

Lithium battery

CR2032 lithium button cell battery

Lithium 9 volt, AA, & AAA sizes

Lithium batteries are disposable (primary) batteries that have lithium metal or lithium compounds as an anode. Depending on the design and chemical compounds used, lithium cells can produce voltages from 1.5 V to about 3.7 V, over twice the voltage of an ordinary zinc-carbon battery or alkaline battery.^[1] Lithium batteries are widely used in products such as portable consumer electronic devices.

Lithium primary batteries account for 28% of all primary battery sales in Japan but only 1% of all battery sales in Switzerland. In the UK and EU only 0.5% of all battery sales including secondary types are lithium primaries.

Description

The term "lithium battery" refers to a family of different chemistries, comprising many types of cathodes and electrolytes.

The most common type of lithium cell used in consumer applications uses metallic lithium as anode and manganese dioxide as cathode, with a salt of lithium dissolved in an organic solvent.

Disassembled CR2032 battery From left — negative cup from inner side with layer of lithium (oxidized in air), separator (porous material), cathode (manganese dioxide), metal grid — current collector, metal casing (+) (damaged during opening the cell), on the bottom is plastic sealing ring

Another type of lithium cell having a large energy density is the lithium-thionyl chloride cell. Lithium-thionyl chloride batteries are generally not sold to the consumer market, and find more use in commercial/industrial applications, or are installed into devices where no consumer replacement is performed. In this cell, a liquid mixture of thionyl chloride (SOCl₂) and lithium tetrachloroaluminate (LiAlCl₄) acts as the electrolyte and cathode respectively. A porous carbon material serves as a cathode current collector which receives electrons from the external circuit. Lithium-thionyl chloride batteries are well suited to extremely low-current applications where long life is necessary, such as wireless alarm systems.

Chemistry	Cathode	Electrolyte	Nominal voltage	Circuit voltage	Wh/kg	Wh/dm ³
Li-MnO ₂ (Li-Mn, "CR")	Heat-treated manganese dioxide	Lithium perchlorate in propylene carbonate and dimethoxyethane	3 V	3.3 V	280	580
	The most common consumer grade battery, about 80% of the lithium battery market. Uses inexpensive materials. Suitable for low-drain, long-life, low-cost applications. High energy density per both mass and volume. Can deliver high pulse currents. Wide temperature range. With discharge the internal impedance rises and the terminal voltage decreases. Maximum temperature limited to about 60 °C. High self-discharge at high temperatures.					
Li-SOCl ₂	Thionyl chloride	Lithium tetrachloroaluminate in thionyl chloride	3.5 V	3.65 V	500	1200
	Liquid cathode. For low temperature applications. Can operate down to -55 °C, where it retains over 50% of its rated capacity. Negligible amount of gas generated in nominal use, limited amount under abuse. Has relatively high internal impedance and limited short-circuit current. High energy density, about 500 Wh/kg. Toxic. Electrolyte reacts with water. Low-current cells used for portable electronics and memory backup. High-current cells used in military applications. In long storage forms passivation layer on anode, which may lead to temporary voltage delay when put into service. High cost and safety concerns limit use in civilian applications. Can explode when shorted. Underwriters Laboratories require trained technician for replacement of these batteries. Hazardous waste, Class 9 Hazmat shipment. ^[6]					
Li-SOCl ₂ .BrCl, Li-BCX	Thionyl chloride with bromine chloride	Lithium tetrachloroaluminate in thionyl chloride	3.7-3.8 V	3.9 V	350	770
	Liquid cathode. A variant of the thionyl chloride battery, with 300 mV higher voltage. The higher voltage drops back to 3.5 V soon as the bromine chloride gets consumed during the first 10-20% of discharge. The cells with added bromine chloride are thought to be safer when abused.					
Li-SO ₂ Cl ₂	Sulfuryl chloride		3.7	3.95	330	720
	Liquid cathode. Similar to thionyl chloride. Discharge does not result in buildup of elemental sulfur, which is thought to be involved in some hazardous reactions, therefore sulfuryl chloride batteries may be safer. Commercial deployment hindered by tendency of the electrolyte to corrode the lithium anodes, reducing the shelf life. Chlorine is added to some cells to make them more resistant to abuse. Sulfuryl chloride cells give less maximum current than thionyl chloride ones, due to polarization of the carbon cathode. Sulfuryl chloride reacts violently with water, releasing hydrogen chloride and sulfuric acid. ^[7]					

