



SURFACE VEHICLE RECOMMENDED PRACTICE

J1715™/2

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(R) Battery Terminology

RATIONALE

This SAE Recommended Practice is revised based on two factors. First, in accordance with SAE procedures, a determination was made that the document's content needed to be revised to reflect terms and definitions as they are being used currently. Second, since the original issuance of this document, recent battery technologies—such as lithium-ion—have been introduced in the transportation industry. Therefore, a need was identified for this document to include terms and definitions associated with these recent technologies. Revisions based on these two factors will provide readers of this document a source of updated and commonly used battery terms and definitions.

1. SCOPE

This document contains definitions currently used in the automotive industry as they relate to energy storage and batteries for starting, lighting, and ignition applications, as well as for hybrid electric vehicles (HEV) and electric vehicles (EVs). It is intended that this document be a resource for those writing other battery, HEV, and EV documents, specifications, standards, or recommended practices. The use of the term “battery” in this document can be assumed to be a rechargeable battery (secondary battery). The terminology may be applied to other industries if desired.

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.

AIR6897	Battery Management Systems for Rechargeable Lithium Batteries Used in Aerospace Applications
SAE J670	Vehicle Dynamics Terminology
SAE J1715	Hybrid Electric Vehicle (HEV) and Electric Vehicle (EV) Terminology
SAE J2012	Diagnostic Trouble Code Definitions
SAE J2403	Medium/Heavy-Duty E/E Systems Diagnosis Nomenclature

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For more information on this standard, visit
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2.1.2 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

ANSI/IEEE 100 Standard Dictionary of Electrical and Electronic Terms, latest revision

2.1.3 Japanese Electric Vehicle Society Publications

Available from Japanese Electric Vehicle Association, evinfo@gw.jeva.or.jp.

JEVS Z 805 Glossary of Terms Relating to Electric Vehicles

2.1.4 NIST Publications

Available from NIST, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070, Tel: 301-975-6478, www.nist.gov.

For definitions of SI units of measurement—mass, EMF, current, power, etc.

2.1.5 Sandia Publications

Available from Sandia National Laboratories, P.O. Box 5800, Albuquerque, NM 87185, www.sandia.gov.

SAND88-2852 UC-212 Glossary of Testing Terminology for Rechargeable Batteries

2.1.6 USABC Publications

Available from USCAR, 1000 Town Center Drive, Suite 300, Southfield, MI 48075, Tel: 248-223-9000, www.uscar.org.

USABC Test Procedures Manual

2.1.7 IEC Publications

Available from IEC Central Office, 3, rue de Varembe, P.O. Box 131, CH-1211 Geneva 20, Switzerland, Tel: +41 22 919 02 11, www.iec.ch.

IEC 60060-482:2004 International Electro Technical Vocabulary (IEV) - Part 482: Primary and Secondary Cells and Batteries

Electropedia: The World's Online Electrotechnical Vocabulary (<http://www.electropedia.org/>)

2.1.8 NHTSA Publications

Available from U.S. Department of Transportation 1200 New Jersey Avenue, SE, Washington, DC 20590, Tel: 850-368-4200 <https://www.nhtsa.gov/>.

DOT HS812 717 Safety Performance of Rechargeable Energy Storage Systems

2.1.9 GB Publications

Available from 106# Zhongmao Building, Sungang, Beizhan Rd., Luohu, Shenzhen, China, Tel +86-755-2583-1330 <https://www.gbstandards.org/>

GB/T 19596-2017 Terminology of Electric Vehicles

2.1.10 UNECE Publications

Available from www.unece.org.

Global Technical Regulation No. 20 Global Technical Regulation on the Electric Vehicle Safety (EVS)

3. ABBREVIATIONS/ACRONYMS

AC	Alternating current
AGM	Absorbed glass mat
BCU	Battery control unit
BMS	Battery management system
BOL	Beginning of life
C	Capacity
CCA	Cold cranking amps
CI	Constant current charge or discharge
CI/CV	A constant current charge followed by a constant-voltage charge
CV	Constant voltage charge
DCT	Dynamic capacity test
DoD	Depth of discharge
DST	Dynamic stress test
EOL	End of life
EV	Electric vehicle
HEV	Hybrid electric vehicle
HPPC	Hybrid pulse power characterization test
OCAC	Open circuit voltage after charge
OCAD	Open circuit voltage after discharge
OCV	Open circuit voltage
P/E	Power to energy ratio
RESS	Rechargeable energy storage system
RPT	Reference performance tests
RUL	Remaining useful life
SoC	State of charge
SoE	State of energy

SoF	State of function
SoH	State of health
SoP	State of power
SoS	State of safety
SoT	State of temperature
VRLA	Valve regulated lead acid

4. BATTERY TERMINOLOGY

4.1 Absorbed Glass Mat (AGM)

A separator used in valve regulated lead acid batteries which is made from matted glass fibers which allows the sulfuric acid electrolyte to be absorbed and held in the mat.

NOTE 1: Absorbed glass mat and absorbent glass mat are also used.

NOTE 2: An alternative generic term (AGM) used to define VRLA lead acid batteries.

4.2 Active Cell Balancing

A process used to equalize the voltages and state of charge among cells by redistributing charge among the cells as determined and controlled by a battery management system (BMS).

4.3 Active Material

The constituents of a cell that participate in electrochemical charge and/or discharge reactions.

NOTE: This does not include separators, current collectors, catalysts, or supports.

4.4 Active Protective Device

Components integral to the cell or battery that require external controls to take actions to mitigate abusive and/or out-of-range conditions as defined by the manufacturer.

4.5 A·h Throughput

A measure of total amount of ampere-hours (A·h) a battery has stored and delivered during its operation.

4.6 Alternating Current (AC) Recharge Energy

The AC energy measured from the power outlet required to return the energy storage system to full charge.

NOTE: This measurement must include energy needed to power charging equipment (e.g., electric vehicle supply equipment).

4.7 Anode

The negative battery electrode at which oxidation (a loss of electrons) takes place during discharge.

4.8 Aqueous Electrolyte Batteries

Batteries composed of cells that contain water-based electrolytes.

4.9 Auxiliary Battery

A battery which powers a vehicle's low voltage auxiliary system.

4.10 Available or Deliverable Capacity

The total capacity that can be withdrawn from a battery under specified operating conditions such as discharge rate, temperature, age, and stand time.

4.11 Average Power

Total energy withdrawn (or returned) from (or to) an electrochemical cell divided by the time of discharge (or charge).

4.12 Average Voltage

The ratio of the energy to capacity for a given discharge or charge.

NOTE: Also known as current weighted voltage.

4.13 Battery (RESS Battery)

A general term that inclusively refers to electrochemical cells, modules, packs, and energy storage systems.

NOTE: More specific terminology should be used to describe the level of functionality where appropriate.

4.14 Battery Auxiliaries

The components required to support the battery functionality such as a tray, cooling system, pumps, and/or control electronics.

4.15 Battery Base

A structure that supports or restrains a battery.

4.16 Battery Cell (RESS Cell)

See [4.97](#) (electrochemical cell).

4.17 Battery Control Unit (BCU)

Electronics that control, manage, monitor, or calculate the parameters related with battery states, and provide communications between the battery system and other vehicle control units.

NOTE: BCU is a subsystem of BMS.

4.18 Battery Crate

A container with frame walls for holding several cells or batteries.

NOTE: Typically it is used for shipping purposes.

4.19 Battery Durability

A measurement of being able to perform for a long period before certain degradation is reached.

EXAMPLE: Specifying a battery needs to perform for 10 years or last 100000 miles, or meet 1000 charge and discharge cycles.

4.20 Battery Electronics

See [4.17](#) (battery control unit).

4.21 Battery Energy

See [4.107](#) (energy output).

4.22 Battery Management System

An electronic system that monitors, manages, and may communicate information about performance, safety, and supervisory control of a battery through battery state estimations and/or fault detections and predictions.

4.23 Battery Module (RESS Module)

Multiple electrochemical cells connected in series or parallel.

NOTE: Battery modules may or may not include sensors such as voltage and temperature sensors, safety components, and a cooling structure so that each module can be controlled and managed independently.

4.24 Battery Pack (RESS Pack)

A battery assembly that consists of one or more modules.

NOTE: A pack may include sensors, interlocks, contactors, battery management controller, safety devices, thermal management, and structural components.

4.25 Battery State Estimator

Software or hardware to estimate battery state(s).

EXAMPLE: State of charge (SoC), state of energy (SoE), state of health (SoH), state of power (SoP), state of function (SoF), state of temperature (SoT), or state of safety (SoS).

4.26 Battery System

See [4.108](#) (energy storage system).

4.27 Battery System Components

Components contained within a hybrid electric vehicle or electric vehicle traction energy storage system.

NOTE: These include the modules, interconnects, venting systems, restraint devices, electronic controls, and the battery box or container that holds the individual electrochemical cells.

4.28 Battery System Density

Battery mass divided by its volume.

4.29 Battery System Mass Fraction

Battery weight divided by gross vehicle weight.

4.30 Battery Terminal

Mechanism to allow electrical connections of batteries to external electrical devices.

NOTE: The electrical devices can be cells, modules, packs, electrical circuits, and/or external applications.

4.31 Battery Terminal Cover (Protector)

A cover consisting of insulating material to protect battery terminals from making external electrical contact.

4.32 Battery Voltage

The voltage measured between the battery terminals.

4.33 Beginning of Life (BoL)

A point in time that represents when a battery is considered to be initially activated for use as determined by the manufacturer.

NOTE: This point in time may start at cell activation, or a pack after the end of line test, or when the battery is released to market.

4.34 Bipolar Battery

A battery which uses conductive plates that act as an anode for one cell and a cathode for the adjacent cell.

NOTE: The plate may be made of metal or a conductive polymer (which may be a carbon-filled composite).

4.35 Boost Charge

Accelerated charge applied at greater than normal values of electric currents or of voltages (for a particular design) during a short time interval.

4.36 Calendar Life

Calendar life refers to the total time elapsed from beginning of life to end of life of a battery.

4.37 Capacitor

An electrostatic device capable of accumulating and holding a charge of electrons that consists of two opposing electrodes separated by a dielectric material.

4.38 Capacity (C)

The total coulometric charge that can be withdrawn from a fully charged electrochemical cell under specified conditions.

4.39 Capacity Recovery

The ratio of battery capacity, measured after storage at a defined temperature for a defined time, to its initial capacity as defined by the manufacturer.

4.40 Capacity Turnover

The ratio of total cumulative discharge coulombs to the rated capacity of a battery after it has reached end of life (EoL) during cycling.

NOTE: Capacity turnover is a way to normalize and compare battery cycle life based on different depth of discharge (DoD).

4.41 Cathode

The positive battery electrode at which reduction (a gain of electrons) takes place during discharge.

4.42 Cell

A basic electrochemical functional unit that at minimum consists of a positive electrode, a negative electrode, and an electrolyte.

4.43 Cell Balancing

A process used to equalize the voltages and state of charge among the cells.

4.44 Cell Case

A physical enclosure that contains and seals the cell assembly.

4.45 Charge

Operation during which a secondary battery is supplied with electric energy from an external circuit which results in chemical changes within the battery and thus the storage of energy as chemical energy.

4.46 Charge Acceptance

Ability of a secondary battery to increase its state of charge under specified conditions.

4.47 Charge Cutoff (Cut-Off) Voltage

Specified voltage of a battery at which the battery charge is terminated.

4.48 Charge Current

Electric current delivered by a battery during its charge.

4.49 Charge Efficiency

See [4.73](#) (coulombic efficiency).

4.50 Charge Factor

Factor by which the electric charge on discharge has to be multiplied to determine the electric charge on charge required for the battery to recover its original state of charge.

NOTE: The charge factor is the reciprocal of the charge efficiency.

4.51 Charge Profile

Schedule used for charging a battery, usually defined by voltage, current, or power versus time.

4.52 Charge Rate

A charge current value that is calculated as the rated capacity divided by the corresponding charge time.

4.53 Charge Retention

Ability of a battery to retain capacity on open circuit under specified conditions.

4.54 Charge Segment

A subsection of a charge regime.

4.55 Charge Step

A change from one power level to another in a charge regime.

4.56 Charge Voltage

Voltage between the terminals of a battery when being charged.

4.57 Charge Voltage Limit

The maximum voltage permitted during operations under specified conditions.

4.58 CI

See [4.67](#) (constant current charge) or [4.68](#) (constant current discharge).

4.59 CI/CV

A constant current charge followed by a constant-voltage charge.

4.60 Clamp Voltage

Specified voltage of a battery at which battery charge and discharge voltage cannot be exceeded.

4.61 C_n

The capacity (C) obtained from a battery discharged at a constant current to an end-of-discharge condition (discharge cutoff voltage) in n hours at 25 °C.

NOTE: C_n is established once and is not adjusted through the battery's life.

4.62 C_n Hour Rate

The constant current rate at which a fully charged battery can be discharged to its discharge cut-off voltage in n hours at 25 °C. See [4.63](#) (C_n/n rate).

4.63 C_n/n Rate

The constant current rate at which a fully charged battery can be discharged to its discharge cut-off voltage in n hours at 25 °C. For example:

C₁/1: The constant current required to discharge modules in 1 hour at 25 °C.

C₂/2: The constant current required to discharge modules in 2 hours at 25 °C.

C₃/3: The constant current required to discharge modules in 3 hours at 25 °C.

NOTE 1: 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 C₁/1 discharge rate is 100 A, the C₂/2 is 50 A, and C₃/3 is 33 A. It is expected that using the method will results in discharge times less than 1 hour, 2 hours, and 3 hours for C₁/1, C₂/2, and C₃/3, respectively.

NOTE 2: C_n/n is also commonly written with or without subscript notation; e.g., C/n, C/2; C_n, C₂₀; C_n or C20.

4.64 Cold Cranking Amps (CCA)

A number of amps rating that allows comparison of the batteries' ability to deliver discharge power at -18 °C.

NOTE: SAE J537 and EN 50342-1:2015 standards have different definition of CCA test procedures.

