Battery storage systems

Batteries

These are electrochemical devices that store energy chemically and convert it into electricity.
Their use with UPS systems involves several batteries being connected in series (string) to reach the DC stage voltage required by the UPS. Strings are often connected in parallel to increase runtime in the event of a mains outage and/or for redundancy.
Batteries can be installed within the UPS (normally for small UPS systems) or assembled in external cabinets or on shelving. The batteries available for use with UPS systems include:

- Normal/long life VRLA batteries with flame-retardant containers.
- Long life open-vented lead batteries with flame-retardant containers.
- Long life nickel-cadmium (NiCd) batteries for special applications.
- Lithium-ion (Li-ion) batteries with integrated monitoring and equalisation system.

VRLA batteries

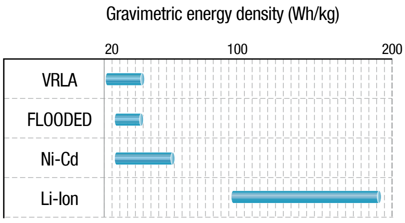
VRLA (Valve Regulated Lead Acid) batteries are lead batteries with a sealed safety valve container for releasing excess gas in the event of internal overpressure.
Their development was aimed at limiting the emission of hydrogen into the atmosphere and to avoid the use of liquid electrolyte. The liquid electrolyte is replaced by gel electrolyte (GEL technology) or absorbed inside the separators (AGM technology) to prevent acid leaking.
Sealed batteries do not allow for water to be added to the electrolyte, therefore the evaporation of the water contained in the electrolyte, due for example to high room temperatures or internal heating as a result of charging/discharging cycles, decreases their lifetime.

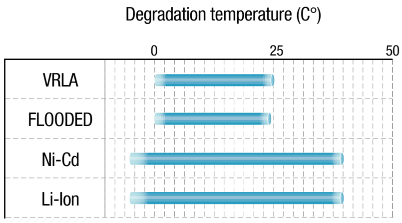
Open-vented lead batteries

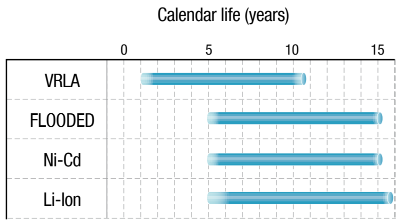
These batteries are made with lead-based electrodes and immersed in a liquid electrolyte comprising water and sulphuric acid. They have an expected lifetime of 15-20 years and statistically are very reliable until at least halfway through their lifetime. Subsequently, a cell short circuit may occur, causing a slight reduction in the runtime but this does not cause a critical situation. Using a liquid electrolyte has some disadvantages, such as shelf installation instead of cabinets to enable electrolyte top-ups and regular inspections, and requires a suitably ventilated dedicated room for reasons of safety.

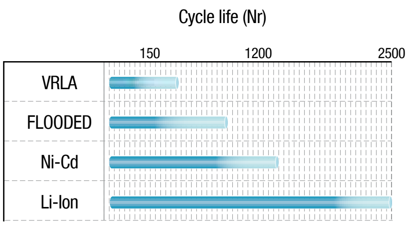
Nickel-Cadmium batteries

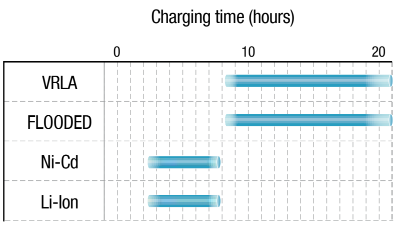
NiCd technology uses alkaline liquid electrolyte and is especially robust and reliable. These batteries are designed to operate in difficult environmental conditions and support demanding work cycles (frequent charging/discharging), and are usually installed in dedicated rooms on shelving that enables the electrolyte to be topped up.
As Cadmium is toxic the use of this type of battery is limited. Furthermore, the requirement for regular complete discharge cycles restricts the number of possible applications with UPS systems.











socomec Innovative Power Solutions

Lithium-ion batteries

The Lithium-Ion battery (or Li-Ion battery or LIB), introduced commercially in 1991, has three main components: the positive and negative electrodes and the electrolyte.

The negative electrode (anode) is primarily composed of graphite. A Li-Titanate anode (which can be combined with any other cathode) has also been developed for better safety and battery performance, but with a significantly lower energy density.

The positive electrode (cathode) is composed of a metal oxide.

The Lithium-Cobalt oxide (LCO) offers a higher energy density but presents safety risks, especially when damaged. This chemical composition is widely used in consumer electronics.

The lithium iron phosphate (LFP), the lithium manganese oxide (LMO) and the lithium nickel manganese cobalt oxide (NMC) batteries offer a lower energy density, but are inherently safer.

The electrolyte is composed of a lithium salt in an organic solvent.

The rapid evolution of the Lithium-Ion battery technology over the last decade - due to its wide use in many markets such as electric vehicles, Energy Storage Systems and consumer electronics - has provided several advantages, such as energy efficiency, environmental friendliness, and space savings.

These aspects contribute to the reduction of the Total Cost of Ownership of many UPS applications and provide a reliably available back-up power solution in a reduced footprint, with an extended life time and reduced maintenance.

Ensuring permanent power supply for business continuity whilst reducing the Total Cost of Ownership is a main concern for any critical infrastructure.

Li-Ion batteries bring significant advantages in UPS applications, including the considerable reduction in weight and floor space for the same runtime, the possibility of recharging them quickly, and their long cyclic and calendar lifetime.

Lithium-ion capacitors

A Lithium-Ion Capacitor (LIC) is a hybrid between a Lithium-Ion battery and a supercapacitor. A Lithium-Ion battery cathode contains lithium, inducing a thermal runaway reaction when the Li spinel decomposes and reacts with the electrolyte. On the other hand, an LIC cathode is a typical supercapacitor cathode using activated carbon, which therefore never undergoes thermal runaway.

An LIC anode is similar to a Lithium-Ion battery anode, but is subjected to lithium doping when charging, and a lithium evacuation when discharging. Its electrolyte is also similar to a Lithium-Ion battery electrolyte and contains Lithium salts.

LIC cells can be charged and discharged using current levels much higher than for traditional lead-acid batteries, which makes this solution ideal for any application or process facing frequent utility micro-interruptions. It does not suffer degradation due to cycling and it is rapidly available again to cope with any subsequent outages.

The LIC is also the ideal back-up power supply solution for a wide temperature range (-10 °C to +70 °C), avoiding additional cooling costs.

Finally the LIC has a very long operating life time (over 15 years) without requiring maintenance, whereas a standard VRLA battery needs to be replaced every five to seven years despite its “design life” often being specified as 10 years.