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INTERNATIONAL
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SURFACE VEHICLE RECOMMENDED PRACTICE

An American National Standard

SAE J1253

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LOW-TEMPERATURE CRANKING LOAD REQUIREMENTS OF AN ENGINE

1. ***Scope—***The electrical cranking system components, which include the battery, cables, and cranking motor, must be carefully selected to provide the necessary speed to start an engine under the most severe climatic conditions for which the system is intended. Engine cranking loads increase with cold temperatures, therefore, the initial selection of these components needs to consider low-temperature engine torque requirements. To insure an adequate electrical cranking system is obtained, it is important that proper test procedures are used for obtaining the cranking load requirements of the engine.

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 J300—Engine Oil Viscosity Classification
SAE J544—Electric Starting Motor Test Procedure

3. ***Procedure—***The following test procedure is recommended for obtaining low-temperature cranking torque requirements:

3.1 Engine Preparation

3.1.1 The engine to be tested should be equipped with all accessories that provide parasitic loads, such as power steering pump, automatic transmission, etc.

3.1.2 The engine, if new, should be run in to stabilize friction loads—equivalent to 1500 miles (2400 kilometers) or 18 h at 2400 engine rpm.

3.1.3 The engine is winterized with anti-freeze solution for the temperature at which the test will be run.

3.1.4 The engine oil selected for the low temperature test should be representative of the high limit viscosity for the SAE grade recommended by the engine manufacturer for the operating temperature range (refer to SAE J300). Sufficient oil of the same viscosity should be obtained for the complete test program so variations in test results can be minimized.

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3.1.5 Fuel dilution of the engine oil will reduce its viscosity, therefore, to avoid this possibility, the cranking test is run without fuel in the carburetor, or with fuel system cut off.

3.1.6 To prepare the engine for test, the engine is warmed up and oil drained hot. This procedure should be repeated two times to assure complete change of oil when oil grade change is made. The oil filter is changed for the final fill. When the same grade of oil is used for other test temperatures and/or additional test days, the engine warm up procedure is repeated and only one drain is required.

3.1.7 Install a thermocouple in the center of the greatest mass of oil so soak temperatures can be monitored.

3.1.8 Equip engine with necessary instrumentation to provide cranking speed, battery voltage, cranking motor voltage, and current data. (The cranking speed can be determined from oscillographic current or voltage traces by calculation of the time span between the current or voltage peaks caused by the cylinder compression loads. The mean cranking speed is obtained over two consecutive revolutions. The mean torque is obtained by measuring the mean cranking current over the same period and calculated as described in 3.2.)

3.1.9 Prior to starting the cold soak period, warm up the engine for approximately 5 to 10 min to circulate oil, run carburetor bowl dry and disable ignition or cut off fuel system, and adjust throttle plate to the idle position.

3.1.10 The engine with the calibrated motor is soaked at the test temperature for a period of 16 to 24 h, which can be monitored by the oil thermocouple.

3.2 Cranking Motor Preparation—The cranking motor is used to measure the engine cranking torque. To minimize performance variances, a new cranking motor should be "run in" until the motor performance becomes stabilized prior to calibration which is determining the speed, torque, and current under load using a standard SAE terminal voltage curve (Reference Table 1 of SAE J544) unless otherwise specified.

After completion of the cranking load tests, a recalibration curve should be run to verify initial performance.

NOTE—Since torque is proportional to cranking motor current, determination of engine torque can be calculated by obtaining the cranking motor running torque corresponding to the cranking motor current measured at the test temperature from the performance characteristics of the calibrated cranking motor and multiplying this value by the proper flywheel ring gear to cranking motor pinion gear ratio.

3.3 Cranking Load Tests

3.3.1 A sufficient number of cranking tests should be run to obtain a curve of average torque versus average engine speed over an approximate range of 30 to 120 engine rpm for gasoline engines, 50 to 150 rpm for direct injection diesel engines, and 120 to 220 rpm for small indirect injection diesel engines.

3.3.2 To obtain the range of speeds required to plot the torque curve, various battery capacities or a regulated DC power supply that can simulate desired battery conditions are used to supply the appropriate cranking motor terminal voltages. The batteries are not required to be cold soaked but should be maintained at full charge.

3.3.3 The cranking time for each test should be approximately 10 s with readings between 5 to 10 s used as the plotting points. Allow a minimum of 30 min additional soak time before performing the next cranking test.

3.3.4 Using the test data, calibrated cranking motor performance characteristics and engine ring gear to cranking motor pinion gear ratio, calculate the engine torque requirements for each test speed and plot an engine torque requirement curve as shown in Figure 3 of SAE J544.

3.3.5 It should be noted that since gear efficiencies have been neglected, the torque measured is not true engine torque but that as seen by the cranking motor. However, it provides suitable design and application data for determining cranking motor requirements.

3.3.6 Once the engine torque requirement curve has been determined and the speed required to start the engine is known, cranking motor performance requirements for the engine application can be determined.

4. Notes

4.1 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.

PREPARED BY THE SAE CRANKING MOTOR STANDARDS COMMITTEE