

# Battery Terms Glossary

## **Alkaline**

A primary battery (non-rechargeable) often used in electronics applications requiring heavy currents for long periods of time (i.e.: cd players, radios, etc.). Alkaline batteries can deliver 50-100% more total energy than conventional Carbon/Zinc batteries of the same size, hence their popularity in consumer applications.

## **Ampere-Hour Capacity**

The quantity of electricity measured in ampere-hours (Ah) that may be delivered by a cell or battery under specified conditions.

## **Anode**

The electrode in an electrochemical cell where oxidation takes place. During discharge, the negative electrode of the cell is the anode. During charge, the positive electrode is the anode.

## **Battery or Pack**

Two or more electrochemical cells electrically interconnected in an appropriate series/parallel arrangement to provide the required operating voltage and current levels. Under common usage, the term "battery" is often also applied to a single cell.

## **Bobbin**

A cylindrical cell design utilizing an internal cylindrical electrode and an external electrode arranged as a sleeve inside the cell container.

## **C-Rate (also see Hourly Rate)**

Discharge or charge current, in amperes, expressed in multiples of the rated capacity. For example, C/10 discharge current for a battery rated at 1.5 Ah is:  $1.5 \text{ Ah} / 10 = 150 \text{ mA}$  (A cell's capacity is not the same at all discharge rates and usually increases with decreasing rate.)

## **Capacity**

The total number of ampere-hours or watt-hours that can be withdrawn from a fully charged cell or battery under specified conditions of discharge.

## **Carbon/Zinc**

A primary battery (non-rechargeable) commonly used in low drain consumer applications (i.e.: clocks, calculators, garage door openers, etc.). Available in the same sizes as the Alkaline and Manganese Dioxide ("AA", "AAA", 9volt, "C", "D") the Carbon/Zinc is one of the most widely used dry primary batteries because of its low cost and reliable performance.

## **Cathode**

The electrode in an electrochemical cell where reduction takes place. During discharge, the positive electrode of the cell is the cathode. During charge in a rechargeable battery, the negative electrode is the cathode.

## **Cell**

The basic electrochemical unit used to generate or store electrical energy.

## **Cell Mismatch**

Cells within a battery pack that contain different capacity and voltage levels.

## **Cell Reversal**

The stronger cells of a battery (several cells connected in series) impose a voltage of reverse polarity across a weaker cell during a deep discharge.

## **Charge**

The conversion of electrical energy, provided in the form of electrical current from an external source, to restore the chemical energy in a cell or battery.

## **Closed-circuit Voltage (CCV)**

The potential or voltage of a battery when it is discharging or charging.

## **Condition**

A process that utilizes a series of heavy discharges and recharges on a battery to assure optimum performance.

## **Constant Current**

A battery discharge regime whereby the current drawn during the discharge remains constant.

## **Constant Power**

A battery discharge regime whereby the current during the discharge increases as the battery voltage decreases.

## **Constant Resistance**

A battery discharge regime whereby the resistance of the equipment load remains constant throughout discharge.

## **Continuous Test**

A test in which a battery is discharged to a prescribed end point voltage without interruption.

## **Current Density**

The current per unit active area of the surface of an electrode.

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## **Current Drain**

The current withdrawn from a battery during discharge.

## **Current Limiting Chargers**

A charger that keeps the charge current constant during the charge process but allows the voltage to fluctuate (typically used on NiCd and NiMH chargers).

## **Cutoff Voltage**

The battery voltage at which the discharge is terminated. The cutoff voltage is specified by the battery manufacturer and is generally a function of discharge rate.

## **Cycle**

A sequence where a charged battery is discharged and recharged.

## **Cycle Life**

The number of cycles under specified conditions that are available from a secondary battery before it fails to meet specified criteria as to performance.

## **Cylindrical Cell**

The positive and negative plates are rolled up and placed into a cylindrical container (as opposed to stacking the plates in a prismatic cell design).

## **Direct Current**

Electrical current that flows in one direction only. Batteries produce direct current as the current flows from a negative to a positive source.

## **Discharge**

The conversion of the chemical energy of a battery into electrical energy, and the withdrawal of the electrical energy into a load.

## **Discharge Rate**

The rate, usually expressed in amperes, at which electrical current is taken from the battery.

## **Drain**

The current withdrawn from a battery during discharge.

## **Dry Cell**

A cell with immobilized electrolyte. The term "dry cell" is often used to describe the Leclanche cell.

## **Dumb Battery**

Straight battery pack without internal circuits enabling communication between the battery and the user.

## **Electric Current**

The movement of electrons along a conductor.

## **Electrode**

The site, area or location at which electrochemical processes take place.

## **Electrolyte**

The medium which provides the ion transport mechanism between the positive and negative electrodes of a cell.

## **End Voltage Cutoff**

The prescribed voltage at which the discharge (or charge, if end-of-charge voltage) of a battery may be considered complete.

## **Energy**

The output capability of a cell or battery, usually expressed in watt-hours.

## **Energy Density**

The ratio of the energy available from a battery to its volume (Wh/L) or weight (Wh/kg).  
Prismatic Cell

## **Float**

The use of batteries in which they are charged by an application to be ready for use if the primary power to the application fails. Also called standby or backup.

## **Float Charge**

Similar to trickle charge. Compensates for the self-discharge on a SLA battery

## **Forced Discharge**

Discharging a cell in a battery, by the other cells or an external power source, below zero volts into voltage reversal.

## **Gassing**

The evolution of gas from one or more of the electrodes in a cell. Gassing commonly results from local action (self-discharge) or from the electrolysis of water in the electrolyte during charging.

## **Hourly Rate**

A discharge rate, in amperes, of a battery which will deliver the specified hours of service to a given cutoff voltage.

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## Internal Impedance

The opposition exhibited by a circuit element (cell or battery) to the flow of an alternating current (a/c.) of a particular frequency as a result of resistance, induction and capacitance.

## Internal Resistance (IR)

The opposition exhibited by a circuit element to the flow of direct current (D.C.). In a cell, the internal resistance is the sum of the ionic and electronic resistances of the cell components.

## IR Drop

A voltage drop associated with the electrical resistance (R) of a battery or current flow (I). The voltage drop is the product of the current (in amperes) and the resistance (in ohms).

## Limiting Current

The maximum current drain under which the particular battery will perform adequately under a continuous drain. The rate is based on whatever drain rate reduces the running voltage to 1.1 volts.

## Lithium Ion (Li Ion)

One of the newer rechargeable battery technologies, Li Ion batteries can deliver 40% more capacity than comparably sized NiCd batteries and are one of the lightest rechargeable batteries available today. Li Ion batteries are the batteries of choice in notebook computers, wireless telephones and many camcorder models. They are also one of the more expensive rechargeable technologies.

## Lead Acid

Still the most popular battery used today its main application is for the automobile industry, although it has a growing number of other applications. Its advantages are low cost, high voltage per cell and good capacity life. Disadvantages are poor low temperature characteristics, it is relatively heavy, and it cannot be left in a discharged state for too long without being damaged. Related Batteries: Absorbent Glass Matt (AGM) Gel/Gel Cell

## Lithium

A primary battery (non-rechargeable) that is quickly entering mainstream electronic designs, particularly in consumer, portable equipment and non-volatile memory back up applications where small size, long life and low cost are the primary requirements. Lithium batteries have superior cold temperature performance and a shelf life of 5-10 years.

## Load Current

The discharge current provided by a battery, or drawn by a battery powered device.

## Manganese Dioxide

A primary battery (non-rechargeable) similar to that of the alkaline battery though not as strong in total energy. Available in the same size as Alkaline and Carbon/Zinc ("AA", "AAA", "C", "D", 9volt) the Manganese Dioxide chemistry is noted for its ability to retain its charge while being stored at high temperatures and operates well at temperatures as low as -40°C with little loss of capacity.

## Memory Effect

A phenomenon in which a cell or battery operated in successive cycles to the same, but less than full, depth of discharge temporarily loses the rest of its capacity at normal voltage levels.

## Metal Hydride

An intermetallic compound or alloy in which hydrogen has been absorbed-, also, the negative electrode in a nickel-metal hydride battery.

## Midpoint Voltage

The voltage of a battery midway in the discharge between the start of the discharge and the end voltage.

## Milliamps

Refers to battery capacity. A 1/1000th of an amp, e.g.: 1.0Ah = 1000mAh.

## Nickel Cadmium (NiCd)

One of the most proven and historically most widely used rechargeable batteries. Very dependable and "robust" but contain cadmium and have relatively low capacity when compared to other rechargeable systems. Very good high rate discharge capabilities make them very popular in high drain applications such as power tools.

## Nickel Metal Hydride (NiMh)

Interchangeable with most NiCd batteries, nickel metal hydride (NiMh) batteries generally deliver 10-25% greater capacity than NiCds and are environmentally more friendly than NiCds since they do not contain cadmium. Used in many wireless phone and camcorders.

## Nominal Voltage

The characteristic operating voltage or rated voltage of a battery.

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## **Ohm**

A measure of resistance that causes one volt to produce a current of one ampere.

## **Open-Circuit Voltage**

The difference in potential between the terminals of a cell when the circuit is open (no-load condition).

## **Overcharge**

The forcing of current through a cell after all the active material has been converted to the charged state, that is, continued charging after reaching 100 percent state-of-charge.

## **Overdischarge**

The process of discharging a cell or battery beyond its cutoff voltage and possibly into voltage reversal.

## **Parallel**

Term used to describe the interconnection of cells or batteries in which all the like terminals are connected together. Results in increased capacity.

## **Primary Battery**

A battery which is not intended to be recharged and is discarded when the battery has delivered all of its electrical energy.

## **Prismatic Cell**

The positive and negative plates are stacked rather than rolled as done in a cylindrical cell.

## **Pulse Current**

A periodic current drain of higher than normal drain rates.

## **Rapid Charge**

A charge time that is between slow charge and fast charge (typically 3 to 6 hours for a NiCd).

## **Rated Capacity**

The number of ampere-hours a battery can deliver under specific conditions (e.g., rate of discharge, end voltage, temperature); usually specified by the battery manufacturer.

## **Rechargeable battery**

A galvanic battery which, after discharge, may be restored to the fully charged state by the passage of an electrical current through the cell in the opposite direction to that of discharge.

## **Recondition**

One or more deep discharge cycles below 1.0 volt/cell at a very low, controlled current. Recondition helps to revert large crystals to small desirable sized, often restoring the battery to its full capacity.

## **Resistance**

The degree to which the flow of electrons is opposed by the material the electrons must pass through. Resistance is expressed in OHMS.

## **Reversal**

The changing of the normal polarity of a battery due to over-discharge.

## **Safety Vent**

A venting mechanism designed into a cell which activates under specific conditions of abuse to relieve internal pressure.

## **Secondary Battery**

A battery that can be recharged and reused many times.

## **Self-Discharge**

The loss of useful capacity of a battery on storage due to internal chemical action (local action).

## **Series**

The interconnection of cells in such a manner that the positive terminal of the first is connected to the negative terminal of the second, and so on, resulting in increased voltage.

## **Shelf Life**

The duration of storage under specified conditions at the end of which the battery still retains the ability to give a specified performance.

## **Short Circuit**

An unwanted electrical connection between a negative and positive source. Short circuits can damage the battery and equipment and can cause sparks or fire.

## **Silver/Oxide**

A primary battery (non-rechargeable) it is a major contribution to miniature power sources, and is well suited for hearing aids, instruments, photoelectric exposure devices and electronic watches. These cells are primarily made in the smaller "button" sizes.

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## **Slow Charge**

Typically an over-night charge lasting about 14 hours at a charge current of 0.1C. Battery does not require instant removal when fully charged.

## **Smart Battery**

Battery with internal circuit enabling some communication between the battery and the user. Some batteries feature a capacity indicator only, others offer an external bus to interface with the equipment the battery powers and the intelligent charger.

## **Spiral Wound**

An electrode structure of high surface area created by winding the electrodes and separator into a spiral-wound jelly-roll configuration.

## **Standby**

The use of batteries in which they are charged by an application to be ready for use if the primary power to the application fails. Also called float or backup.

## **State of Charge**

The capacity remaining in a battery.

## **Sulfation**

Growth of lead sulfate crystals in Lead-Acid batteries which inhibits current flow. Sulfation is caused by storage at low state of charge.

## **Temperature Cutoff**

A protective or safety device (e.g., thermostat, PTC, etc.) which senses temperature in a battery and opens or cuts off the electrical circuit if the specified temperature is exceeded, thus preventing a further rise in temperature due to the charge or discharge of a battery.

## **Terminal**

A device at the end of a cell or wire for making a connection to an adjoining cell or wire.

## **Thermistor**

A temperature sensitive resistor usually made from specially processed oxides that are used to sense end of charge temperature rises and terminates high rate charging.

## **Thermostat**

A temperature sensitive switch.

## **Top-Up Charge**

A low rate charge following the main charge, designed to ensure maximum capacity.

## **Trickle Charge**

A charge at a low rate, balancing losses through local action and/or periodic discharge, to maintain a cell or battery in a fully charged condition.

## **Voltage**

A unit of measuring electrical pressure, all batteries are rated in volts DC (Direct Current).

## **Volumetric Energy Density**

The ratio of the energy output of a cell or battery to its volume (Wh/L).

## **Watts**

A measurement of energy, arrived at by multiplying the voltage by the amperage.

## **Watt Hours**

A common measurement of energy produced in a given amount of time, arrived at by multiplying the voltage by the amp hours.

## **Zinc/Air**

A primary battery (non-rechargeable) that was commonly used for applications such as watches and hearing aids. In relation to their physical size, Zinc/Air batteries store more energy per unit of weight (in terms of 220 W h/kg) than any other primary type.

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