SAE International™

SURFACE VEHICLE STANDARD

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Hydraulic Motor Test Procedures

RATIONALE

This SAE standard is revised to make minor changes to the definition and correct errors for clarification.

1. SCOPE

This test code describes tests for determining characteristics of hydraulic positive displacement motors as used on construction and industrial machinery as referenced in SAE J1116. These characteristics are to be recorded on data sheets similar to the one shown in Figure 1. Two sets of data sheets are to be submitted: one at 49 °C (120 °F) and one at 82 °C (180 °F).

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. Torque efficiency

g. Overall efficiency

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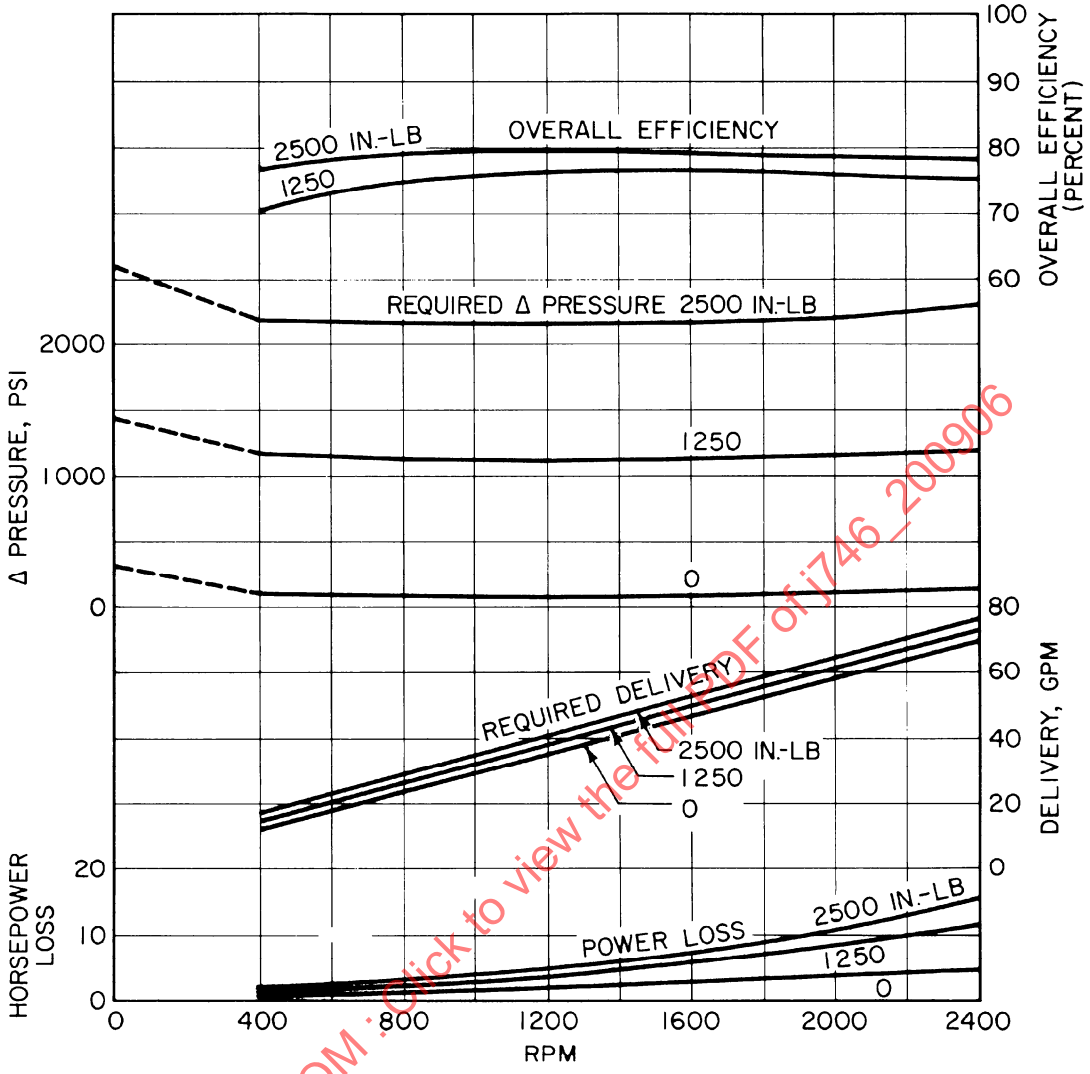

PERFORMANCE DATA ON A CONSTANT DISPLACEMENT HYDRAULIC MOTOR

Manufacturer: Acme Mfg. Co.

Series or type: ZYX

Model: 8Z24

Motor rotation: Double

SAE volumetric rating: 35.5 GPM/1000 RPM

Test fluid: Mineral base hydraulic oil

Fluid viscosity @ test temperature: 100 SUS

Temperature of test fluid: 120 °F

FIGURE 1 - WORK SHEET

2. REFERENCE

2.1 Applicable Publication

The following publication forms 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 724-776-4970 (outside USA), www.sae.org.

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

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 must be accurate within ±1% and speed measurement must be accurate within ±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 ±2.0%.

3.4 Pressure Measurement

Pressure measurement shall be accurate within ±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 ±2.8 °C (± 5 °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.

4. GENERAL DEFINITIONS AND TEST CONDITIONS

4.1 Temperature

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

4.2 Pressure

Shall be expressed in Newtons per square centimeter gage (N/cm^2g) 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 (Lpm) 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 (Lpm) or gallons per minute (gpm).

4.6 Pressure

Shall be defined as the pressure differential across motor ports in pounds per square inch gage (psig) or Newtons per square centimeter gage (N/cm^2g).

5. WORKING FORMULAS

5.1 SAE Theoretical Torque

$$= \frac{\text{SAE volumetric rating (Lpm) x pressure } (N/cm^2g)}{628.3} = N \cdot m \quad \text{(Eq. 1)}$$

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

5.2 SAE Theoretical Delivery (Flow)

$$= \frac{\text{SAE volumetric rating (Lpm) x rpm}}{1000} = Lpm \quad \text{(Eq. 3)}$$

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

5.3 SAE Theoretical Hydraulic Power

$$= \frac{\text{SAE theoretical deliv ery (Lpm) x } N/cm^2g}{6} = watts\ (W) \quad \text{(Eq. 5)}$$

$$= \frac{\text{SAE theoretical delivery (gpm) x psig}}{1714} = horsepower\ (hp) \quad \text{(Eq. 6)}$$

5.4 Hydraulic Power

$$= \frac{\text{Delivery (Lpm) x } \Delta \text{ pressure } (N/cm^2g)}{6} = watts\ (W) \quad \text{(Eq. 7)}$$

$$= \frac{\text{Delivery (gpm) x } \Delta \text{ pressure (psig)}}{1714} = horsepower\ (hp) \quad \text{(Eq. 8)}$$

5.5 Power Output

$$= (\text{Output Torque (N} \cdot \text{m)} \times \text{rpm} \times 0.105 = \text{watts (W)} \quad \text{(Eq. 9)}$$

$$= \frac{\text{Output Torque (lb-in) x rpm}}{63\ 025} = \text{horsepower (hp)} \quad \text{(Eq. 10)}$$

5.6 Power Loss

$$= \text{Hydraulic power (W)} - \text{Power output (W)} = \text{watts (W)} \quad \text{(Eq. 11)}$$

$$= \text{Hydraulic power (hp)} - \text{Power output (hp)} = \text{horsepower (hp)} \quad \text{(Eq. 12)}$$

5.7 Overall Efficiency

$$= \frac{\text{Power output}}{\text{Hydraulic power}} \times 100 = \text{percent (\%)} \quad \text{(Eq. 13)}$$

5.8 Torque Efficiency

$$= \frac{\text{Power output}}{\text{SAE theoretical hydraulic power}} \times 100 = \text{percent (\%)} \quad \text{(Eq. 14)}$$

$$= \frac{\text{Output torque}}{\text{SAE theoretical torque}} \times 100 = \text{percent (\%)} \quad \text{(Eq. 15)}$$

6. TEST 1

a. Set up the motor as in Figure 2, except uncoupled from load.

b. Operate the motor from minimum to maximum speed in suitable increments, one speed being 1000 rpm. If 1000 rpm is too fast, operate at 100 rpm and then convert to 1000 rpm to use the SAE equations. Record inlet and outlet pressure, delivery, and rpm.

c. Couple the motor to the load and repeat Test 1, step b at maximum rated torque and one intermediate torque. Record inlet and outlet pressure, torque, delivery, and rpm.

d. Set up the motor as recommended in Figure 3.

e. Operate the motor at 1 rpm. Record the maximum and minimum pressure differential required to maintain the same torque as in Test 1, step c.