SAE INTERNATIONAL

AEROSPACE RECOMMENDED PRACTICE

ARP1797™ REV. B

Issued 1983-09
Reaffirmed 2014-12
Revised 2024-07

Superseding ARP1797A

Aircraft and Aircraft Engine Fuel Pump Low Lubricity Fluid Endurance Test

RATIONALE

This SAE Aerospace Recommended Practice document is being updated at Issue B (as part of Five-Year Review activity) to clarify the units used, and the ability of the user to deviate from the specified test conditions.

INTRODUCTION

In recent years, more hydrotreating and hydrocracking equipment are used in the production of aircraft turbine fuels. Hydrogen refining techniques remove the crude oil's sulfur and polar constituents. Some high quality hydro-refined fuel products have very poor lubricating properties. These low lubricity fuels have caused friction and wear problems in aircraft components. A standard test method is required to provide a basis for evaluating the capability of aircraft and aircraft engine fuel pumps utilizing these low lubricity fuels. The procedure recommended herein is based on experience gathered by a number of facilities conducting component tests to investigate low lubricity fuels. In addition, this procedure is intended for the investigation of potential wear problems in fluid machinery due to low lubricity fluids and NOT wear or material removal problems associated with fluid viscosity, cavitation, machine geometry, and aircraft operational modes that impact bearings, bearing dams, and gear surfaces. Also, this procedure is not intended as a qualification test procedure.

1. SCOPE

This procedure is intended to apply to fuel pumps.

This procedure will be defined in terms of recommended test fluid, test setup, test conditions, and test method.

This procedure may be used for other fuel system components, by testing in conjunction with the pump, which normally supplies the component inlet flow, or a substitute test pump of similar capacity.

This procedure may be used, with variations in test conditions and test fluid, for performing pump evaluation tests. Tests at progressively increasing pump speeds and pressures will provide design limitation data. Alternate test periods on a test pump and another pump, of a design for which actual service durability is known, will provide useful comparison data.

1.1 Purpose

This recommended practice defines procedures for testing aircraft and aircraft engine fuel pumps to ensure their operability with respect to low lubricity fuels. This is achieved by verification testing on a standard low lubricity test fluid. This procedure is intended to produce a uniform reproducible test condition for fuel pump endurance testing using low lubricity fluid, to provide a common reference for endurance capability. Pump endurance capability is to be established in terms of internal parts wear and change in pump performance. Pass/fail criterion are normally established by the purchasing authority. This document is not a pump qualification test procedure.

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2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D971	Standard Test Method for Interfacial Tension of Insulating Liquids Against Water by the Ring Method
ASTM D1655	Standard Specification for Aviation Turbine Fuels
ASTM D4306	Standard Practice for Aviation Fuel Sample Containers for Tests Affected by Trace Contamination
ASTM D5001	Standard Test Method for Measurement of Lubricity of Aviation Turbine Fuels by the Ball-on-Cylinder Fuel Lubricity Evaluator (BOCLE)
ASTM D7566	Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons

2.1.2 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

MIL-PRF-7024	Calibrating Fluids, Aircraft Fuel System Components
MIL-STD-810	Department of Defense Test Method Standard for Environmental Engineering Considerations and Laboratory Tests

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 NAPTC Publications

Copies of these documents are available online from DTIC at https://discover.dtic.mil.

Grabel, L. (1977). *Lubricity properties of high temperature jet fuel. Final report* (Report no. NAPTC-PE-112). United States.

3. GENERAL REQUIREMENTS

3.1 Duration of Test

The pump shall operate 100 hours minimum.

3.2 Test Fluid

The value and validity of low lubricity tests, as defined by this document, are dependent on consistently maintained and accurate lubricity measurement of the test fluid. The following fluid and wear scar limits are recommended:

Test Fluid: MIL-PRF-7024 Type II.

Wear Scar: Between 0.85 and 0.96 mm (refer to ASTM D7566 and ASTM D1655). The wear scar shall be measured by the method defined in ASTM D5001. If the test fluid does not meet wear scar requirements, the fluid may be circulated through a clay filter until such time as the fluid meets the wear scar requirements given in this paragraph.

3.3 Test Setup

In accordance with Figure 1 and Appendix A.

3.4 Test Conditions

3.4.1 Pump speed, engine flow, and discharge pressure shall be maintained at the conditions required for engine maximum normal steady-state loading condition for the duration of the test. Deviation from these conditions is allowed if the supplier or purchasing authority requires different engine maximum normal steady-state loading condition for technical reasons.

3.4.2 Ambient Temperature and Pressure

Record room temperature and atmospheric pressure at the test site. Standard ambient conditions are (refer to MIL-STD-810H):

- Temperature: 25 °C ± 10 °C (77 °F ± 18 °F)
- Atmospheric pressure: Record test site pressure

3.4.3 Fluid Pressure in Supply Tank (P1)

As required to maintain P2.

3.4.4 Fluid Pressure at Pump Inlet (P2)

Within normal pump operation, therefore between the pump's specified minimum and maximum inlet pressure.

3.4.5 Fluid Temperature in Supply Tank (T1)

±3 °C (5.4 °F) of T2.

3.4.6 Fluid Temperature at Pump Inlet (T2)

38 to 41 °C (100 to 106 °F) or that determined by the gear stage inlet temperature of the performance specification for the conditions specified in 3.4.1.

3.4.7 Accuracy of flow, temperature, pump speed, pressure, and instrumentation shall be within ±1% of actual value unless otherwise specified.

3.5 Precautions

The procedure in this document may involve hazardous materials, operations, and equipment. This procedure does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this procedure to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

4. DETAILED REQUIREMENTS:

4.1 The test setup will be made in accordance with Figure 1.

4.1.1 Supply tank minimum volume shall be equivalent to maximum test flow for 1 minute or 0.3 m^3 (79.25 gallons), whichever is smaller.

4.1.2 Fluid contacting surfaces, except for fluid test article interfaces and filter media, shall not contain materials that will be reactive with the test fluid. Therefore, materials such as rubber, pipe joint compounds, packing lubricants, copper, etc., are not permitted.

4.1.3 The test setup shall be constructed such that all surfaces in contact with the fluid can be cleaned.

4.1.4 Adequate vents must be provided to allow removal of all trapped air.

4.1.5 The test setup must be adequately grounded to dissipate static charges generated during filling and testing.

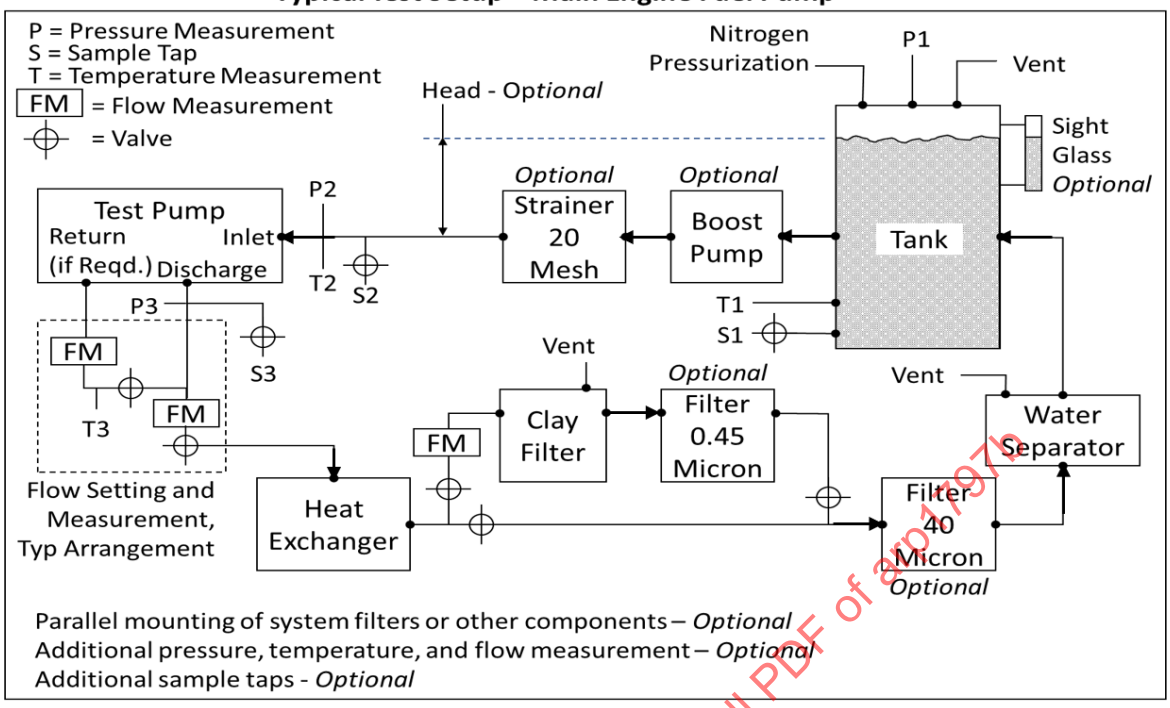
4.1.6 Fixtures and fittings must be provided in order to simulate fluid installation interfaces. If a test or setup unit is used for setting up the test rig, the actual fixtures and fittings of the test setup must be used.

4.1.7 Flow setting and measurement piping arrangement is optional in order to allow simulation of operational arrangement (see Figure 1). However, the arrangement must be such that the total pump flow can be determined and monitored by one or a combination of the flow meters.

4.1.8 The sample container shall be constructed of a material that does not contribute to the lubricity of the sample per ASTM D4306.

4.2 The test setup shall be prepared by circulating the test fluid in the test setup and circulating with the test pump or a test equipment pump, in place of the test pump, to obtain the required fluid condition in accordance with 3.2. The affected piece parts shall be replaced if used for setup preparation and if more than 10 hours are required to obtain the required fuel condition.

Typical Test Setup – Main Engine Fuel Pump



Typical Test Setup – Airframe Fuel Pump

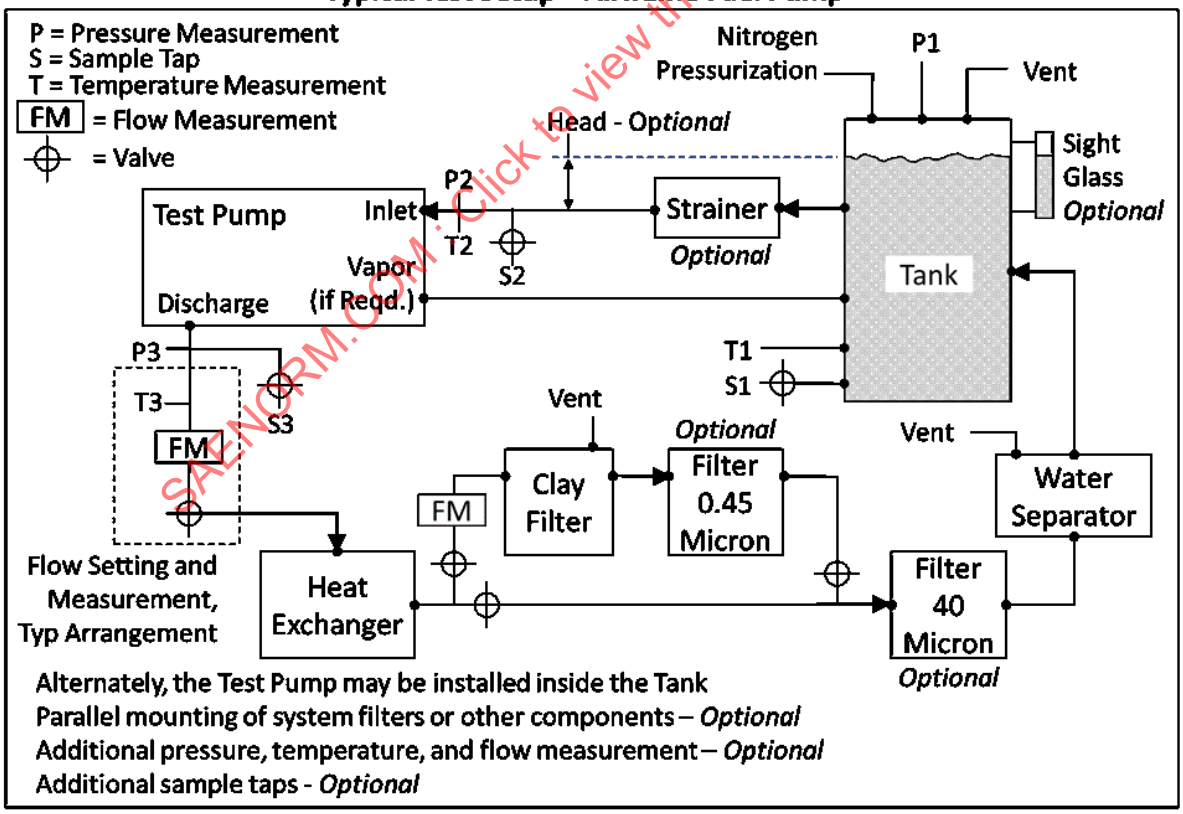


Figure 1