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Standard Test Method for Evaluating Hydraulic Transmission Fluid Antiwear Properties¹

This standard is issued under the fixed designation D 4862; 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.

1. Scope

1.1 This test method covers a procedure to determine the antiwear properties of a hydraulic transmission fluid by assessing the condition of a specimen cam ring (3.1.3) used in a special apparatus to test the fluid.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems 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 ASTM Standards:

D 235 Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Drycleaning Solvents)²

3. Terminology

3.1 Descriptions of Terms Specific to This Standard:

3.1.1 *grinding pattern*—distinctive, wavy-lined finish of the inner surface of the pump cam ring. See Annex A1.

3.1.2 *pressure plate*—end plate that serves as a diffuser for fluid discharged from the ring-vane-rotor assembly.

3.1.3 *pump cam ring*—housing for rotating elements of the power steering pump.

3.1.4 *rotor*—rotating element fitted with vanes.

3.1.5 *test power steering pump*—positive-displacement vane-type pump that provides hydraulic pressure for the power steering mechanism.

3.1.6 *thrust plate*—end plates that absorb hydraulic thrust load imposed by rotating vanes.

3.1.7 *vanes*—rectangular paddles that fit into slots of the pump rotor to direct fluid within the cam ring.

4. Summary of Test Method

4.1 The fluid is evaluated using a motor-driven power steering pump (5.1.2) at a speed of 2950 r/min, pump outlet pressure at 5200 kPa, and pump-out fluid temperature of 145 to 150°C for 50 test hours. The antiwear performance of the fluid is evaluated at the end of the test by disassembling the pump and visually inspecting it for evidence of scuffing, scoring, or chatter wear on the specimen cam ring (3.1.3).

5. Significance and Use

5.1 This test method is intended to be used to aid in determining the acceptability of a fluid for use in a transmission application.

5.2 This test method can also be used for other hydraulic transmission applications where fluid-related wear effects are of concern.

6. Apparatus

6.1 *Test Stand*—The test stand is built typically with welded structural steel components by the individual user and the components are assembled in accordance with Fig. 1.

6.2 *Test Power Steering Pump*—The test power steering pump shall be equipped with the following:

6.2.1 *Relief Valve*, 9300-to-10 000 kPa and a 3.56-mm venturi.³

6.2.2 The pump may be modified by replacing the drive shaft bushing with needle bearings.

6.2.3 *Rotating Group Assembly*, a new assembly for each test.⁴

6.2.4 Remove the plastic dipstick from the cap by cutting flush with the inside cap surface before using the test.

6.3 *Drive Assembly*—The drive assembly shall consist of the following:

6.3.1 *Induction Motor*, 11-kW, 60-Hz having a speed of 3480 r/min.

6.3.2 *Pulley*, mounted on the motor shaft.

6.3.3 *Pulley*, mounted on the pump drive shaft.

6.3.4 *V-Belt*, 9.5 mm drive.

6.3.5 *Device* (mechanical, hydraulic, or pneumatic) to provide the proper belt load during the test.

6.4 *Filter*,⁵ 40 μ m throwaway elements with Vitron A seals.

6.5 *Pressure Regulator*, relief valve pressure regulator, 0 to 14 000 kPa range.⁶

³ Model 135 Test Power Steering Pump with 9300 to 10 000 kPa relief, 3.56 mm venturi available from Product Engineering Experimental Procurement, Saginaw Div., GM, 3900 Holland Rd. (Plant 3), Saginaw, MI 48605, or equivalent has been found satisfactory for this purpose.

⁴ Special Test Assembly Cam Ring and Kit No. L-76707, available from Product Engineering Experimental Procurement, Saginaw Div., GM, 3900 Holland Rd. (Plant 3), Saginaw, MI 48605, or equivalent has been found satisfactory for this purpose.

⁵ Bendix Filter No. 28070-0 or No. 037812-00-60 A 4Q71, or equivalent has been found satisfactory for this purpose.

⁶ Pressure Regulator, available from Fluid Control, Inc., PO Box 40, Mentor, OH, has been found satisfactory for this purpose. An equivalent may be used.

¹ This test method is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.B on Automotive Lubricants.

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² Annual Book of ASTM Standards, Vol 06.03.

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6.6 *Heat Exchanger*, plate type with steel distributor strip.⁷

6.7 *Hoses*:

6.7.1 *Passenger Car High-Pressure Power Steering Hose*.⁸

6.7.2 *Passenger Car Low-Pressure Power Steering Return Hose*, 30 to 40 cm long.

6.8 *Temperature Controller*, a digital or analog temperature controller.⁹

6.8.1 For temperature control, use an iron-constantan thermocouple located at the outlet of the heat exchanger.

6.9 *Temperature Control Solenoid*, a 12.7-mm solenoid valve¹⁰ located in the water-in port of the heat exchanger.

6.10 *Pressure Gage*, master gage or equivalent, 0 to 10 000 kPa or 0 to 14 000 kPa range.

6.11 *Temperature Measuring Equipment*—The temperature measuring equipment shall consist of the following:

6.11.1 A potentiometer to indicate or record the temperature of the pump-out fluid.

6.11.2 A 3.2-mm shielded thermocouple positioned so that the tip extends into the middle of the output fluid stream as shown in Fig. 1.

7. Reagent

7.1 *Stoddard Solvent*, See Specification D 235.

8. Preparation of Apparatus

8.1 *General Test Description*—The antiwear characteristics of a fluid are evaluated in a power steering pump mounted in a manner similar to that in actual vehicle installations. The pump is run at 2950 ± 50 r/min with pump-out fluid temperature of 145 to 150°C (293°F) for 50 h. Dismantle the pump upon completion of the test and inspect the cam ring, vanes, and end plates for evidence of wear. Fluid samples from the beginning and end of the test can be retained for laboratory reference purposes.

8.2 Test Pump Installation:

8.2.1 Clean the water and fluid sides of the heat exchanger. On the water side, remove all deposits or mineral buildup. On the fluid side, flush the heat exchanger with Stoddard solvent until clean. Blow dry the fluid side with compressed air. Mount the test pump on the stand with the belt and pulleys aligned.

8.2.2 Adjust the belt load, using commercial belt load gage, to the following:

8.2.2.1 *With Cold New Belt*—Adjust to 535 to 555 N (120 to 125 lb) per strand.

8.2.2.2 *With Cold Used Belt*—Adjust to 335 to 355 N (75 to 80 lb) per strand.

8.2.3 Connect high- and low-pressure hoses and pressure and temperature transducers. Use new hoses for each test. Do not install the filter element at this time.

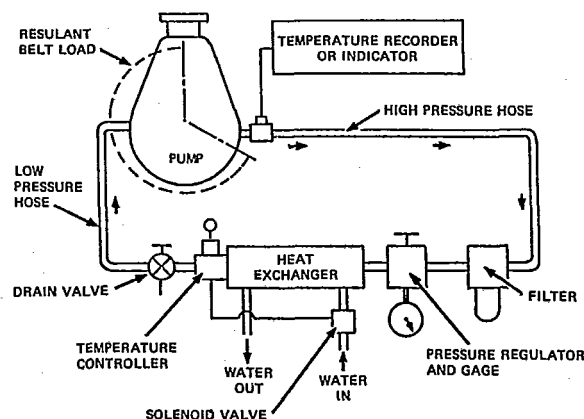
8.3 Ring Assembly Break-in and Acceptance Procedure:

⁷ Heat Exchanger, available from Harrison Radiator Div., GM, Upper Mountain Rd., Lockport, NY 14094, or equivalent has been found satisfactory for this purpose.

⁸ GM Part No. 7816083 or equivalent has been found satisfactory for this purpose.

⁹ Honeywell Model MP953 C10262 or equivalent has been found satisfactory for this purpose.

¹⁰ Honeywell 12.7-mm Solenoid Valve or equivalent has been found satisfactory for this purpose.



NOTE—Connections between filter, gage, and regulator should be as short as possible and should not restrict flow.

FIG. 1 Test Component Arrangement

8.3.1 Fill the pump and system with test fluid, operating the drive motor intermittently, until the fluid level stabilizes at the bottom of the filler neck on the pump. Run the pump at approximately 3000 r/min and 700 kPa (100 psi) pressure for 5 min, then run the pump at approximately 3000 r/min and 3500 kPa (508 psi) pressure for 5 min. Drain fluid from the system as the temperature increases to prevent overflowing. Reduce pressure to the minimum setting, shut off the drive motor and allow the pump to coast to a stop.

8.3.2 Drain fluid from the system, remove the pump from the stand, and disassemble to remove the ring for inspection while leaving the vanes in place in the rotor.

8.3.3 Inspect the inner surface of the ring. It must be free of water spots, discoloration, or any other flaws that would interfere with the end-of-test inspection. If the ring is flawed, discard it, install a new ring, and evaluate it, beginning with 8.3.1. When a flawless ring is found, reinstall it in the pump and proceed to conduct the test. The cam ring should be rated (Annex A1) and only run if the rating is 1.0.

8.4 Preparation of Test Apparatus:

8.4.1 Remove the filter housing and clean out any debris from break-in step(s) (8.3). Install the 40- μ m filter element and replace filter housing. Remount the pump to the test stand and adjust belt loading in accordance with 8.2.1. Fill the pump (to the bottom of filler neck) and the system with new test fluid, operating the drive motor intermittently. System fluid capacity at room temperature is 1.4 ± 0.2 L (473 ± 6.8 fl oz). Connect and activate temperature and pressure transducers (calibrate pressure transducer before each test). Start the test pump (minimum pressure setting) and add test fluid as necessary to maintain fluid level at FULL mark.

8.4.2 Continue pump operation (minimum pressure setting) for at least 5 min or as long as necessary to clear air from the system. Operate the pump at each of three pressures, 1500 kPa, 3500 kPa, and 5000 kPa (217 psi, 508 psi, and 725 psi), for 5 min or as long as necessary to clear air from the system at each of the pressures. Increase pump pressure to 6200 kPa (899 psi) and when pump-out fluid temperature reaches 145°C (293°F) set the test hour counter to zero and begin the test. Pump-out fluid temperature should not exceed 145°C (293°F) during the test.