The Engineering Society For Advancing Mobility Land Sea Air and Space®
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SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1339

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Submitted for recognition as an American National Standard

TEST METHOD FOR MEASURING POWER CONSUMPTION OF ENGINE COOLING FANS

***Foreword*—**This Document has also changed to comply with the new SAE Technical Standards Board format.

1. ***Scope*—**This SAE Recommended Practice is intended for use in testing and evaluating the approximate power consumption of engine cooling fans. This power consumption would then be used to estimate net engine power per SAE J1349. The procedure also provides a general description of equipment necessary to measure the approximate fan power consumption in a vehicle installation.

The test conditions in the procedure generally will not match those of the installation for which fuel consumption information is desired. The power required by a given fan depends on the geometric details of the installation, including the shroud and its clearance. These details should be duplicated in the test setup if accurate power measurement is expected. Required power at a given air density and speed also depend on the volumetric flow rate, or else the pressure rise across the fan, since these two parameters are mutually dependent. These parameters depend on the pressure drop across the radiator core and the ram pressure due to vehicle motion. Core drop and ram pressure tend to offset each other, but can be expected to cancel one another at only one vehicle speed at most. Tests run in the absence of the radiator core will not impose the proper pressure-rise requirement on the fan. Tests run with the radiator core in place will impose a greater pressure-rise requirement on the fan than it will likely experience at high vehicle speeds, when part of the rise will be provided by ram air. For these reasons, the test procedure should be recognized as providing only an approximate measure of installed fan power.

Although the test procedure is based on running the fan with a motoring dynamometer, the actual installation can be used as a test fixture if an accurate torque meter is available. In this case, the same qualifications discussed apply. Finally, for the effect of a fan clutch in reducing fan use and power consumption, which is not a part of this procedure, refer to SAE J1342.

1.1 **Purpose—**This document provides a recommended test procedure for measuring and comparing the power consumption of fans over a range of speeds. The resulting power consumption data are intended for predicting the fuel consumption of engines using these fans, and in comparing one fan versus another on the basis of power requirements. There is no known comparable ISO specification.

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2. *References*

2.1 Applicable Publications—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1342—Method for Determining Power Consumption of Engine Cooling Fan-Drive Systems
SAE J1349—Engine Power Test Code—Spark Ignition and Compression Ignition—Net Power Rating

3. *Test Procedure*

3.1 Equipment and Facilities

3.1.1 A calibrated motoring dynamometer.

3.1.2 Structure with minimum length and height of 150% of the fan diameter to support a sharp-edged orifice (a fan shroud). The actual vehicle or other installation can be used if any shutters are blocked open and a torque meter can be installed. A separate belt drive using an auxiliary power source can facilitate power measurement.

3.1.3 A calibrated tachometer.

3.1.4 Equipment necessary for measurement of air temperature and barometric pressure.

3.2 Test Conditions—The fan is mounted within a sharp-edged orifice which is 103% of the fan diameter but no more than 19.05 mm (0.75 in) larger than the fan diameter. The fan is mounted such that 50% of its projected width penetrates the orifice.

Optional—The fan may be mounted at the penetration and in the shroud proposed for the end use application.

3.3 Test Procedures—Operate the fan within a range of speeds representative of the intended use. Select sufficient discrete speeds to establish a curve for the speed range. Measure torque at each speed. Calculate the fan power using the formula of 4.2.

4. *Computations and Results*

4.1 Definition of Symbols—(See Table 1.)

4.2 Calculations

4.2.1 AIR DENSITY—(See Equation 1.)

$$D = KB/(t + A) \qquad \text{(Eq. 1)}$$

4.2.2 AIR DENSITY CORRECTION FACTOR—(See Equation 2.)

$$C = D^*/D \qquad \text{(Eq. 2)}$$

4.2.3 FAN POWER—(See Equation 3.)

$$P = NT/X \qquad \text{(Eq. 3)}$$

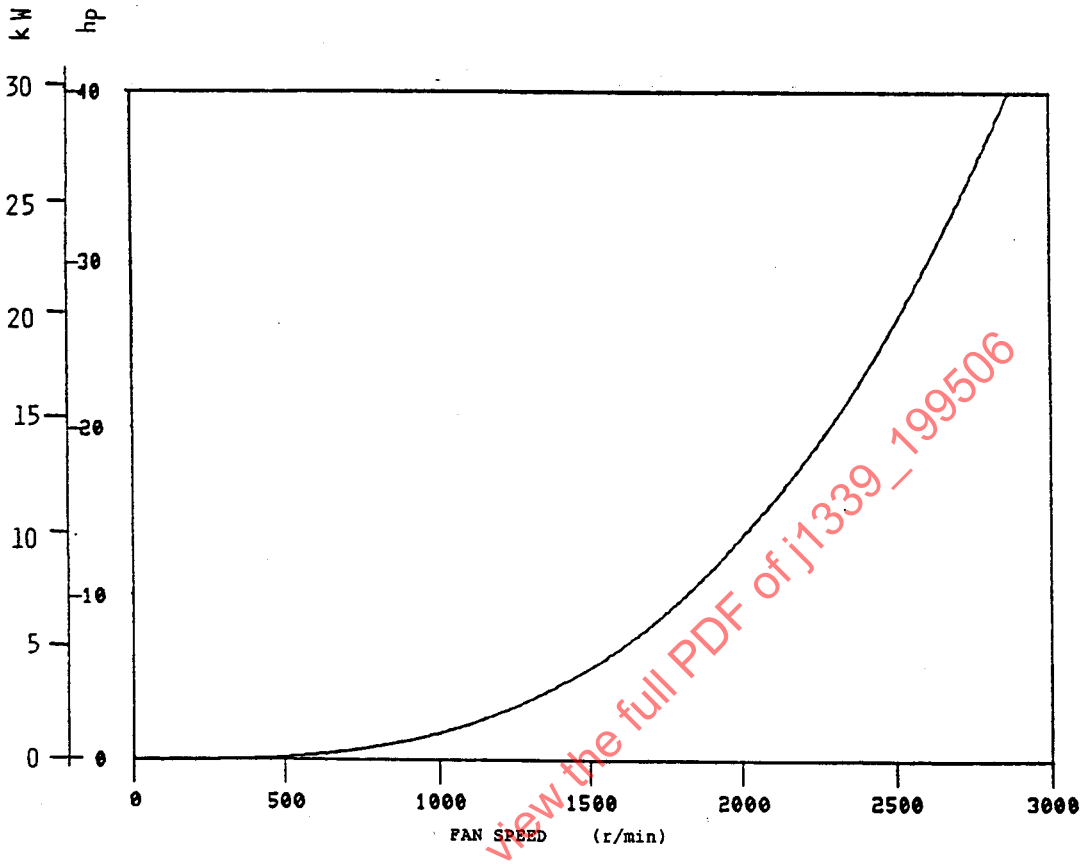
4.2.4 CORRECTED FAN POWER—(See Equation 4.)

$$Pc = PC \qquad \text{(Eq. 4)}$$

TABLE 1—DEFINITION OF SYMBOLS

Symbol	Definition	Units SI	Units English
A	Correction for absolute temperature	273 °C	460 °F
B	Barometric pressure	kPa	in Hg
D	Air density	kg/m^3	lb/ft^3
t	Ambient temperature	°C	°F
P	Fan power	kW	hp
N	Fan speed	r/min	r/min
T	Fan torque	N·m	lbf-ft
K	Density conversion factor	$\frac{3.487\ kg\ °C}{m^3 kPa}$	$\frac{1.325\ lb\ °F}{ft^3\ in\ hg}$
X	Power conversion factor	$\frac{9549\ N{\cdot}mr/min}{kW}$	$\frac{5252\ lbf{\cdot}ft\ r/min}{hp}$
D*	Standard air density	$1.2012\ kg/m^3$	$0.075\ lb/ft^3$
Subscripts			
c	Corrected to standard air density		

4.3 Presentation of Results—The corrected power, Pc, shall be plotted versus fan speed N, as shown in Figure 1.



Presentation of typical fan power data.
711.2 mm (28 in) diameter, six-blade fan mounted within a sharp-edged orifice with a diameter 25.4 mm (1 in) larger than the fan diameter. Data corrected to standard air density.

FIGURE 1—FAN POWER CONSUMPTION AT ZERO AIR PRESSURE

5. Notes

5.1 Marginal Indicia—The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

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