

# Acronyms and Glossary of Common Battery Terms

DECEMBER 2024



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## ACRONYMS/ABBREVIATIONS

### A

**AC** - alternating current

**AGM** – absorbent (or absorptive) glassmat

**Ah** – ampere hour

### B

**BMS** – battery management system

### C

**CCA** – cold cranking amps

**CI** – constant current

**CV** – constant voltage

### D

**DC** – direct current

**DOD** – depth of discharge

### E

**EOL** – end of life

**EV** – electric vehicle

### H

**HEV** – hybrid electric vehicle

### O

**OCV** – open circuit voltage

### P

**PHEV** – plug-in hybrid electric vehicle

### R

**RC** – reserve capacity

### S

**SOC** – state of charge

**SOH** – state of health

### V

**VRLA** – valve regulated lead-acid

## GLOSSARY

### A

**ACTIVE MATERIAL** — The porous structure of lead compounds that chemically produce and store energy within a lead-acid battery. The active material in the positive plates is lead dioxide and that in the negative is metallic sponge lead.

**AGM (Absorbent Glass Mat)** — A type of non-woven separator material comprised almost entirely of glass microfibers that absorb and retain the electrolyte leaving no free electrolyte in the cell to spill and allow for a recombination of charging gasses. VRLA batteries made with this material are often referred to as “AGM” batteries.

**ANODE** — The negative electrode. It is the part of a battery that oxidizes and sends electrons to the cathode (the positive electrode) on discharge.

**AMPERE (Amp, A)** — The unit of measure of the electron flow rate, or current, through a circuit.

**AMPERE-HOUR (Amp-Hr, Ah)** — A unit of measure for a battery’s electrical storage capacity obtained by multiplying the current in amperes by the time in hours of discharge. (Example: A battery that delivers 5 amperes for 20 hours delivers 5 amperes X 20 hours = 100 Amp-Hr of capacity.)

**AMPERE-HOUR THROUGHPUT** — The total sum of amp-hour capacity used during cycling over the life of the battery.

**AUXILIARY BATTERY** — A battery used to power low voltage auxiliary requirements of the vehicle or application.

### B

**BATTERY MANAGEMENT SYSTEM (BMS)** — An electronic sensing system containing a program that monitors battery condition, performance and health that can be used by the application to make system decisions.

**BIPOLAR BATTERY** — A battery which uses a conductive interface to directly connect an anode on one side and the cathode on the other side of an adjacent cell .

**BOOST CHARGE** — The process of ensuring that the cells and plates within a battery are charged sufficiently for the battery to perform its desired function. Boost charging is typically done for a short duration at a higher-than-normal charge current.

### C

**CAPACITY** — The total amount of electrochemical energy a battery can store and deliver to an external circuit. It is normally expressed in terms of Ah or runtime at a desired discharge rate. The nominal or nameplate capacity of a battery is specified as the number of Amp-Hrs or runtime that a conditioned battery should deliver at a specific discharge rate, temperature and cutoff voltage specified by the battery manufacturer. The capacity of a battery is affected by a number of factors such as: active material weight, density of the active material, adhesion of the active material to the grid, number, design and dimensions of plates, plate spacing, design of separators, specific gravity and quantity of available electrolyte, grid alloys, final limiting voltage, discharge rate, temperature, internal and external resistance, age, and life history of the battery. The actual capacity of a battery is not a constant value and is seen to decrease with increasing discharge rate and/or decreasing temperature in addition to age and usage.

**CATHODE** — A positive electrode made of a material that is electrochemically reduced and receives electrons from the anode (the negative electrode) on discharge in an electrochemical reaction that supplies electrons (i.e., electricity) to an external circuit.

**CONTAINER AND COVER** — The reservoir and lid containing the battery parts and electrolyte made from impact and acid-resistant materials.

**CELL** — The basic electrochemical current-producing unit in a battery, consisting of a positive electrode (set of positive plates), a negative electrode (set of negative plates), electrolyte, separators and casing. It is a single unit housed within one cavity of a monoblock battery container. There are six cells in a 12-volt lead-acid battery.

**CHARGE ACCEPTANCE** — The ability of a secondary battery to accept energy charge in use or under a test with a given set of charging parameters (temperature, voltage, stand time, battery state of charge).

**CELL BALANCING** — The process (either manually or through the application of a BMS) of altering individual cell voltage and state of charge through the distribution of charge current to produce uniform cells. This process can help improve the battery's performance, safety, and longevity.

**CHARGE (Q)** — A quantity of electrical capacity. The SI unit is the coulomb—equivalent to an ampere-second. However, the ampere-hour is the customary unit for batteries.

**CHARGE /CHARGING** — The process of applying an external electrical energy source to a battery during which time the electrical energy is converted to stored chemical energy through reactions at the anodes and cathodes of the battery.

**CHARGE CURRENT** — The rate of energy (flow of electrons) imparted to a battery during charging.

**CHARGE CUT-OFF VOLTAGE** — The battery voltage at which the charging is terminated when reached under specified charging conditions.

**CIRCUIT** — An electrical circuit is the path followed by a flow of electrons. A closed circuit is a complete path. An open circuit has a broken, or disconnected, path.

**CIRCUIT (Series)** — A circuit that has only one path for the flow of current. Batteries arranged in series are connected with negative of the first to positive of the second, negative of the second to positive of the third, etc. A series circuit adds the voltages of each battery without increasing capacity.

**CIRCUIT (Parallel)** — A circuit that provides more than one path for the flow of current. A parallel arrangement of batteries (usually of like voltages and capacities) has all positive terminals connected to a conductor and all negative terminals connected to another conductor. A parallel circuit adds the capacities of all batteries without increasing battery voltage.

**COLD CRANKING PERFORMANCE RATING (CCA)** — The rating set by the battery manufacturer indicating the discharge load in amperes which a new fully charged and conditioned battery at  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ ) can continuously deliver for 30 seconds and maintain a terminal voltage equal to or higher than 1.20 volts per cell (7.2 V for a 12 V battery) subject to statistical analysis. European standards (EN) also have a CCA rating defined somewhat differently. Numerically, the values tend to be similar, but they may not always be identical.

**CONDUCTANCE (G)** — The ability to transmit current in a circuit or battery. It is the reciprocal of resistance and measured in Siemens.

**CONSTANT CURRENT/POWER (CHARGE/DISCHARGE)** — While charging or discharging the battery, the rate of charge (I) or power (I $\times$ V) flowing either into or out of the battery is held constant.

**CORROSION** — The electrochemical reaction between a material, usually a metal, and its environment that produces a deterioration of the material and its properties. The positive lead grids in a battery gradually corrode in service often leading to battery failure. Battery terminals are also subject to corrosion if they are not properly maintained.

**CURRENT (I)** — The rate of flow of electricity, or the movement of electrons, along a conductor (comparable to the flow of a stream of water).  
The unit of measure for current is the ampere.

**CURRENT (ALTERNATING) (AC)** — An electrical current that periodically reverses direction and changes its magnitude continuously with time, in contrast to direct current. A battery does not deliver alternating current.

**CURRENT (DIRECT) (DC)** — An electrical current flowing in an electrical circuit in one direction only. A secondary battery delivers direct current and must be recharged with direct current in the opposite direction of the discharge.

**CYCLE** — In a battery, one discharge plus one recharge equals one cycle.

**CYCLE LIFE** — The count of total cycles for a given standard test profile, measured until the battery is unable to meet minimum test criteria (e.g. discharge voltage or current). Different standardized tests have different sized cycles and testing parameters depending upon the type of battery. Results are not directly comparable.

**CYLINDRICAL CELL/BATTERY** — A battery cell construction where the positive and negative electrodes and separators are jelly-rolled into a cylindrical shape as opposed to a layered, flat electrode orientation (known as prismatic) and inserted into a tube-shaped housing.

## D

**DEEP DISCHARGE** — A discharge when a relatively large portion of the battery capacity, for a given rate of discharge, is removed. Typically the voltage cutoff is 1.75 VPC to avoid cell reversal. Deep cycle batteries are designed to be repeatedly deep discharged without significant damage.

**DEPTH OF DISCHARGE** — The calculated percentage of the amount of capacity removed relative to the full charged capacity available at a given rate of discharge and temperature. The nameplate capacity rating or measured capacity reference value is often used for the full charged capacity.

**DISCHARGING** — When a battery is delivering current, it is said to be discharging.

## E

**ENHANCED FLOODED BATTERY (EFB)** — An EFB is a vented (flooded) lead-acid starter battery with additional design features to significantly improve the cycling capability and service life compared to standard flooded batteries, especially for start-stop vehicle applications. Also known as an Advanced Flooded Battery.

**ELECTRODE** — The combination of active material that electrochemically stores and releases energy and a conducting substrate that supports or contains the material and allows useful electrical energy to flow to an external circuit.

**ELECTROLYTE** — An ionic (non-metallic) conductor of electricity (typically liquid) placed between the positive and negative electrodes of a battery. Ion movement enables internal current flow. In a lead-acid battery, the electrolyte is sulfuric acid diluted with water that also participates in the chemical reactions.

**ELECTRONIC BATTERY TESTER** — An electronic device that assesses the condition of a battery through an ohmic measurement such as resistance or conductance, typically without drawing large current loads.

**ELEMENT** — A set of positive and negative plates assembled with separators that makes up one cell.

**EQUALIZATION CHARGE** — The process of ensuring that the cells and electrodes within a battery are all at full charge and that the electrolyte is uniform and free of stratification. This is normally done by charging the battery under controlled conditions (charge current, time and upper voltage limits).

## F

**FLOAT CHARGE** — A constant voltage charging method intended for extended periods of time in which the voltage set point is lowered and optimized for low water loss and reduced grid corrosion while maintaining the battery at a full state of charge.

**FLOODED CELL or BATTERY** — A cell or battery with electrodes submerged in a free-flowing liquid electrolyte that is not absorbed or otherwise immobilized. Typical designs have venting systems open to the atmosphere for gas escape. They must generally be maintained continuously in a nearly upright orientation to prevent spillage.

**FLOW BATTERY** — A type of rechargeable electrochemical cell in which chemical energy is provided by two chemical redox components dissolved in liquid electrolytes stored in separate tanks that are pumped through the system on separate sides of a membrane and conductive current collectors. With a simple flow battery it is straightforward to increase the energy storage capacity by increasing the quantity of electrolytes stored in the separate tanks. The electrochemical cells can be electrically connected in series or parallel, so determining the power of the flow battery system.

**FORMATION** — In battery manufacturing, formation is the process of charging the battery for the first time. Electrochemically, in the presence of sulfuric acid electrolyte, formation changes the electrically inactive lead oxide/sulfate materials in the electrodes into electrically active lead dioxide (positive) and metallic sponge lead (negative).

## G

**GASSING** — The output of hydrogen and oxygen gasses from the respective negative and positive electrodes during the final phase of charging, created from the decomposition of water in the electrolyte.

**GEL** — Electrolyte that has been immobilized by the addition of a chemical agent, normally fine silica, to prevent spillage and allow gas recombination. Batteries made with gelled electrolyte are often referred to as Gel batteries. Gel batteries are one type of VRLA batteries.

**GRID** — A lead alloy framework that supports the active material of a battery plate and conducts current generated by the active materials to an external connector.

**GROUND** — The reference zero potential of a circuit. In automotive use, the result of attaching one battery cable to the body or frame of a vehicle that is used as a path for completing a circuit in lieu of a direct wire from a component. Today, over 99% of automotive and LTV applications, use the negative terminal of the battery as the vehicle ground.

## H

**HYDROMETER** — A device used to measure the concentration of sulfuric acid in the electrolyte through specific gravity of the electrolyte. The specific gravity is often used to estimate the charge level of a battery. A temperature compensation factor is applied to the density measurement to calculate the specific gravity of the electrolyte at a given temperature.

**I**

**INTERNAL IMPEDANCE** — The opposition to the flow of a small alternating current in battery at a particular frequency combining resistance and reactance. Measured in ohms or milliohms.

**INTERNAL RESISTANCE** — The opposition to direct discharge current flow within a battery that causes a drop in battery voltage. Measured in ohms or milliohms.

**INTERCELL CONNECTORS** — Lead structures that connect adjoining battery cells in series, the positive of one cell to the negative of the next.

**L**

**LEAD SULFATE** — The crystallized material that is deposited in each lead-acid battery electrode as a result of discharge of the charged lead materials in the electrodes and sulfuric acid within the electrolyte.

**LITHIUM ION BATTERY** — A sealed rechargeable battery that uses various cathode and anode materials and lithium ions as the primary ionic conductor in an organic electrolyte.

**LOAD TESTER** — An instrument that assesses battery performance by drawing a relatively large discharge current from a battery using an electrical load device while measuring voltage.

**LOW WATER LOSS BATTERY** — A flooded battery that does not require periodic water addition under normal driving conditions; also referred to as a maintenance-free battery.

**M**

**MAINTENANCE FREE BATTERY** — A battery that normally requires no service watering during its lifetime of use.

**MEMORY EFFECT** — Certain types of batteries, such as nickel-cadmium and nickel-metal hydride, can develop a memory effect when only partially discharged before recharging. This “memory” reduces the capacity of subsequent charges and thus future battery performance. The effect can also be caused by poorly designed chargers.

**MONOBLOCK** — A term used to describe a single housing containing individual and connected battery cells.

**N**

**NEGATIVE** — Designating, or pertaining to, a point of electrical potential. The negative battery terminal is the point from which electrons flow during discharge.

## O

**OHM** — A unit for measuring electrical resistance or impedance within an electrical circuit or battery.

**OHM'S LAW** — Expresses the relationship between volts (V) and current (I) in an electrical circuit with resistance (R). It can be expressed as follows: Volts (V) = Amperes (I) x Ohms (R)

At high discharge rates when coupled with the polarized voltage of the battery, the discharge current times the internal battery resistance ( $I \times R$ ) relates to the voltage drop under load within the battery.

**OPEN CIRCUIT VOLTAGE** — The voltage of a battery measured in the absence of charge or discharge current. After a specified stabilizing rest period it is often used to estimate the charge level of a battery.

**OVER-CHARGE/OVER-DISCHARGE** — A continued excess charging of a fully charged battery or, conversely, the excess discharging of a fully discharged battery. A lead-acid battery requires more charge than discharge due to inefficiencies, but excessive overcharge is abusive and leads to damage. Over-discharge generally refers continuing discharge passed a cutoff voltage limit and can also lead to damage.

## P

**PLATES** — Thin, flat structures comprised of a lead conductive grid and active material. The grid supports the active material and conducts electrons out of the cell. Plates are either positive or negative, depending on the active material they hold.

**POSITIVE** — Designating, or pertaining to, a kind of electrical potential; opposite of negative. A point or terminal on a battery having the higher relative electrical potential. The positive battery terminal is the point to which electrons flow during discharge.

**PRIMARY BATTERY** — A battery that can store and deliver electrical energy but cannot be recharged. A lead-acid battery is not a primary battery.

**PRISMATIC CELL/BATTERY** — A cell constructed with flat, rectilinear plates housed in a container with flat interior walls.

## R

**RECHARGEABLE BATTERY** — A battery that can have its capacity restored by a charging current.

**RESERVE CAPACITY RATING** — A rating published by the battery manufacturer that is expressed as the number of minutes to reach 1.75 V/cell volts per cell when a new fully charged battery at 26.7°C (80°F) is continuously discharged at 25 Amperes, subject to statistical analysis.

**RESISTANCE** — The opposition to the free flow of direct current in a circuit or battery. Resistance (measured in units of ohms or milliohms) in batteries is a measure of the rapid change in voltage with respect to the rapid change in current.



## S

**SEALED BATTERY** — A battery that does not have accessible vent caps or a VRLA (valve regulated lead-acid battery).

**SECONDARY BATTERY** — A battery that can deliver electrical energy and can be recharged by passing direct current in a direction opposite to that of discharge. A lead-acid battery is a secondary battery.

**SELF-DISCHARGE** — Internal chemical reactions taking place within the electrodes that result in a loss in stored charge.

**SEPARATOR** — A porous membrane divider between the positive and negative plates in a cell that allows the flow of ionic current to pass through it, but not electronic current. Separators are made from numerous porous materials impervious to electrolyte and oxidation such as: polyethylene-silica, glass fiber, porous rubber, PVC, phenolic cellulose, etc.

**SERVICE LIFE** — The normal operating period of time for a battery in an application until it no longer satisfies the minimum application requirements.

**SHORT CIRCUIT** — An unintended current bypass in an electrical device or wiring. Outside a battery a short circuit is established when an unintended conductive path is established between the two terminals of a battery. Inside a battery, a cell short circuit is the result of contact between the positive and negative plates that will cause a cell to discharge and render the battery useless.

**SODIUM ION BATTERY** — A sealed rechargeable battery similar to Lithium Ion that uses sodium ions (instead of lithium) as charge carriers.

**SPECIFIC GRAVITY (Sp. Gr. or 'SG')** — Specific Gravity is a measure of the sulfuric acid electrolyte concentration in a battery at a specific temperature. This measurement is based on the density of the electrolyte compared to the density of water and is typically determined by the use of a hydrometer (see Hydrometer). By definition, the specific gravity of water is 1.00 and the specific gravity of the sulfuric acid electrolyte in a typical fully charged lead-acid battery is 1.265-1.300. Specific gravity measurements are typically used to determine battery charge level or if the battery has a bad cell.

**STATE OF CHARGE** — The percentage of remaining discharge capacity or discharge time available in a battery under prevailing conditions of discharge compared to a fully charged battery under the same or defined conditions:  $SOC = 100\% \times C_{\text{remaining}} / C_{\text{charged}}$

Because of various methods of defining state of charge, it is problematic to use without setting specific calculations.

**STRATIFICATION** — The unequal concentration of electrolyte due to density gradients from the bottom to the top of a cell. This condition is encountered most often in batteries recharged from a deep discharge at constant voltage without a great deal of gassing for mixing wherein recharged higher concentration sulfuric acid sinks to the bottom of the cell. Continued deep cycling of a 'stratified' battery will result in softening of the bottoms of the positive plates and sulfation of the bottoms of the negative plates. Equalization charging is a way to avoid acid electrolyte stratification.

**SULFATION** — The generation or conversion of the normal lead sulfate discharge crystals in the plates to a state that resists recharge. Sulfation often develops when a battery is stored or cycled in a partially discharged state at warm temperatures. It is a vague term for low charge acceptance in a discharged condition with no quantitative measurement.

**T**

**TERMINALS** — The electrical structures on the battery to which the external circuit is connected. Typically, batteries have either top-terminals (posts) or side-terminals. Some batteries have both types of terminals (dual-terminal).

**THERMAL RUNAWAY** — An uncontrolled increase in battery internal temperature during a voltage-controlled charging process where the current rate increases as the battery temperature continues to rise causing the electrolyte to boil away.

**TRICKLE CHARGE** — A technique used to describe maintaining the charge level of a battery by charging with a small current either through float charging (which is constant voltage) or a small constant current charge.

**V**

**VALVE REGULATED LEAD-ACID BATTERY (VRLA BATTERY)** — A battery constructed with a fully enclosed case venting system sealed with a 1-way valve, under pressure above atmospheric, where venting of gasses is regulated through the valve that operates in a normally closed position. This configuration enables an oxygen charge shuttle reaction (recombination) inside the battery. When oxygen produced at the positive electrode reaches the negative electrode, the negative electrode is discharged slightly removing the oxygen and limiting the production of hydrogen gas. Instead the VRLA battery regenerates water and no excessive gasses for venting. The valve ensures that air (extra oxygen) never enters the battery to discharge the negative electrode. If the internal pressure exceeds the valve pressure limit by a fixed amount, the battery will vent to limit further pressure rise. Gel and AGM are two types of valve-regulated batteries.

**VENTS** — Mechanisms that allow gasses to escape from the battery while retaining the electrolyte within the case. Flame arresting vents typically contain porous disks that reduce the probability of an internal explosion as a result of an external spark. Vents come in both permanently fixed and removable designs.

**VENTED BATTERY** — A battery where the internal cell components (electrodes and electrolyte) are subject to normal atmospheric pressure, and gasses produced are allowed to pass through an engineered venting system.

**VOLT** — The unit of measure for electrical potential.

**VOLTAGE** — An electromotive force or potential difference expressed in volts.

**VOLTMETER** — An electronic device used to measure voltage, normally in a digital format.

**VOLTAGE DROP** — The net difference in the electrical potential (voltage) when measured across a resistance or impedance (ohms) with applied current. See Ohm's Law.

**VRLA** — See Valve Regulated Lead-Acid battery.

**W**

**WATT** — The unit for measuring electrical power, i.e., the rate of doing work, in moving electrons by, or against, an electrical potential. Formula: Watts = Amperes x Volts.

**WATT-HOUR (Watt-Hr, Wh)** — The unit of measure for electrical energy equivalent to a power consumption of one watt per for one hour.

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