AEROSPACE RECOMMENDED PRACTICE

Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

ARP 575A	
Issued	2/1/59
Revised	3/1/74

FILTER PATCH TESTING PROCEDURES FOR AEROSPACE HYDRAULIC PUMPS AND MOTORS

1. **PURPOSE**

   This Aerospace Recommended Practice (ARP) sets forth recommendations of SAE Subcommittee A-6C (Fluid Power Distribution Elements) relative to the procedure and methods to be used in the obtaining and evaluation of filter patch tests for aerospace hydraulic pumps and motors. These patches are to be used in a quality control program to insure that units are operating properly prior to delivery to the customer. This is to promote an optimum in cleanliness standards in aerospace hydraulic circuits. It is expected that this will promote a longer service life of the pump or motor.

2. **SCOPE**

2.1 These recommendations are written to cover the subject of obtaining filter patch test samples from aerospace hydraulic units of the categories shown below. The same procedure shall apply regardless of the unit drive category.

2.1.1 Engine Mounted Units:

2.1.2 Auxiliary Power Driven Units: Units in this classification should include electric motor driven units, air turbine driven units, units driven by hydraulic motors, and other auxiliary driven units.

3. **DEFINITION**

3.1 A filter patch is a membrane on which pump or motor generated contaminants have been collected. This patch is analyzed and compared with a "standard" patch which has been mutually established between the pump/motor manufacturer and the customer, and serves as a basis for rejection or acceptance of a pump or motor prior to delivery.

3.1.1 Inlet Patch: This is an indication of contaminant level or cleanliness of the fluid provided in the system for testing the unit.

3.1.2 Outlet Patch: This patch provides an indication of the degree of internal pump or motor wear by the amount of contamination generated in the displacement portion of the unit.

3.1.3 Case Drain Patch (where applicable): This is an indication of contaminant level or internal wear rate of the unit other than that indicated by the outlet patch.

4. **GENERAL RECOMMENDATIONS**

4.1 The tests outlined in this ARP cover a cleanliness test procedure only. Prior to conducting this test, other standard production-type tests should have been satisfactorily completed. For this test a standard maximum contaminant generated patch sample should have been agreed upon by the unit manufacturer and the customer. The manufacturer shall also specify the detail test procedure. This standard sample should be an actual patch similar to that shown in Fig. 3 and should show maximum contaminant generated patches for the 2 hr test. This time period may be varied depending upon the application. These samples should relate to the outlet, inlet, and case drain patch samples.

ARP 575A

4.2 Test Constants:

4.2.1 Unless otherwise specified, hydraulic fluid conforming to Specification MIL-H-5606 shall be used.

4.2.2 Fluid Temperature: The unit inlet fluid temperature shall be 160°F ± 10°F (71.1°C ± 5.6°) unless otherwise specified.

4.2.3 Filter Requirements: In these tests, "T" type filters should be placed in the pump inlet line, case drain line and outlet line.

The filters should be located as close to the pump as practicable and in no case should there be any other component or element between the filter and the test unit. The outlet filter should be in the high pressure position of the circuit. In the installation of these filters, they should be mounted vertically, with the filter bowls in a downward position.

The filter bodies may be of the MIL-F-8815 type or similar. The filter size should be rated for the minimum pressure drop at the maximum inlet and outlet pump capacity used in the aircraft installation. The case drain filter may be sized to provide minimum pressure drop. The filter elements should be 15 micron absolute. Non-depth-type elements might be used if easier back flushing is desired.

4.3 Test Methods:

4.3.1 Operate at the aerospace installation rated speed ± 100 rpm with an inlet oil temperature as specified in 4.2.2. This temperature should be obtained within the first 20 min. of operation.

4.3.2 Under conditions described in 4.3.1, operate for 30 min. cycling the unit between cutoff (if applicable) and rated full flow pressure at a rate of 10 cycles per minute. This 30 min. run test is preliminary to the actual patch sampling test. Following this test, the outlet and case filter elements should be cleaned by a reverse flushing with compressed air and oil solvent or replaced with new elements. A specifically designed tool should be used for this process, similar to that shown in Fig. 1 (See Para. 4.3.5).

4.3.3 Under the conditions described in 4.3.1, operate the unit for 2 hours. During the first 15 min., the unit outlet pressure, if a pump, should be cycled at a rate of 6 cycles per minute from rated pressure (full flow) to 0 flow pressure. The 0 flow pressure should be that for the specific installation.

During the remaining 1-3/4 hr. the unit should be cycled for 9 min. at cutoff (0 flow) and 1 min. at full flow. At the end of this time, all three filter elements and filter bowls (inlet, outlet, and case drain) should be inspected for metal particles. This inspection will be made by pouring the fluid and metal particles in the bottom of the filter bowl into the glass funnel as shown in the diagram in Fig. 2. An optional method of determining inlet fluid contamination may be to draw a 100 ML bomb sample from the inlet line between the filter and the pump while the pump is running during last 15 min. of test.

This funnel should empty into a filter bowl in which a 47 millimetre (mm) disc 0.45 micron pore size surface - retention type membrane (Millipore HAW P04700 or equivalent) has been inserted. The vacuum pump should be in operation to draw the fluid through the filter bowl, leaving the contaminant which was separated by the filter. Approximately 15 to 30 cc's of filtered oil solvent (Grow Solvent #2934 or equivalent) shall be used to wash the inside of the filter bowl and back flush the filter element then poured through the glass funnel. After this operation, the hydraulic fluid remaining on the sides of the filter bowl should be washed out with a similar amount of solvent until the millipore filter bowl membrane is a clear white. After drying the resultant filter patch may be coated with clear lacquer and permanently attached to the log sheet of the test.

4.3.4 Compare the patches obtained in 4.3.3 with the standard patch, and determine if the unit is acceptable. If not, disassemble, inspect and repair unit as necessary, and repeat the 2-hr test in 4.3.3.

4.3.5 For filter cleaning the filters should be immersed in the flushing fluid. Flushing fluid be filtered to 2 micron absolute. Flow of the flushing fluid through filters should be at rated filter capacity.

4.3.6 Immediately prior to shipment, the case drain of the unit should be drained and power flushed with oil that is filtered through a 2 micron filter element.

The unit should be shipped with the pump not less than 90% full of oil that has been filtered through the 2 micron filter element.

PREPARED BY
SUBCOMMITTEE A-6C, FLUID POWER DISTRIBUTION ELEMENTS OF
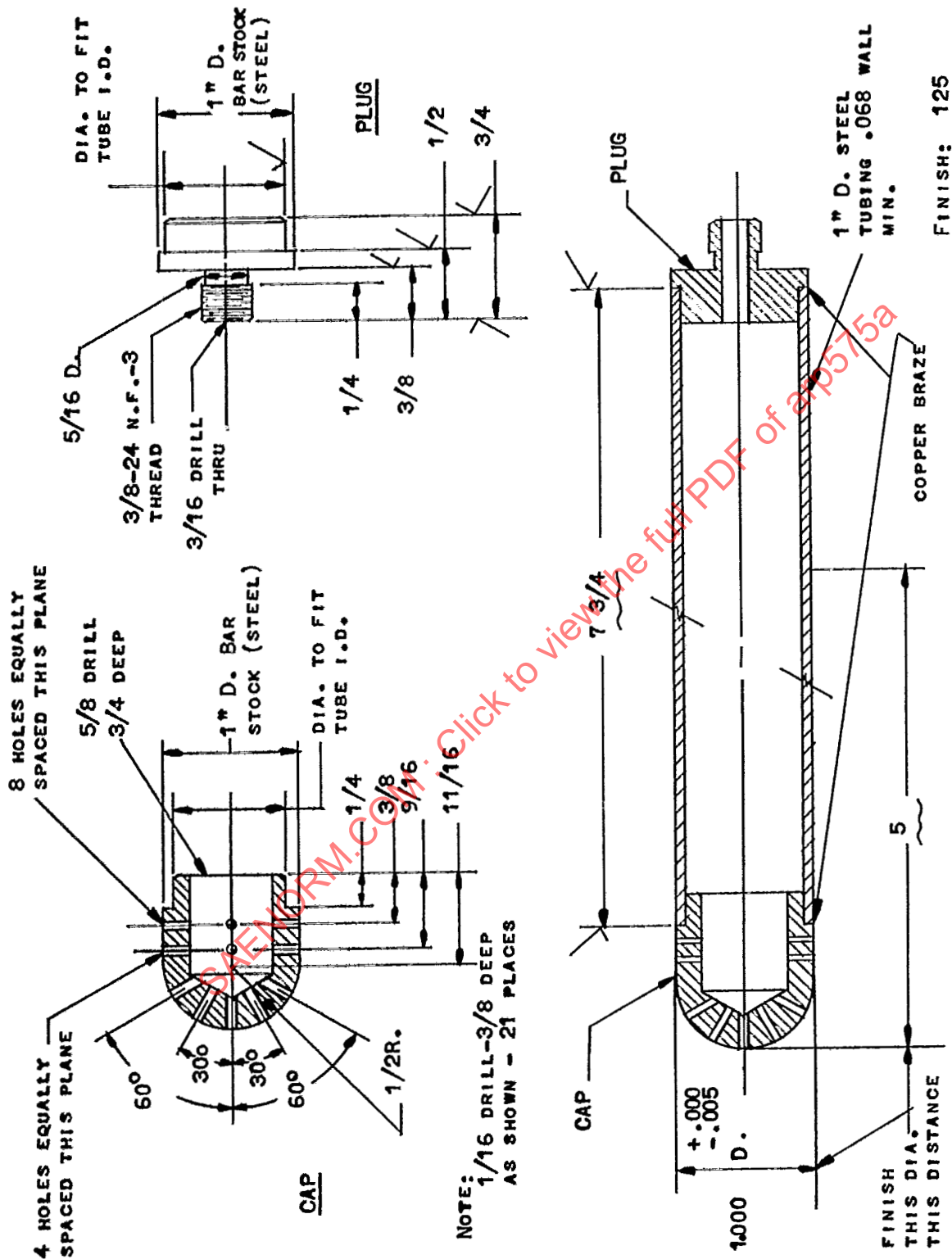SAE COMMITTEE A-6, AEROSPACE FLUID POWER & CONTROL TECHNOLOGIES

FIGURE 1. TOOL - FILTER ELEMENT CLEANING

PROBLEM HARD COPY