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An American National Standard

Standard Test Method for Indicating Wear Characteristics of Petroleum Hydraulic Fluids in a High Pressure Constant Volume Vane Pump[1]

This standard is issued under the fixed designation D 6973; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ϵ^1 NOTE—Editorial changes were made throughout in March 2005.

1. Scope

1.1 This test method covers a constant volume high-pressure vane pump test procedure for indicating the wear characteristics of petroleum hydraulic fluids. See Annex A1 for recommended testing conditions for water-based synthetic fluids.

1.2 The values stated in SI units are to be regarded as standard. The values in parentheses are for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ISO Standards:*[2]

ISO 4021 Hydraulic Fluid Power—Particulate Contamination Analysis—Extraction of Fluid Samples from Lines of an Operating System

ISO 4406 Hydraulic Fluid Power—Fluids—Method for Coding the Level of Contamination by Solids Particles

ISO 7745 Hydraulic Fluid Power—Fire-Resistant (FR) Fluids—Guidelines for Use

ISO 11171 Hydraulic Fluid Power—Calibration of Automatic Particle Counters for Liquids

ISO 11500 Hydraulic Fluid Power—Determination of Particulate Contamination by Automatic Counting Using the Light Extinction Principle

2.2 *Other Documents:*

SAE 100R13–20 Hydraulic Hose Specification[3]

ANSI/(NFPA) T2.13.1 R3-1998 Recommended Practice—Hydraulic Fluid Power—Use of Fire-Resistant Fluids in Industrial Systems[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *flushing*, *v*—the process of cleaning the test system before testing to prevent cross-contamination.

4. Summary of Test Method

4.1 Hydraulic fluid in the amount of 190 ± 4 L (50 ± 1 gal) is circulated through a rotary vane pump system for 50 h at a pump speed of 2400 ± 20 r/min and a pump outlet pressure of 20.7 ± 0.2 MPa (3000 ± 20 psig). Fluid temperature at the pump inlet is 95 ± 3°C (203 ± 5°F). An ISO Grade 32 or 10W viscosity is required.

4.2 The cam ring and all ten vanes should be individually weighed before and after the test. The weight loss of the cam ring should be reported with the combined weight loss of all ten vanes. The intra-vanes (inserts) are not part of the required weight loss measurements and should be separately measured if desired. Other reported values are fluid cleanliness before and after the test, initial flow rate, and final flow rate.

4.3 Prior to installing the hydraulic test fluid into the rig, a stand flush is required to remove any contaminants. A minimum quantity of 190 ± 4 L (50 ± 1 gal) of fluid (see Note 1) made of the same chemical formulation as the test fluid, is required for the stand flush. Therefore the total quantity of oil required for the test is 380 L (100 gal).

5. Significance and Use

5.1 This test method is an indicator of the wear characteristics of petroleum hydraulic fluids operating in a constant volume vane pump. Excessive wear in vane pumps could lead to malfunction of hydraulic systems in critical industrial or mobile hydraulic applications.

[1] This test method is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.N0 on Lubricating Properties.

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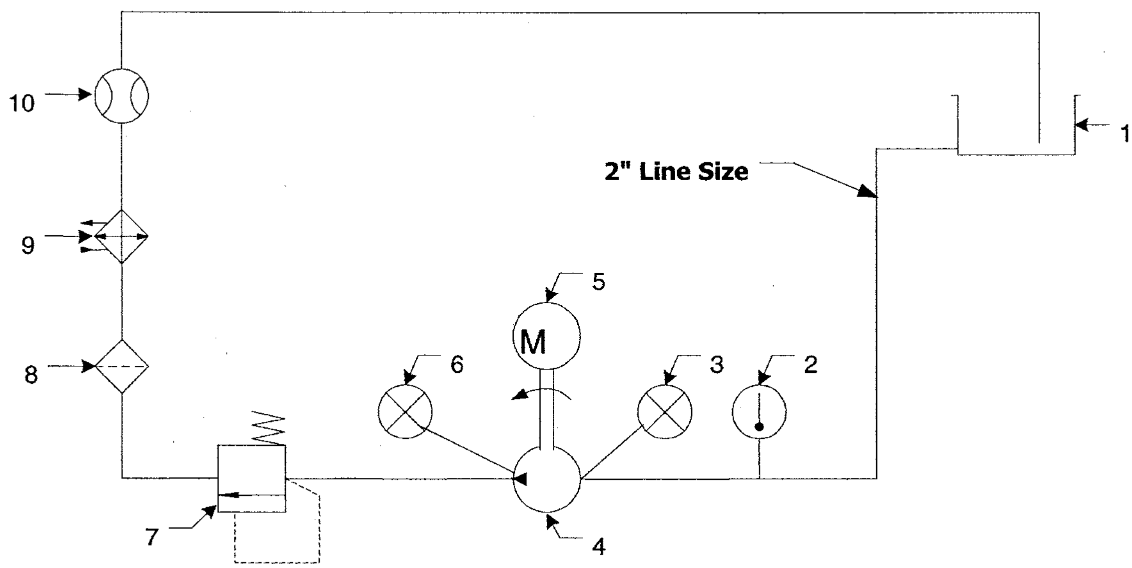
[2] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

[3] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

[4] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.



Description of components:

1 Reservoir (50 gallons of oil; Elevated above pump centerline to provide gravity feed)

2 Temperature gage or thermocouple

3 Inlet pressure gage

4 Pump: 35VQ25A-11*20 (Cartridge kit P/N 4998040-002)

5 Electric motor (125 hp)

6 Outlet pressure gage

7 Pressure relief valve

8 Filter

9 Cooler

10 Flowmeter

NOTE—See Eaton Overhaul Manual I-3144–S (Appendix B)[7]

FIG. 1 System Schematic

6. Apparatus

6.1 The basic system consists of the following (see Fig. 1):

6.1.1 *Electric Motor*, or other suitable drive, capable of a rotational speed of 2400 rpm with 93 kW (125 hp) as suggested minimum power requirement (see Fig. 1, Item 5).

6.1.2 *Test Stand Base*, with appropriate, rigid mounting for the motor, pump, reservoir, and other components.

6.1.3 *Rotary Intra-Vane Pump*, replaceable cartridge type,[5,6] Vickers 35VQ25A-11*20 (Cartridge Kit P/N 4998040-002)[7] rated at 81 cm^3/rev (4.98 in.^{3}/rev) flow at 1200 rev/min. A protective shield around the pump is recommended.

6.1.3.1 There are to be no modifications to the pump housing.

[5] The replaceable cartridge consists of the inlet support plate, outlet support plate, flex side plates, seal pack, rotor, cam ring, intra-vane, and vanes.

[6] The individual cartridge parts can be purchased separately, if desired. The Eaton part numbers for these items are cartridge screws: P/N 410609, alignment pins: P/N 418108, inlet support plate: P/N 430806, outlet support plate: P/N 412003, flex side plate kit: P/N 923953, seal pack: P/N 433766, rotor: P/N 262154, cam ring: P/N 4999594-001, vane kit (includes ten intra-vanes and ten vanes): 922700.

[7] Available from any Eaton distributor.

6.1.4 *Reservoir*, equipped with a baffle and lid, all of stainless steel construction.

6.1.4.1 Additional fluid ports may be added to the reservoir as required by the user to assist in measuring fluid level, reservoir temperature, and so forth.

6.1.4.2 If the reservoir is positioned so that the contents cannot be visually checked for air entrainment by removing the lid, a fluid-sight glass viewing port may be located in the side of the reservoir.

6.1.5 *Pump Outlet Pressure Control Valve*, with either manual or remote control (see Fig. 1, Item 7).

6.1.6 *Temperature-control Device*, suitable for controlling coolant flow to the heat exchanger to maintain test fluid at the specified temperature (see Fig. 1, Item 9).

6.1.7 *Temperature Indicator*, (see Fig. 1, Item 2) shall have a minimum accuracy of ±1°C and shall have an appropriate sensor to monitor pump inlet temperature.

6.1.7.1 To prevent a flow disturbance near the pump inlet port, the temperature probe shall have a diameter of not more than 6 mm (0.25 in.) and positioned not less than 30 cm (12 in.) from the pump inlet port.

6.1.7.2 The test fluid temperature probe shall be positioned greater than 30 cm (12 in.) from the pump inlet cover (see Fig. 2). The fluid temperature probe shall be inserted into the midpoint of flow.

6.1.8 *Heat-Exchanger*, (see Fig. 1, Item 9). The heat exchanger should be of adequate size and design to remove the excess heat from the test system when utilizing the available coolant supply.

6.1.9 *Outlet Pressure Indicator*, (see Fig. 1, Item 6), to measure pump discharge pressure, and shall have an accuracy of at least ±1 bar (±15 psi).

6.1.10 *Inlet Pressure Indicator*, (see Fig. 1, Item 3), to measure pump inlet pressure, and shall have an accuracy of at least ±7 kPa (±1 psi).

6.1.11 *Filter Unit*, (see Fig. 1, Item 8), to limit system debris from causing wear to the test pump. The filter performance should be $\beta_3 \geq 100$.

6.1.11.1 The filter housing shall be installed with dual pressure gages (see Fig. 1, Item 13) or a differential pressure transducer to monitor pressure across the filter to warn of impending collapse of the element.

6.1.11.2 If dual pressure gages are used to monitor filter pressure, the rated collapse pressure of the filter element should be known.

6.1.12 *Flow-Measuring Device*, (see Fig. 1, Item 12), with an accuracy of at least ±1 L/min (±0.25 gpm).

6.1.12.1 It is suggested that the test circuit be equipped with some automated shutdown capabilities for safety reasons. Safety relays could be any of the following: low-level, high pressure, high temperature, and low flow safety switches incorporated into the system.

6.1.12.2 A check should be made to ensure that the flush and test fluid are compatible with seals or any other materials in the system.

6.1.13 *Flexible Motor Coupling*, to connect the motor drive and the pump.

6.1.14 *Fluid Sampling Port*, in accordance with ISO 4021.

6.2 The various components of the test system shall be placed in the system as indicated in Fig. 1.

6.2.1 The test system shall be arranged and provided with necessary drain valves so that complete draining is possible with no fluid trap areas.

6.2.2 Good hydraulics piping practices should be used when constructing the test system to avoid air entrainment points and flow restrictions.

6.2.3 The pump should be mounted so that its internal surfaces can easily be inspected and cleaned, alignment can be checked, and the operator has comfortable access when torquing the head.

6.2.4 A pressure transducer, to measure inlet pressure, shall be placed within 30.5 cm (12 in.) of the opening of the pump cover.

6.2.5 The inlet pressure of the pump shall be 13.8 ± 7 kPa (2 ± 1 psig) once the break-in procedure is complete and test conditions have been met (see 12.2).

NOTE 1—See Annex A1 for recommended testing conditions for water-based synthetic fluids.

6.2.6 The reservoir should be mounted so that it can be cleaned and filled with ease and the contents may be readily inspected by removal of the reservoir lid or inspection cover.

6.2.7 The inlet line (from the reservoir to the pump intake) shall have an internal diameter of at least 5.08 cm (2 in.) and shall have a straight run of at least 61 cm (24 in.) to the pump inlet port.

NOTE 2—Some users prefer to use a radius bend at the reservoir outlet instead of an elbow. If used, the straight run described in 6.2.7, shall still be measured between the end of the bend and the pump inlet port.

6.2.8 The high pressure discharge line (from the pump to the pressure control valve) shall have a minimum inside diameter of 1¼ in. with a maximum allowable working pressure rating greater than 207 Bar (3000 psi). A seamless steel pipe size and schedule (2 in. double extra strong pipe–XXS) or equivalent high-pressure hose (SAE 100R13–20) are recommended for the discharge line.

6.2.9 The fluid return line and fittings (from the pressure control valve to the filter, flowmeter, heat exchanger, and reservoir) should have a minimum inside diameter of 2.54 cm (1 in.). A seamless steel pipe size of (1 in. Schedule 40) is recommended.

6.2.10 A shut-off valve may be located in the plumbing between the reservoir and the inlet to the pump. The full flow valve shall have a minimum orifice diameter of 5.08 cm (2 in.) and shall be positioned no closer than 30 cm (12 in.) from the pump inlet port.

NOTE 3—Some users find the addition of a shut-off valve on the return line to be a useful addition to the piping since it allows filter changes and other system maintenance to be performed without draining the reservoir. (**Caution**—If a shut-off valve is installed in the fluid return line, the user shall take procedural steps to ensure that this valve has been opened before the pump is started. If the valve is not opened, low pressure system components may rupture.)

7. Reagents and Materials

7.1 (**Warning—**Use adequate safety provisions with all solvents.)