SAE International™

SURFACE VEHICLE RECOMMENDED PRACTICE

SAE J1718

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Measurement of Hydrogen Gas Emission from Battery-Powered Passenger Cars and Light Trucks During Battery Charging

1. ***Scope***—This SAE Recommended Practice describes a procedure for measuring gaseous hydrogen emissions from the aqueous battery system of a battery-powered passenger car or light truck. The purpose of this procedure is to determine what concentrations of hydrogen gas an electric vehicle together with its charger will generate while being charged in a residential garage. Gaseous emissions are measured during a sequence of vehicle tests and laboratory tests that simulate normal and abnormal conditions during operational use. The results of this test may be used to determine whether or not forced air ventilation is required when a particular electric vehicle and its associated battery and charging system are used in a residential garage.

a. Gaseous emissions are measured in an enclosure during charging cycles at temperature extremes simulating garage charging at the manufacturer's recommended upper and lower operating limits of the battery under test.
b. To prevent damage of the battery under normal operating conditions due to ignition of gases within the battery by an external spark or flame, battery systems that are vented shall be equipped with a suitable flame arresting system. A flame arrestor may be provided either for each individual cell or at the outlet of a battery venting system.
c. Because certain failures in the charging system could cause gassing to be many times the normal rate, the measurement of hydrogen during the test should include appropriate abnormal conditions such as single point failures in the charging control subsystem.

These are tests of the charging system which may involve components both on and off the vehicle. It is also expected that there will be a wide variety of designs to accomplish battery charging. It is therefore required that great care be exercised in the detailed execution of these tests so that their intent is preserved.

The Scope of this document is intended to cover all battery conditions which may maximize gassing. However, it does not include the testing of batteries at their end of life. It is generally accepted that aged batteries will emit more gas while charging and the achievement of the aged condition by accelerated means would be difficult to control and the test results would not be reproducible.

1.1 **Rationale**—This Recommended Practice defines a procedure for measuring gaseous hydrogen emissions from the aqueous battery system of a battery-powered passenger car or light truck. The purpose of this procedure is to determine what concentrations of hydrogen gas an electric vehicle together with its charger will generate while being charged in a residential garage. Hydrogen is generated from aqueous batteries during charge. Today's use of aqueous batteries is limited to Neighborhood Electric Vehicles or special military vehicles.

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SAE J1718 is not relevant to the new fleet of general purpose electric or hybrid electric vehicles that are being developed with advanced battery technology, which are sealed battery systems with a different chemistry that does not produce hydrogen on charge. Aqueous batteries don't have sufficiently high energy density or specific energy to be competitive with today's advanced battery technologies that will be used in the new vehicles under development. Furthermore, procedures that address hydrogen safety in fuel cell vehicles are addressed elsewhere.

2. References

2.1 Applicable Documents—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 J1634—Electric Vehicle Energy Consumption and Range Test Procedure
SAE J1715—Electric Vehicle Terminology

2.1.2 NFPA PUBLICATION—Available from National Fire Protection Association, Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 30—Flammable and Combustible Liquids Code

2.1.3 UL PUBLICATION—Available from Underwriters Laboratories, 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 1989—Standard for Standby Batteries

*3. Definitions—*The following definitions apply to the terms used:

3.1 Flame Arrestors—Devices located at the outlet(s) of a battery venting system designed to prevent damage of the battery system from an external spark or flame that could ignite gases within the battery system under normal operating conditions. A Flame Arrestor must prevent propagation of an external flame into the battery system when tested in accordance with the Flame Arrestor Vent Cap Tests described in UL 1989 or comparable procedures. It is accepted that flame arrestors may also be incorporated within a battery system to prevent internal propagation of explosions. However, their testing lies outside the scope of this procedure.

3.2 Adequate Ventilation—As defined in NFPA 30, ventilation is considered adequate if it is sufficient to prevent accumulation of vapor-air mixtures in concentrations over one-fourth of the lower flammable limit (LFL).

4. Power Control and Charger

4.1 The vehicle and off-board equipment involved in charge control are to be either supplied by the manufacturer or the equipment must be as specified by the vehicle manufacturer.

5. Test Facilities and Equipment

5.1 Provisions must be made for controlling the environment of the vehicle, cooling the vehicle, and charging and discharging the battery system. All temperatures have tolerances of ±5 °C unless otherwise stated.

5.2 Environment—Appropriate controls must be provided to maintain ambient test temperatures at 43 °C (110 °F) and –18 °C (0 °F).

5.3 Energy Dissipation—A means of dissipating the energy from the battery system must be provided. This could take various forms such as a chassis dynamometer or electrical load.

5.4 Vehicle Powertrain Cooling—A fan of adequate capacity may be needed to maintain vehicle powertrain cooling if the vehicle is running on the chassis dynamometer.

5.5 Battery Operating Temperatures—Batteries are intended to be tested at the extremes of their recommended operating temperatures. It may be necessary to provide a means of achieving the maximum and minimum battery operating temperatures specified by the manufacturer, such as soaking, discharging, or heating or cooling elements as agreed to by the manufacturer.

5.6 DC Current, Voltage, and Temperature Measurement—Instrumentation to measure DC current, voltage, and temperature of the battery system must be provided. If it is not available on board the vehicle, it must be provided externally. The required degree of accuracy shall be as specified in SAE J1634.

5.7 Test Enclosure—An enclosure with internal dimensions of 3 x 6 x 2.6 m (10 x 20 x 8.5 ft) high will accommodate vehicles with up to 3300 mm (130 in) wheelbase, and has been found convenient for testing most U.S. passenger cars. The foregoing dimensions may be adjusted to accommodate different size vehicles without significantly affecting the test results. The enclosure door must allow entry of the maximum size vehicle. Door sealing may be accomplished by a resilient gasket, an inflatable seal, or a pressure sealing zipper if a flexible door is used.

Care must be taken to limit the permeation of hydrogen (see Appendix A for leak check). Permeable materials may be covered with polyvinyl fluoride sheet of approximately 0.15 mm (0.006 in) thickness. One wall, door, or ceiling should be of flexible material such as 0.15 mm (0.006 in) polyvinyl fluoride sheet to provide a safety "blow-out" panel, and to allow for minor temperature changes of the contained gas without excessive "breathing."

A mixing blower is needed for Appendix A tests but is optional for Section 8 tests.

5.8 Gas Monitoring Equipment—The enclosure must be equipped with a combustible gas monitoring system capable of measuring hydrogen concentrations reliably in the range of 400 to 40 000 ppm.

5.9 The following calibration gases are required:

a. Industrial-grade hydrogen gas
b. 2.00% hydrogen by volume in air (nominal)

The sample should be withdrawn from the enclosure through a tube of 6.4 mm (1/4 in) ID, terminating 50.8 to 305 mm (2 to 12 in) inside the wall and located on the geometric center of the wall opposite the door or on one of the sides or below the center of the ceiling. The tubing connecting this tube to the analyzer should be of 6.4 mm (1/4 in) OD stainless steel or similar inert material and should be as short as possible.

5.10 Purge Blower—A blower of adequate capacity is required for purging the enclosure between tests.

5.11 Temperature Measuring Device—Two temperature measuring devices for monitoring the enclosure temperature should be installed 76 cm (30 in) above the floor and 10 cm (4 in) in from either side, both midway along the length of the enclosure.

6. Test Overview—The test method provides for sealing the vehicle in an enclosure during the test. Hydrogen emissions are determined from the changes in the hydrogen concentrations in the enclosure. The complete enclosure measurement system should be checked initially and periodically for calibration, hydrogen retention (leakage), and self emission. Appendix A gives details.