SURFACE VEHICLE RECOMMENDED PRACTICE

J1798™/1 MAY2026

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Superseding J1798/1 AUG2020

Recommended Practice for Performance Rating of
Lead Acid and Nickel Metal Hydride
Electric Vehicle Battery Modules

RATIONALE

With the changes in battery technology, the latest version of SAE J1798 divides along chemistry lines. The slash /1 document (SAE J1798/1) only covers lead acid and nickel metal hydride chemistries. This document supersedes SAE J1798, which has been stabilized.

SAE J1798/1 has been reaffirmed to comply with the SAE Five-Year Review policy.

A reaffirmed status is given to technical reports that have been reviewed by the technical committee and deemed to be current with no need for immediate revision. No changes have been made to this document as a result of this review.

FOREWORD

With the rapid development and deployment of electric vehicles, it is important to develop performance standards and guidelines to ensure components utilized in the manufacturing of electric vehicles meet requirements needed for vehicle operation.

The mission of this document as an SAE Recommended Practice is to provide direction for standardization of methods and techniques to verify and determine performance characteristics of the standard electric vehicle battery lead acid and nickel metal hydride modules, as described in SAE J1797 or manufacturer's specifications. This document will provide industry the opportunity to establish and maintain performance standards to meet vehicle requirements. It is intended that the test procedures provide guidance for battery manufacturers' test facilities, and vehicle manufacturers to assess module performance with the same testing platform. This document is a menu for recommended tests that may be run as required for comparative measurements. It is understood that all module chemistries may not be used at the temperatures specified in any given procedure.

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1. SCOPE

This SAE Recommended Practice provides for common test and verification methods to determine lead acid and nickel metal hydride electric vehicle battery module performance. The document creates the necessary performance tests to determine (a) what the basic performance of EV battery modules is, and (b) if battery modules meet minimum performance specification established by vehicle manufacturers or other purchasers. Specific values for these minimum performance specifications are not a part of this document.

1.1 Field of Application

This document applies to electric vehicles (as defined in SAE J1715) that use only a battery as a source of energy for propulsion.

1.2 Product Classification

Electrochemical energy storage devices.

1.3 Form

An electric vehicle propulsion battery will consist of a battery configuration of several (typically 12 V) modules interconnected in one or more series strings. The lead acid and nickel metal hydride modules typically do not require individual cell monitoring or sophisticated electronic control for proper operation.

This document provides test methods to determine performance of such modules, including, but not limited to, modules built in accordance with SAE J1797. Use of this document is intended for independently packaged modules operating at ambient temperature. Testing of a fully configured propulsion battery system, or battery subsystems designed to operate at elevated temperatures, is expected to require additional testing methods beyond those included in this document.

2. REFERENCES

2.1 Applicable Documents

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 International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1715 Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) Terminology

SAE J1715/2 Battery Terminology

SAE J1797 Recommended Practice for Packaging of Electric Vehicle Battery Modules

SAE J2288 Life Cycle Testing of Electric Vehicle Battery Modules

2.1.2 Other Publications

United States Advanced Battery Consortium Electric Vehicle Battery Test Procedures Manual, Revision 2, Published January 1996.

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3. DEFINITIONS

3.1 C RATE (C)

C rate (C) is a value which expresses the rated current capacity of a cell or battery. A module discharging at the C rate will deliver its nominal rated capacity for 1 hour. Charging and discharging currents are generally expressed as multiples of C. The time to discharge a battery is inversely proportional to the discharge rate.

- nC is a charge or discharge rate which is n times the rated current capacity of the battery, where n is a number (fraction or multiple).
- C_n is the battery capacity in ampere-hours which corresponds to complete discharge of the battery in n hours (n is usually a subscript). Also written as the n-hour rate.

Examples of C rate:

$C_1/1$: The constant current required to discharge modules in 1 hour at 25 °C.
$C_2/2$: The constant current required to discharge modules in 2 hours at 25 °C.
$C_3/3$: The constant current required to discharge modules in 3 hours at 25 °C.

NOTE: If the rating is not supplied by the manufacturer, then the constant current rate may be calculated based on a fraction of the rated capacity. For example, if a module is rated at 100 A·h, then the $C_1/1$ discharge rate is 100 A, the $C_2/2$ is 50 A, and $C_3/3$ is 33 A. It is expected that using the method will result in discharge times less than 1 hour, 2 hours, and 3 hours for $C_1/1$, $C_2/2$, and $C_3/3$, respectively.

3.2 P RATE (P)

P rate (P) is a value which expresses the rated power capacity of a cell or battery. A module discharging at the P rate will deliver its nominal rated power for 1 hour. Discharging powers are generally expressed as multiples of P.

- P_n/n is the battery constant power rate at which a fully charged battery can be discharged to its nominal voltage in n hours (n is usually a subscript). Also written as the n-hour rate.

Examples of P rate:

$P_1/1$: The constant power required to discharge modules in 1 hour at 25 °C.
$P_2/2$: The constant power required to discharge modules in 2 hours at 25 °C.
$P_3/3$: The constant power required to discharge modules in 3 hours at 25 °C.

NOTE: If the rating is not supplied by the manufacturer, then the constant power rate may be calculated based on a fraction of the nominal voltage times the rated capacity (V_{nom} x A·h). For example, if a module is rated at 100 A·h and has a nominal voltage of 12 V, then the $P_1/1$ discharge power is 1200 W, the $P_2/2$ is 600 W, and $P_3/3$ is 400 W. It is expected that using the method will result in discharge times less than 1 hour, 2 hours, and 3 hours for $P_1/1$, $P_2/2$, and $P_3/3$, respectively.

4. BATTERY MODULE SELECTION

If battery modules are constructed to SAE J1797 or other requirements as defined by the vehicle manufacturer, they should first be determined to comply with the physical requirements of SAE J1797 or other vehicle specification, including dimensions, open circuit voltage, mass, and terminations. If the measured performance is to be used to establish or verify battery ratings, modules selected for testing should be representative of those to be manufactured and delivered to the market.

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5. TEST CONDITIONS

5.1 Test Samples

The number of test samples required to be subjected to each test condition for each test in this document will be determined by the vehicle manufacturer or other entity requesting tests. A single battery tested does not assure that any production quantity of modules will meet the tested values obtained. Reporting -1.28 standard deviation values from a statistical sample size of 23 modules will give assurance of 90% conformance, but it is not the intention to propose that any or all variations of the tests in this document be run on such a large sample size.

5.2 Test Temperature

Testing shall be performed at a controlled ambient temperature of 25 °C ± 2 °C tolerance unless otherwise specified within this document. Measured module temperatures shall fall within this range at the start of discharge except for tests specifically required to be performed at other temperatures. This may require cooling to be applied to reduce the time between the end of a charge or discharge and the beginning of the next charge or discharge. If required, cooling shall be applied using the manufacturer's recommended temperature control means, which shall specify the required coolant flow rates, heat transfer properties, etc. Designation of both the cooling method and soak time are to be reported as described in Appendix A. Actual test temperature, environmental, and ambient should be recorded as part of the test procedure.

5.3 Temperature Sensing Locations

A minimum of one ambient temperature measurement and one temperature measurement per module, insulated from ambient environment, is recommended. Different battery manufacturers may recommend specific locations for temperature sensing such as the center of the case side wall, one of the terminals, or the center of the end wall. As a default, use the center of the side wall. Placement in any of these locations should not affect the results as long as the device is not exposed to external conditions that may skew the readings. The terminal location on a module may require precautions to ensure there is no shock hazard. Designation of the temperature sensor location should be reported as described in Appendix A.

5.4 Data Recording

Data recording should include time, temperature, voltage, current, visual observations, and profiles of any data generated by vibration or shock. Data should include a record of any maintenance performed on module during test sequence.

5.5 Sampling Frequency

All parameters should be measured and stored at a sample rate adequate to ensure that all relevant changes in the parameters are recorded for later data analysis and shall be kept for record purposes. Additionally, for tests involving short-term transient conditions (e.g., peak power measurement) both the sampling frequency (typically once per second) and the time skew between corresponding current and voltage measurements (typically 0.1 second or less) are important during the critical test periods.

5.6 Measurement Accuracy

The equipment should be able to meet the requirements in Table 1:

Table 1 - Measurement accuracy

Parameter	Accuracy
Voltage	<1% of reading
Current	<1% of reading
Temperature	±1.0 °C

Additionally, the combination of accuracy and sampling rate should be adequate to assure that important derived parameters, including accumulated ampere-hours and kilowatt-hours, can be determined within ±3%.

NOTE: Voltage sensor leads should be located as close to the terminals as possible to avoid any ambiguous readings due to resistance, noise, or other sources for error.

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