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**SAE J544 MAR88**

**Electric Starting  
Motor Test Procedure**

SAE Recommended Practice  
Reaffirmed March 1988

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**ELECTRIC STARTING MOTOR TEST PROCEDURE**

1. INTRODUCTION:

Prior to 1981, SAE J544 addressed both starting motor and generator performance curves. Review of this technical report for improvement indicated that a recommended test procedure for development of the performance curves was needed and that starting motors and generators should be addressed in separate SAE technical reports. The generator performance curve information is now contained in SAE J56. The SAE J544 identity has been retained for testing the output performance and plotting the performance curves of starting motors.

2. PURPOSE:

This SAE Recommended Practice provides a standard procedure for testing the output performance and plotting the performance curve of electric starting motors, and a graphical method of determining engine cranking speed.

3. TESTING PROCEDURE:

The motor shall be mounted in a test stand as shown in Fig. 1. For larger starting motors, the torque may be measured directly at the motor axis with a special test end frame because of torque limitation of test equipment. The torque measurement may be recorded and should be identified on the performance curve as either a frame reaction at the motor axis or at the torque loading point shown in Fig. 1.

NOTE: If the latter test method is used, the effect of inertia should be taken into account.

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### 3. TESTING PROCEDURE: (Continued)

Performance curves are established by running the starting motor in one of two methods. Method A is plotting a curve from discrete points while Method B is achieved by operating the motor in a continuous mode while the output is automatically recorded and/or plotted. Deviations from either of these two methods shall be noted on the performance curve. When a solenoid is used for meshing the starting motor pinion gear with the flywheel ring gear, the applied voltage and total current draw shall include the solenoid and be noted on the performance curve.

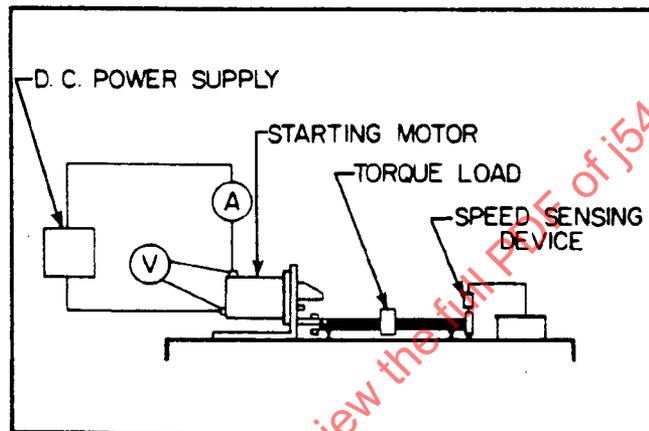


FIGURE 1 - Typical Test Set-up for Starting Motors

- 3.1 Test Method A: Run the starting motor at various discrete torque loads and record the voltage, torque, current, and speed. The terminal voltage is preferably adjusted to a voltage curve selected from Table 1. The voltage curve selected shall not exceed the recommendation of the motor manufacturer. Enough points shall be recorded to develop a curve. The points shall be plotted and the curves developed as shown in Fig. 2.

Cooling intervals between each test point shall be made to insure that the effects of temperature changes are negligible. Ambient test temperature shall be noted on the performance curve.

- 3.2 Test Method B: Operate the starting motor continuously, decreasing the torque load from the stall point. The terminal voltage is preferably maintained to a voltage curve selected from Table I. The voltage curve selected shall not exceed the recommendation of the motor manufacturer. Plotting equipment is used to record the voltage, torque, current, and speed as shown in Fig. 2. The loading rate is to be such that the effect of temperature change is negligible. Ambient test temperature shall be noted on the performance curve.

TABLE 1 - Recommended Terminal Voltage Curves for Starting Motor Tests

Curve Name	Curve Data <sup>a</sup>	
	Volts at Open Circuit	Volts at Amperes
24V Heavy Duty	24	16 at 1000
24V Standard Duty	24	12 at 600
12V High Output	12	10 at 1000
12V Extra Heavy Duty	12	8 at 1000
12V Heavy Duty	12	6 at 1000
12V Medium Duty	12	6 at 600
12V Standard Duty	12	6 at 400
6V Standard Duty	6	2 at 800

<sup>a</sup>The terminal voltage curve is a straight line defined by the data points.

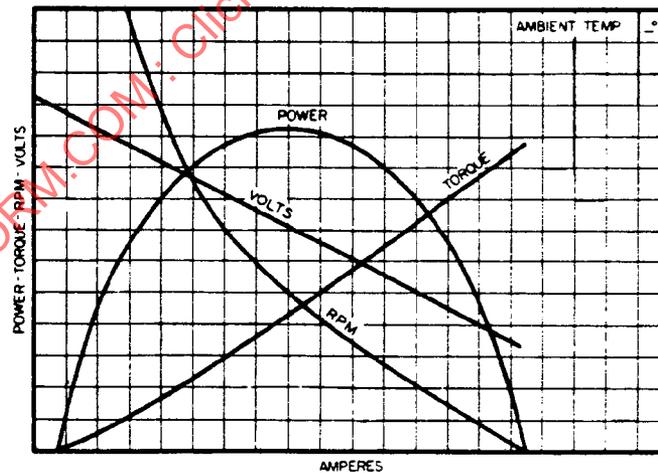


FIGURE 2 - Standard Form for Starting Motor Characteristic Curves

#### 4. INSTRUMENTATION:

The voltmeter and the ammeter shall have an accuracy of  $\pm 1\%$  of the full scale reading (full scale value not to exceed the maximum performance reading by more than 50%). The speed sensing device and torque measuring device shall have an accuracy of  $\pm 1\%$  of the actual reading.

#### 5. GRAPHICAL METHOD OF DETERMINING ENGINE CRANKING SPEED:

With the starting motor performance curve generated by the above procedure and a cranking demand curve developed for a particular engine (Reference: Low Temperature Cranking Load Requirements of an Engine - SAE J1253 MAR86, the cranking speed can be determined by using the graphical method shown in Fig. 3.

The starting motor performance curve may need to be corrected for temperature and terminal voltages expected on the actual application. The motor performance corrections can be obtained from the motor manufacturer.

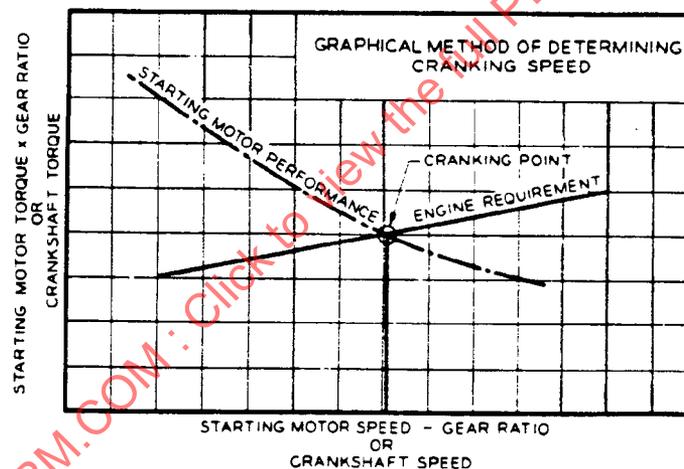


FIGURE 3 - Method of Determining Cranking Speeds

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J56 JUN83, Electrical Generating System (Alternator Type) Performance Curve and Test Procedure

SAE J1253 MAR86, Low Temperature Cranking Load Requirements of an Engine

APPLICATION:

This SAE Recommended Practice provides a standard procedure for testing the output performance and plotting the performance curve of electric starting motors, and a graphical method of determining engine cranking speed.

COMMITTEE COMPOSITION:

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