



SURFACE VEHICLE RECOMMENDED PRACTICE	J2464™	AUG2021
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(R) Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing		

RATIONALE

Abuse testing is performed to characterize the response of a rechargeable energy storage system (RESS) to off-normal conditions or environments. The primary purpose of abuse testing is to gather response information to external/internal inputs that are designed to simulate actual use and abuse conditions. This response information is used to expose the hazards, if any, associated with a given RESS under a given set of use and abuse conditions and to help quantify the hazard mitigation efforts that should be taken for a particular RESS design.

Revisions are intended to update and improve the test description and methods.

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1. SCOPE

This SAE Recommended Practice is intended as a guide toward standard practice and is subject to change to keep pace with experience and technical advances. It describes a body of tests which may be used as needed for abuse testing of electric or hybrid electric vehicle rechargeable energy storage systems (RESS) to determine the response of such electrical energy storage and control systems to conditions or events which are beyond their normal operating range. This document does not establish pass/fail criteria. However, SAE J2929 does define pass/fail criteria for automotive RESS safety testing.

Abuse test procedures in this document are intended to cover a broad range of vehicle applications as well as a broad range of electrical energy storage devices, including individual RESS cells (batteries or capacitors), modules, and packs.

RESS includes any type of rechargeable electrical energy storage device, such as batteries and capacitors. This document does not apply to RESS that uses mechanical devices to store energy (e.g., electro-mechanical flywheels) or fuel cells.

1.1 Purpose

This document is designed to provide a common framework of tests to evaluate the response of various RESS technologies to abusive conditions. These tests are intended to characterize the RESS response to undesirable abusive conditions also termed “off-normal” conditions or environments that may arise as a result of operator negligence, vehicle accidents, device or system defects, poorly informed or trained users or mechanics, failure of specific RESS control and support hardware, or transportation/handling incidents or accidents.

Tests in this document represent conditions for which the RESS was not designed or intended for use, but can reasonably be expected to be encountered infrequently during field use.

These tests were derived from failure mode and effect analysis, user input, and historical abuse testing. The outcome of testing shall be documented for use by potential users of the tested RESS.

It is not the intent of this procedure to establish acceptance criteria since each application has its own unique safety requirements. Moreover, cell, module, and pack safety contribute to a safety approach that will employ active and passive protection devices such as thermal and electronic controls, state of health monitoring, automatic disconnects, as well as mechanical protection and ancillary support systems.

This document is not intended to certify the RESS for shipping.

Users of these technologies shall make their own determination as to what measures to take to ensure a sound application of said technology. The test data from SAE J2464 may be used as input to battery safety and hazards risk mitigation approach that has been developed (refer to “Analysis of Battery Safety and Hazards Risk Mitigation”).

SAE J2464 tests can be used to characterize the hazard level associated with an RESS without active protective devices. The hazard level response of the RESS without active protective devices to various abuse conditions can be used as basis for determination of safety mechanism and integrity level of safety functions required by functional safety. Higher safety integrity levels may require higher levels of redundancy or diagnostic coverage. Functional safety standards such as the relevant sections of ISO 26262 and IEC 61508 can provide guidance on determination of these hazards.

The scope of this document is to evaluate the response to abusive conditions at the cell, module and pack levels of RESS integration. While the abusive conditions developed in this test are intended to be representative of potential hazardous conditions in the vehicle environment, not all types of vehicle level hazards are within the scope of this document.

The tests described in this document should be supplemented with additional testing (performed at the test sponsor’s or manufacturer’s discretion) based on their need for data and their determination of the most susceptible condition of the technology. The primary purpose of the tests is to gather response information to external/internal inputs. Specific tests and/or measurements in this document may not be appropriate for some RESS technologies and designs if it can be demonstrated by the RESS users (or system integrators) that the test is not applicable or the results will be duplicated by other tests.

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 J1739	Potential Failure Mode and Effects Analysis (FMEA) Including Design FMEA, Supplemental FMEA-MSR, and Process FMEA
SAE J1950	Proving Ground Vehicle Corrosion Testing
SAE J2344	Guidelines for Electric Vehicle Safety
SAE J2929	Safety Standard for Electric and Hybrid Vehicle Propulsion Battery Systems Utilizing Lithium-Based Rechargeable Cells
SAE J2950	Recommended Practices for Shipping Transport and Handling of Automotive-Type Battery System - Lithium Ion

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 Electrochemical Society Publications

Available from the Electrochemical Society, 65 South Main Street, Building D, Pennington, NJ 08534-2839, Tel: 609-737-1902, <http://www.ecsdl.org/vsearch/servlet/VerityServlet?KEY=ECSTF8&ONLINE=YES>.

Ashtiani, C., "Analysis of Battery Safety and Hazards Risk Mitigation," ECS Transactions 11 (19), 1 (2008).

2.2.2 Sandia National Laboratories Publications

Available from <https://www.sandia.gov/news/publications/index.html>.

SAND99-0497	Electrochemical Storage System Abuse Test Procedure Manual
SAND2005-3123	FreedomCAR Electrical Energy Storage System Abuse Test Manual for Electric and Hybrid Electric Vehicle Applications
SAND2017-6925	Recommended Practices for Abuse Testing Rechargeable Energy Storage Systems (RESSs)

2.2.3 AIHA Publications

Available from American Industrial Hygiene Association, 2700 Prosperity Ave., Suite 250, Fairfax, VA 22031, Tel: 703-849-8888, www.aiha.org.

Refer to the following link for Emergency Response Planning Guidelines, Level 2 (ERPG-2) description: <https://response.restoration.noaa.gov/oil-and-chemical-spills/chemical-spills/resources/emergency-response-planning-guidelines-erpgs.html>.

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