

PROCEDURE AND METHOD EVALUATION OF FILTER PATCH TESTING FOR
AIRCRAFT HYDRAULIC PUMPS

Issued 2/1/59
Revised

1. PURPOSE:

- 1.1 The purpose of this bulletin is to set forth recommendations of the SAE Subcommittee A-6C (Hydraulic Pumps, Motors and Air Compressors) relative to the procedure and methods to be used in the obtaining and evaluation of filter patch tests for aircraft hydraulic pumps. This is to promote an optimum in cleanliness standards in aircraft hydraulic circuits. It is expected that this will promote a longer service life of the pump.

2. SCOPE:

- 2.1 These recommendations are written to cover the subject of obtaining filter patch test samples from aircraft hydraulic pumps of the categories shown below. The same procedure shall apply regardless of the pump drive category.
- 2.1.1 Engine Mounted Pumps.
- 2.1.2 Auxiliary Power Driven Pumps - Pumps in this classification should include electric motor driven pumps, ram air turbine driven pumps, pumps driven from power obtained from the main hydraulic system, and other auxiliary driven pumps.

3. DEFINITION:

- 3.1 A pump filter patch sample consists of the filter paper and accumulated contaminant, which is used as a method of determining the quantity and type of contaminant that exists and is collected in the following manner.
- 3.1.1 Inlet Patch - This is an indication of contaminant level or cleanliness of the circuit being used for testing the pump.
- 3.1.2 Outlet Patch - This is an indication to a large degree of the contaminant being generated in the main rotating section of the pump. To a smaller degree, it indicates what may have passed through the inlet filter, as well as through the pump.
- 3.1.3 Case Drain Patch - This is an indication of total contaminant level or wear rate of the pump.

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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 patch sample should have been agreed upon by the pump manufacturer and airframe or engine user. This standard sample should be an actual patch similar to that shown on page 7 and should show maximum contaminant patches for the 2 hour, 4 hour and 6 hour tests. These samples should relate to the outlet and case drain patch samples. Generally speaking, the same maximum contaminant sample can be used for both the outlet and case drain samples. A single typical clean inlet patch may be shown for a standard.

4.2 Test Constants:

4.2.1 Fluid Medium - In these tests the fluid used in the actual aircraft in field service should be used. If this is not stipulated, mineral oil conforming to MIL-H-5606 specification for aircraft hydraulic units should be used.

4.2.2 Oil Temperature - The temperature shall be 160°F. $\pm 10^\circ$ unless the normal actual aircraft circuit temperature is greater, in which case the latter should be used.

4.2.3 Filter Requirements - In these tests, 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 pump. 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 cups in a downward position.

The filter bodies may be of the AN-6235 type or equivalent. The filter size should be rated for the maximum inlet and outlet pump capacity used in the aircraft installation. The case drain filter may be of the AN-6235-4 size. The filter elements should be 5 - 10 micron sintered bronze.

4.3 Test Conditions:

4.3.1 Operate at the aircraft installation rated speed ± 100 rpm with an inlet oil temperature as specified in Para. 4.2.2. This temperature should be obtained within the first 20 minutes of operation. The pump speed in this test, if mutually agreed by the airframe and pump manufacturer, may be 3600 ± 100 rpm, if desired.

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4.3.2 Under conditions described in Para. 4.3.1, operate for 30 minutes with the outlet pressure at maximum psi, full flow pressure. This 30 minutes flushing test is preliminary to the actual patch sampling test. Following this test, the filter elements should be cleaned by a reverse flushing with compressed air and oil solvent. A specifically designed tool should be used for this process, similar to that shown in the drawing on page 5.

4.3.3 Under the conditions described in Para. 4.3.1, operate the unit for two hours. During the first fifteen minutes, the pump outlet pressure should be cycled at a rate of 4 to 6 cycles per minute from 66% of rated pressure ± 500 psi (full flow) to 0 flow pressure. The 0 flow pressure should be that for the specific aircraft installation.

During the remaining 1-3/4 hours, the unit should be cycled for 9 minutes at cutoff (0 flow) and 1 minute at full flow. At this time, all three filter cups (inlet, outlet, and case drain) should be inspected for metal particles. This inspection will be made by pouring the oil and metal particles in the bottom of the filter cup into the glass funnel as shown in the diagram on page 6.

This funnel should empty into a filter cup in which Whatman #40 filter paper has been inserted. The vacuum pump should be in operation to draw the fluid through the filter cup, leaving the contaminant which was separated by the filter. Approximately 15 to 30 cc's of filtered oil solvent (Grow Solvent #2934) shall be used to wash the inside of the filter cup and also poured through the glass funnel. After this operation, the red hydraulic fluid remaining on the sides of the filter cup should be washed out with a similar amount of solvent until the Whatman filter cup paper is a clear white.

4.3.4 Clean filter bowls and elements as described in Para. 4.3.2 and reinstall.

4.3.5 Compare the patch taken in Para. 4.3.3 with the applicable standard two-hour sample. If the patch has less contamination than the standard, the pump should be considered satisfactory to start the second two-hour patch test. (If the patch sample does not pass the standard two-hour sample, the unit should be disassembled, inspected, repaired, and the two-hour test repeated.)

4.3.6 Second two-hour test: Operate unit under the conditions described in Para. 4.3.1. The unit outlet pressure shall be cycled for 9 minutes at cutoff and one-minute at full flow pressure. Obtain a patch sample as described in Para. 4.3.3 and compare with the standard fourth hour sample. If the patch has less contamination than the standard and first two-hour patch, the pump should be considered satisfactory to start the third two-hour patch test.

If the patch sample does not meet the above, the unit should be disassembled, inspected, repaired, and the tests repeated starting at Para. 4.3.3.

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4.3.7 Clean filter bowls and filters as described in Para. 4.3.2 and reinstall.

4.3.8 Third two-hour test: Operate unit under the conditions described in Para. 4.3.1. The unit outlet pressure should be cycled for 9 minutes at cutoff and one minute at full flow pressure. Obtain a patch sample as described in Para. 4.3.3 and compare with the standard sixth hour sample. If the patch has less contamination than the standard and the second two-hour patch, the pump may be prepared for shipment. If the patch sample does not meet the above, the unit should be disassembled, inspected, repaired, and the tests repeated starting at Para. 4.3.3.

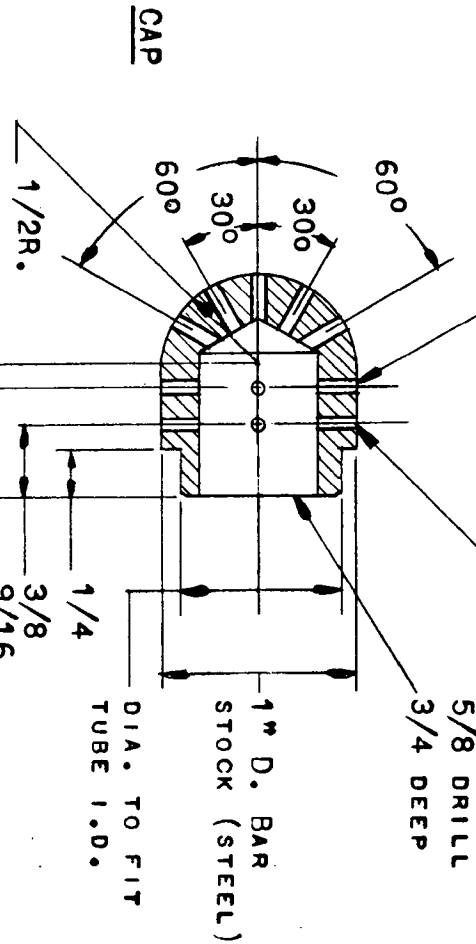
4.3.9 Immediately prior to shipment, the case drain of the unit should be power flushed with oil that is filtered through a 2 micron filter element.

The unit should be shipped with the case full of oil that has been filtered through the 2 micron filter element.

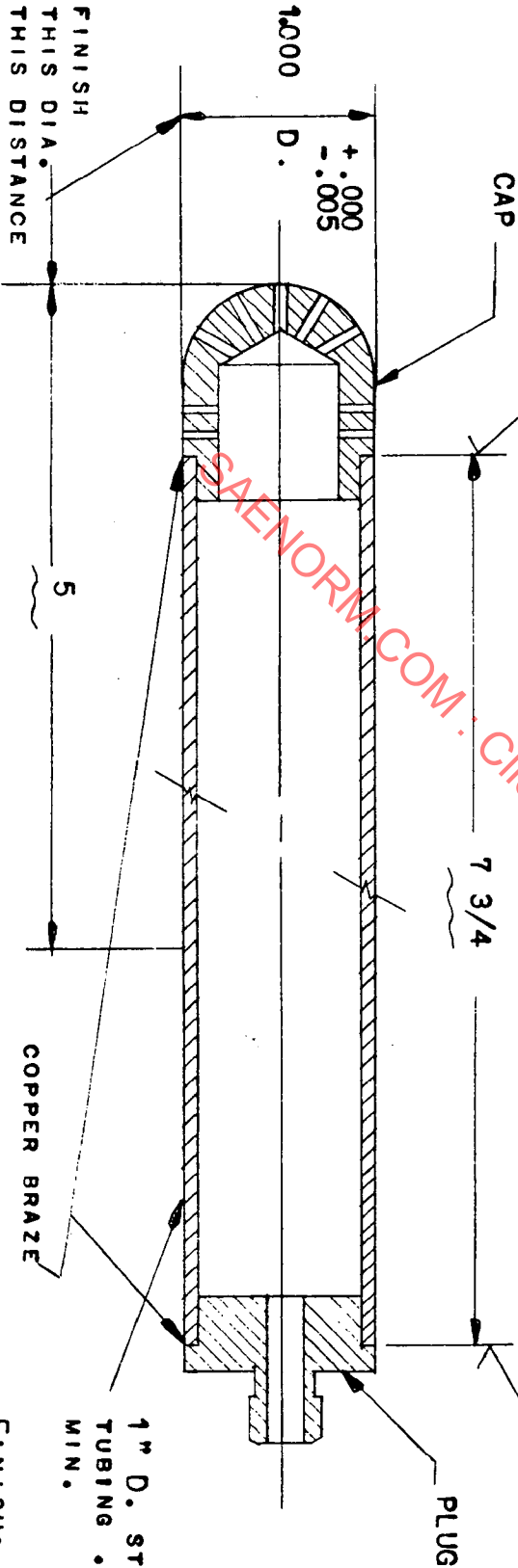
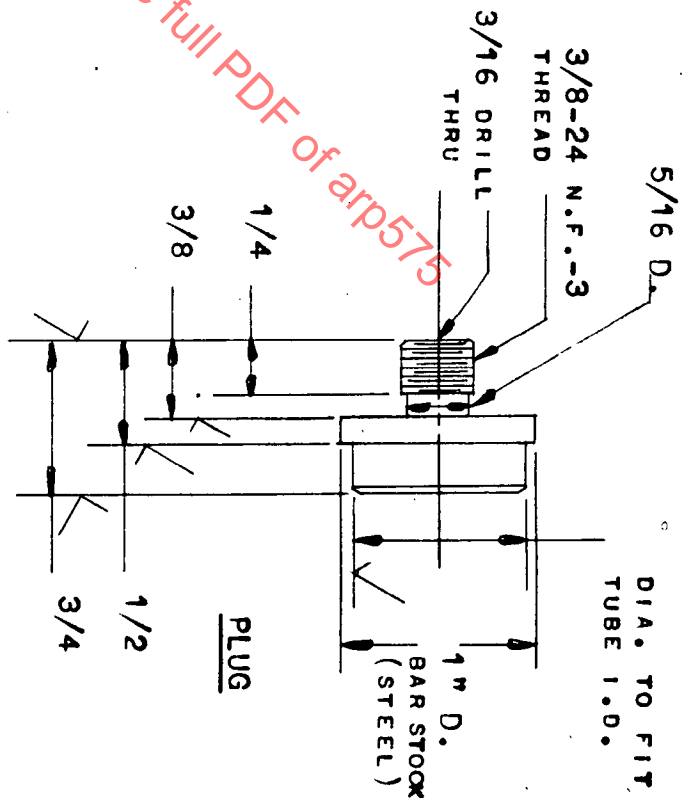
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4 HOLES EQUALLY
SPACED THIS PLANE

8 HOLES EQUALLY
SPACED THIS PLANE



NOTE:
1/16 DRILL-3/8 DEEP
AS SHOWN - 21 PLACES



TOOL - FILTER ELEMENT CLEANING

FINISH: 125