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SURFACE VEHICLE STANDARD

SAE J1495 | REV. MAR92

Issued 1986-05
Revised 1992-03-20

Submitted for recognition as an American National Standard

Superseding J1495 MAY86

(R) TEST PROCEDURE FOR BATTERY FLAME RETARDANT VENTING SYSTEMS

1. ***Scope***—This SAE Standard details procedures for testing lead-acid SLI (starting, lighting, and ignition), Heavy-Duty, EV (electric vehicle) and RV (recreational vehicle) batteries to determine the effectiveness of the battery venting system to retard the propagation of an externally ignited flame of battery gas into the interior of the battery where an explosive mixture is usually present.

   NOTE—At this time 1992, there is no known comparable ISO Standard.

2. ***References***—There are no referenced publications specified herein.

3. ***Safety Precautions and Procedures***

   WARNING—Testing of a battery venting system can result in an explosion. Extreme caution must be exercised to avoid personal injury. Absolutely no testing should be permitted where the prescribed safety precautions and procedures are not followed or exceeded.

3.1 All test apparatus, except the charging source, must be fully contained in an externally vented explosion test chamber, for example, Figure 1.

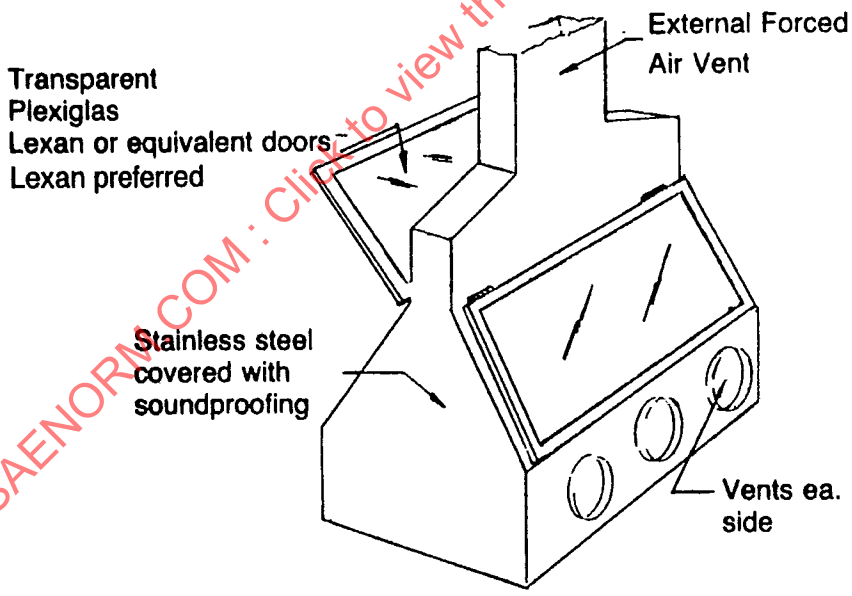

FIGURE 1—TEST CHAMBER

3.2 The battery charging source must be located outside the explosion test chamber convenient to the control of the testing personnel. The charging circuit must have two emergency disconnect switches located (1) readily accessible to the testing personnel and (2) at a remote position at least 3 m (10 ft) from the explosion test chamber. These disconnect switches are intended for emergency use only, since their use may damage some types of chargers.

3.3 A suitable test area should be designated, for example, 3 m^2 (32 ft^2) or more. Signs restricting unauthorized persons from this area should be posted and observed while any electrical circuit in the explosion test chamber is or could be energized.

3.4 During testing, entry to the area in which the explosion test chamber is located should be clearly marked to restrict all persons not fully familiar with all safety requirements and not wearing full protection from the hazard to be encountered.

3.5 Smoking, open flames, unprotected lights, or other spark sources must not be permitted in the area during testing.

3.6 Full face protection devices must be worn by all persons within the restricted area.

3.7 The battery spark source circuit must have an emergency disconnect switch to the testing personnel.

3.8 The exhaust fan of the explosion test chamber should be operated during the entire spark test procedure. On completion of any test sequence, charging and sparking circuits into the explosion test chamber must have been interrupted for at least 5 min with the exhaust fan operating before anyone is permitted access to the chamber. This time interval allows any hydrogen to be purged from the chamber and to preclude the possibility of a delayed explosion occurring due to a sustained "hidden" flame.

WARNING—HYDROGEN GAS CAN BURN WITHOUT VISIBLE FLAME.

4. Equipment Required for Spark Test

4.1 Where the spark test is to be conducted on a battery

4.1.1 An explosion chamber, for example, Figure 1, with an explosion-proof fan of adequate size to produce approximately one chamber volume change per minute, vented directly to the exterior of the building.

4.1.2 A battery charging source capable of constant voltage or current control, with at least 40 A output at 17.5 V.

4.1.3 A fully-charged 12-V battery to serve as an ignition source. This battery should be equipped with a functional flame retardant venting system.

4.1.4 Battery on which the test is to be performed.

4.1.5 Wiring and fixture equivalent to those shown in Figures 2A or 2B.

4.2 Where the spark test is to be conducted on a test fixture

4.2.1 An explosion chamber, for example, Figure 1, with an explosion-proof exhaust fan of adequate size to produce approximately one chamber volume change per minute, vented directly to the exterior of the building.

4.2.2 A charging source capable of constant voltage or current control, to be at least a 40 A output at 17.5 V.

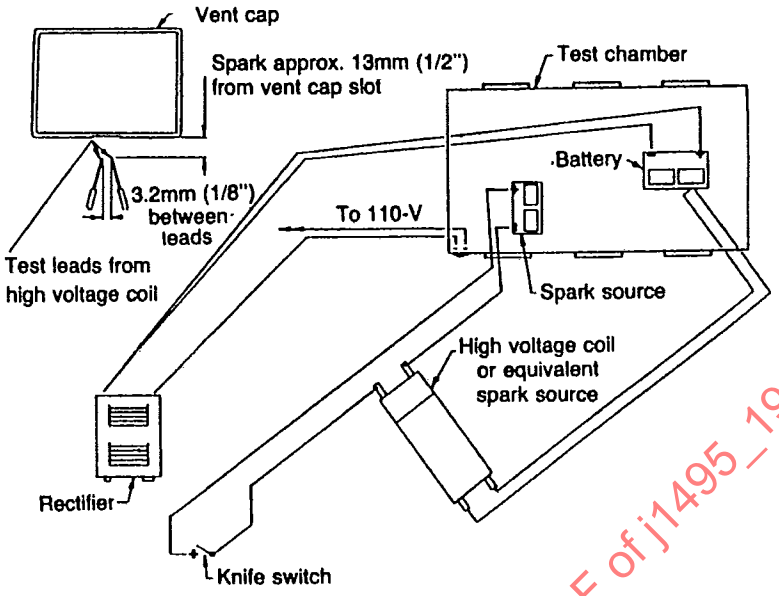

FIGURE 2A—SCHEMATIC FOR TEST ON BATTERY

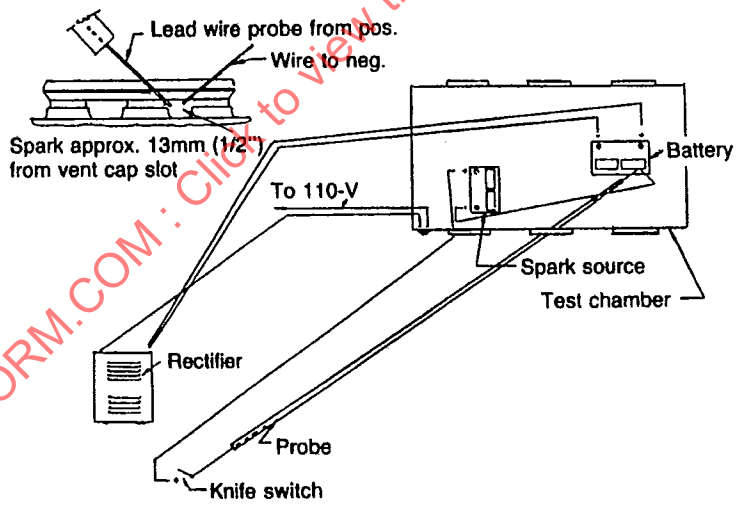

FIGURE 2B—SCHEMATIC FOR TEST ON BATTERY

4.2.3 A fully charged 12-V battery to serve as an ignition source. This battery should be equipped with a functional flame retardant venting system.

4.2.4 A second fully charged battery to serve as a gas mixture source. This battery must be vented only through the test fixture or functional flame retardant venting system.

4.2.5 A test fixture, for example, Figure 3.

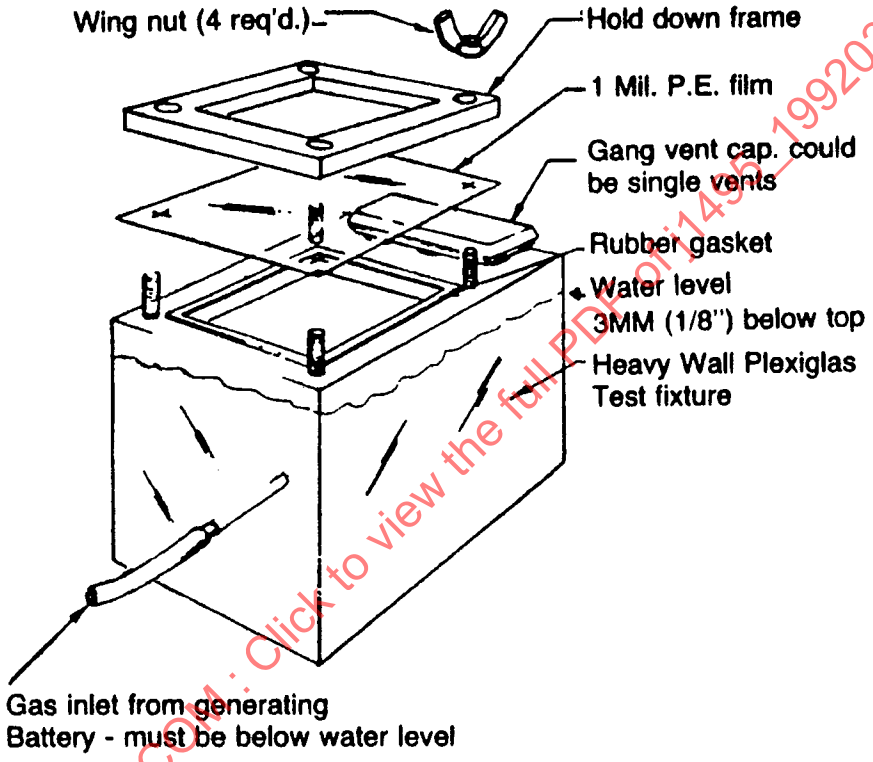

FIGURE 3—TEST FIXTURE

4.2.6 Tubing and fittings equivalent to those shown in Figure 4.

5. Equipment Arrangement and Spark Test Preparation

5.1 Where the spark test is to be conducted on a battery

5.1.1 Arrange test apparatus as shown in Figure 2A or alternate Figure 2B.

5.1.2 Before spark testing, the test battery system should be checked for gas leakage at any place other than the vent opening, for example, with a soap solution.

5.1.3 Prior to the start of the test, the spark source battery must be fully charged.

5.1.4 Prior to the start of the test, the battery to which the test vent is affixed must be fully charged and gassing vigorously.

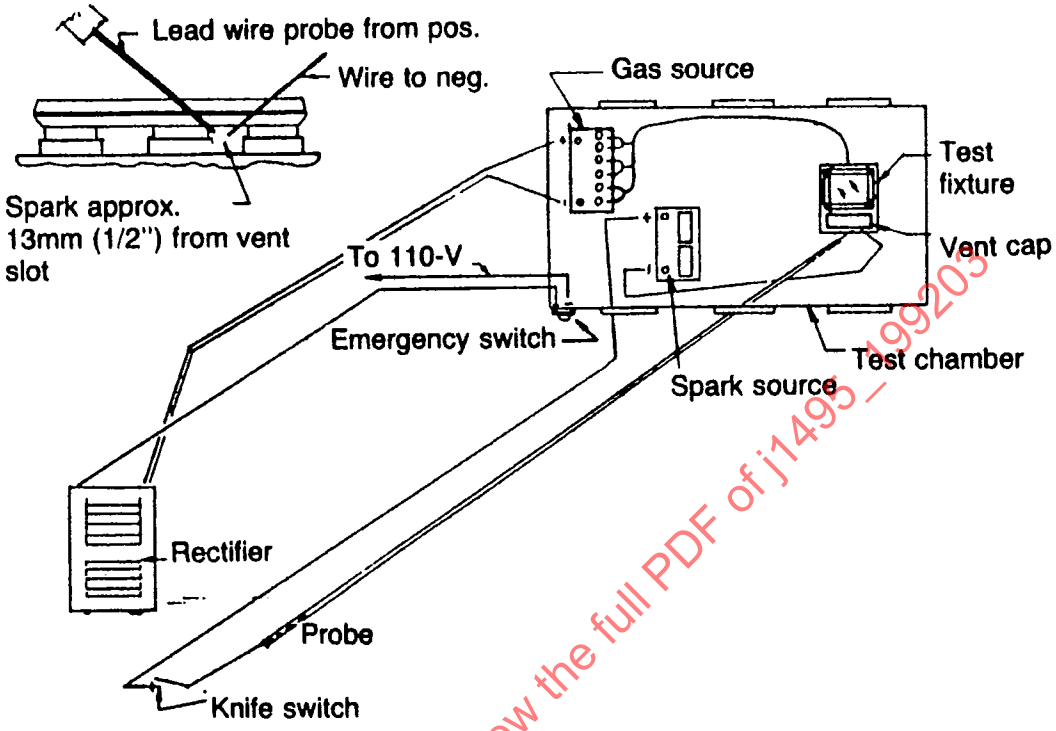

FIGURE 4—SCHEMATIC FOR TEXT FIXTURE

5.1.5 Prior to the start of the test, the test vent must be preconditioned as in 6.1.

5.2 Where the spark test is to be conducted on the test fixture

5.2.1 Arrange the test apparatus as shown in Figure 4. Note that the gas inlet to the test fixture must be well below the water level as shown in Figure 3 to prevent ignited gases from entering the gas generating battery.

5.2.2 Fill the test fixture with water to a level 3 mm (1/8 in) below the underside of the top. Place the hold-down frame over a 1 mil thickness of polyethylene film cut as shown in Figure 3. Place the frame, with film in place, over the four studs so that the film covers the open area between the fixture and the frame. Tighten the frame down finger tight with wing nuts to insure a gas-tight seal around the gasket. Fit the vent system to be tested into the fixture.

5.2.3 Before spark testing, the whole system should be checked for gas leakage at any place other than the vent opening, for example, with a soap solution.

5.2.4 Prior to the start of the test, the spark source battery must be fully charged.

5.2.5 Prior to the start of the test, the gas generating battery must be fully charged and gassing vigorously.

5.2.6 Prior to the start of the test, the test vent must be preconditioned as in 6.1.

6. Preconditioning the Vent System

6.1 Standard Preconditioning—Preconditioning shall consist of subjecting the battery to which the venting system is attached to an overcharge of 2 to 4 A for a period of 16 to 24 h. This will put the vent system in an acid moistened state as is typical of its in-service condition. The spark test shall be conducted within 1 h of completion of the preconditioning charge.

6.2 Hot and Cold Cycle Preconditioning (Optional)

6.2.1 Place the vent system in a cold box at -29 °C (-20 °F) for 16 h.

6.2.2 Remove from cold box and place it in an oven at 71 °C (160 °F) for 8 h.

6.2.3 Repeat this sequence for a total of 3 full cycles.

6.2.4 At the completion of the third full cycle, condition the vent system as in 6.1.

7. Spark Test Procedure

7.1 When the spark test is to be conducted on a battery

7.1.1 Spark testing is to be conducted at 25 °C ± 5 °C (77 °F ± 9 °F).

7.1.2 Battery temperature should be 27 °C (80 °F).

7.1.3 If the battery temperature is above 27 °C (80 °F), a voltage correction of -0.038 V/°C (-0.021 V/°F) for every degree above 27 °C (80 °F) must be used to guarantee an equivalent amount of gas generation.

7.1.4 When the test battery is gassing vigorously, charge the battery at a potential of 2.92 V/cell. (Charging current shall not exceed 40 A.)

7.1.5 Allow the gas flow rate to stabilize. (Gas flow should stabilize in 1 to 5 min.)

7.1.6 Create a spark of not less that 0.02 mJ of energy 1.3 cm (0.5 in) from the test vent opening in the path of the gas flow.

7.1.7 Repeat the spark at 10 s intervals for a minimum of 6 sparks per vent insuring that evolved gases are ignited. (If the ignited evolved gases ignite the battery, time must be allowed for the battery to self-extinguish or ignite the gas within the battery.)

7.1.8 If the vent system is functioning properly, no gas ignition will occur within the test battery.

7.2 Where the spark test is to be conducted on the test fixture

7.2.1 Spark testing is to be conducted at 25 °C ± 5 °C (77 °F ± 9 °F).

7.2.2 Battery temperature is above 27 °C (80 °F).

7.2.3 If the battery temperature is above 27 °C (80 °F), a voltage correction of -0.038 V/°C (-0.021 V/°F) for every degree above 27 °C (80 °F) must be used to generate an equivalent amount of gas generation.

7.2.4 When the gas generation battery is gassing vigorously, charge the battery at a potential of 2.92 V/cell. (Charging current shall not exceed 40 A.)

7.2.5 Allow the gas flow rate to stabilize. (Gas flow should stabilize in 1 to 5 min.)

7.2.6 Create a spark of not less that 0.02 mJ of energy 1.3 cm (0.5 in) from the test vent opening in the path of the gas flow.

7.2.7 Repeat the spark at 10 s intervals for a minimum of 6 sparks per vent insuring that evolved gases are ignited. (If the ignited evolved gases ignite the vent system, time must be allowed for the vent system to self-extinguish or ignite the gas within the test fixture.)