



SURFACE VEHICLE STANDARD

J746™
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Superseding J746 JUN2009

(R) Hydraulic Motor Test Procedures

RATIONALE

This standard is revised to update references and SI units, and to also add test system cleanliness (3.8), a pressure gauge to the motor drain, presentation of results section (Section 7), and an appendix section (Appendix A).

1. SCOPE

This test code describes tests for determining characteristics of hydraulic positive displacement motors as used on off-road self-propelled work machines as referenced in SAE J1116.

1.1 Purpose

This test code establishes conditions for motor tests, outlines a procedure for tests, and establishes a method of presenting motor test data.

The procedure covers the following determinations:

- a. SAE volumetric rating
- b. SAE running torque characteristics
- c. SAE stall torque characteristics
- d. Power output
- e. Power loss
- f. SAE power and torque efficiency
- g. Overall efficiency
- h. Required delivery

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2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publication

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1116 Categories of Off-Road Self-Propelled Work Machines

2.1.2 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 4406 Hydraulic Fluid Power - Fluids - Method for Coding the Level of Contamination by Solid Particles

3. MATERIAL AND APPARATUS

3.1 Test Fluid

Test fluid shall preferably be a mineral base oil designed for hydraulic service. Fluid viscosity shall be within the limits of 95 to 115 SUS at 49 °C (120 °F) and 50 to 54 SUS at 82 °C (180 °F).

3.2 Motor Torque and Speed Measuring Apparatus

Torque measurement shall be accurate within $\pm 1\%$ and speed measurement shall be accurate within $\pm 0.5\%$. The test setup shall not impose radial or axial loads upon the driveshaft of the hydraulic motor under test.

3.3 Flow Measurement

Flow measurement shall be accurate within $\pm 2.0\%$.

3.4 Pressure Measurement

Pressure measurement shall be accurate within $\pm 2.0\%$.

3.5 Temperature Measurement and Control

Fluid temperature shall be measured in the motor outlet line by means of a thermometer or thermocouple. Fluid temperature shall be maintained at the prescribed level throughout the test within $\pm 3\text{ }^{\circ}\text{C}$ ($\pm 5\text{ }^{\circ}\text{F}$).

3.6 Drain Line

Total pressure drop in drain line, if required, shall be as low as possible.

3.7 Motor Outlet Line

Total pressure drop in outlet line shall be as low as possible.

3.8 System Cleanliness

Test system shall have a contamination level not to exceed ISO 4406 Code -/17/14.

4. GENERAL DEFINITIONS AND TEST CONDITIONS

4.1 Temperature

Shall be expressed in degrees Celsius (°C) or Fahrenheit (°F).

4.2 Pressure

Shall be expressed in kilopascal gauge (kPag) or pounds per square inch gage (psig).

4.3 SAE Volumetric Rating

The SAE volumetric rating of a hydraulic motor shall be defined as delivery to the motor in liters per minute (L/min) or gallons per minute (gpm) at a speed of 1000 rpm and zero torque on the shaft at a fluid temperature of 49 °C (120 °F).

4.4 SAE Stall Pressure

Shall be defined as the differential pressure required to maintain a specified motor torque at 1 rpm.

4.5 Delivery (Input Flow)

Shall be defined as the measured flow rate to the motor. It equals the sum of exhaust flow plus drain line flow. It shall be expressed in liters per minute (L/min) or gallons per minute (gpm).

4.6 Required Delivery

Shall be defined as the amount of delivery (input flow) required to maintain a given rpm at a constant known torque.

4.7 Pressure Drop (Δp)

Shall be defined as the pressure differential across motor ports in kilopascal gauge (kPag) or pounds per square inch gage (psig).

5. WORKING FORMULAS

5.1 SAE Theoretical Torque

$$= \frac{\text{SAE volumetric rating (L/min)} \times \Delta \text{ pressure (kPag)}}{6283} = \text{N}\cdot\text{m} \quad (\text{Eq. 1})$$

$$= \frac{\text{SAE volumetric rating (gpm)} \times \Delta \text{ pressure (psig)}}{27.2} = \text{lb}\cdot\text{in} \quad (\text{Eq. 2})$$

5.2 SAE Theoretical Delivery (Flow)

$$= \frac{\text{SAE volumetric rating (L/min)} \times \text{rpm}}{1000} = \text{L/min} \quad (\text{Eq. 3})$$

$$= \frac{\text{SAE volumetric rating (gpm)} \times \text{rpm}}{1000} = \text{gpm} \quad (\text{Eq. 4})$$