SAE International™ SURFACE VEHICLE STANDARD

SAE J819

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Superseded by J1393

Engine Cooling System Field Test (Air-to-Boil)

1. ***Scope***—This SAE Standard applies to all self-propelled construction and industrial machines using liquid-cooled internal combustion engines.

1.1 **Purpose**—The purpose of this code is to provide a procedure to determine the cooling system reserve capacity under the conditions existing when tested.

1.2 **Rationale**—Technical content of SAE J819 is now included in SAE J1393.

2. ***References***

2.1 **Applicable Publication**—The following publication forms a part of this specification to the extent specified herein. Unless otherwise indicated the latest version of SAE publications shall apply.

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

SAE J814—Engine Coolants

3. ***Definitions***

3.1 **Air-to-Boil (ATB) Temperature**—is the ambient air temperature that will cause the cooling system to boil when the machine is operated under specified conditions and modes of operation, usually at maximum productivity.

3.2 **Theoretical Coolant Boiling Temperature**—is the temperature at which the coolant will boil at sea level, including any system pressurization allowed by the radiator cap. (For further information, see SAE J814.)

3.3 **ΔT**—is the temperature differential between radiator top tank and ambient air.

3.4 **Coolant**—Water.

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4. Facilities and Apparatus

4.1 **Facilities—**The test course shall be level within 2% grade where data is recorded. The remainder of the course to be such as to cause minimum deviation of engine load.

4.2 **Apparatus**

4.2.1 Means for measuring temperature, accuracy ±1 °C (2 °F).

4.2.2 Means to measure engine speed, accuracy ±2%.

4.2.3 Means to establish output shaft speed, accuracy ±2%, if data is to be recorded.

4.2.4 Means to measure machine speed, accuracy ±2%, if data is to be recorded.

4.2.5 Means to measure time, accuracy ±1 s.

4.2.6 Means to provide a controllable holdback (towed load) for drawbar type tests.

4.2.7 Means to measure average fuel consumption within 1% total fuel consumed during test period, if data is to be recorded.

5. Procedure

5.1 If the machine has not recently been used, it should be limbered up in a manner recommended by the manufacturer. Any malfunction or maladjustment noted during this limbering-up period must be corrected.

5.2 Do not run a cooling test if the ambient temperature is below 24 °C (75 °F) because the large changes in air density and radiation from noncooling system parts give false results.

5.3 Do not test if wind velocity exceeds 10 km/h (6 mph) unless wind is at 90 degrees to the test course.

5.4 Prior to start of the test, the machine shall be inspected to assure that:

5.4.1 It is serviced as specified.

5.4.2 It delivers specified power. This may be checked by application of the Drawbar Test Procedure for Construction, Forestry, and Industrial Machines, or other suitable means.

5.4.3 All items directly related to the cooling system, such as: Fan speed, fan belt adjustment, fan to core spacing, baffling, coolant and other fluid levels, radiator pressure cap ratings, etc., are properly adjusted and the core is clean inside and out, and the fins are straight and in good condition.

5.4.4 Test apparatus is installed and checked for proper function.

5.5 Block the thermostat(s) open to assure full water flow throughout the test.

5.6 Install temperature measuring equipment in radiator top tank or engine coolant out line.

5.7 Shade thermometers and thermocouples from sun or other sources of nonpertinent radiated heat.

5.8 Operate machine under steady load and speed conditions, which must be proper for any converter in the driveline. Record data in two opposing directions of the course with readings at the same point on the test sections being taken at intervals of at least 15 min. Continue operating and recording data until stabilization of the cooling system is achieved. Stabilization shall be considered achieved when the variation in ΔT between two consecutive laps is within 1 °C (2 °F), or as specified in any one direction of travel and within 2 °C (4 °F), or as specified for opposing directions.

5.9 The coolant must not boil during the test.

5.10 The interpolation of system performance at different ambients may be made on the basis a degree change in ambient will cause a degree change in coolant temperature, under conditions of 5.2 and 5.3.

5.10.1 (OPTIONAL)—Additional test information for the analysis of the cooling system may be obtained by measuring the following:

5.10.2 Radiator bottom tank temperature.

5.10.3 Average temperature of air entering the radiator.

5.10.4 Average temperature of air leaving the radiator.

5.10.5 Engine air intake temperature.

5.10.6 Air flow rate through radiator.

5.10.7 Coolant flow rate.

5.10.8 De-aeration ability of the cooling system.

5.10.9 Top tank pressure.

5.10.10 Engine oil temperature.

5.10.11 Engine compartment temperature.

6. Reporting of Results

6.1 **Air-to-Boil Temperature**—Subtract top tank or engine coolant out line temperature from theoretical coolant boiling temperature (corrected for any pressurization) and then add the result to actual ambient temperature recorded during test.

Example ATB = (100 – 80) + 30 = 50 where 100 is theoretical coolant boiling temperature, 80 is top tank temperature, and 30 is ambient temperature. All temperatures are degrees Centigrade.

6.2 **(Optional) Percent Engine Power Utilization—**Rate of fuel used during test divided by rate of fuel consumed if engine were operated at maximum rated power