

Test Method for Determining Power Consumption of Engine Cooling Fan Drive Systems**RATIONALE**

This document has been revised to comply with current SAE formatting practice. Metric units have been added where appropriate and some terms have been redefined for clarity.

1. SCOPE

The technique outlined in this SAE Recommended Practice was developed as part of an overall program for determining and evaluating fuel consumption of heavy-duty trucks and buses, but it is applicable to off highway vehicles as well.

It is recommended that the specific operating conditions be carefully reviewed on the basis of actual installation data. Cooling requirements are affected by all heat exchangers that are cooled by the fan drive system. These may include radiators, condensers, charge air coolers, oil coolers, and others.

Because of the variation in size, shape, configuration, and mountings available in cooling fans and fan drive systems, specific test devices have not been included.

Using known power/speed relationships for a given fan, this procedure can be used to calculate the fan drive system's power consumption for engine cooling systems using fixed ratio, viscous or speed modulating, and mechanical on/off fan drives including electronically activated fan drives. This power consumption may then be used in determining engine net power per SAE J1349. For fan power/speed relationships, refer to SAE J1339.

1.1 Purpose

The purpose of this document is to provide a recommended method for determining and comparing the power consumption of fan drives over a variety of operating conditions. The resulting power consumption data is useful in predicting the fuel consumption of engines using these fan drives and in comparing one fan drive to another on the basis of power consumption. There is no known comparable ISO specification.

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http://www.sae.org/technical/standards/J1342_201206**

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 Publications

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 J1339 Test Method for Measuring Performance of Engine Cooling Fans

SAE J1349 Engine Power Test Code - Spark Ignition and Compression Ignition – As Installed Net Power Rating

3. METHOD OF PRESENTING TEST DATA

To evaluate the power requirement differential between the fixed ratio fan drive and a speed modulating or on/off drive the following formula will be utilized for all duty cycle conditions. Typical curves are shown in Figure 1.

To evaluate the power, use the equation:

$$\text{Total Power} = (N_i - N_o)(N_o^2)(K) + (N_o^3)(K) + P_l \quad (\text{Eq. 1})$$

where:

$(N_i - N_o)(N_o^2)(K)$ = Slip/drag power (kW)

$(N_o^3)(K)$ = Fan power (kW)

N_i = Fan drive input speed (r/min)

N_o = Fan drive output speed or fan speed (r/min)

K = Fan constant

P_l = Power loss associated with the fan drive system minus the fan and clutch but including belts, pulleys, and pulley bearings (kW)

"K" fan constant is obtained by dividing fan power by the (fan speed)³ required to consume that power.

Input Speed Constant

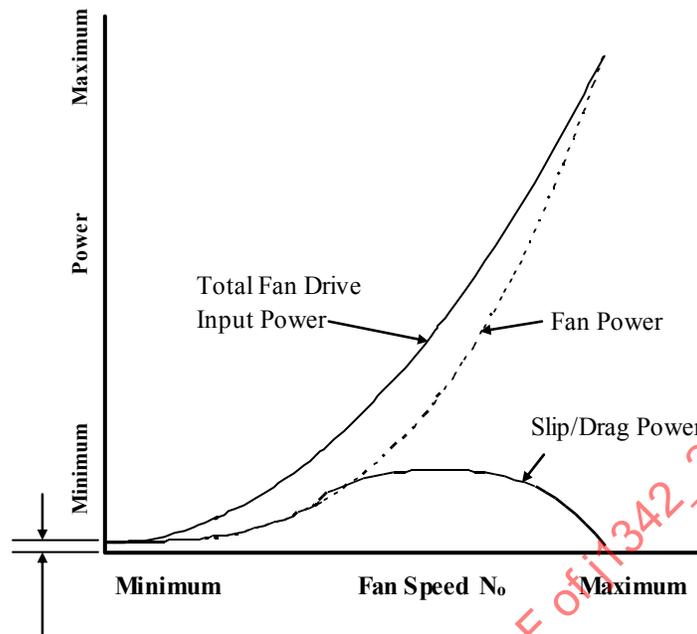


FIGURE 1 - POWER VERSUS FAN SPEED

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Fan output speed (N_o) can be determined from curves such as those presented in Figures 2 and 3. Curves as shown in Figure 2 can be provided by the fan drive manufacturer. Curves as shown in Figure 3 would normally be derived by the fan drive user.

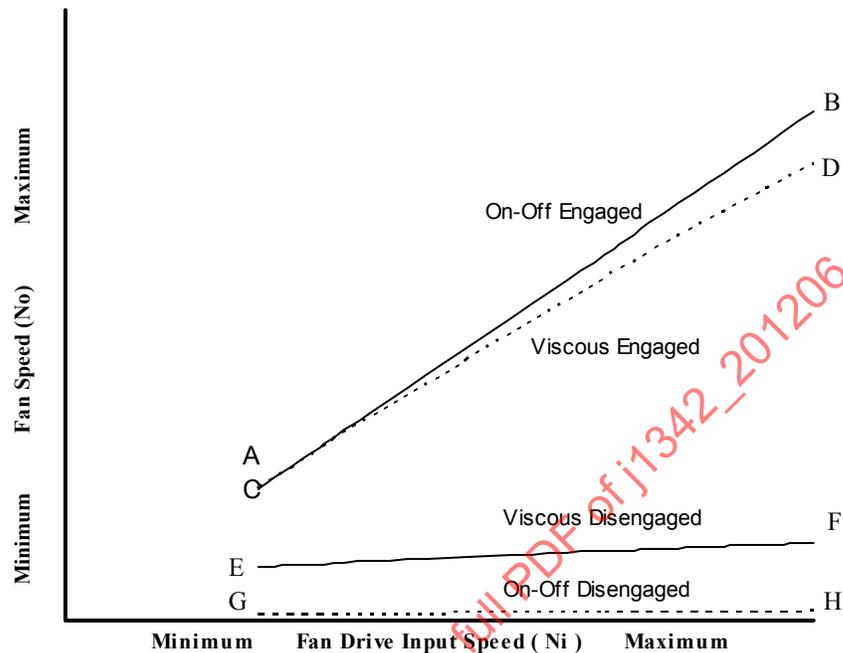


FIGURE 2 - FAN SPEED VERSUS FAN-DRIVE INPUT SPEED

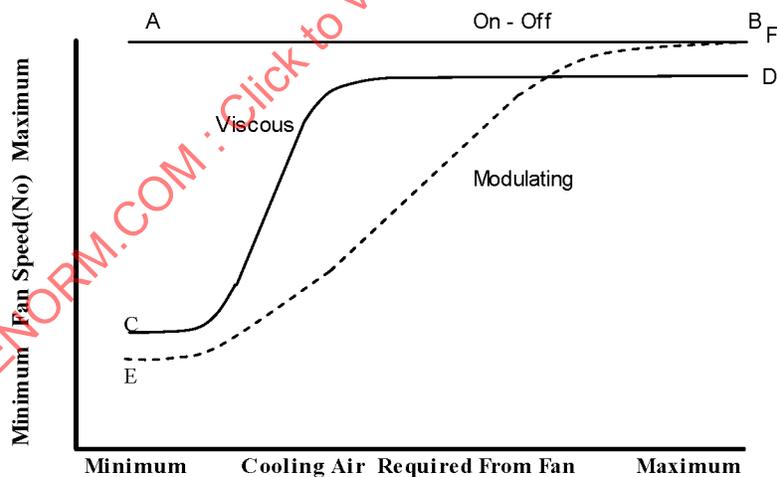


FIGURE 3 - FAN SPEED VERSUS COOLING AIR REQUIRED

4. PROCEDURE FOR ANALYZING VARIOUS TYPES OF FAN DRIVE SYSTEMS

4.1 The Section 3 method applied to the on/off drive is as follows:

When operating conditions do not require fan drive actuation, fan speed (N_o) will fall on line G – H (Figure 2), or may be zero (0) rpm ($N_o = 0$), depending on the particular fan clutch being analyzed.

When operating conditions require fan drive actuation, fan output speed (N_o) will fall along line A – B of Figure 2. Given a specific input speed (N_i), the output speed (N_o) can be determined from line A – B of Figure 3.