ELECTROCHEM®
AN ULTRALIFE COMPANY

Key Battery Terminology

Active Material	The material in the electrodes of a cell or battery that takes part in the electrochemical reactions of charge or discharge.
Ambient Temperature	The average temperature of the surroundings.
Anode	The negative electrode in a (battery) cell.
Battery (Pack)	One or more cells electrically connected in an appropriate arrangement to provide the required operating voltage and current levels.
Bobbin Cell	This refers to one of the most basic cell designs where one electrode typically consists of a solid cylindrical core and the other electrode is an annular layer surrounding it. Such a cell has a relatively low electrode surface area, resulting in a lower power cell than other cell designs.
Boost Charge	Charging of batteries in storage to maintain their capacity and counter the effects of self-discharge.
Capacity	Measured in amp-hours. The quantity of electrical energy that can be delivered by a cell or battery. The capacity is proportional to the size of the battery for a given chemistry.
Cathode	The positive electrode in a (battery) cell.
Cell	The basic electrochemical unit providing a source of electrical energy by direct conversion of chemical energy. A cell consists of an assembly of electrodes, separators, electrolyte, a container and electrical terminals.
Charging	The act of providing external electrical energy to a rechargeable battery (or cell), in order to reuse it multiple times. During charging, ions move through the electrolyte from the cathode to the anode.
Chemistry	Cells are classified based on the specific chemistry of the materials contained within. Common chemistries include variations of Lead, Nickel and Lithium metal. The chemistry dictates the cell voltage and the performance characteristics and each chemistry has its optimum charging algorithm; traditionally different battery chemistries are not interchangeable in the same charger. Each chemistry also possesses its own shipping, handling and disposal regulatory requirements.
Constant Current Charge	A method of charging a battery using a fixed current.
Constant Voltage Charge	A method of charging the battery by applying a fixed voltage, and allowing variations in the current; also called constant potential charge.
Current	Measured in amps. This corresponds to the rate at which electrons can be removed from the battery. The current capability of a battery depends on the cell design and the chemistry.
Cycle Life	The number of charge/discharge cycles a battery can provide before it is at its end of life; typically a battery is considered end of life (EOL) when its nominal capacity falls below 60% - 80% of its initial capacity. Factors that contribute to the depletion of a battery's cycle life are usage, temperature, aging, maintenance history, internal resistance and depth of discharge.

CCV	Closed circuit voltage measured, when a battery or cell is under a load from an external source.
C-Rate	C-rate is a measure of the rate (or current) at which a battery is discharged, relative to its maximum capacity. Example: A battery rated at 1Ah provides 1A for one hour if discharged at a 1C rate.
Discharge	A loss or release of energy from cell or battery. The conversion of chemical energy into electrical energy and withdrawal of the energy into a load. During discharge, the ions move through the electrolyte from the negative electrode back to the positive electrode.
Duty Cycle	The operating regime of a cell or battery including factors such as charge and discharge rate, depth of discharge, cycle length, and length of time in the standby mode.
Electrode	The key, energy delivering active material that makes up a cell. This is the site or location where the fundamental electrochemical processes take place.
Electrolyte	The medium (i.e. aqueous solution, gel, organic, inorganic, etc.) which provides ion transport between the cathode and anode of a cell.
Energy	Measured in watt-hours or Ampere-hours. This is the product of the Voltage and the cell Capacity.
Energy Density	Energy in a cell or battery normalized over its size (in weight or volume). Can be measured gravimetrically (watt-hours per kilogram) or volumetrically (watt-hours per liter).
Gassing	The evolution of gas from one or more of the electrodes in a cell. Gassing commonly results from local action (self-discharging) or from the electrolysis of the electrolyte during charging.
Impedance	The impedance of a cell is a complex quantity that refers to the resistance to flow of an Alternating Current (AC) through a cell. It includes the DC resistance as well as capacitance and inductance, which change with frequency.
Internal Resistance	This is a concept typically used with DC (Direct Current). It refers to the resistance to flow of an electric current within a cell or battery; it is the sum of all the ionic and electronic and kinetic resistances of the cell components. A battery with low internal resistance provides excellent current flow and delivers all available energy without a significant voltage drop.
Load	A term used to define the current drain on a battery based on the resistance of any device connected to it. Internal battery resistance and depleting state-of-charge cause the voltage to drop.
Memory Effect	Some cell chemistries (like Ni/Cd) require the cell to be fully discharged before being recharged in order to maintain their discharge capacities. If this is not done, the capacity from cycle to cycle diminishes fairly rapidly.
Negative Electrode	The electrode acting as an anode when a cell or battery is discharging.
Nominal Voltage	The voltage of a battery midway in the discharge between the fully charged state and the end voltage at which a battery spends most of its time on the discharge curve.

Open Circuit Voltage (OCV)	Voltage measurement where the battery or cell is under no load from an external source.
Operating Temperature	The temperature at which a battery operates. The battery will operate effectively within a specified temperature range which varies based on the battery's function and application purposes. If the battery is used outside of this range, the application may fail prematurely.
Overcharge	Charging beyond the maximum, safe capacity limit of a cell or battery. This typically has very negative consequences depending on the cell chemistry, hence must be avoided.
Over Discharge	Discharge past the point where the full capacity of the cell battery has been obtained. This can also lead to undesirable situations.
Parallel Pack	Cells are connected in parallel to increase the capacity of a battery pack. The positive terminals of all cells are connected together (or to a common conductor), while the negative terminals of all cells are connected in a similar fashion. The battery pack capacity will be the sum of all cell capacities combined, while the pack voltage will be the voltage of one cell.
Passivation	This is a phenomenon where a protective layer forms on the surface of an electrode upon initial contact with the electrolyte upon assembly. After an initial passivation layer is formed, the process slows down considerably and prevents further reaction on the electrode surface and thereby extends the shelf life of the battery (cell). This is an important characteristic of Lithium cells.
Positive Electrode	The electrode acting as a cathode when a cell or battery is discharging.
Power Density	The ratio of the power available from a battery to its volume (W/L).
Primary Battery	Also known as a non-rechargeable or single use battery. Typically a primary battery provides higher energy density in the same package compared to a rechargeable battery. This provides a longer run time in applications.
Protection Circuit	Electrical circuit built into a battery pack to ensure safety under all operational/ environmental circumstances; preventing abuses such as excessive current, operation at extreme temperatures, overcharge and over-discharge.
Rated Capacity	The Number of Ampere-hours a battery can deliver under specific conditions (rate of discharge, end voltage, temperature); usually the manufacturer's rating.
Secondary Battery	Also known as a rechargeable battery.
Self-Discharge Rate	During extended storage, cells will slowly lose some of their capacity (energy) due to internal chemical reactions to the chemistry. This affects shelf-life.
Separator	An ion permeable, electronically insulating, spacer or material separating the positive and negative electrodes in a cell, thereby preventing electronic contact (or short) between them. The separator is a critical component in a cell that enables the electrochemical reactions to proceed as designed.
Series Pack Configuration	Cells are connected in series to increase the voltage of the battery pack. The positive terminal of the first cell in the series is connected to the negative terminal of the second cell in the series and so on. The voltage of the battery

	pack is the sum of all cell voltages, while the capacity of the battery pack will be the lowest capacity cell in the series.
Shelf Life	The length of time a cell or battery can be stored under specified conditions before being used in a device. This duration will depend on the chemistry, the initial state of charge, the ambient temperature as well as any leakage current in the electrical circuit (in the case of a battery pack).
Smart Battery	A Smart Battery is a rechargeable battery pack incorporating a Battery Management System (BMS) with an external communication data bus (usually a 2-wire system called SMBus). The BMS protects the battery from operating outside its safe limits by monitoring key cell parameters (current, voltage, temperature, cycle count, state of charge, etc.) in a single or multi-cell pack, performing cell balancing to ensure optimum performance, battery authentication, as well as external communication of the battery health data with a smart charger and/or host device through the SMBus.
Spirally Wound Cell	A cylindrical cell which uses an electrode structure made by winding electrode sheets or ribbons separated by a separator, into a cylindrical "jelly roll" construction in order to increase the electrode surface area and provide a higher rate cell compared to a bobbin cell.
State of Charge (SOC)	The available capacity at any given time in a battery expressed as a percentage of rated capacity.
State of Health (SOH)	While there is no standard definition for this, it generally refers to how a cell or battery is performing in relation to its design expectation. The impedance is one way to report the state of health.
Sulfation	Process occurring in lead batteries that have been stored and allowed to self-discharge for extended periods of time. Large crystals of lead sulfate grow that interfere with the function of the active materials.
Temperature Effects	Battery life dramatically shortens when operated at extreme high or low temperatures. High temperatures increase internal cell pressure, which can result in leaks or other cell integrity issues. Low temperatures can increase internal resistance which produces heat. This heat can cause the electrolyte to evaporate in a non-hermetic system, hence reduces capacity.
Thermal Runaway	A condition whereby a battery on charge or discharge will overheat in an uncontrolled manner due to internal chemical reactions triggered upon reaching a threshold due to overcharge or over-discharge or other electrical or mechanical abuse.
Voltage Delay	Time delay for a battery to deliver the required operating voltage after it is placed under load. Typically a voltage depression followed by a recovery will be observed when this phenomenon is present.
Voltage Depression	An abnormally low voltage, below the expected value, during the discharge of a battery. Sometimes seen in extremely low temperatures (typically < -20°C).
Voltage (potential)	Measured in volts. The cell voltage is defined by its chemistry (i.e. active materials). This is independent of the size of the battery.
Working Voltage	The typical voltage or range of voltages of a battery during discharge.