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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1342

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Submitted for recognition as an American National Standard

(R) Test Method for Determining Power Consumption of Engine Cooling Fan-Drive Systems

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.

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, or oil coolers.

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 know 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, speed modulating, and on/off 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.

2. ***References***

2.1 **Applicable Publications—**The following publications form 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 PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1339—Test Method for Measuring Power Consumption of Engine Cooling Fans
SAE J1349—Engine Power Test Code—Spark Ignition and Compression Ignition—Net Power Rating

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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 fan drive, the following formula will be utilized for all duty cycle conditions. Typical curves are shown in Figure 1.

To evaluate the power, see Equation 1:

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

where:

$(N_i\text{-}N_o)(N_o^2)(K)$ = Slip/drag power
$(N_o^3)(K)$ = Fan power
N_i = Input speed
N_o = Fan output speed
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

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

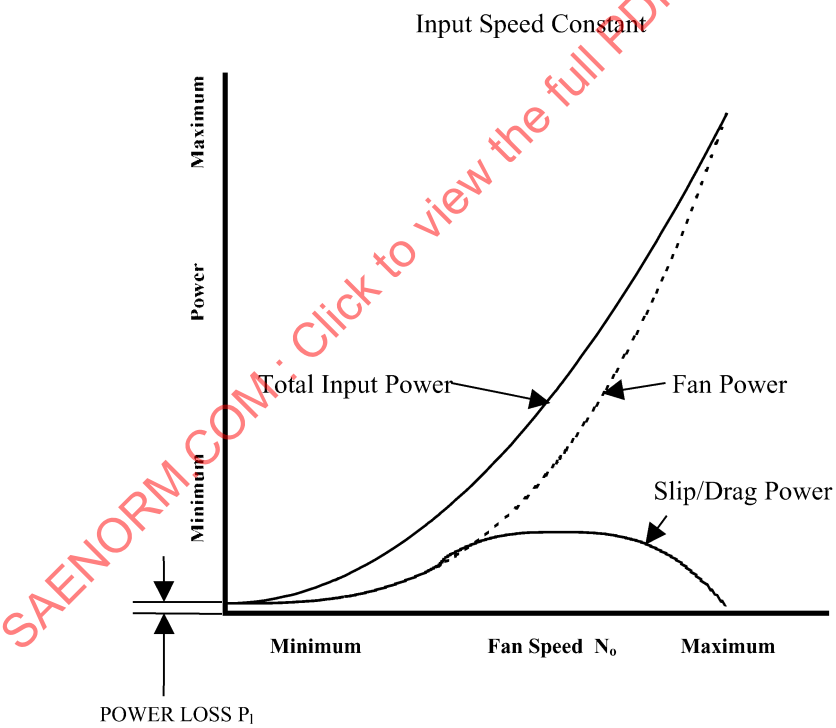

FIGURE 1—POWER VERSUS FAN SPEED

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 shall be provided by the fan-drive manufacturer. Curves as shown in Figure 3 would normally be derived by the fan-drive user.

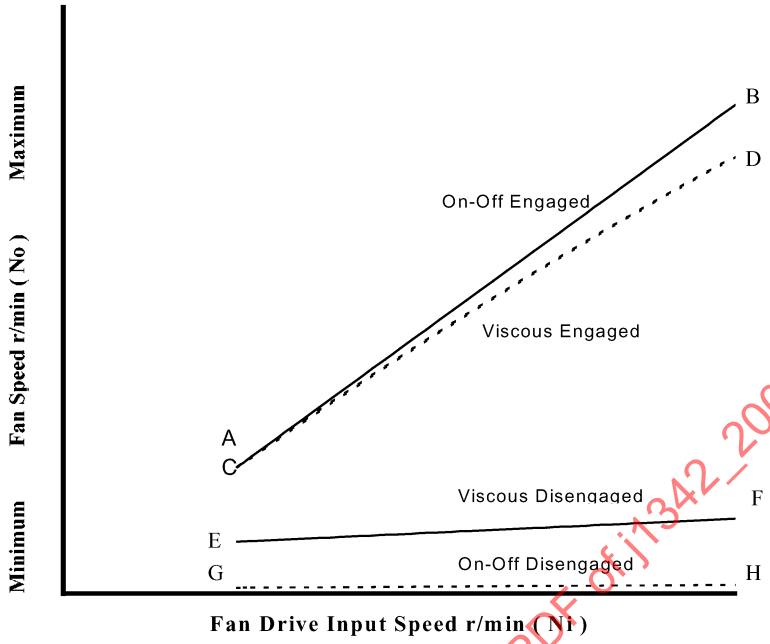

FIGURE 2—FAN SPEED VERSUS FAN-DRIVE INPUT SPEED

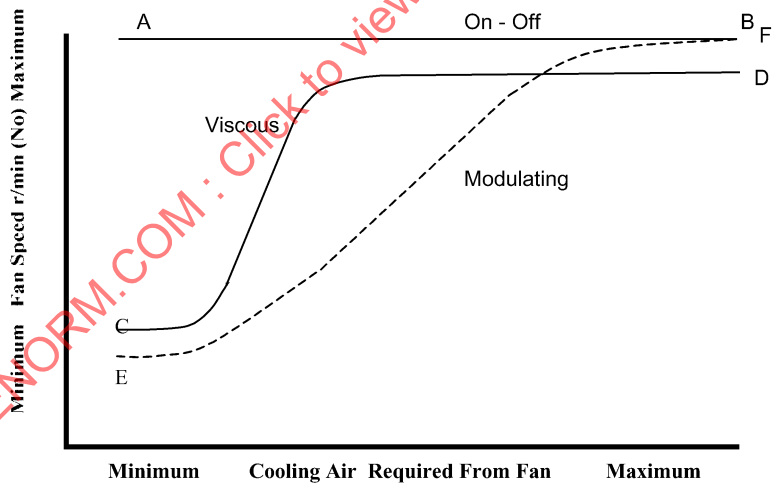

FIGURE 3—FAN SPEED VERSUS COOLING AIR

4. Procedure for Analyzing Various Types of Fan-Drive Systems

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

When operating conditions do not require fan drive actuation, fan-output speed (N_o) will fall on line G – H (Figure 2), or may be 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.

4.2 The Section 3 method applied to on/off viscous fan drives is as follows:

When operating conditions do not require fan drive actuation, fan speed (N_o) will fall on line E – F of Figure 2.

When operating conditions require fan drive actuation, fan speed (N_o) will fall on line C – D of Figure 3.

4.3 The Section 3 method applied to speed modulating viscous and hydraulic fan drives is as follows:

When operating conditions do not require fan drive actuation, fan speed (N_o) will fall on line E – F of Figure 2.

When operating conditions require fan drive actuation, fan speed (N_o) will fall within the boundaries of ABFE, Figure 2. Given the percent cooling required from the fan at a specific input speed (N_i), the output speed (N_o) can be determined from line E – F of Figure 3.

5. ***Summary—***After the total power requirements of any fan drive system has been determined, it can then be compared to the power requirement of a fixed ratio fan drive system to determine the power difference at any operating point. Total power difference can be estimated by summing the various operating point differences in proportion to the respective time at each point in the duty cycle of the vehicle.

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