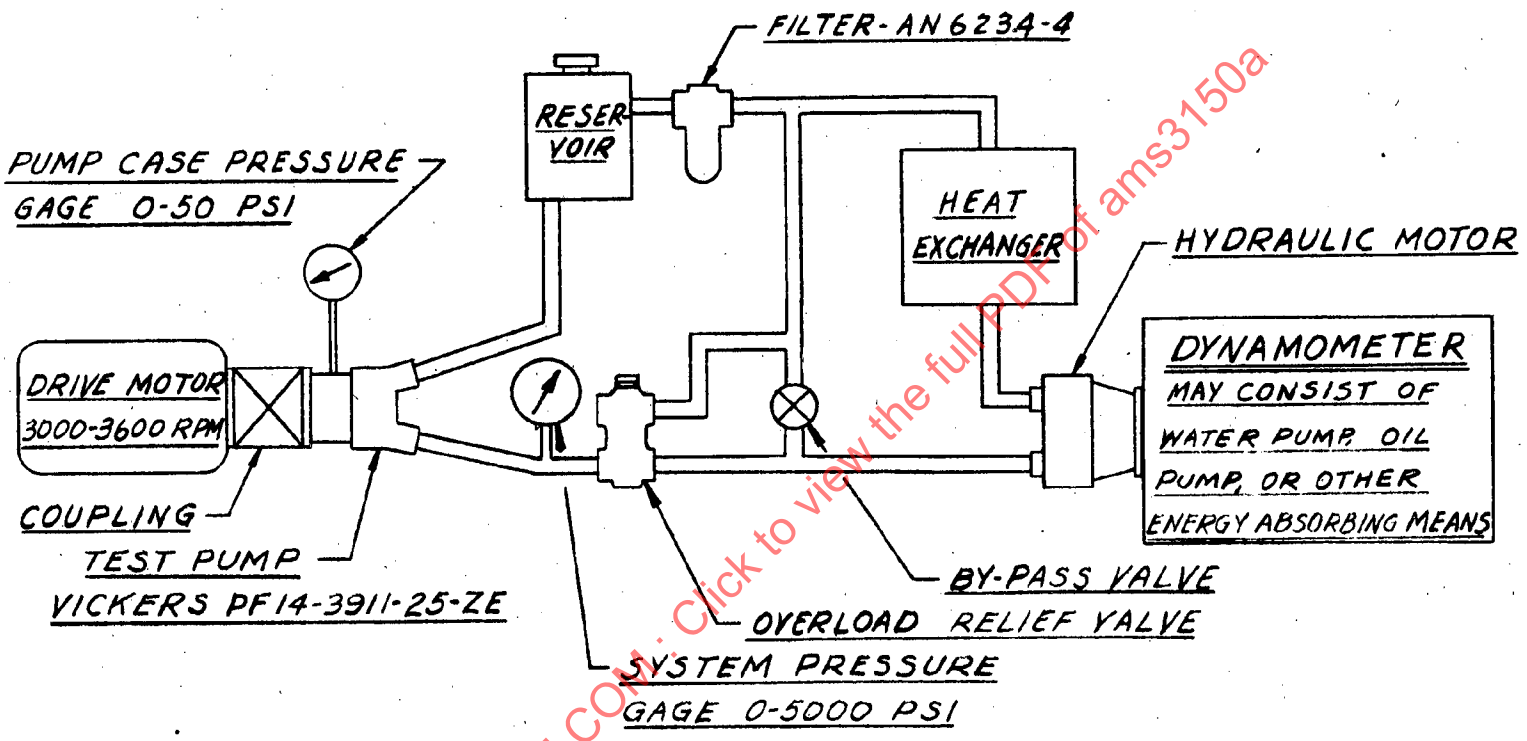


Figure 2 - EXHAUST MANIFOLD TEST



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