Lithium Battery Safety

Emanuele Ripiccini

OHS-PR

COSEC meeting
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Outline

- Thermal runaway
- EPFL directive
  - Charging
  - Storage
  - What to do in an emergency
  - Disposal
- Incidents

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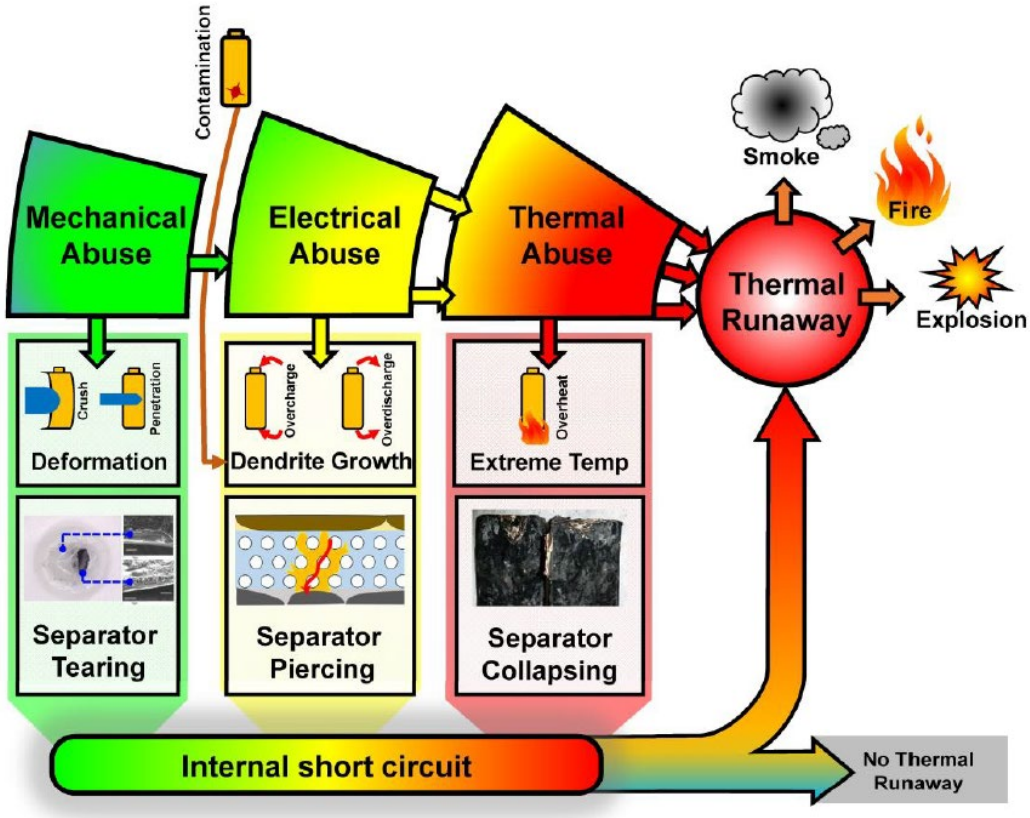
Thermal runaway

Thermal runaway is a self-sustaining chain reaction caused by internal overheating of the battery.



Source : "Thermal Runaway Mechanism of Lithium Ion Battery for Electric Vehicles: A Review" X. Feng, et al Tsinghua University – Beijing

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Thermal runaway

Thermal runaway of a battery can be described in three main temperature stages:

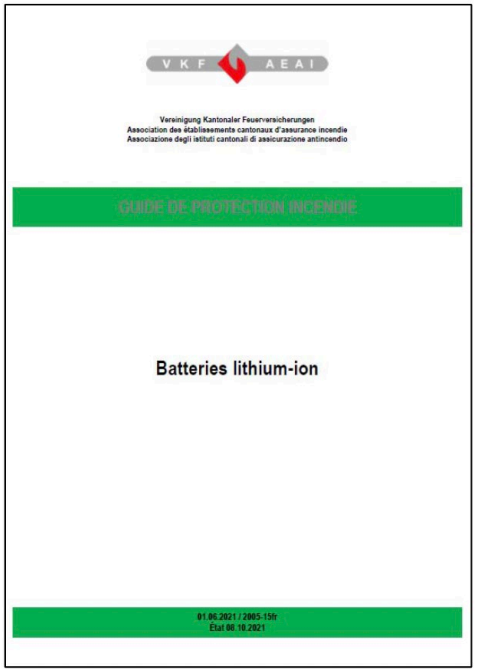
- **Stage 1: Ambient temperature up to 125°C – Start of thermal runaway**
- **Stage 2: 125°C – 180°C – Gas release, accelerated heating, and smoke generation**
- **Stage 3: 180°C and above – Explosive decomposition (flame)**

Molécule	Concentration (%)
CO	~40
H_2	~30
CO_2	~20
Méthane	7
Ethylène	3
Ethane	1
Propylène	1
HF	~0.3

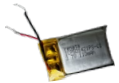
Source : Saft

Guideline from the Association of Cantonal Fire Insurance Establishments (AEAI)

Risque	Entrepôts (chap. 4.1)	Systèmes de stockage (chap. 4.4-4.6)	Véhicules (chap. 4.8-4.12)		Hazard Level (HL)
Faible	< 1 kWh par m^3 d'unité de stockage	< 15 kWh par compartiment coupe-feu	< 1 kWh par véhicule	→	I
Moyen	1 – 50 kWh par m^3 d'unité de stockage	15 – 100 kWh par compartiment coupe-feu	1 – 50 kWh par véhicule	→	II
Élevé	> 50 kWh par m^3 d'unité de stockage	> 100 kWh par compartiment coupe-feu	> 50 kWh par véhicule	→	III



Examples

Battery	Charge (mAh)	Voltage (V)	Energy (kWh)	Number of batteries needed to get 1 kWh	Number of batteries needed to get 15 kWh/fire compartment
	110	3.7	0.000407	2457	36855
	2000	3.7	0.0074	135	2027
	6000	3.7	0.022	45	675
	10000	3.7	0.037	27	405
	10000	22.2	0.222	5	68
	20000	22.2	0.444	3	34
	62000	3.7	0.230	5	65

Complementary safety directive

Domaine Sécurité et Exploitation)
Sécurité et Santé au Travail

Technical Directive Complementary to LEX 1.5.1: Use of Lithium Batteries

September 2025
Version 1.2

Aim:

- Limit the probability of thermal runaway of a lithium battery.
- Limit the spread of a fire caused by the thermal runaway of a lithium battery

https://go.epfl.ch/directive_BL_EN

Web page

https://go.epfl.ch/lithium_batteries

Charging

General rules

- Follow the manufacturer's instructions.
- Avoid heat sources, flammable materials, vibration and direct sunlight.
- Charge on non-combustible surfaces whenever possible.
- Charging and storage are strictly prohibited in ATEX areas.
- Do not charge damaged batteries at EPFL.
- Charging and storage in basements are strongly discouraged.

Specific cases:

E-bike, e-scooter and self-balancing scooter batteries

- Supervised charging is mandatory (absence > 30 min = temporary stop).
- EPFL charging station

Lithium batteries without a BMS (Battery Management System)

- Charge only with a suitable balanced charger.
- If available, use a charger with temperature monitoring.
- Charging outside working hours is strongly discouraged.

Other lithium batteries

- Use only the supplied charger or a model-appropriate charger.
- Recharging non-rechargeable batteries is strictly prohibited (e.g., button cells).
- On construction sites: unattended charging is prohibited outside working hours.

Electric bikes, e-scooters and self-balancing scooters

It is forbidden to store or charge electric bike and e-scooter batteries in any premises outside office hours.

In addition, it is forbidden to charge them if an absence of more than 30 minutes is planned in the charging room.

Storage

General rules:

- Storage > 2 weeks
  - Follow the manufacturer's instructions.
  - If no specific instructions → Store the battery at ~50% state of charge.
- Follow the precautions in Table 1 (storage according to battery type and energy).

Table exemptions:

- The following batteries are not subject to the storage restrictions:
- Laptop, phone, tablet and watch (smartwatch/pedometer) batteries.
- UPS, power banks, installed electric/hybrid vehicle batteries, pallet trucks.
- Power tools and small batteries with an integrated BMS in electronic devices.

Type of battery	Total energy in the room [Wh]	Maximum battery energy [Wh]	Number of batteries in the room	Storage only
Commercial lithium batteries	< 100	≤ 15	≤ 10	Lithium battery bag
			> 10	Fireballs + Lithium battery box
		≥ 15	–	
	≥ 100	≤ 500	≤ 20	
			> 20	Contact OHS
		> 500	–	
Non commercial or altered lithium batteries	–	–	–	

The exemption regime becomes void if the battery and/or the system using it has been modified through handling not authorized by the system supplier.

Storage solutions

Lithium battery bag

Swaytronic LiPo Safe Bag

Max storage energy: 15 Wh

Lithium battery box

RO-Safety

Max storage energy: 220 Wh

RO-Safety XL

Max storage energy: 666 Wh

Fireballs

Swaytronic Fireballs Fire protection – fire extinguishing granulate

Bag test

LiPo 2.2 Ah 7.4 V, 16.28 Wh

Box test

Thermal runaway of a LiPo 31 Wh (max per enclosure: 666 Wh)

Maximum temperature inside the box: 80°C.

Battery outside the bag: no damage.

Battery inside the bag: no damage.

Bag containing the failing battery: melted.

What to do in case of an issue

Battery on fire or releasing smoke

1. Leave the room immediately.
2. Call as soon as possible on 021 693 3000 (or 115 from a landline).
3. If a lithium-battery fire extinguisher is available, AND you are trained to use it, try to extinguish the fire without putting yourself at risk.

DO NOT USE WATER OR ANY OTHER EXTINGUISHING MEANS NOT INTENDED FOR THIS PURPOSE.

Swollen battery or liquid leakage

Call 021 693 3000 (or 115 from a landline) so that the response team can secure your battery until it is disposed of by a specialized company.

Disposal of a lithium battery

When should a battery be disposed of?

- Battery at end of life.
- Damaged outer casing.

Disposal procedure:

1. Cover exposed electrodes with insulating tape.
2. Button cells → Wrap them completely with insulating tape.
3. If possible, package batteries separately in plastic bags.
4. Take the battery to the central waste collection point (PL 0 04) and place it in the dedicated metal container. **At associated campuses, please contact the building safety officer.**

Recent incidents

Date	Incident	Victims	Fire	Damage	Analysis	Measures
01/2026	Thermal runaway – mobile phone battery	0	Fire outbreak	$	Improper handling	Ongoing
12/2025	Thermal runaway – NMR spectrometer battery	0	Fire outbreak	$$$$	Deep discharge after prolonged storage below the charge limit (?)	Replace the spectrometer with a model without a lithium battery
10/2025	Thermal runaway – racing car battery	0	No	$$$	(?)	• Dedicated fire blanket • Dedicated fire extinguisher• Box + fireball
08/2025	Onset of thermal runaway	0	No	$$	Improper connection (?)	• Improved storage conditions • Follow the battery supplier's guidelines

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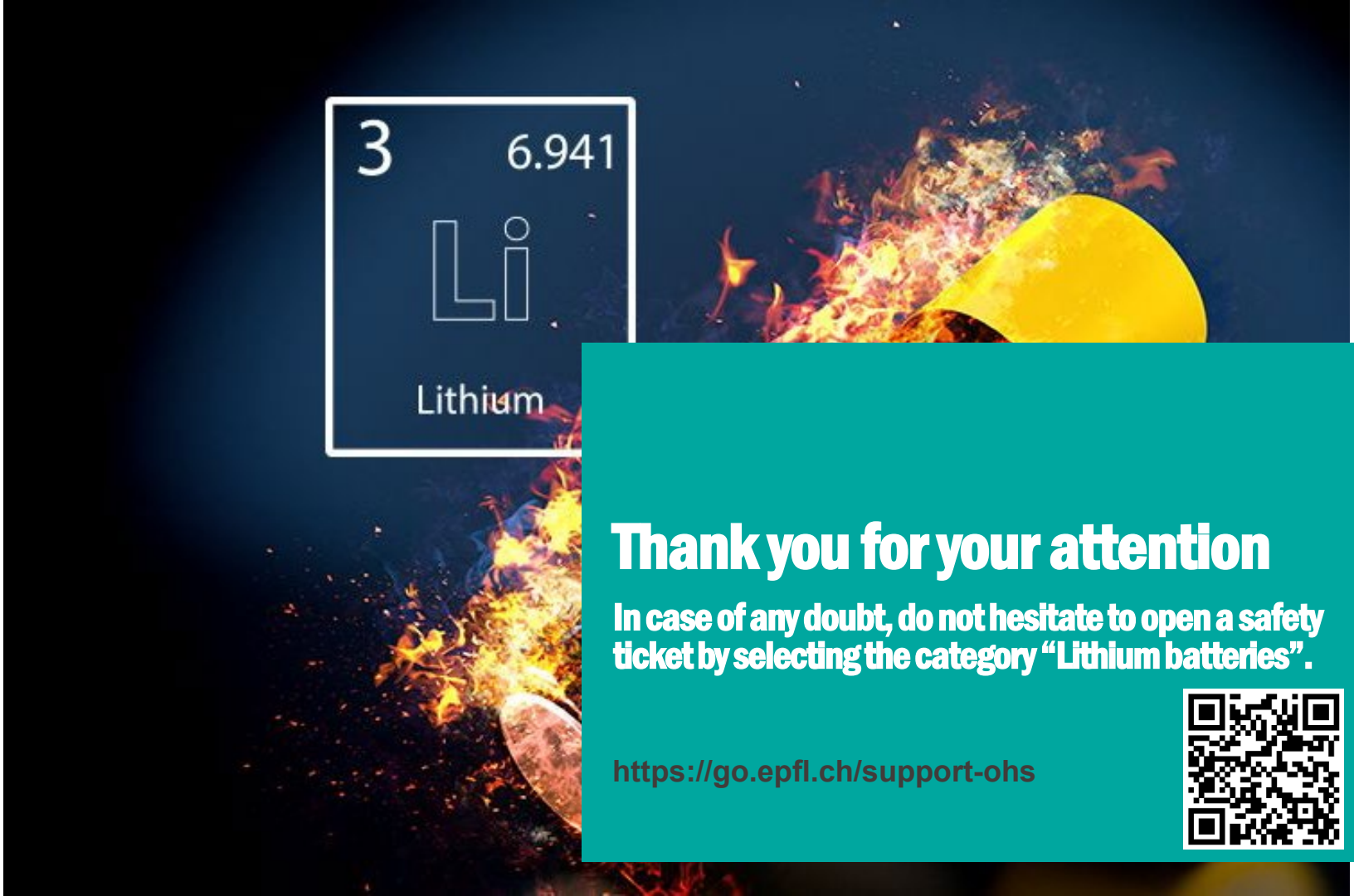

Thank you for your attention

In case of any doubt, do not hesitate to open a safety ticket by selecting the category "Lithium batteries".

https://go.epfl.ch/support-ohs