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Superseding J544 MAR88

Submitted for recognition as an American National Standard

(R) ELECTRIC STARTING MOTOR TEST PROCEDURE

Foreword—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.

1. **Scope**—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.

2. **References**

2.1 **Applicable Publications**—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, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J56—Electrical Generating System (Alternator Type) Performance Curve and Test Procedure
SAE J1253—Low Temperature Cranking Load Requirements of an Engine

3. **Testing Procedure**—The motor shall be mounted in a test stand as shown in Figure 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 Figure 1.

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

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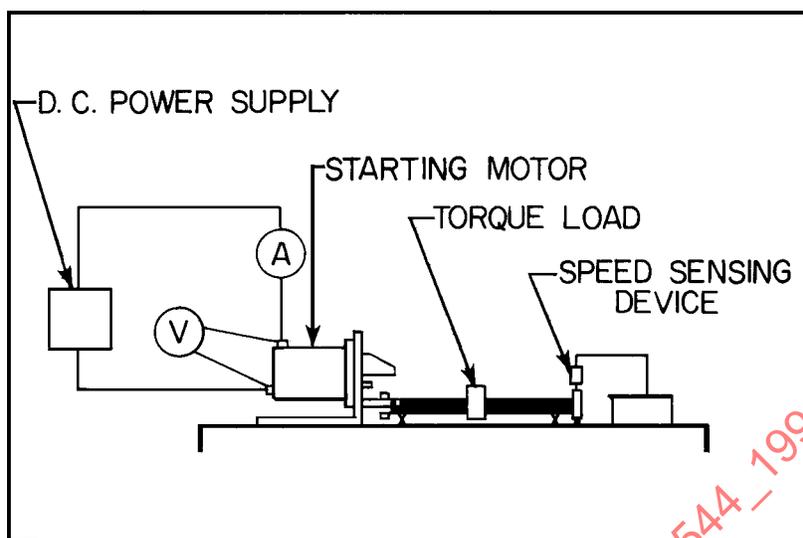


FIGURE 1—TYPICAL TEST SET-UP FOR STARTING MOTORS

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.

- 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 Figure 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.

**TABLE 1—RECOMMENDED TERMINAL VOLTAGE CURVES
FOR STARTING MOTOR TESTS**

Curve Name	Curve Data ⁽¹⁾	
	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

1. The terminal voltage curve is a straight line defined by the data points

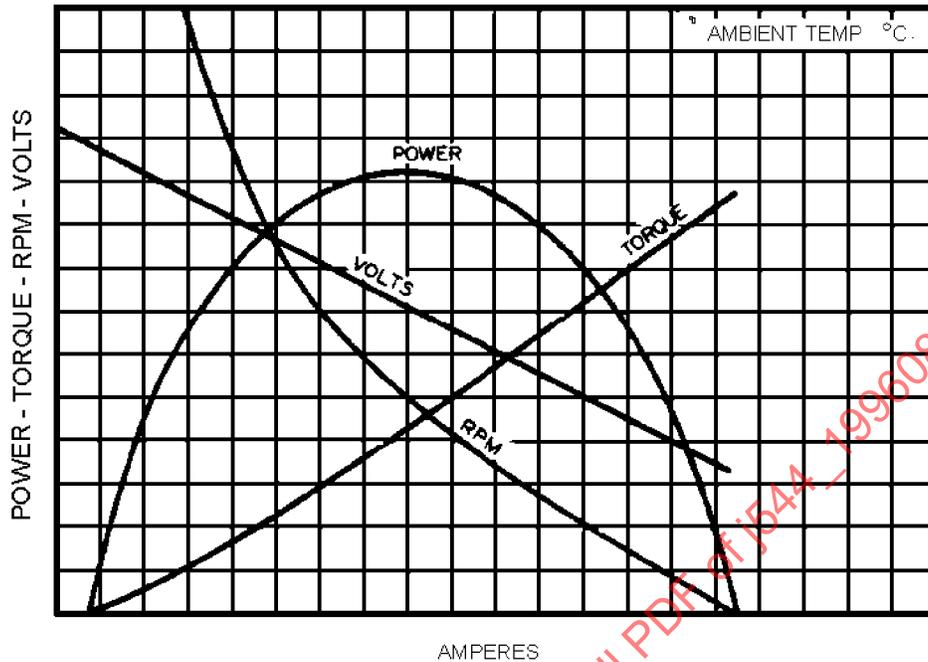


FIGURE 2—STANDARD FORM FOR STARTING MOTOR CHARACTERISTIC CURVES

- 3.2 Test Method B**—Operate the starting motor continuously, increasing torque load from no load to stall. The terminal voltage is preferably maintained to a voltage curve selected from Table 1. 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 Figure 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.
- 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 previous procedure and a cranking demand curve developed for a particular engine (Reference: SAE J1253) the cranking speed can be determined by using the graphical method shown in Figure 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.

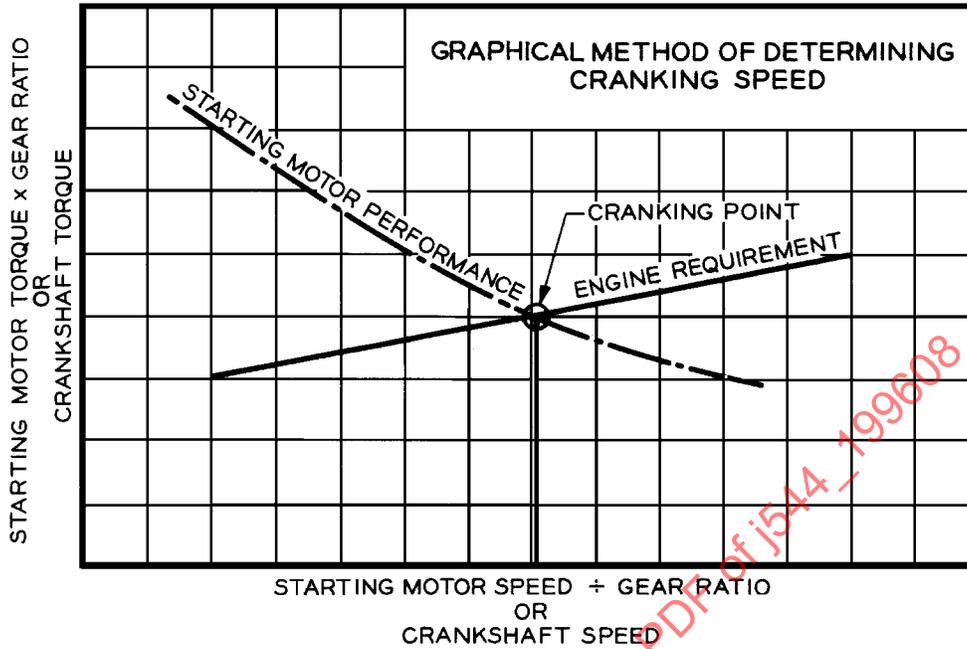


FIGURE 3—METHOD OF DETERMINING CRANKING SPEEDS

6. **Notes**

- 6.1 **Marginal Indicia**—The change bar (I) 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.

PREPARED BY THE SAE CRANKING MOTOR STANDARDS COMMITTEE