SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

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(R) Test Method for Measuring Power Consumption of Hydraulic Pumps for Trucks and Buses

RATIONALE

The SAE J1341 document was reviewed and revised as part of the 5 year SAE review process. The original document prescribed different tests for the power consumption of fixed displacement and variable displacement hydraulic power steering pumps. This revision details a common test procedure so that the power consumption of different pump technologies can be compared for a given application.

1. SCOPE

This document covers evaluation techniques for determining the power consumption characteristics of engine driven hydraulic pumps used on heavy-duty trucks and buses. The testing technique outlined in this SAE Recommended Practice was developed as part of an overall program for testing and evaluating fuel consumption of heavy-duty trucks and buses. The technique outlined in this document provides a description of the test to be run to determine power consumption of these engine driven components, the type of equipment and facilities which are generally required to perform these tests are discussed in SAE J745. It is recommended that the specific operating conditions suggested throughout the test be carefully reviewed on the basis of actual data obtained on the specific vehicle operation.

1.1 Purpose

The purpose of this document is to expand on the scope of the existing SAE J745. All of the specifications and apparatus utilized in that document for construction and industrial machinery can be utilized in this procedure. Information presented in the manner outlined as follows can be used to compare the hydraulic power requirements of fixed or variable-displacement pumps and estimate actual power consumption after the vehicle duty cycle has been determined.

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2. REFERENCE

2.1 Applicable Document

The following publication forms a part of this specification to the extent specified herein. Unless otherwise specified, 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 J745 Hydraulic Power Pump Test Procedure

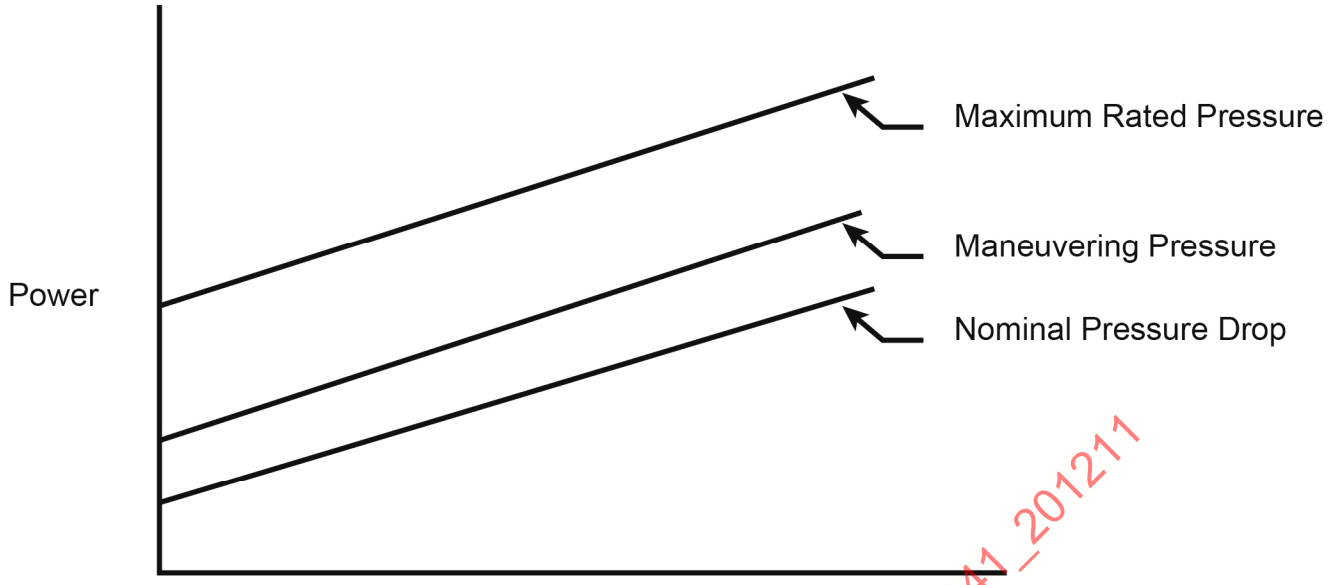
NOTE: Only Test 2, Performance Characteristics, and Test 4, Response Time and Recovery Time, of SAE J745 are relevant to power loss.

3. EVALUATION TECHNIQUES FOR ENGINE DRIVEN PUMPS

Three curves are required to evaluate power consumption as a function of pump speed as shown in Figure 1. The first is the nominal pressure drop that is a function of the open center steering valve used in conjunction with the test pump. This is the baseline pressure that the pump will see in a lanekeeping mode of vehicle operation. In most cases this pressure can be approximated as 50 psi, or alternatively 2% of maximum system pressure. A second curve taken at 1/3 of maximum system pressure is a practical maneuvering level. In most conditions the pressure required to steer a moving vehicle varies between nominal and 1/2 system pressure. The final curve is taken at the maximum rated system pressure. This curve has practical significance at lower engine speeds where static parking maneuvers occur. It has more of a theoretical importance at higher engine speeds, as this is the point where steering systems consume the most power although in practice in might require a contrived vehicle maneuver to achieve. The actual controlled pressures shown in Figure 1 are determined by the steering gear to be used in the target application, however in practice many applications are similar.

The curves shown in Figure 1 are useful to compare the performance of different engine driven pumps. If these curves are to be used to predict actual power consumption on a vehicle, the pumps must be properly selected. Factors that influence the selection are axle weight, tire size, vehicle speed, steering geometry, etc. Proper selection requires that the flow out of the pump is within the range specified by the steering gear manufacturer. These ranges can be quite large, and significantly different power consumption can be achieved by comparing pumps operating at the upper and lower specification limits.

Figure 2 reports power consumption as a function of output pressure for a given pump speed. The speed of an engine driven pump is a fixed ratio of engine speed. Typically the most common engine speeds are idle and the engine speed corresponding to the vehicle cruising speed. Additionally, an intermediate value at 1000 engine rpm to represent maneuvering power consumption under conditions such as docking, parking, or low-speed city maneuvering can be used Therefore to properly generate Figure 2 the pump drive ratio, engine idle speed, and engine cruising speed of the intended application are required to calculate the various pump speeds of interest.



500 to Maximum Rated RPM

FIGURE 1 - POWER VERSUS PUMP RPM

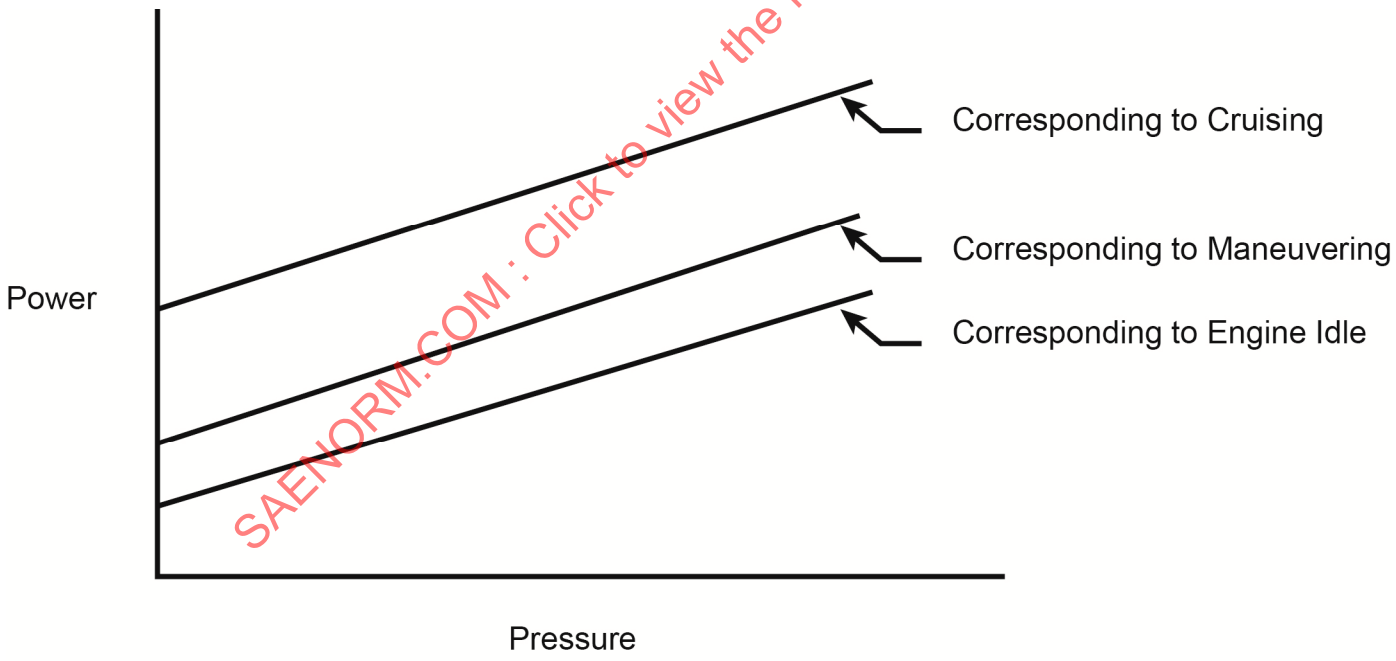


FIGURE 2 - POWER VERSUS PRESSURE AT PUMP SPEEDS

Just as with the test results reported in Figure 1, Figure 2 can be used to compare the power consumption characteristics of different engine driven pumps, but for actual prediction of in-vehicle power consumption it must be assumed that the pumps are properly selected. The actual values of pump driving speed corresponding to engine idle and cruising are a function of the specific vehicle application, including the engine, pump drive ratio, and transmission.

Figure 1 and Figure 2 could be combined for a three dimensional visualization of the power consumption of an engine driven pump for the complete map of operating conditions determined by drive speed and gear pressure.