VGB POWERTECH

Practical Guide

to the handling of lithium batteries with regard to hazardous substances law and fire protection

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Contents

1 Preliminary remarks

To date, there are no regulations in public law for the storage and handling of lithium batteries. DIN VDE 0132:2018-07 section 5.1.5 provides information on hazards and measures to be taken in the case of fire or damaged lithium batteries. In TRGS 510 (December 2020), "Storage of hazardous substances in non-stationary containers", section 13.2 paragraph (3) 3 states that an increase in hazardousness may result, from the dangers specific to the product, e.g. from ignition sources due to a short circuit in connection with lithium batteries. No further information on storage is provided.

VdS 3103:2019-06, "Lithium batteries" is an aid to loss prevention for the insurance industry and may apply within an insurance contract. The same applies to VdS 3856:2019-06, "Sprinkler protection of lithium batteries", which provides supplementary technical
information on extinguishing systems for the storage of large quantities of lithium batteries.

This guide therefore does not list all the measures required in individual cases. In addition, the state of the art and the legal basis may have changed since the publication of this guide. Customary office quantities or small quantities are not considered here.

This guide has been carefully prepared. This does not release the user from the obligation and responsibility to check the information for completeness, up-to-dateness and correctness.

2 Fundamentals

Lithium batteries are chemical energy stores that can release the stored charge in the form of electrical energy in an electrochemical reaction. Basically, a differentiation can be made between two different types of batteries:

- Primary batteries (non-rechargeable batteries)
- Secondary batteries (rechargeable batteries)

With today's manufacturing standards, it can be assumed that lithium batteries can be regarded as comparatively safe when handled properly and correctly. However, if an uncontrolled and accelerated release of the chemically stored energy occurs as a result of technical defects or improper handling, this usually takes the form of thermal energy, which can lead to a fire.

3 Possible dangers

Incorrect handling and improper use such as

- mechanical damage (internal short circuits),
- thermal stress (internal short circuits, external heating),
- overcharging (strong temperature increase due to exothermic processes),

may result in the following hazards:

- Electric shock and danger of electric arcing (depending on the capacity class)
- Leakage of hazardous substances (see below)
- Fire hazard due to the materials and components used
- Thermal hazards
- Bursting of batteries and battery cells when heated

The hazards mentioned can also occur with a time delay, up to several hours after the effect of the damage.

In cases of improper use, contact with hazardous substances cannot be ruled out. Depending on the composition, substances with the following properties may be released:

	H350i: May cause cancer if inhaled. H372: Causes damage to organs through prolonged or repeated exposure.
	H317: May cause an allergic skin reaction. H335: May cause respiratory irritation. H302: Harmful if swallowed.
	H331: Toxic if inhaled.
	H314: Causes severe skin burns and eye damage. H290: May be corrosive to metals.
	H226: Flammable liquid and vapour.
	H271: May cause fire or explosion; strong oxidizer.

4 Regulations according to VdS 3103: 2019-06 (3)

4.1 Safety rules according to lithium battery capacity classes

Low Capacity Computers, multimedia, small electrical appliances, defibrillators	Medium Capacity Pedelecs, e-bikes, e-scooters, large electrical appliances	High Capacity Electromobility (automotive), off-grid large-scale equipment
Lithium metal batteries:		
≤ 2g Li per battery	> 2 g Li per battery and ≤ 12 kg gross per battery	> 2 g Li per battery > 12 kg gross per battery
Lithium-ion batteries:		
≤ 100 Wh per battery	> 100 Wh per battery and ≤ 12 kg gross per battery	> 100 Wh per battery and / or > 12 kg gross per battery

4.2 General safety rules / protective measures

- Compliance with the relevant manufacturer's specifications (technical product data sheets)
- Prevention of external short circuits (protection against short circuit of the battery terminals, e.g. by using terminal caps)
- Prevention of internal short circuits (protection against mechanical damage)
- Do not expose directly and permanently to high temperatures or heat sources (including direct sunlight). Battery temperature not to exceed 80 °C
- In areas that are not protected by automatic fire extinguishing systems, a structural or spatial separation of at least 2.5 m from other combustible materials must be maintained.
- Damaged or defective lithium batteries must be removed immediately from storage and production areas and temporarily stored at a safe distance or in a separated fire protection area until disposal.

Batteries are only to be stored when they have a test certificate to UN 38.3 (prototypes only in exceptional cases and with separate hazard assessment).

4.3 Additional safety rules / protective measures for the respective capacity classes (according to VdS 3103)

Low Capacity	Medium Capacity	High Capacity
Computers, multimedia, small electrical appliances, defibrillators	Pedelecs, e-bikes, e-scooters, large electrical appliances	Electromobility (automotive), off-grid large-scale equipment
None (In the case of larger contiguous storage quantities (volumes over 7 m^3 or more than six europallets) the instructions for batteries of medium capacity apply)	Storage in separated fire-resistant areas or in compliance with a safety distance (spatial separation of 5 m)	Storage in separated fire-resistant areas or in compliance with a safety distance (cooled spatial separation of 5 m)
	Avoidance of mixed storage with other fire-accelerating products	Separation and quantity limitation
	Monitoring of the storage area by means of a suitable fire alarm system with connection to a permanently staffed office	Automatic extinguishing systems
	For larger storage quantities (occupied area > 60 m^2 and / or storage heights > 3 m), the instructions for high capacity batteries apply.	Regulation of protective measures in consultation with the property insurer

5 Recommendations for operational implementation

Low Capacity	Medium Capacity	High Capacity
Computers, multimedia, Small electrical appliances, defibrillators	Pedelecs, e-bikes, e-scooters, large electrical appliances	Electromobility (automotive), off-grid large-scale equipment
Storage		
Keep a safe distance of 1.5 m from other combustible materials *For storage > 7 m^3: Provide fire alarm system* *Well ventilated in a cool place (no sources of heat such as heaters)* *Enter storage location in fire protection plan* *No mixed storage with other goods*	Recommendation: Comply with VdS regulations (see above).	Recommendation: Comply with VdS regulations (see above).
Charging		
In addition to the above recommendations for storage: *Good ventilation and heat dissipation capability* *On a non-combustible surface (metal table or plate)* *Observe the power consumption at permanently installed sockets, do not connect socket extensions in series.* *Avoid unattended charging if possible. If necessary, use a timer.* *Preferably use fire protection switches (AFDD switches)*	*In addition to the above recommendations for storage:* *See low capacity* *Only in an area with fire alarm systems* *Keep a safe distance* *Provide suitable, fire-retardant disposal containers that prevent spreading*	*In addition to the above recommendations for storage:* See low and medium capacity Charging preferably outside buildings
The ideal condition is storage and charging in a separate fire compartment. There are various containers, cabinets, etc. for safe storage and charging available on the market.		

5.1 Additional requirements

- Preparation of a risk assessment and operating instructions
- Instruction of the workforce
- Compliance with dangerous goods regulations for those involved in transport
- Minimum marking of cabinets, rooms and containers:




- An apparently intact battery can be damaged by mechanical effects (e.g. impact or falling) and may be defective.
- Follow sorting instructions for collecting batteries and high-capacity batteries (including defective ones) for disposal.

Pay attention to product warnings and react as necessary.

5.2 Detecting a defective battery

- Damaged or significantly deformed casing
- Discoloration on metal parts of the battery
- Melting points on the plastic casing
- Warming of the battery when switched off
- Battery leakage

5.3 Behaviour in the event of danger

- In the event of malfunctions, switch off the charger immediately and, if possible, disconnect the plug connections while observing personal safety.

- Use personal protective equipment (PPE) when cleaning up spills from batteries, and use suitable chemical binders.
- Water is recommended as an extinguishing agent due to its cooling effect. Burning lithium-ion batteries are difficult to extinguish, so attention should be paid to preventing the further spread of fire.
- Observe the scene of the fire, as re-ignition can occur even after hours or days.

Note:

Always store defective batteries in special fire-resistant containers and, if necessary, cover with dry sand, vermiculite, or extinguishing granules (cf. BDEW Application Aid for Handling of Lithium Batteries (*Anwendungshilfe Umgang mit Lithiumbatterien*), section 4.2.2 and Disposal Manual for Energy Service Providers (*Entsorgungshandbuch für Energiedienstleister*), section 6.28).

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- Provision of an international platform for the accumulation, exchange, and transfer of technical know-how.
- Acting as "gate-keeper" and provider of technical know-how for the member companies and other associations of our industry.
- Harmonisation of technical and operational standards.
- Identification and organisation of joint R&D activities.
- Exclusive member access to qualified expert knowledge.
- Representation of members' interests.

Results of the work of vgbe energy are published in vgbe-Standards and in the international vgbe energy journal.

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