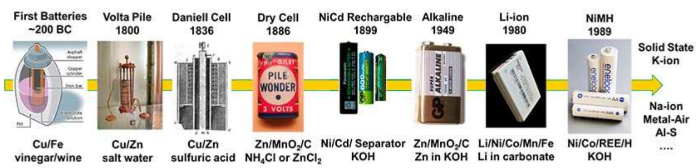
History of Battery

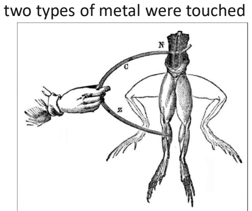


Dr. Vahid Esfahanian
An Introduction to Battery Technologies
Lecture #2

History of Battery cell

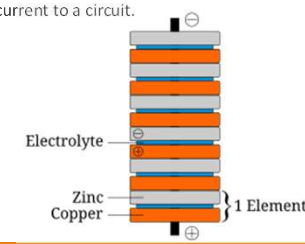
Galvani (1790):

- A copper wire was attached to the exposed nerve and a zinc wire was attached to the leg muscle.
- When the two types of metal were touched together

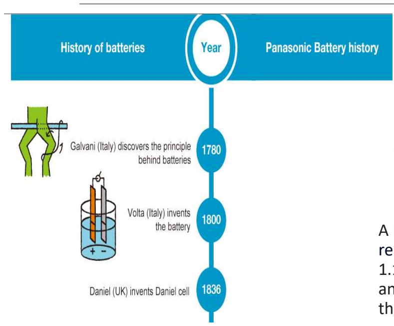


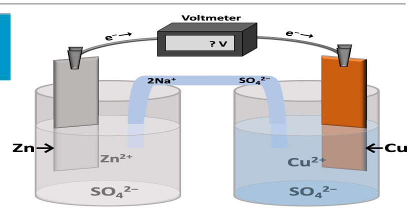
Volta(1799):

The voltaic pile was the first electrical battery that could continuously provide an electric current to a circuit.



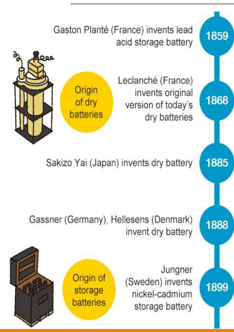
Battery History

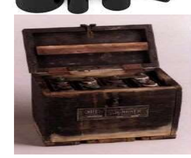




A Daniell cell is a device that transforms chemical energy released by redox reactions into electrical energy. It has a 1.1 V electrical potential. Zinc (Zn), which serves as the anode in a Daniell Cell, and Copper (Cu), which serves as the cathode, are the two different metals in use.

Battery History

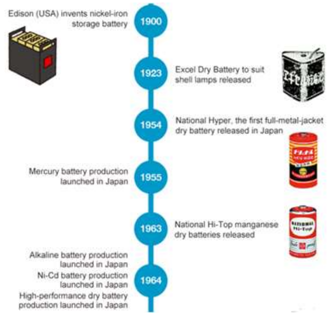


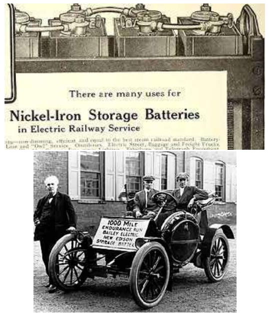


A dry cell is a type of electric battery, commonly used for portable electrical devices. Unlike wet cell batteries, which have a liquid electrolyte, dry cells use an electrolyte in the form of a paste, and are thus less susceptible to leakage.

Waldmar Jungner patented a rechargeable nickel-cadmium cell with electrodes made of these two metals in a solution of potassium hydroxide.

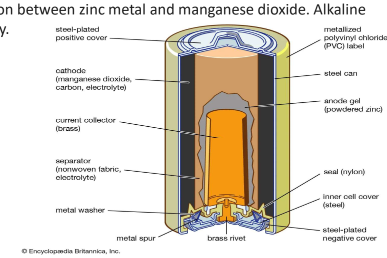
Battery History



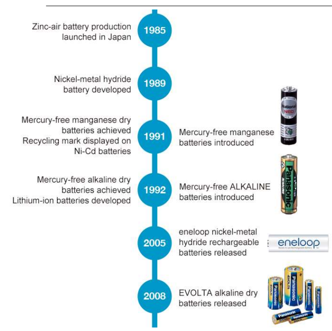


History of Battery cell

An alkaline battery is a type of primary battery where the electrolyte (most commonly potassium hydroxide) has a pH value above 7. Typically these batteries derive energy from the reaction between zinc metal and manganese dioxide. Alkaline battery.



History of Battery cell



Battery standards

International standard IEC 60086–3 defines an alphanumeric coding system for “Watch batteries”

Let’s make an example!
Define the characteristics of with code numbers CR2032
1-The first letter indicates the chemistry of the cell
2-The second letter is usually R, indicating that the cell has a round shape.
3-The first one or two digits are the nominal diameter of the cell in millimeters rounded down The last two digits are the overall height in tenths of a millimeter.

IEC International Electrotechnical Commission

What are the descriptions of SR515 ?

Watch cells standard Table

Table 1.1 Common specification of coin cells [1].

Letter code	Common name	Positive electrode	Electrolyte	Negative electrode	Nominal voltage (V)	End-point voltage (V)
L	Alkaline	Manganese dioxide	Alkali	Zinc	1.5	1.0
S	Silver	Silver oxide	Alkali	Zinc	1.55	1.2
P	Zinc–air	Oxygen	Alkali	Zinc	1.4	1.2
C	Lithium	Manganese dioxide	Organic	Lithium	3	2.0
B		Carbon monofluoride	Organic	Lithium	3	2.0
G		Copper oxide	Organic	Lithium	1.5	1.2
Z	Nickel oxyhydroxide	Manganese dioxide nickel oxyhydroxide	Alkali	Zinc	1.5	?
M, N	Mercury	Mercuric oxide	Alkali	Zinc	1.35/1.40	1.1

Table 1.2 Diameter code for the first one or two digits for coin cells [1].

Number code	Nominal diameter (mm)	Tolerance (mm)	Number code	Nominal diameter (mm)	Tolerance (mm)
4	4.8	±0.15	12	12.5	±0.25
5	5.8	±0.15	16	16.0	±0.25
6	6.8	±0.10	20	20.0	±0.25
7	7.9	±0.15	23	23.0	±0.50
9	9.5	±0.15	24	24.5	±0.50
10	10.0	±0.20	44	5.4	±0.20
11	11.6	±0.20			

Battery Standards

IEC 60086 :Covers primary batteries (non-rechargeable) and provides general requirements for dimensions, nomenclature, terminal configurations, markings, test methods, performance, safety, and environmental aspects.

IEC 62133:Covers safety and test requirements for portable sealed secondary lithium cells and batteries.

IEC 62619: Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications.

Battery Safety

Proper care must be taken when handling and working with lithium batteries and cells. If used properly, they can be quite safe. But if misused, they can present a serious fire hazard.

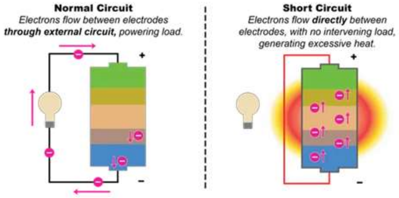
A "catastrophic failure" of an electric bicycle lithium-ion battery pack being charged caused a fire last week that destroyed a Coeur d'Alene Police Department equipment storage building

Phone battery explosion

Car battery explosion

Short circuit

A short circuit occurs when the two terminals of a battery pack or single cell are connected together. Essentially, connecting its positive terminal to its own negative terminal. This creates a short loop of current that flows directly through battery with nothing to slow it down other than the battery's own low internal resistance.



Excess temperature

- batteries to operate less efficiently
- Your cells will die sooner
- Not deliver their full rated capacities
- Every battery has its own operating temperature range for example, Lithium battery cells should never exceed 130°C.

THERMAL RUNAWAY :Thermal runaway is a dangerous phenomenon that can occur in batteries, particularly lithium-ion batteries. It's a chain reaction where a battery cell rapidly overheats, causing a cascade of chemical reactions that release heat faster than it can be dissipated. This leads to a potentially explosive situation, including venting, fire, or even explosion.

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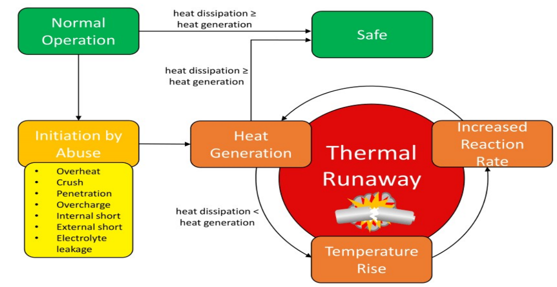
Thermal Runaway diagram



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