



Solar Panels for Recreation and Small-Scale Installations.  
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## Battery Terminology A to Z



### A

**AB5** - A metal alloy (e.g., LaNi<sub>5</sub>) capable of undergoing a reversible hydrogen absorption/desorption reaction as the battery is charged and discharged, respectively. This is the most popular electrode used in nickel metal hydride batteries.

**Absorption** - The taking up or retention of one material by another by chemical or molecular action.

**Accumulator** - A rechargeable battery or cell (see also Secondary battery).

**Acid battery** - The battery in which acid is used as electrolyte, e.g., lead-acid battery in which sulfuric acid is the electrolyte.

**Active Material** - Electrode material which produces electrical energy during discharge from chemical energy stored during charge

**Actual Capacity** - The total battery capacity, usually expressed in ampere-hours or milliampere-hours, available to perform work. The actual capacity of a particular battery is determined by a number of factors, including the cut-off voltage, discharge rate, temperature, method of charge and the age and life history of the battery.

**AGM (Absorbent Glass Mat)** - A type of non-woven separator material composed almost entirely of glass microfibers that absorbs and retains the electrolyte, leaving no free electrolyte in the cell to spill. VRLA batteries made with this material are often referred to as "AGM" batteries.

**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.

**Alkaline storage battery** - A battery which employs alkaline aqueous solution for its electrolyte. The Nickel-cadmium battery as designed.

**Alloy** - A mixture of several other metals or a metal and a non-metal.

**Alternator** - A type of generator used in automobiles to produce electric current.

**Ambient Humidity** - The average humidity of the surroundings.

**Ambient Temperature** - The average temperature of the surroundings.

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

**Ampere-Hour (Amp-Hrs, 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-hrs of capacity.)

**Ampere-Hour Capacity** - The number of ampere-hours which can be delivered by a battery on a single discharge.

**Anode** - During discharge, the negative electrode of the cell is the anode. During charge, that reverses and the positive electrode of the cell is the anode. The anode gives up electrons to the load circuit and dissolves into the electrolyte.

**Aqueous Batteries** - Batteries with water-based electrolytes. The electrolyte may not appear to be liquid since it can be absorbed by the battery's separator.

**Assembled battery** - Any battery composed of multiple cells.

### B

**Battery (Battery Pack)** - Two or more electrically connected cells in a series/parallel arrangement, designed to create the desired voltage/capacity. "Battery" is the common term for a single cell

**Battery Capacity** - The electric output of a cell or battery on a service test delivered before the cell reaches a specified final electrical condition and may be expressed in ampere-hours, watt-hours, or similar units. The capacity in watt-hours is equal to the capacity in ampere-hours multiplied by the battery voltage.

**Battery Charger** - A device capable of supplying electrical energy to a battery.

**Battery-Charge Rate** - The current expressed in amperes (A) or milli amps (mA) at which a battery is charged.

**BCI Group** - The Battery Council International (BCI) Group Number "fingerprints" a battery with the following characteristics: (a) dimensions (L x W x H), (b) voltage (6V or 12V), (c) polarity (right-hand front positive, left-hand front positive, etc.), (d) type terminals (top, side, "L", etc.). The BCI Group Number does not designate a battery's capacity; it merely defines the above-listed physical characteristics.

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

**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 high current.

**British Thermal Unit (Btu)** - A unit of heat energy defined as the amount of heat required to raise the temperature of one pound of water by one degree Fahrenheit. In America, the British thermal unit is sometimes called the heat unit. In defining the Btu, it is necessary to specify the temperature of the water; thus, there have been several definitions over the years. However, one Btu is equal to about 251.996 (small) calories, or 0.251 996 of the (kilo-)calories counted by dieters. Using the current definition of the calorie (the IT calorie), one Btu equals approximately 778.169-foot-pounds, 1.055 056 kilojoules or 0.293 071 watt-hour.

**Button Cell** - A battery cell with overall height less than its diameter. Button cells are manufactured with circular disc electrodes that are separated with a separator sheet

## C

**C** - Used to signify a charge or discharge rate equal to the capacity of a battery divided by 1 hour. Thus, C for a 1600 mAh battery would be 1.6 A, C/5 for the same battery would be 320 mA and C/10 would be 160 mA. Because C is dependent on the capacity of a battery the C rate for batteries of different capacities must also be different.

**C-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.)

**CA or Cranking Amps** - A rather optimistic market driven rating, especially for "economy" or "value-priced" batteries. The same as CCA, but at at 32 degrees F (0 C) temperature. The standard BCI rating is CCA, at 0 degrees F (about -18 C). The MCA, or Marine Cranking Amps is basically the same as CA. CCA is about 20% less than CA or MCA.

**Cadmium (Cd)** - Metallic element is the chemically-active material of the Nickel-cadmium battery's negative electrode. When the battery is charged, the negative electrode surface consists of cadmium. As the battery discharges, the cadmium progressively changes into cadmium hydroxide (CdOH<sub>2</sub>).

**Cadmium hydroxide** - Active material used at the negative electrode of the Nickel-cadmium cell.

**Cadmium salt** - A chemical compound in which the hydrogen atom has been replaced by the cadmium atom: e.g.)  $2\text{HNO}_3 + \text{Cd}(\text{OH})_2 \rightarrow \text{Cd}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$  cadmium nitrate.

**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.

**Capacity Offset** - A correction factor applied to the rating of a battery if discharged under different C-rates from the one rated.

**Capacity Retention (or Charge Retention)** - The fraction of the full capacity available from a battery under specified conditions of discharge after it has been stored for a period of time.

**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.

**CCA** - Is a rating used in the battery industry to define a battery's ability to start an engine in cold temperatures. A great number of amperes is needed to start the engine, but only for a short time. The actual rating is the number of amps that can be removed from a new fully charged battery at 0°F for 30 seconds while maintaining a voltage of at least 7.2 volts (for a 12-volt battery). As a battery ages with use, it may no longer be able to meet its original CCA rating. The higher the CCA rating, the greater the starting power of the battery.

**CCA or Cold Cranking Amps** - The maximum amperes that can be continuously removed from a battery for 30 seconds at zero degrees F before its voltage drops too low to use (1.2 volts per cell, or 7.2 volts). This term is used only for engine starting batteries, and has little to do with the amp-hour capacity or deep cycle batteries. This rating will also appear on many deep cycle marine batteries. See also CA and MCA.

**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.

**Change in Temperature ( $\Delta T$ )** - Charge termination based on difference between ambient temperature and cell temperature

**Change in Temperature/Change in Time ( $dT/dt$ )** - Charge termination based on change in temperature over time. This termination is meant to detect rapid temperature increases created just before a battery or cell reaches its full charge. Normal  $dT/dt$  is 1°C/minute

**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.

**Charge Acceptance** - A cell's ability to store energy. Can be affected by temperature, charge rate, and state of charge

**Charge Control** - Technique for effectively terminating the charging of a rechargeable battery.

**Charge Efficiency** - Ratio of a cell's output during discharge to its input during charge. Ratio can be expressed in efficiency of capacity, nominal voltage, or power

**Charge Rate** - Current applied to a cell to restore its capacity. Charge rate is usually expressed in terms of the cell's C Rate

**Charge retention** - Residual capacity after a period of storage of a fully charged battery.

**Chemical cells** - The type of cells which convert energy obtained by chemical reactions into electrical current. Most of the popularly used cells belong to this group.

**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 (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. If two 12-volt batteries of 50 ampere-hour capacity each are connected in parallel, the circuit voltage is 12 volts, and the ampere-hour capacity of the combination is 100 ampere-hours.

**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. If two 12-volt batteries of 50 ampere-hours capacity each are connected in series, the circuit voltage is equal to the sum of the two battery voltages, or 24 volts, and the ampere-hour capacity of the combination is 50 ampere-hours.

**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.

**Conductance** - The ability to transmit current in a circuit or battery.

**Constant Current** - A battery discharge regime whereby the current drawn during the discharge Discharge remains constant.

**Constant Current Charge** - A charge during which the current is maintained at a constant value. Sealed nickel-cadmium batteries are normally charged at a 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.

**Constant voltage charge** - A charge during which the voltage across the battery terminals is maintained at a constant value. This method is not normally used for sealed nickel-cadmium cells or batteries.

**Constant-Current Charge** - A charging process in which the current applied to the battery is maintained at a constant value.

**Constant-Voltage Charge** - A charging process in which the voltage applied to a battery is held at a constant value.

**Container and Cover** - The reservoir and lid containing the battery parts and electrolyte made from impact and acid-resistant material such as polypropylene.

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

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

**Coulomb** - The amount of electricity transported by a current of one ampere flowing for one second.

**Current** - The rate of flow of electricity, or the movement of electrons along a conductor. It is comparable to the flow of a stream of water. The unit of measure for current is the ampere.

**Current (Alternating) (AC)** - A current that varies periodically in magnitude and direction. 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.

**Current Collector**- An inert structure of high electrical conductivity used to conduct current from or to an electrode during discharge or charge.

**Current Density** - The current per unit active area of the surface of an electrode.

**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).

**Cut-off voltage** - The specified voltage at which a discharge of a cell or battery is considered finished. (Final voltage)

**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.

**Cycle use** - A method of battery use involving repeated charging and discharging.

**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).

## D

**Deep Cycling** - Application in which the cell or battery is successively and repeatedly charged, then completely and fully discharged.

**Deep Discharge** - Discharge of at least 80% of the rated capacity of a cell or battery.

**Delta V** - Detecting the voltage drop which indicates a cell is fully charged. See "negative Delta V (-ΔV)"

**Discharge** - An operation during which a battery delivers current to an external circuit by the conversion of chemical energy into electrical energy

**Discharge Capacity** - Capacity that can be discharged from a battery. The unit as Ah, (ampere-hour).

**Discharge Rate** - Rate at which electrical current is removed from a cell or battery, usually measured in milli-amperes (mA) or multiples of the C Rate

**Discharge Voltage** - Voltage a battery's or cell's terminals during discharge

**Duty Cycle** - Operating regime for a battery or cell, including charge and discharge rates, charge termination, depth of discharge, and time in rest mode

## E

**Electrode** - Matrices of a battery or cell which provide the sites for the electrochemical process to take place

**Electrolyte** - Medium which provides the ion transport mechanism between a battery's or cell's electrodes. Potassium Hydroxide (KOH) is the electrolyte in NiMH batteries, for example.

**Electrolyte Retention Capability** - The degree to which a separator retains electrolyte

**End voltage** - The voltage that indicates the end limit of discharge. This voltage is almost equivalent to capacity in practical use

**Endothermic** - Heat absorption caused by a chemical reaction

**Energy** - Overall amount of power a battery or cell can deliver over time. Product of the battery's or cell's voltage, discharge rate, and discharge time. Usually expressed in milli-Watt hours (mWh) or mWh =  $V \times mA \times hrs$

**Energy Density** - Ratio of a battery's or cell's energy to its weight or volume. Also called Power Density. See also "gravimetric energy density" and "volumetric energy density"

**Exercise** - Commonly understood as one or more discharge cycles to one volt per cell with subsequent recharge. Used to maintain NiCd & NiMH batteries.

**Exothermic** - Release of heat caused by a chemical reaction

## F

**Fast Charge** - Rate of charging a cell or battery to full charge capacity in 2 1/2 hours or less

**Final Voltage** - The specified voltage at which a discharge of a battery is considered finished

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

**Foam** - Positive electrode made with a porous nickel metal instead of a nickel sintered strip. Thicker and porous, it holds more active material greatly increasing its capacity

## G

**Gas Permeability** - The degree of mobility of gas through porous film, fabric or other plate-separating material

**Gas Recombination On Negative Electrode** - The method to suppress hydrogen generation by recombining oxygen gas on the negative electrode, and making the negative electrode chemically discharged when oxygen gas is generated at the positive electrode at the end of charging

**Gravimetric Energy Density** - Ratio of a battery's or cell's energy to its weight. Also called power density. Usually expressed in Watt-Hours per kilogram (Wh/kg)

## H

**High-Rate Discharge** - Discharge at a comparatively high current rate in comparison with cell capacity.

**Hour Rate** - The hour rate is associated with both discharging and charging the battery, and is expressed in terms of discharge time at its nominal capacity rating. "H-hou" represents the length of time it takes to discharge a battery, and "i" represents the rate of discharge.

## I

**IEC** - International Electrotechnical Commission, a non-profit, non-governmental international standards organization. Prepares and publishes international standards for all electrical, electronic, and related technologies

**Impedance** - Used in terms of the battery's internal resistance

**Intelligent battery** - Battery with internal circuit enabling some communication between the battery and 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.

**Intercalated** - Reaction where lithium ions are reversibly removed or inserted into a host without a significant structural change taking place

**Internal Pressure** - Pressure within a sealed battery or cell caused by oxygen or hydrogen evolution

**Internal Resistance** - Opposition or resistance of a battery or cell to an alternating current, usually 1000 Hz. Internal resistance is the ohmic component of a battery's or cell's resistance to the flow of electrical current within the battery or cell

**Interstitial** - A space between closely set things, or between the parts which compose a body. A narrow chink; a crack, crevice, or hole

**ION** - An atom or a group of atoms charged either positively or negatively.

**IR-DROP** - A drop in cell voltage or voltage of inter-cell conductor due to cell internal resistance.

## L

**Leakage** - The escape of electrolyte to the outer surface of the battery.

**Lithium Cobaltite (LiCoO<sub>2</sub>)** - Dark blue, water-insoluble powder. Exhibits both the fluxing properties of lithium oxide and the adherence-promoting properties of cobalt oxide. Intercalates lithium ions in battery and cell applications.

**Lithium Ion** - Advanced chemistry/technology for primary and secondary batteries. Offers increased performance and twice the energy density of nickel-based batteries. There are several major varieties of lithium-ion battery technology, each of which has unique properties. Lithium-ion secondary batteries can charge to full capacity in as little as 3 hours.

**Lithium Iron Phosphate** - A variety of lithium-ion chemistry/technology that offers high discharge rate capability, long cycle life, and long calendar life.

**Lithium Polymer** - A variation of lithium-ion battery which differs only construction—chemistry is the same. Lithium polymer allows for very flexible packaging, lower cost, and safer operation.

**Lithium Primary Battery** - Have the highest specific energy (energy by weight) and energy density (energy by volume) of all primary battery types. Have open circuit voltages (OCVs) between 2.7 and 3.6V. Their relatively high internal impedance limits them mostly to low drain applications.

**Load Current** - The discharge current provided by a battery, or drawn by a battery powered device

**Low-Voltage Cut-off** - A special sensor which ends discharge at a specified voltage level

**Low-Voltage Disconnect** - Voltage-sensing device to automatically disconnect a battery or cell from a load at predetermined voltage. Low-voltage disconnects prevent cell reversal during discharge.

## M

**Maintenance Charge (Float Charge)** - Method for maintaining the charge of a battery or cell by continuously charging it at a rate sufficient to balance its self-discharge

**Manganese Dioxide Lithium** - Generally equivalent to poly batteries and cells in construction, energy density, safety and OCV, though with roughly half the service life. Well-suited to applications with high continuous- or pulse-current requirements due to their lower internal impedance. Available in standard cylindrical and coin styles.

**Matched Cells** - Cells carefully selected by the factory to display within 5% of the same capacity at the time of manufacturer.

**Matching** - Grouping individual cells within 2% of capacity to prevent cell reversal.

**Memory** - Reversible capacity loss found on NiCd and to a lesser extent on NiMH batteries. The modern definition of memory commonly refers to a change in crystalline formation from the desirable small size to a large size.

**Memory Effect (Voltage Depression)** - Phenomenon in which repeated cycling to less than full discharge result in depression in discharge voltage and loss of capacity of the cell Metal Hydride (MH): negative electrode of a battery or cell. Composed of hydrogen-storing Misch metal alloys.

**Migration** - Movement of charged ions under the influence of a potential gradient.

**Misch Metal (M)** - Matrix of the negative electrode of a battery or cell. Composed of hydrogen-storing alloys.

**Mobility of Ions** - Velocity of ions moving in electrolyte between electrodes of opposite polarity.

## N

**Negative Delta V (-ΔV)** - Charge termination based on detecting a decrease in voltage which indicates a cell or battery is charged. Designed to terminate charge as over-charge starts.

**Negative Electrode** - Electrode in a battery or cell acting as the anode during discharge. Composed of hydrogen-storing alloys. Also called the minus electrode.

**Nickel Hydroxide** - Active material used at the positive electrode of the Nickel-cadmium cell.

**Nickel Metal Hydride (NiMH)** - Battery or cell system comprised of a Nickel (Ni) positive electrode and a metal hydride (MH) electrode.

**Nickel Tab** - Mechanical connector used to electrically connect cells in a battery pack.

**Nominal Capacity** - The standard capacity designated by a battery manufacturer to identify a particular cell model.

**Nominal Voltage** - Average working voltage of a battery or cell. Calculated by multiplying the power (mWh) by the capacity (mAh). (Cell voltages of 1.20 and 1.25 volts are used for NiCd and NiMH batteries.)

## O

**Open Circuit Voltage (OCV)** - Potential difference between the electrodes of a battery or cell, measured at the terminals in a no-load condition

**Operating Voltage** - Voltage between the two terminals of the battery without any load.

**Over-Charge** - Forcing of current into a battery or cell after all of its active material has been converted into stored energy

**Over-Discharge** - Discharging a battery or cell after all of its stored energy has been released

**Overvoltage** - The difference between the actual potential of electro-chemical reaction and the theoretical value at which the reaction becomes balanced.

**Oxygen Recombination** - Process in which oxygen generated at the positive electrode of a battery or cell during over-charge reacts with hydrogen at its negative electrode, producing water

**Ohm** - A unit of electrical resistance, named after German physicist Georg Simon Ohm, equal to that of a conductor in which a current of one ampere is produced by a potential of one volt across its terminals.

## P

**Parallel** - Interconnecting cells, or batteries with like terminals, are connected to increase the capacity of the resulting battery pack. This resulting battery pack's capacity is equal to the sum of capacities of the parallel-connected batteries or cells

**PBE** - Plastic Bonded Electrodes. PBE utilizes a manufacturing technique that produces a high-energy density negative electrode that allows higher capacity for a given cell size and a greatly reduced self-discharge.

**Peak Voltage Detection (PVD)** - Automatic charge termination based on the battery or cell being charged reaching peak voltage. Designed to terminate charge just as over-charge begins.

**Permanent Charge** - The charging current which can be continuously maintained, regardless of the state of charge of the cell.

**Polarity Reversal** - Reversing of polarity of the terminals of a small-capacity cell in a multi-cell battery due to over discharge.

**Polarizations** - Obstacles to current flow within NiMH cells

**Porosity** - The term expressing the porous degree of a sintered plate. The equation for its calculation is: Porosity =  $(V1/V2) \times 100$ . V1 is the volume of pores and V2 is the total volume of the plate including pores.

**Positive Electrode** - Electrode of a battery or cell acting as the cathode during discharge. Composed of nickel base (Ni) or nickel hydroxide

**Positive Temperature Coefficient Device (PTC) or Thermostat** - safety device used in battery packs. At a predetermined temperature threshold, internal resistance goes from a low-resistance state to a high-resistance one to provide over-current and over-temperature protection

**Potassium Hydroxide (KOH)** - Electrolyte providing ion transport mechanism between the electrodes of NiMH cells

**Potential** - Energy of an electrical charge, measured by its power to perform work; electro-motive force.

Potential energy per unit charge is voltage.

**Potential of oxygen evolution** - Oxygen gas evolves due to the electrolysis of water in the battery being charged when it reaches a certain potential. This is called the potential of oxygen evolution.

**Power** - Time rate of energy transfer, measured in Watts (W). Product the voltage (V) across a battery or cell and the current (A) through the battery or cell.  $W = V \times A$

**Primary Battery** - A battery or cell that is not rechargeable and that is disposed of once it has delivered all of its electrical energy

**Pulse Discharge** - A high-rate discharge, usually of 1 second or less.

## Q

**Quantity of charge** - The amount of electric energy supplied to a battery. Its unit is Ah, (ampere-hour.)

**Quick charge** - A method of charging a Nickel-cadmium battery for a short time at a high current level.

## R

**Rapid Charge** - Rate of charging a battery or cell to full charge capacity in 2 1/2 to 6 hours

**Rated Capacity** - Amount of milli-amperes (mA) a battery or cell can deliver under specified conditions. Rated capacity is measured at C/5 discharge rate to 1 volt @ 25°C after being charged at C/10 for 16 hours. Maximum charge/discharge rate of a battery or cell. Expressed in a multiple of the C rate

**Rechargeable Battery or Cell** - A battery or cell in which passing electrical current through it in the opposite direction of its discharge can reverse the electrochemical process, recharging the battery or cell.

**Recombination** - The action by which oxygen gas produced on overcharge is recombined chemically to avoid venting of a sealed cell and loss of water from the electrolyte.

**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 sizes, often restoring the battery to its full capacity.

**Recycling** - Reclamation of materials without endangering human health and the environment. Nickel-cadmium cells are fully recyclable.

**Resealable Safety Vent** - Resealable vent built into cylindrical and prismatic cells which prevents the build-up of high internal pressures.

**Residual Capacity** - The capacity remaining in a battery after field use, prior to charge.

**Reversal Charge** - The Nickel-cadmium cell is reverse-charged when connected to a charger in the wrong way, and current is forced to flow from the negative to positive electrodes, contrary to the direction of flow during normal charge. Here polarity is reversed, but all electric energy is consumed to generate gas.

**Reverse Load Charge** - Charge method that intersperses discharge pulses between charge pulses to promote the recombination of gases generated during fast charge. Reverse Load charge also helps to reduce memory.

## S

**Safety Vent** - A safety mechanism that is activated when the internal gas pressure rises above a normal level. There are two types: Automatically resealable, and unresealable.

**Sealed Cells** - A cell which remains closed and does not release either gas or liquid when operated within the limits of charge and temperature specified by the manufacturer. The cell cannot receive addition to the electrolyte.

**Secondary Batteries (Rechargeable)** - A battery or cell in which passing electrical current through it in the opposite direction of its discharge can reverse the electrochemical process, recharging the battery or cell. Commonly called rechargeable batteries.

**Self-Discharge** - Loss of energy or capacity in a battery or cell due to internal chemical reactions.

**Separator** - Ion permeable, electrically nonconductive material which electrically separates the positive and negative electrodes of a battery or cell.

**Series** - Interconnecting cells, or batteries with like un-terminals, are connected to increase the voltage of the resulting battery pack. This resulting battery pack's voltage is equal to the sum of voltages of the connected batteries or cells in the series.



**Shelf Life** - Under specified conditions, the duration for which a battery or cell can be stored and still retain its performance.

**Silver Calcium Battery** - Silver Calcium Battery is a type of lead-acid battery with grids made from lead-calcium-silver alloy. They stand out for its resistance to corrosion and the destructive effects of high temperatures. This makes it ideal for the installations of Uninterrupted Power supply.

**Sintered Electrode** - Sintered electrodes were originally developed by Saft and utilized nickel powder to form a highly porous metal sponge. The pores of this material are impregnated with the active material, yielding high discharge performance and very long life.

**Sintered Plaque** - A thin nickel-plated grid on which nickel powder has been coated.

**Sintered Plate** - The plaque on which active materials have been imbedded for charge and discharge reactions.

**SLA** - Sealed lead acid. An inexpensive secondary battery using lead

**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.

**Soft Cell** - A cell whose voltage rises above its defined boundaries during charging. This voltage rise may be caused by high cell impedance as a result of prolonged battery storage, very cold battery temperature or lack of electrolyte.

**Stand-by use** - The use of cells or batteries in which they are constantly charged so as to be always ready for use.

**Standard Charge** - C/10 charge at 25°C for 16 hours. Sometimes called an overnight charge.

**State of Charge** - The available capacity of a cell or battery at any given time. Expressed as a percentage of C or its rated capacity.

**State of Charge (SOC)** - Ratio of electricity, usually expressed in capacity, remaining in a battery or cell on discharge compared to its rated capacity.

**Storage Life / Shelf Life** - The length of time a cell or battery can be stored on open circuit without permanent deterioration of its performance. Nickel-cadmium cells or batteries can be stored at any state of charge including a fully discharged state.

**Sulfation** - Growth of lead sulphate crystals in SLA batteries which inhibits current flow. Sulfation is caused by storage at low state of charge.

**Sulphur Dioxide Lithium** - Used almost exclusively in military/aerospace applications. These cells have somewhat lower energy density than manganese dioxide lithium or poly lithium cells. Service life and energy density are generally less than half that of thionyl chloride lithium cells. Require emergency vent structures for safety reasons.

## T

**Tab** - The mechanical lug used to connect cells together to form a battery or to connect it to equipment.

**Temperature Cut-Off (TCO)** - Secondary charge termination at a specified temperature; used in timed, rapid, and fast charge systems

**Thermal Fuse** - A one-time, non-resettable fuse used to protect against over-current Thermal runaway — A critical condition arising during constant voltage charging in which the current and the temperature of the battery produce a cumulative mutually-reinforcing effect which further increases them and can lead to the destruction of the battery.

**Thermal Runaway** - A critical condition arising during constant voltage charging in which the current and the temperature of the battery produce a cumulative mutually-reinforcing effect which further increases them and can lead to the destruction of the battery.

**Thermistor** - Temperature sensing device, used to measure the temperature of a battery pack or cell. Typically a Negative Temperature Coefficient (NTC) device. Exhibits a predictable and precise decrease in resistance with an increase in temperature.

**Thermostat** - Circuit protection device used to prevent over-current and over-temperature. A thermostat will go from a low-resistance state to an open circuit at a predetermined temperature.

**Thionyl Chloride Lithium** - Offer extremely long service life (15 to 20 years) and low self-discharge

rates. Ideal for applications with low continuous-current or moderate pulse-current requirements, and applications where physical access is limited. Highest energy density of all lithium types. Manufactured in welded, hermetically sealed cases in cylindrical, coin, and wafer types.

**Three Phase Zone** - The area where 3 phases (gas, liquid, and solid) contact with each other, Reactions of substances composing these 3 phases take place easily.

**Time Charge** - A charging method, terminated after a predetermined amount of time, designed to charge a battery or cell within 6 to 16 hours.

**Top-Off Charge** - Charge step designed to fully charge a battery or cell when a rapid or fast charge termination that does not reach 100% SOC is used. Most commonly used after a dT/dt termination.

**Transport** - Movement of ions within a cell. Cations carry net-positive charges; anions carry net-negative charges.

## V

**Voltage Cut-off** - Electronics board which disconnect the load from a battery pack.

**Voltage Delay** - During open circuit storage, some battery systems develop a passivation film on the surface of the active material. On the initial discharge, these batteries may momentarily demonstrate a lower-than-normal voltage until this film is removed by the discharge.

**Voltage Limit** - A voltage value a battery is not permitted to rise above on charge and/or fall below on discharge.

**Voltage-Limiting Charger** - A charger that limits the maximum voltage to a battery but allows the current to drop while maintaining the voltage limit. A voltage limiting charge normally also includes current limiting. (Typically used on SLA and Li-ion chargers).

**Volumetric Energy Density** - Ratio of a cell's energy to its total volume. Usually expressed in Watt-hours per litre (Wh/l). Also called "power density."

## W

**Watt** - A measurement of total power. It is amperes multiplied by volts. 120 volt @ 1 amp = 120 watts @ 10 amps.

**Wet Cell** - A cell, the electrolyte of which is in liquid form and free to flow and move.

**Watt Hours (Wh)** - Amount of electric energy that can be withdrawn from a battery or cell under specified conditions. This energy is measured in milli-Watt-hours (mWh). Product of the discharge voltage, discharge rate, and discharge time.

**Working Voltage** - Voltage range of a battery or cell during discharge.

