

# -DENIOS-

ENVIRONMENTAL PROTECTION  
& WORK SAFETY

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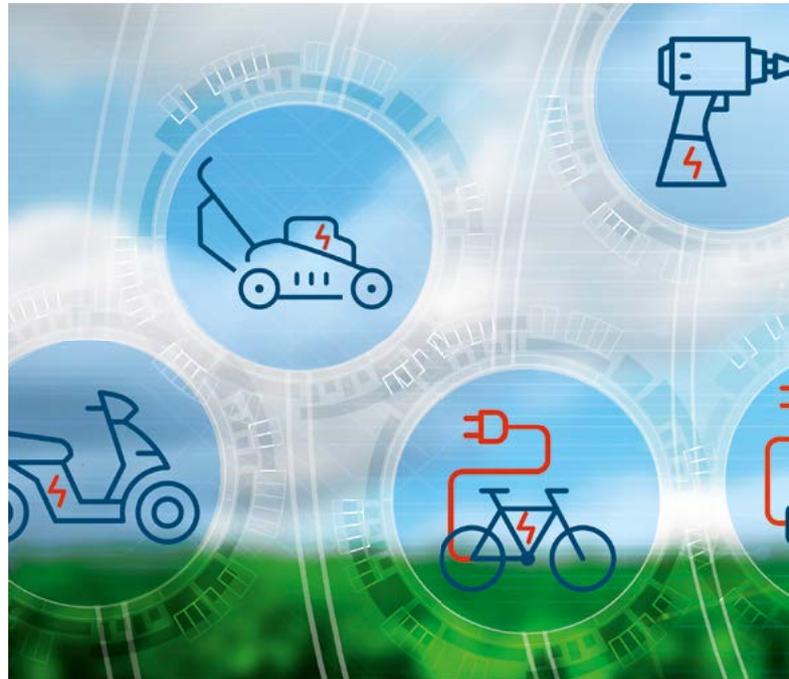
Lithium



## Lithium energy storage devices Safe storage and testing

- Storage and test rooms
- Safety cabinets
- Equipment and Service

# Safely storing and testing lithium energy storage devices



## Safe and easy working with lithium

Lithium-based energy storage devices offer high performance with a compact design. These advantages mean they are being increasingly used in applications such as mobile, electronically operated devices or vehicles. Alongside these advantages, this technology also poses safety risks. In particular, there is an increased risk of fire and bursting. As yet, there is no unified legislation on accident prevention. Safety measures need to be taken depending on the individual case, to avoid and limit damage and to guarantee insurance cover. This is where DENIOS can help. As a manufacturer of technical room systems and as international hazardous substance and fire protection experts we have been supporting and advising our customers for over 30 years. We have summarised our expertise in the storage and charging of lithium energy storage devices for you in compact form.

Find our expertise from Page ➔ 4



Storing and testing lithium energy storage devices safely

### Storing or testing: how you use it makes a difference

For your safety we have developed our technical room systems to a high standard. We don't differentiate here between storing and testing. When it comes to the worst case scenario, all our systems need to do the same thing - withstand the extreme fire load.

The difference comes in the way you use it: when used for storage, the technical room system is filled with goods or they are removed from storage. Doors are opened and closed. Goods need to be easy to reach, lift and transport. They must be protected from external and climatic influences. The use of the room, transport routes and access are the priorities.

When used for testing, other aspects such as the manageability of the test object, the test process including test equipment and data collection need to be considered in the design of the room.

Whether you are storing or testing lithium energy storage devices, the right room solution is a DENIOS one.

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## DENIOS expertise



### How dangerous are lithium-ion batteries?

They are particularly small and efficient and therefore interesting for a variety of applications - lithium energy storage devices. Not only smartphones and tablets draw their energy from lithium cells, they also play an important role in the field of electromobility.

The other side of the coin: dangerous incidents involving lithium energy storage devices are repeatedly reported. In 2017, a fire in a parking garage made the headlines, caused by the battery of an e-bike. In 2018 a man from Hamburg died when a battery charger exploded.

It's not just members of the public, but also companies who are faced with the urgent problem of ensuring the safest possible handling and storage. In this chapter we'll take an in-depth look at the hazard potential of lithium energy storage devices and offer some valuable tips on how to prevent damage.

- Properties of lithium energy storage devices (from page ➔ 6)
- Hazard prevention (from page ➔ 8)

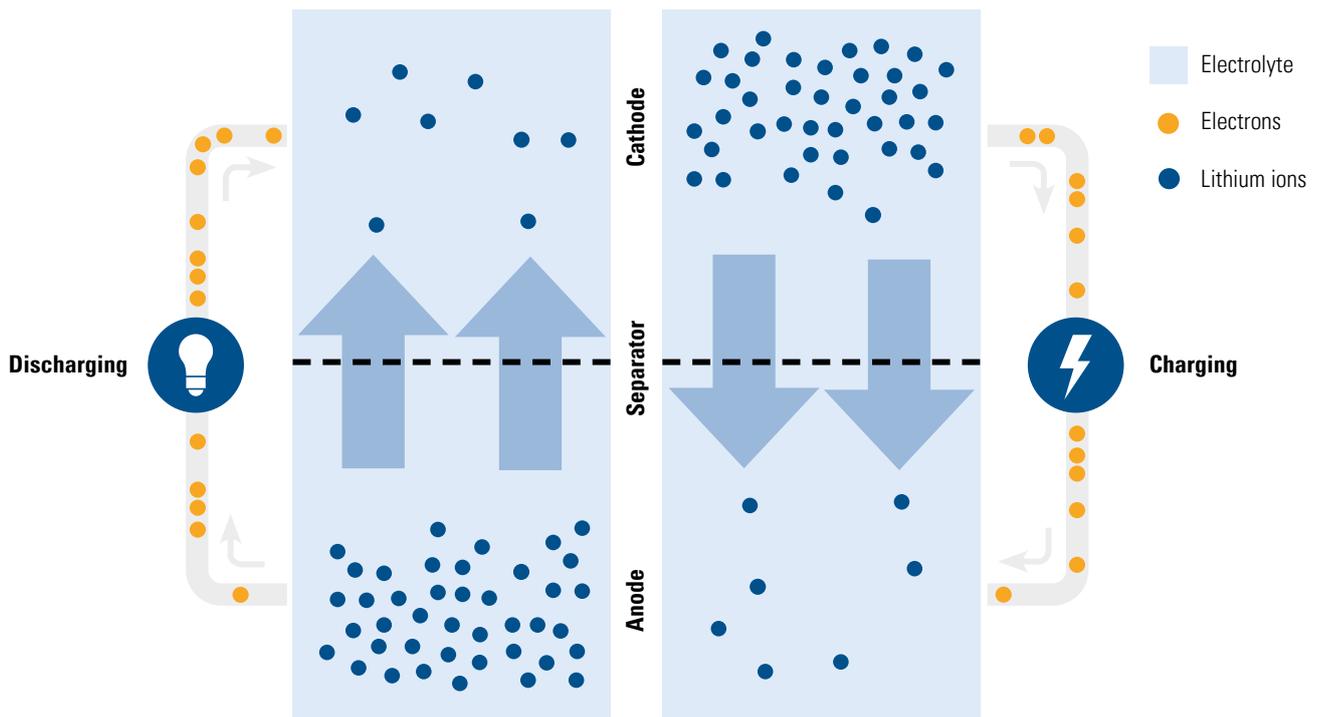


"We bring together your requirements with our knowledge of the application, the legal requirements and the technical possibilities."

DENIOS expertise



### Design and operation of a lithium cell



In order to be able to evaluate the potential hazards associated with lithium energy storage devices, understanding how they work can be very helpful. Important to know: there are many different energy storage systems where lithium is used in a pure or bonded form. Lithium cells are basically divided into primary (non rechargeable) and secondary (rechargeable) cells. A battery pack is made up of several cells depending on capacity. Each lithium cell has a positive and a negative electrode, the anode and the cathode. Between them, there is an ion-conducting electrolyte. This ensures the transport of the lithium ions between the electrodes during the charging and discharging processes. The best known form of lithium energy storage device is the lithium-ion battery, where a liquid electrolyte is used. The separator is also an important part of the device. It prevents direct contact between the anode and cathode and therefore prevents a short-circuit. During the discharging process lithium ions and electrons are released on the anode side. The electrons flow through the external circuit and perform the electrical work. At the same time, the lithium ions cross through the electrolyte fluid and the separator over to the cathode. When charging, the process is reversed.

Depending on the system, the design of a lithium energy storage device and the materials used may vary. In a lithium polymer battery the electrolyte is bound in the molecular structure of a polymer foil. There is therefore no need for the special separator. Lithium polymer energy storage devices are only able to generate low discharge currents. The polymer foil however allows for a flat design, which is useful in mobile telephones and laptops for example. The thin film lithium cell is an energy storage device where the electrolyte is replaced by an ion-conductive glass. This allows lithium metal to be used and therefore provides an extremely high energy density. This technology is currently an important part of lithium energy storage device research.

## Chemical properties

While the German Federal Institute for Occupational Safety and Health (BAuA) regards lithium-ion batteries as products under the REACH regulation, the American Occupational Safety and Health Administration (OSHA) classifies batteries as mixtures. In practice, many companies prepare and make available safety data sheets for lithium batteries even without a legal obligation to do so. These usually provide valuable information on battery storage and handling. However, details of chemical composition can often also be found, which provide information on the hazard. Basically a lithium battery can be divided into the anode, electrolyte fluid and cathode.

As a rule, graphite (C) is used as the anode material, which does not have to be labelled under the CLP Regulation.

The electrolyte fluid consists of an organic solvent and a conducting salt. While there is a large variety of possible solvents, lithium hexafluorophosphate (LiPF<sub>6</sub>) is almost exclusively used as the conducting salt.

### Electrolyte fluid = organic solvent + conducting salt (LiPF<sub>6</sub>)

The exact chemical composition of the respective solvent mixture is usually a manufacturer's secret. However, by looking through various data sheets, an overview of the components used can be obtained.

The flashpoints of the solvent components range from +160°C to partly below 0°C. This explains the thermal instability of a lithium battery (see page ➔ 8).

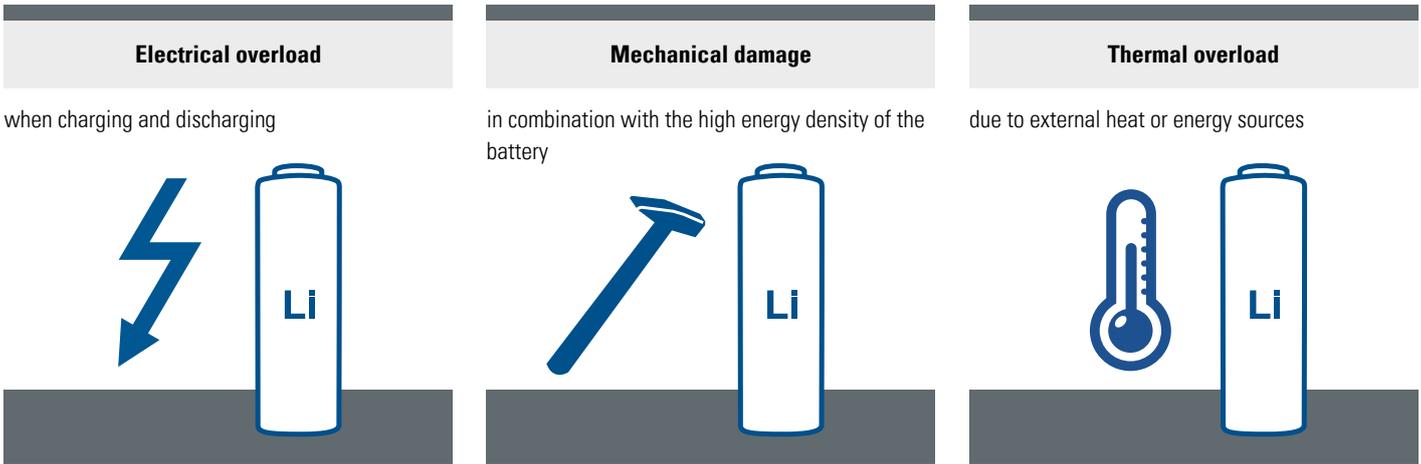
Among other things, the conducting salt contains fluorine (F). The release of hydrofluoric acid (HF) in unconcentrated form can lead to various hazardous situations in a damaged lithium battery.

Many different materials are used for the cathode. The exact composition of the cathode material significantly determines properties such as lifetime, charging times and performance. Iron, manganese, cobalt or nickel are often used in the cathode.



### Hazards and risks when handling lithium energy storage devices

Lithium-ion batteries can cause a fire. The causes are:



In normal operation, the use of lithium batteries is considered safe. But according to VDE, this only applies as long as everyone handles them properly. As soon as there is a technical fault or a battery is damaged, the situation can quickly become critical. The German insurance industry (GDV) therefore calls for lithium batteries to be "treated as a hazardous substance in principle".

The situation becomes especially dangerous when a lithium battery releases its stored energy in an uncontrolled manner. As soon as the heat created exceeds the melting point of the separator, an uncontrollable chain reaction is started, the dreaded "thermal runaway". An explosive burning of the battery is the result. These lithium-ion batteries fires are difficult to control and the fire spreads quickly. The fire brigade can often only protect neighbouring areas.

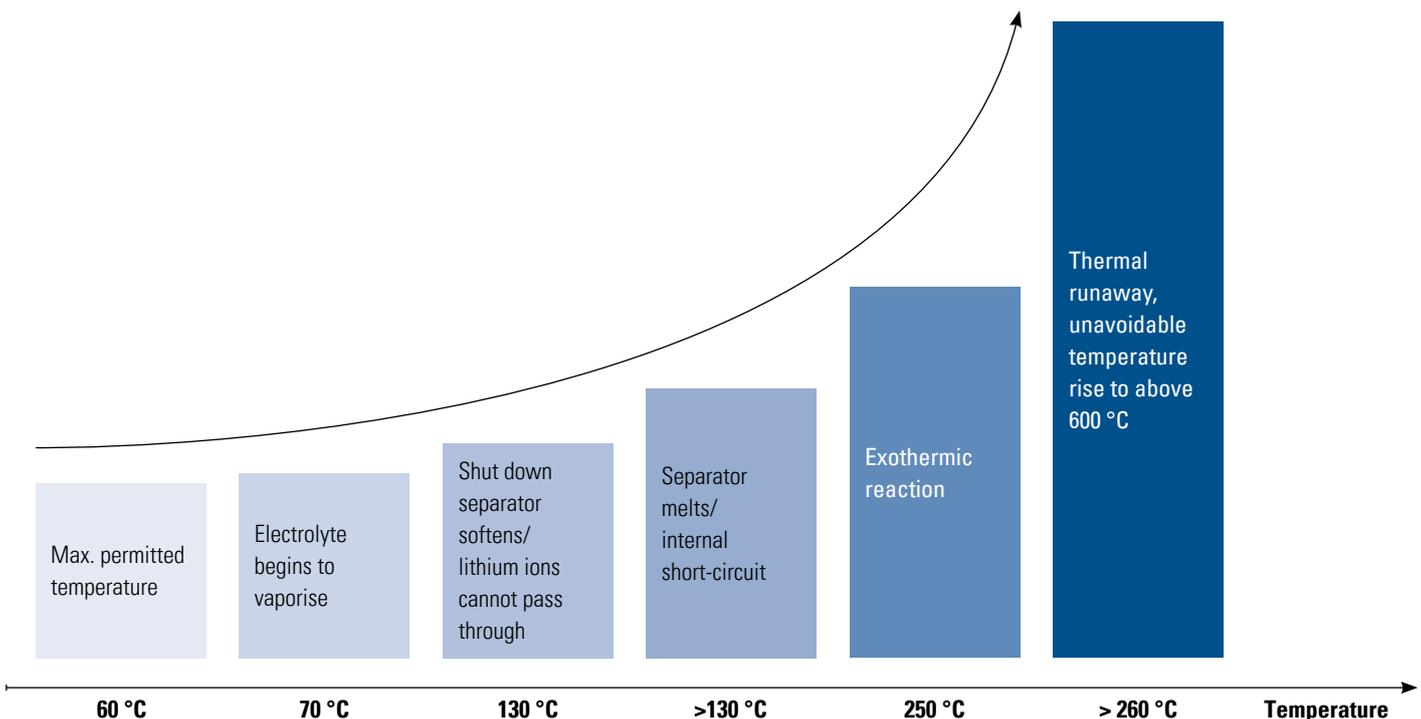


Figure: Example of how temperature changes in the event of an incident

## Fire fighting for lithium battery fires

The size of the battery plays a decisive role in fire fighting. Large batteries, for example from burning electric cars, regularly present fire brigades with an enormous challenge.

These fires are hard to control. The only question is: why?

This question can be answered by building a traction battery. A large traction battery consists of many smaller cells that are connected together.

If a single cell heats up, in the worst case in the middle of the module, the



Schematic structure of a **larger**, failing battery module and water cooling

neighbouring cells will also inevitably heat up. This results in a chain reaction that leads to a considerably higher release of energy. If the chain reaction was triggered at the centre of the battery, it is almost impossible to reach it with an extinguishing agent, e.g. water, and thus stop or contain the reaction. If you now try to cool the module, the water only reaches the outer layers or the battery housing.

The situation is different for smaller modules where fewer cells are used. Here, external cooling usually has a direct effect on the reacting cells.



Schematic structure of a **smaller**, failing battery module and water cooling

In the summer of 2019, the VdS published leaflet 3856 "Sprinkler protection of lithium batteries". For the first time a differentiation was made by energy content per storage unit and the risk was classified according to the following table:

Hazard Level (HL)	Risk	Energy content in kWh / storage unit
I	Low	< 1
II	Medium	1.0 - 50
III	High	> 50

The recommendation is to store a maximum of 50 kWh per storage unit (e.g. Euro pallet). This is equivalent to Hazard Level II. The sprinkler system must be designed in accordance with VdS CEA 4001. Tests by the American property insurer FM-Global and the German Insurance Association (GDV) have shown that the spread of lithium battery fires in high racks can be prevented by a **targeted sprinkler** system. However, the findings from the tests are only valid for small lithium batteries packed in cardboard boxes. The sprinkling of large battery units is nevertheless advisable, as although the fire is not usually extinguished at the individual battery, the spread to neighbouring batteries can be slowed, if not prevented.

**Powder extinguishing agents**, such as aerosols, are used to suppress fire on the batteries. Especially with smaller storage volumes, such as safety cabinets or emergency containers, valuable time can be saved. A cooling effect does not take place here, however.

**Extinguishing granules**, which are often used in transport boxes for faulty lithium batteries, thermally insulate the battery. The extinguishing or insulation effect is immediately active and functions completely autonomously. A prerequisite, however, is that the batteries are surrounded by a sufficient quantity of granules, which greatly restricts handling.

### Safety regulations according to performance class (VdS 3103: 2019-06)



#### Low performance

Computer, multimedia, small electrical devices



#### Mid-range performance

Pedelecs, electric bicycles, electric scooters, larger garden equipment



#### High performance

Automotive, mains-independent large equipment



#### Lithium metal energy storage devices:

≤ 2 g Li per energy storage device

> 2g Li per energy storage device and  
≤ 12 kg gross per energy storage device

> 2g Li per energy storage device and  
> 12 kg gross per energy storage device

#### Lithium-ion energy storage devices:

≤ 100 Wh per energy storage device

> 100 Wh per energy storage device and  
≤ 12 kg gross per energy storage device

> 100 Wh per energy storage device and/or  
> 12 kg gross per energy storage device

#### General safety regulations:

- Observe manufacturer's instructions (technical product data sheets)
- Protect battery poles from short-circuit
- Protect from mechanical damage
- Do not expose to direct and long-term high temperatures or heat sources (including direct sunlight)
- Ensure structural or spatial separation (min. 2.5 m) from other combustible materials, if there is no automatic extinguishing equipment present
- Ensure damaged or faulty batteries are removed immediately from storage and production areas (until they are disposed of store them at a safe distance or in a fire-rated, separate area)
- Only store batteries with a UN 38.3 test certificate (prototypes should only be stored in exceptional circumstances and with a risk assessment)



#### Specific safety regulations:

- None

*Where larger volumes are stored together (volume over 7 m<sup>3</sup> or more than six Euro pallets) the notices for mid-range performance batteries apply*

- Storage in fire-rated, separated areas or with a safety distance (spatial separation of 5 m)
- Avoidance of mixed storage with other fire accelerant products
- Monitoring of the storage area with a suitable fire alarm system with connection to a permanently-manned location
- Where fire extinguishing equipment is available: inclusion of information on suitable extinguishing media in the technical product data sheets

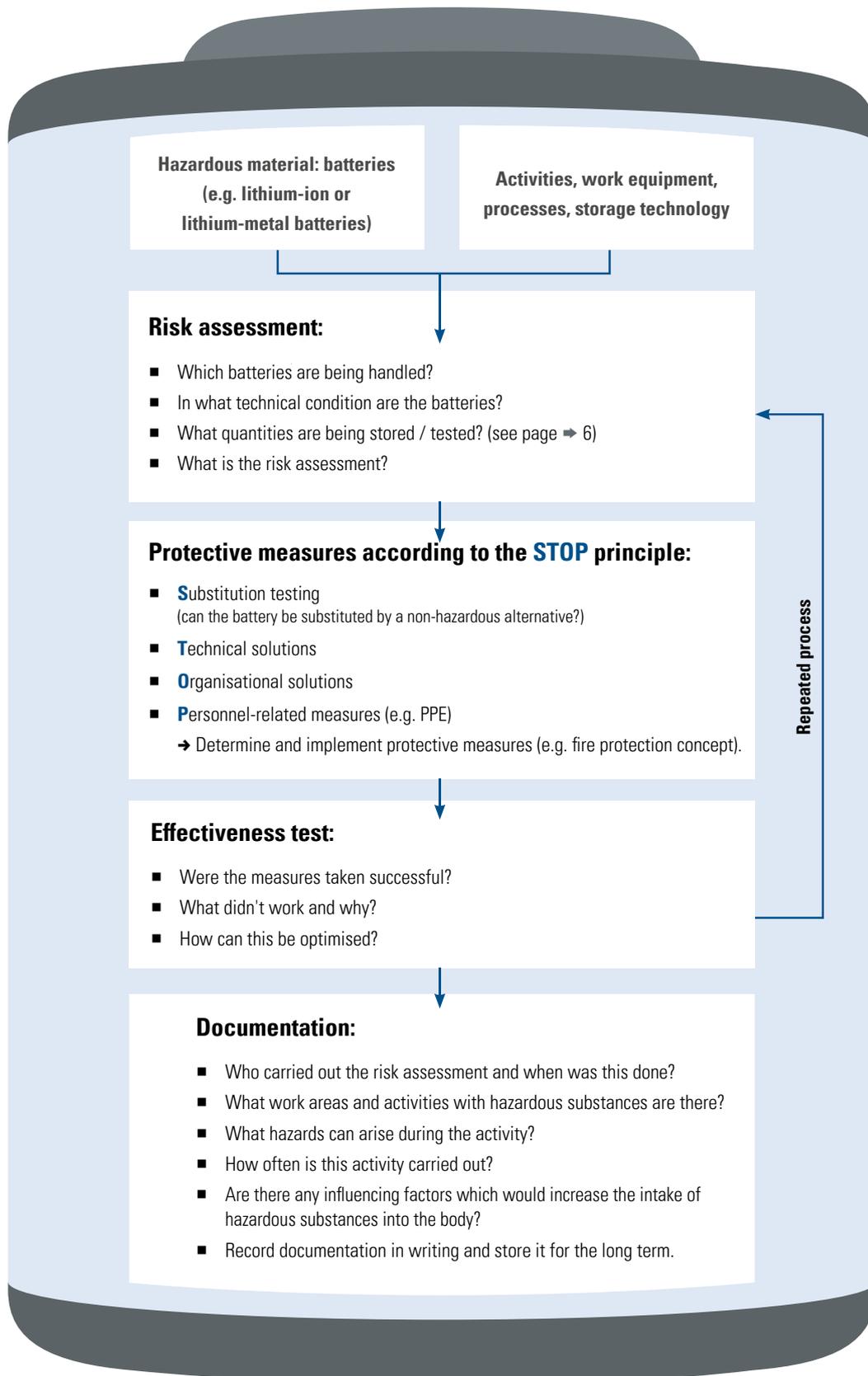
Protective measures to be agreed with insurers for individual cases, e.g.

- Storage in fire-rated, separated areas or with a safety distance (spatial separation of 5 m)
- Separation and limitation of quantities
- Automatic extinguishing equipment



**Where larger volumes are stored (area covered > 60 m<sup>2</sup> and/or height > 3m) the notices for high performance batteries apply**

## Risk assessment process



# Storage rooms



## Constructive safety with approval from the authorities

DENIOS offers various technical room systems for the fire-rated storage of lithium energy storage devices:

- The walk-in storage system WFP Li-Ion (page ➔ 14)
- The spacious racking system RFP Li-Ion (page ➔ 18)
- The compact store RFP 115 Li-Ion (page ➔ 21)

All systems are manufactured with a sturdy, double steel frame design and are approved as an entire system, with fire protection from 90 (REI F90) up to 120 minutes (REI 120) from inside and from outside. They are therefore suitable for installation directly next to the external wall of neighbouring buildings or for use as a fire-rated separate area, e.g. in a production hall. They can be moved when empty and so can be repositioned on your site if necessary. With an integral spill pallet in steel, the storage rooms are set up to contain any leaked electrolyte and contaminated extinguishing water. All equipment which could be a potential source of sparks can be provided with appropriate protection if an Ex zone is needed. Pressure relief panels can be fitted in the roof to ensure active safety in the event of an incident. Take a look at the comprehensive range of equipment available from page ➔ 44.



Storage rooms

**"DENIOS storage rooms make it easy to handle lithium energy storage devices in a responsible way."**

# Storage rooms

## Walk-in fire-rated storage WFP Li-Ion

### Charging lithium batteries in fire-rated storage container WFP Li-Ion



When charging lithium batteries, the potential risk is significantly increased compared to storage. Especially if the batteries are damaged. The greatest danger is if a short circuit occurs in the battery when fully charged. This is when the stored energy is at its greatest and therefore the effects of thermal runaway are also at their highest (see page ➔ 8 ). Due to the self-amplifying reaction of lithium batteries, this can lead to the battery bursting. You can reduce the risks by observing the safety rules and the correct storage and charging conditions.

#### Safety rules for charging lithium batteries

**1. The most important rule: Never charge a faulty battery!**

The VdS recommends the immediate removal of damaged or defective batteries from storage and production areas. With regard to feasibility however, it should be borne in mind that a defect is often not recognizable externally and it is therefore not easy to assess the condition of a battery. So, just to be on the safe side, it is recommended that batteries whose condition is unknown should always be placed in a separate quarantine storage facility, which must be taken into account in the fire protection concept.

The compact fire-rated store RFP 115 Li-Ion is ideal as a quarantine store (see page ➔ 21).

**2. Do not store fully discharged batteries for later charging or over too long a period of time.**

The charging of lithium-ion batteries is also critical if they have not been used for a long time. Lithium-ion batteries can be permanently damaged by deep discharge, causing a chemical reaction during charging. This is why gardening tools with rechargeable batteries have a trickle charge for example, which corresponds to a charge level of approx. 30%. This reduces aging effects and prevents deep discharge.

**3. Only use certified chargers or chargers from the manufacturer**

In most commercially available rechargeable batteries, the battery management system (BMS) integrated in the manufacturer's charger prevents overcharging and deep discharge. It is a safety device that protects the performance of the battery and prevents defects. The BMS can also be part of the battery itself.

**4. Only charge lithium batteries in a dry condition at room temperature and in a fireproof place.**

Wintry or hot temperatures as well as high levels of humidity can also cause damage to the cells.



### Safe storage and storage conditions

The fire-rated store WFP Li-Ion already offers safety in case of fire thanks to its certified fire protection. By equipping the unit with air conditioning technology for outdoor installation (from page ➔ 54) and monitoring electronics (from page ➔ 56) additional precautions for preventive fire protection can be taken. With extinguishing technology specially designed for lithium batteries, optimum defensive fire protection is ensured. We recommend using aerosol extinguishing technology (see page ➔ 53), if there are several storage levels, as the extinguishing agent is better distributed in the room and over the storage levels.

**Are you looking for a smaller solution for safe indoor charging of lithium batteries? We recommend the DENIOS safety cabinet SmartStore with 90 minute fire protection from both sides and a fire suppression system (see page ➔ 30f.).**



# Storage rooms

## Walk-in fire-rated storage container WFP Li-Ion

### Walk-in store WFP Li-Ion

You need a store for smaller sized modules, which don't need a forklift for loading and unloading. You might want to safely store a larger piece of equipment or an electric vehicle (e.g. prototype and test equipment). The storage room needs to fulfil an additional function - for example as an analysis laboratory, a convenient place to charge batteries or as a temporary store for dispatch or for storing faulty batteries. The walk-in hazmat store is the convenient solution for all these scenarios.

m<sup>2</sup>

Storage area:  
approx. 7 to 22 m<sup>2</sup>

**DIBt** GENERAL  
CONSTRUCTION  
APPROVAL  
DIBt Deutsches Institut  
für Bautechnik, Berlin  
Z-38.5-292 (for Germany)

**IBS** REI90  
CLASSIFICATION  
report No.  
316 102 803-A  
Fire protection (in Europe)

LABORATORY ASSESSMENT  
**Efectis**  
REI 120  
No. EFR-17-00 1909-B



Walk-in fire-rated storage container  
WFP-X 22 Li-Ion with shelving,

### Overview of advantages

- Tested and approved as a complete system with 90 minute fire protection (REI 90) from inside and outside
- International designs meeting country-specific legislation, (e.g. REI 120 for ES, IT, PL, FR)
- Install directly next to the external wall of neighbouring buildings or as a fire-rated separate area, e.g. in a production hall
- Galvanised components with 2 layers of paint give long lasting corrosion protection



## Basic version

- External cladding in fire protection panels (A class material) with high insulation properties: material thickness 100 mm,  $U = 0.36 \text{ W} / (\text{m}^2\text{K})$
- Support frame made of hot dip galvanised base material
- Tested, one-piece spill pallet with large containment volume
- EL<sub>2</sub> 90-C doors meeting EN 13501-2, tested to EN 1634-1, or country-specific version
- 1-wing door (W x H: 1250 x 2000 mm) or 2-wing door (W x H: 2000 x 2000 mm), either on the short or long side of the store in the steps provided
- For 2-wing doors, a door sequence controller ensures the doors close reliably
- Security lock for protection against unauthorised access
- Removable crane eyes for safe use with a crane and transport safety device

## Versions

The walk-in fire-rated storage container WFP Li-Ion offers two different models:

- WFP-M Li-Ion – clear internal height 2280 mm
- WFP-X Li-Ion – clear internal height 2500 mm

**WFP-M 6 Li-Ion**  
**WFP-X 6 Li-Ion**

**Storage area:**  
**7 m<sup>2</sup>**

**WFP-X 10 Li-Ion**

**Storage area**  
**10 m<sup>2</sup>**

**WFP-M 14 Li-Ion**  
**WFP-X 14 Li-Ion**

**Storage area:**  
**14 m<sup>2</sup>**

**WFP-X 22 Li-Ion**

**Storage area:**  
**22 m<sup>2</sup>**

Designation	Storage area [m <sup>2</sup> ]	Body dimensions W x D x H* [mm]	Internal dimensions W x D x H [mm]	Weight* [kg]
WFP-M 6 Li-Ion	7	3018 x 2784 x 2655	2580 x 2560 x 2280	2370
WFP-M 14 Li-Ion	14	5938 x 2878 x 2789	5500 x 2560 x 2280	3622
WFP-X 6 Li-Ion	7	3018 x 2784 x 2875	2580 x 2560 x 2500	2438
WFP-X 10 Li-Ion	10	4478 x 2784 x 2921	4040 x 2560 x 2500	3054
WFP-X 14 Li-Ion	14	5938 x 2878 x 3009	5500 x 2560 x 2500	3721
WFP-X 22 Li-Ion	22	8858 x 2878 x 3009	8420 x 2560 x 2500	4995

**Note:** Dimensions and weights may differ depending on optional equipment. We reserve the right to make technical changes.  
\*without equipment

**If outdoor installation is planned and there is sufficient distance from fire loads, a store without fire protection may be used if needed.  
e.g. walk-in store MCV.**



# Storage rooms

## Fire-rated storage with shelving RFP Li-Ion

### The spacious shelving solution RFP Li-Ion

Storage with shelving RFP Li-Ion is the best option when larger quantities or larger-scale lithium energy storage devices need to be accommodated. An integrated heavy duty rack with adjustable shelves allows the best possible use to be made of the inner room. The loading surfaces are removable hot dip galvanised grids. They suit the most varied storage options, e.g. individual storage or storage in boxes, on pallets or special carrier frames. The system offers the best possible access via 2-wing doors and optimal use of the room height for easy loading and unloading.



**Storage capacity:  
up to 24 EP**



Order No. 263-173-L0

Fire-rated storage with shelving  
RFP 615.30 Li-Ion, with air conditioning, with four storage levels



#### Overview of advantages

- Tested and approved as a complete system with 90 minute fire protection (F 90) from inside and outside
- International designs meeting country-specific legislation, (e.g. REI 120 for ES, IT, PL, FR)
- Install directly next to the external wall of neighbouring buildings or as a fire-rated separate area, e.g. in a production hall
- Galvanised components with 2 layers of paint give long lasting corrosion protection

## Basic version

- External cladding in fire protection panels (A class material) with high insulation properties: material thickness 100 mm,  $U = 0.36 \text{ W / (m}^2\text{K)}$
- Support frame made of hot dip galvanised base material
- Tested, one-piece spill pallet with large containment volume
- 2-wing  $\text{EI}_2$  90-C door meeting EN 13501-2 on the long side, tested to EN 1634-1, or country-specific version
- A door sequence controller ensures the doors close reliably
- Door opening angle: 90°, 102°, 115°, 128°
- Door dimensions:
  - Models 315.20 and 615.20: 3000 x 2000
  - Models 315.30 and 615.30: 3000 x 3000
- Security lock for protection against unauthorised access
- Removable crane eyes for safe use with a crane and transport safety device
- Accessible-underneath version has separately supplied concrete pad

## Versions



**RFP 315.20 Li-Ion**  
for up to 3 storage levels



**RFP 315.30 Li-Ion**  
for up to 4 storage levels



**RFP 615.20 Li-Ion**  
for up to 3 storage levels



**RFP 615.30 Li-Ion**  
for up to 4 storage levels

## Pressure relief panels

A pressure relief panel can be fitted in the roof area to relieve pressure in the event of an explosion. It will close again automatically when the pressure wave has been dissipated to seal the store so that the fire protection properties are maintained. This has been successfully demonstrated in a 120 minute long fire test.



## Door hold-open device

An electromagnet holds the doors open. When the door closing button is operated or if there is an alarm, the power to the electromagnet is cut. The door is then closed by the upper door closer.



Designation	Storage capacity EP	Body dimensions W x D x H* [mm]	Compartment dimensions W x D [mm]	Weight* [kg]
RFP 315.20 Li-Ion	3 - 9	3660 x 1858 x 2630	2917 x 1440	2500
RFP 315.30 Li-Ion	3 - 12	3660 x 1858 x 3575	2700 x 1440	3100
RFP 615.20 Li-Ion	6 - 18	6882 x 1858 x 2649	2917 x 1440	4400
RFP 615.30 Li-Ion	6 - 24	6882 x 1858 x 3594	2700 x 1440	5600

Note: EP = Euro pallet · Dimensions and weights may differ depending on optional equipment. We reserve the right to make technical changes.  
\*without equipment

# Storage rooms

## Fire-rated storage with shelving RFP SD Li-Ion

### RFP Li-Ion with sliding doors for simple handling and maximum storage capacity

The fire-rated storage with shelving RFP Li-Ion with sliding doors offers fire protection for a large number of lithium energy storage devices. Here, sliding doors offer two unbeatable advantages compared to wing doors: 1. There is no door opening radius, so the working area in front of the technical room system is not affected. When installed outdoors, there is therefore no risk of the doors slamming shut unintentionally due to wind loads. 2. The larger size of sliding doors offers up to 50% more storage capacity.



up to 32 EP



Fire-rated storage container with shelving RFP 815.30 Li-Ion with sliding doors

#### Overview of advantages

- An open sliding door gives easier access to the fire-rated storage container than a wing door and improves logistical efficiency
- If a fire alarm sounds, the lockable, tested fire-rated doors will close automatically
- Up to 120 minute fire resistance for internal and external fire loads
- International designs meeting country-specific legislation
- Install directly next to the external wall of neighbouring buildings or as a fire-rated separate area, e.g. in a production hall

#### Basic version

Even the basic version of fire-rated storage container RFP SD Li-Ion with sliding doors is approved for the storage, dispensing or removal of water-polluting and flammable substances.

Basic equipment includes:

- Tested spill pallet with large containment volume
- External cladding in fire protection panels (A class material) with high insulation properties
- Tested fire-rated sliding doors meeting EN 16034, with manual or electrical operation by remote control
- Security lock for protection against unauthorised access
- Crane eyes for safe use with a crane and transport safety device

Designation	Storage capacity EP	Body dimensions W x D x H* [mm]	Bay dimensions W x D [mm]	Weight* [kg]
RFP 815.30 SD Li-Ion	8 - 32	9342 x 2070 x 3594	3900 x 1235	4900

**Note:** EP = Euro pallet · Dimensions and weights may differ depending on optional equipment. We reserve the right to make technical changes.  
\*without equipment

## The compact store RFP 115 Li-Ion near production

Not every company needs a large store for housing hazardous substances. Fire-rated storage container RFP 115 Li-Ion offers a sturdy, fire-rated design with minimal footprint. If desired, the technical room system is available with a variable number of fixed or pull-out shelves – for optimum use of the inner space according to your needs.



Order No. 263-174-L0

Fire-rated storage container RFP 115 Li-Ion  
with optional storage levels

For even smaller quantities see  
safety cabinets from page → 24



### Overview of advantages

- Fire resistance of 90 minutes (F 90 / REI 90) for internal and external fire loads
- International designs meeting country-specific legislation, e.g. REI 120
- Flexible installation indoors or outdoors with no need for safety distances
- Often used for direct access near work stations as it only has a small footprint

### Basic version

- Integral steel spill pallet with removable hot dip galvanised grids
- Optional storage levels for up to 3 levels
- As standard with an equipotential bonding connection point for avoiding static charges
- Lockable, self-closing 1-wing fire-rated door (1350 x 2000 mm), EI<sub>2</sub>90-C to EN 13501
- Delivered ready assembled, ready for the customer to secure to the ground
- Incl. transport eyes for securing the load

Designation	Storage capacity EP	Body dimensions W x D x H* [mm]	Bay dimensions W x D [mm]	Weight* [kg]
RFP 115 Li-Ion	1 - 3	1910 x 1998 x 2380	1566 x 1526	1075

**Note:** EP = Euro pallet · Dimensions and weights may differ depending on optional equipment. We reserve the right to make technical changes.  
\*Without equipment.

# Storage rooms

## Examples of use

### E-Mobility: safe storage of traction batteries and lithium battery cells



EDAG BFFT Electronics is the EDAG Group's new brand for electrical and electronic development in the automotive sector. For the E-Drive & Battery product range, the customer required a secure outdoor storage facility for traction batteries and lithium battery cells. The customer had already ordered a turnkey fire-rated storage system for lithium energy storage devices from DENIOS AG in the past and was very satisfied with it. For the expansion of production an additional technical room system with some extras was now needed.

#### Practical storage layout and convenient equipment

Batteries weighing up to 700 kg and measuring 2200 x 1800 x 800 mm (W x D x H) are set via a double-wing door on the technical room system storage grid. An automatic door closing and hold-open system ensures the door is held open during the loading and unloading process. To close the doors, the power to the retaining magnets is cut by a manual release button. In the event of a fire the fire detection system in the room automatically closes the door.

The second, walk-in section of the room is equipped with a 1-wing door and storage shelves to store individual battery modules and cells. Removable grids suitable for pallet trucks form the base.

An LED interior lighting system ensures good visibility in both sections of the room. Further useful features include a 230 V socket and an Ethernet connection.

#### Coordinated air conditioning technology

The climate in the room is adjusted to the legal requirements for air quality and temperatures of 22 C +/-2K all year round. Excellent energy efficiency is ensured by the high insulation thickness of the fire protection panels of 100 mm and an interplay of air conditioning, heating and technical ventilation, all optimally coordinated by control technology. The air conditioning system is a heat exchanger with CFC-free operating fluid. An electric finned tube heater serves as a supporting heater for the air conditioning system. A circulating air fan distributes the temperature-controlled air evenly throughout the technical room system. The system is designed for 0.4-times air exchange, which is achieved by technical ventilation. Air inlet and extraction openings are protected from the weather and secured by fire protection flaps.



The entire technical room system has F 90 (REI 90) fire protection with an IBS classification report (Institut für Brandschutztechnik und Sicherheitsforschung - German Institute for Fire Protection Technology and Safety Research). In order to accommodate the large drive batteries weighing up to 700 kg and the small battery cells in a practicable way in one technical room system, the room is divided into two sections: one accessible and one that can be loaded with a forklift truck.

#### Permanent status recording with email alarm

All safety-relevant components of the technical room system are recorded by sensors in the system control and stored for 12 months. Supplementary information on running times and maintenance intervals provides a comprehensive overview. The modern, user-friendly control panel is connected to the high-performance controller via Modbus. This maintains its function even if the control panel fails. The control software developed by DENIOS and coordinated hardware components are optimally designed for the application. The mail server included in the project scope of delivery is controlled via modem and enables fast intervention in the event of a fault.

#### Transport and assembly

The turnkey technical room system was developed by DENIOS at its production site in Bad Oeynhausen, NRW. This was immediately followed by transport, installation, commissioning and customer training by the experienced and professional DENIOS service staff. DENIOS provided the lifting equipment and tools required for the process alongside the installation material and anchoring technology for fixing to the substrate, all of which were perfectly matched to the application. Only the on-site connections were made by the customer.

#### Fire extinguishing technology in the event of an incident

The technical room system has a semi-fixed water extinguishing system for which DENIOS has undertaken the project planning, installation and documentation in accordance with VdS CEA 4001. Thermal runaway can be prevented by cooling the lithium storage medium as early as possible and for a sufficiently long time. If the reaction is already advanced, cooling can prevent or stop a chain reaction.

#### Future expansion measures

In addition to the now sufficient storage capacity, the customer plans to add a test environment in the near future. This will initially comprise a technical room system with test chambers and a technical room system with measuring station. The DENIOS test rooms are perfectly suited for this (see page ► 36).

# Storage cabinets



## Fire resistance from inside and out

For small quantities of lithium batteries of low to mid-range performance, an effective safety design is still needed for storage and charging. As the store is likely to be located inside a building, fire resistance of the body of the storage cabinet should be ensured from inside and outside. Based on our many years of experience working together with customers DENIOS has developed a new generation of safety cabinets: **SafeStore** is designed for the storage of lithium-ion batteries. **SmartStore** is ideal for monitored charging of batteries and as a quarantine store for condition monitoring of critical lithium batteries.



# Storage cabinets

## Safe storage and charging of small quantities

### Product overview

DENIOS hazardous materials cabinets for storing and charging lithium batteries offer the necessary 90 minutes fire protection from both sides. Regardless of whether you are storing new batteries (SafeStore) or faulty batteries (SafeStore Pro) or charging lithium batteries (SmartStore) - DENIOS offers products with the highest level of safety which are easy to use.



SafeStore

SafeStore Pro

SmartStore

#### STORAGE:



#### CHARGING:



#### FIRE PROTECTION FROM OUTSIDE (TYPE 90):



#### FIRE PROTECTION FROM INSIDE:



#### 3-STAGE AUTOMATIC WARNING / FIRE SUPPRESSION SYSTEM:



#### READY TO CONNECT:



#### PROTECTED SOCKETS FOR CONNECTING CHARGERS:



#### TECHNICAL VENTILATION:



## SafeStore storage cabinet

Based on the proven technology of our hazardous materials cabinets, we have developed a sophisticated system to address the special potential risks associated with the storage of lithium-ion batteries. With fire protection from inside and out, there is no chance of dangerous thermal runaway. The SafeStore range offers an attractive, safe choice for the passive storage of new or used lithium-ion batteries.



### Product features

- Storage cabinet for undamaged lithium-ion batteries (passive storage)
- All-round protection: 90 minute fire protection from the outside in (Type 90) in accordance with EN 14470-1
- Over 90 minutes fire resistance for a fire acting from inside to out, in line with EN 1363-1
- With liquid-tight spill pallet (powder coated sheet steel). For the containment of any leaks from burning batteries
- With permanently self-closing doors and quality oil-damped door closers
- Doors can be locked with profile cylinder (closing system compatible) and lock indicator (red/green)
- With adjustable feet to be used on uneven floor surfaces
- Extremely robust construction with scratch-proof paint
- Air extraction connection (NW 75) fitted in the roof of the cabinet



The storage levels are height adjustable on all cabinets without charging facilities. Body colour is always anthracite grey (RAL 7016), wing doors in gentian blue (RAL 5010)

Model	SafeStore-123-L	SafeStore-124-L	SafeStore-125-L	SafeStore-126-L	SafeStore-63-L	SafeStore-64-L	SafeStore-65-L	SafeStore-66-L
Equipment	3 shelves, floor spill pallet	4 shelves, floor spill pallet	5 shelves, floor spill pallet	6 shelves, floor spill pallet	3 shelves, floor spill pallet	4 shelves, floor spill pallet	5 shelves, floor spill pallet	6 shelves, floor spill pallet
External dimensions W x D x H [mm]	1193 x 615 x 1953	599 x 615 x 1953	599 x 615 x 1953	599 x 615 x 1953	599 x 615 x 1953			
Internal dimensions W x D x H [mm]	1050 x 522 x 1647	450 x 522 x 1647	450 x 522 x 1647	450 x 522 x 1647	450 x 522 x 1647			
Containment volume of floor spill pallet [l]	33	33	33	33	22	22	22	22
Weight [kg]	469	479	490	499	292	297	302	307
Order number	261-991-L0	261-992-L0	261-993-L0	261-994-L0	263-604-L0	263-605-L0	263-606-L0	263-607-L0
<b>Accessories (order numbers)</b>								
Base panel, narrow	201-060-L0							
Base panel, wide	201-062-L0							

# Storage cabinets

## Safe storage and charging of small quantities

### SafeStore-Pro and SmartStore hazardous material cabinets safety design

	EVENTS	SYSTEM REACTIONS	SUBSEQUENT MEASURES
WARNING NOTIFICATION	<p>If the internal temperature rises above <b>50 °C</b>, the warning/ fire suppression system sends a warning notification to the central control centre.</p> <p><b>Possible reasons:</b> Temperature accumulation due to battery charging Ventilation system failure</p>	<p><b>Visible and audible alarms</b> The warning light (red LED) is activated and is permanently illuminated, the operating indicator (green LED) extinguishes Alarm is triggered with slow tone interval</p> <p><b>The potential-free switching contact</b> is switched, the alarm is forwarded to the building control system</p>	<p>There is no immediate danger from the warning notification. Immediate inspection of the system by qualified in-house personnel can be carried out in order to initiate any further necessary measures. If the temperature drops back below 50°C, the system returns to normal operation and the visible and audible alarms are switched off.</p>
ALARM STAGE 1	<p><b>Alarm stage 1</b> is triggered when smoke begins to develop in the cabinet, as soon as the smoke detector responds.</p> <p><b>Possible reasons:</b> Smoke detection without simultaneous temperature rise</p>	<p><b>Visible and audible alarms</b> The warning light (red LED) is activated and is permanently illuminated, the operating indicator (green LED) extinguishes Alarm is triggered with medium tone interval</p> <p><b>The potential-free switching contact</b> is switched, the alarm is forwarded to the building control system</p>	<p>Immediate inspection of the system by specialist personnel (e.g. fire brigade) can be carried out in order to initiate any further necessary measures. If the smoke detector does not detect any further smoke development inside the cabinet, the system can be put back into normal operation by briefly disconnecting it from the mains voltage.</p>
ALARM STAGE 2	<p><b>Alarm stage 2</b> is triggered if, in addition to the already activated smoke detector (alarm stage 1), the temperature sensor registers a temperature <b>greater than 70 °C</b> inside the room</p> <p><b>Possible reasons:</b> Fire arise</p>	<p><b>Visible and audible alarms change to</b> The warning light (red LED) changes from permanently illuminated to flashing The alarm changes to a fast tone interval</p> <p><b>For SafeStore Pro at the same time</b> The technical ventilation is switched off The power is switched off to the socket boards</p> <p><b>The fire suppression system</b> is triggered</p>	<p>The complete system can then only be inspected by authorised asecos service technicians and, if possible, put back into normal operation. The fire suppression unit and the smoke detector must be replaced as a minimum.</p>



#### React quickly in the event of fire

With the integral 3-stage warning/fire suppression system, the SmartStore and SafeStore Pro cabinets offer a high level of safety when storing and charging lithium-ion batteries.

The fire starting in the cabinet is detected immediately and evacuation of personnel can start straight away. Connecting the warning/fire suppression system to a permanently manned building control system or fire control centre also ensures that trained emergency response teams

- are quickly alerted and on site within a short time
- can take further measures immediately, after an initial evaluation of the situation
- can remove the cabinet from the building for example. This prevents further damage to buildings and injury to people.

For fast transport, the cabinets are equipped with a transport base. The cabinets are automatically disconnected from the power supply during transport. Once the cabinet is located outside the building in a safe place, the rescue services can determine further necessary measures.

## SafeStore-Pro storage cabinet with 3-stage alarm system

SafeStore-Pro extends the basic SafeStore principle with a warning/fire suppression system. The sophisticated, 3-stage system inside the cabinet is triggered automatically in the event of a fire.

### The 3-stage alarm system

With the integral 3-stage warning/fire suppression system, the Smart and SafeStore-Pro cabinets offer a high level of safety when loading and unloading lithium-ion batteries. A fire starting in the cabinet is immediately recognised. Connecting the warning/fire suppression system to a permanently manned building control system or fire control centre also ensures that appropriate measures can be taken quickly.

### Service & maintenance

In accordance with DGUV Regulation 1 / §14 BetrSichV / §4 ArbStättV, with test report

- Functional inspection and maintenance of mechanical parts
- Safety inspection
- Test of fire-protection technical usability (DIN 12925/EN 14470 cabinets only)
- Technical ventilation inspection
- Visual inspection



**We strongly recommend that the cabinets are sited at ground floor-level so that evacuation can take place quickly in the event of an incident. In addition we recommend that a maintenance agreement is signed for all cabinets with a fire suppression system**



Storage cabinets

Body in anthracite grey (RAL 7016) with wing doors in gentian blue (RAL 5010), with storage levels and fire warning/suppression system

Model	SafeStore-123-LP	SafeStore-124-LP	SafeStore-125-LP	SafeStore-126-LP
Equipment	3 storage levels, floor spill pallet	4 storage levels, floor spill pallet	5 storage levels, floor spill pallet	6 storage levels, floor spill pallet
External dimensions W x D x H [mm]	1193 x 615 x 1953			
Internal dimensions W x D x H [mm]	1050 x 522 x 1647			
Containment volume of floor spill pallet [l]	33	33	33	33
Weight [kg]	474	484	494	505
Order number	263-600-L0	263-601-L0	263-602-L0	263-603-L0
<b>Accessories (order numbers)</b>				
Base panel	201-062-L0	201-062-L0	201-062-L0	201-062-L0
400 V power supply	267-275-L0	267-275-L0	267-275-L0	267-275-L0

\*The position of the storage levels and socket boards is fixed and cannot be altered.

# Storage cabinets

Safe storage and charging of small quantities

## Storage and charging cabinet SmartStore

The SmartStore safety cabinet is ideal for monitored charging of batteries and as a quarantine store for condition monitoring of critical lithium batteries.



**i** SafeStore and SmartStore cabinets are delivered free to the place of use as part of the safety design. We strongly recommend that the cabinets are sited at ground floor-level so that evacuation can take place quickly in the event of an incident. In addition we recommend that a maintenance agreement is signed for all cabinets with a fire suppression system

Model	SmartStore -123-L	SmartStore-124-L	SmartStore-125-L	SmartStore-126-L
Equipment*	3 storage levels, floor spill pallet	4 storage levels, floor spill pallet	5 storage levels, floor spill pallet	6 storage levels, floor spill pallet
External dimensions W x D x H [mm]**	1193 x 615 x 2224			
Internal dimensions W x D x H [mm]	1050 x 522 x 1647			
Containment volume of floor spill pallet [l]	33	33	33	33
Weight [kg]	490	502	514	526
Order number	261-995-L0	261-996-L0	261-997-L0	261-998-L0
Accessories (order numbers)				
Base panel	201-062-L0	201-062-L0	201-062-L0	201-062-L0
400 V power supply	267-275-L0	267-275-L0	267-275-L0	267-275-L0

\*The position of the storage levels and socket boards is fixed and cannot be altered.  
 \*\*Height information incl. ventilation unit

## Safety design

The **SafeStore Pro** and **SmartStore** models have, in addition to fire-resistant, passive fire protection from outside and inside, a high-quality 3-stage warning/fire suppression system inside the cabinet.

In addition, the SmartStore cabinet contains up to 60 slots (depending on version) to charge lithium-ion batteries safely and in a monitored environment.

### Function / Construction:

- 1** Electronic control system incl. potential-free alarm contact to the building control system
- 2** Fire suppression system
- 3** Operation indicator (green LED)
- 4** 2-stage warning light (red LED)
- 5** 2-stage audible alarm signal
- 6** Smoke alarm
- 7** Temperature sensor
- 8** Ready to connect to the mains power supply
- 9** High quality socket board with metal housing and 10\* protected sockets for each storage / charging level, fitted ready for operation inside the cabinet
- 10** All electrical cables for the socket boards are routed in cable ducts to a central terminal box in the top of the cabinet.
- 11** Technical ventilation (to avoid a build up of heat in the inner room)
- 12** Base panel (optional)



Image with optional base panel

**Increased risk when charging!**

see page → 16

The SmartStore offers fire protection from inside and out and has a sophisticated, 3-stage fire warning/suppression system

\*Number of sockets may differ depending on country



Fire suppression system



Socket board with metal housing and 10 protected sockets



Technical ventilation

### Safe storage of lithium batteries for underwater robotics



Lithium energy storage devices such as batteries are now used in a wide variety of applications, including underwater robotics. Kraken Power GmbH, a specialist in this field, deliberately wanted to invest in improved safety when handling lithium batteries in order to better meet the various safety requirements for storage and handling. The right partner was found in DENIOS AG.

#### Challenge and project

Lithium batteries have a high risk potential. The causes of self-ignition are manifold and are mostly due to an invisible defect. The German Association of Insurers (VdS) recommends increased safety precautions, e.g. storage in separate fire protection areas, even for medium-power batteries and damaged energy storage devices.

In order to guarantee insurance protection and to minimise the risk of fire, Kraken Power GmbH uses the special DENIOS AG product range for the safe storage of lithium energy storage devices.

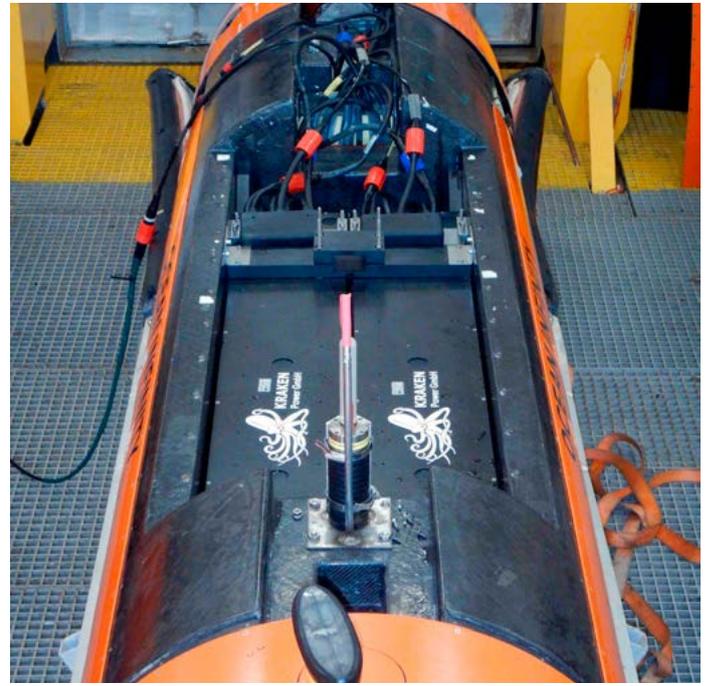
Equally important to Kraken Power was the convenient handling for the separate storage of the lithium modules during the production of the battery units. In order to avoid unnecessary detours to the stores, the "SafeStore" safety cabinet with fire protection on both sides was selected, which could be placed directly at the production site.

With the "SafeStore" Kraken Power has a state-of-the-art safety solution with fire protection on both sides for the storage of lithium modules, uniting fire

#### The perfect solution

With the "SafeStore" from DENIOS, Kraken Power GmbH has received a new generation of safety cabinets with 90 minutes fire protection from inside and outside and equipment components specially designed for the safe storage of lithium batteries. What's special: conventional safety cabinets are only designed for a fire from outside to inside. "SafeStore" also protects against overheating or smoke development inside during storage. Fire resistance is 90 minutes from the inside to the outside and was proven by an additional fire test according to EN 1363-1. If a fire breaks out outside the cabinet, "SafeStore" also withstands 90 minutes from the outside and is classified according to EN 14470-1 as Type 90.

In addition, a liquid-tight floor spill pallet ensures that any leaks from burning batteries are safely contained. An integrated, self-closing door mechanism also ensures permanent fire protection.



Storage cabinets

Kraken Power GmbH, founded in 2016 and based in Bentwisch near Rostock, develops and produces pressure-neutral batteries, drives and electronics for underwater robots, which are sold worldwide. The focus is on the development of uncomplicated and cost-effective technologies for the construction and application of mechanical, electrical and electronic systems that tolerate a hydrostatic pressure of 600 bar. Based on this technology, Kraken Power offers various electric drive and energy supply systems with lithium polymer cells, making it a leading organisation in this sector.

**Would you be interested in a similar solution?**

Do you need a safe storage environment for your lithium batteries too? Just get in touch!

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**Result and benefits**

and insurance protection with economic efficiency. Furthermore, the increased safety requirements, which insurers also place on the storage of lithium energy storage devices, were taken into account.

### Husqvarna® focuses on user safety with DENIOS



The Husqvarna Group is an international group whose roots go back to 1689. Forestry, gardening equipment and accessories are marketed in Europe, America and Asia under the Husqvarna® brand. Lithium-ion technology is an important part of the product range. From chainsaws and mowing robots to abrasive cutters, Husqvarna® promotes battery-powered equipment for efficient and safe working without emissions or noise. Close cooperation with the user is also important to the brand. Husqvarna® turned to DENIOS because of users' growing uncertainty about the safety of lithium-ion batteries.

#### Challenge and project

We hear of dangerous incidents involving lithium-ion batteries again and again. In 2017, a fire in a parking garage made the headlines, caused by the battery of an e-bike. Just as alarming is the recall campaign by a mobile phone manufacturer due to burning and exploding batteries. These messages also unsettle users and distributors of battery-powered devices. Manufacturer Husqvarna® provides comprehensive support for customers and wanted to counter this uncertainty with a user-oriented safety design. This is why Husqvarna® approached DENIOS.

DENIOS has a very good reputation as a specialist in operational environmental protection and work safety and is often relied upon as an expert in the safe

storage and charging of lithium energy storage devices. The range of products related to lithium-ion energy storage devices covers storage rooms and cabinets including equipment for the safe charging of lithium batteries, test rooms and test benches for lithium batteries as well as a wide range of equipment.

Husqvarna®'s request is focussed on the user. Husqvarna® advises users to store their battery-operated devices, including the charging station, in a frost-free location or indoors during the winter months. A safe indoor storage solution is therefore required for a smaller number of batteries or devices including charging facilities.



Storage cabinets

### The perfect solution

Due to the fire hazard posed by lithium batteries, safe indoor storage and charging only makes sense in a fire-rated system that provides fire protection on both sides (inside and outside). The SafeStore, SafeStore Pro and SmartStore safety cabinets from DENIOS are best suited to the application due to their dimensions and compact size. They offer 90 minutes fire resistance from inside and out. The SafeStore Pro and SmartStore models have, in addition to fire-resistant, passive fire protection from outside and inside, a high-quality 3-stage warning/fire suppression system inside the cabinet. In addition, the SmartStore cabinet contains up to 60 slots (depending on version) to charge lithium-ion batteries safely and in a monitored environment.

### Result and customer benefit

With the purchase of DENIOS safety cabinets, Husqvarna® has now created an opportunity to provide customers with comprehensive advice and safety for the storage and charging of battery-powered equipment. As a manufacturer focussing on efficiency and safety for users of Husqvarna® forestry and gardening equipment, the convenient and safe cabinet concept from DENIOS is an ideal addition to the range. The different cabinet types also allow Husqvarna® to offer customers solutions that meet their needs.

### Would you be interested in a similar solution?

Do you need a safe storage environment for your lithium batteries too? Just get in touch!

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# Test environment



## Hazardous experiments need a safe test environment

Newly developed lithium energy storage devices or products with built-in lithium batteries such as vacuum cleaners or electric vehicles have to be thoroughly tested before they are approved for sale. For example, the product tested is stressed beyond its load limits using special processes to enable conclusions to be drawn about the risks it poses or to ensure optimum compatibility between components and the product. These tests take place under special safety conditions. The commercial, application-specific safety and fire protection design is the basis for planning a safe test environment. Many additional aspects such as space requirement, set-up conditions, data capture for customer-specific evaluations etc are also considered when designing a room. For this reason lithium test rooms are almost always designed to customer-specific specifications.



Test environment

**"DENIOS test rooms provide a protected environment, with professional, versatile equipment, for demanding workflows."**

# Test environment

## Test rooms

### Needs analysis and project advice

Groundbreaking solutions are created when customer and manufacturer work closely together. Close cooperation is our top priority. Our experts will support you with planning right from the start. When our quote is given, you'll already have a direct contact and easy communication options. With a diverse team of specialists, DENIOS offers an integrated range of services all in one system, and ensures continuous project management right from the start. **"Made by DENIOS"** represents the highest levels of quality, all from one supplier.

#### Needs analysis and advice – the foundation of your safe test environment

What do your risk assessment and fire protection design say? Which test procedures will be carried out? How will the test environment be integrated into your infrastructure and work processes? Well-directed questions help our engineers clarify what your optimum design could look like. Space requirements, installation location (indoors or outdoors), equipment, safety equipment – your individual requirements profile will be created from our needs analysis. You'll benefit from our expertise as fire safety experts, which we will pass on to you and will use to create your design, allowing your employees and equipment to be protected in the best way possible.

#### Professional project management

Our aim is the precise implementation of your project, on-time, ensured by our specialist staff. We will create an individual technical room system, customised to your individual requirements, in a step by step process in accordance with our integrated service concept (see page ➔ 64).

In addition to the Factory Acceptance Test (FAT), you may also monitor the progress of production phases in person. We have many years of experience with legislation, approval authorities and insurers and will work alongside you throughout the project. We will create a plan together to gain approval for your test environment's structural, environmental, Ex and fire protection aspects - a vital prerequisite for insurance.

After the project has been completed, you will receive comprehensive project documentation as well as tested structural analysis calculations. We also support you while your product is in operation. Our Customer Service Department will ensure that your investment retains its value. With a service and maintenance plan which is tailored to you and your product, we guarantee a high quality, long lasting solution.



**In the automotive field, the EUCAR Hazard Level is used for classifying risk when testing lithium energy storage devices. This information is generally included in the risk assessment. The resulting safety design will then determine suitable equipment for your test room.**

#### The EUCAR Hazard Levels (basic description)

Level 0	No effect, no damage
Level 1	Passive protection activated
Level 2	Defect / Damage
Level 3	Leakage / Loss of mass < 50 %
Level 4	Venting / Loss of mass > 50 %
Level 5	Fire or flames
Level 6	Rupture, parts ejected
Level 7	Cell explodes



## Product features and equipment

DENIOS prides itself on building rooms which perfectly meet your requirements and offer the highest levels of safety. A standard solution often lacks the optimum features for testing lithium energy storage devices. This is why we manufacture test environments almost exclusively to customer-specific requirements. A benefit for you: during design and production we can therefore take advantage of many proven standard elements. This means you'll be able to benefit from the combination of cost-effective standard production and individual design.

### Simulation – the core function of your test room

The simulation of loading situations for lithium energy storage devices requires various process-dependent functions to be available in the test environment. Alongside individual equipment options, test rooms from DENIOS offer the possibility of simulating or supporting various loading situations inside the room:

- Simulation of extreme environmental conditions by loading up to the permitted temperature limits (e.g. -20°C to + 60°C), as well as testing behaviour during temperature variations
- Effect of increased humidity on the test pieces, e.g. formation of condensation
- Loading with minimum and maximum power supply, looking at upper and lower voltage limits
- Shock testing
- Acoustic tests (shaker)
- Corrosion and corrosive gas testing
- Electromagnetic compatibility testing
- Battery cyclic conditioning
- Long term loading tests
- Altitude simulation

### And size? Whatever size you want!

The variable dimensions of the test room mean that it can be designed exactly for the space you have available and the required application. As a compact solution there are numerous space-saving applications which can fit in any position. The low net weight means that its position can also be easily changed (e.g. following internal re-organisation). Large-scale solutions are also possible, from combined storage and test facilities to multi-room complexes with covered-over logistics and access areas.

### Equipment options

Use our comprehensive equipment options to customise your test system – for increased safety and convenience (from page ➔ 44).



### Connection-ready to turnkey solutions - we'll do everything for you

We are also happy to install your equipment into the system for you. Or fit your own internal equipment on our premises.



**If you are looking more for a standard room solution, take a look at our systems for storing lithium energy storage devices. (see page ➔ 12). These can also be used for testing, if no customer-specific adjustments need to be made.**

### Test stand for stationary energy storage devices



Voltavision GmbH in Bochum, Germany is an independent R&D company, operating test equipment for high technology systems in the electromobility and renewable energy sectors. The size of the units tested ranges from lithium-ion batteries for electrical equipment right up to “large” energy storage systems. It was for these large applications that Voltavision and DENIOS developed a test room together, which had a customised test room volume and allowed testing of lithium energy storage devices over a wide temperature range.

#### Challenge and project

The energy revolution needs rethinking - in many respects. More and more energy is supplied by renewable sources such as wind farms or solar installations. Energy is often produced at sites and at times of the day when it can't be used directly. This also means that electrical energy storage devices are becoming an increasingly relevant issue. Comprehensive tests to determine the effects of a wide range of environmental factors on module life are needed.

Professional bodies have made many recommendations, but there are no laws or regulations in the proper sense which constructors and operators can use as guidance. Safety designs are therefore based more on insights than standards.

In this case, the risk assessment was based on the critical need to create a

separate fire compartment to house the test unit. A fire-rated system which would resist a fire load from inside or outside for 90 minutes was required. Standard climate control chambers available on the market did not meet this requirement.



Test environment

### The solution

Working together, Voltavision and DENIOS developed a fire-rated test stand (F90/REI90) for stationary energy storage devices. Very large batteries, within the permitted test volume of up to 30 m<sup>3</sup>, can be subjected to defined thermal and electrical conditions. A temperature range of - 20 °C to + 60 °C, e.g. for artificial ageing processes, can be simulated under standardised test conditions. The batteries are tested for cycling stability and calendar life. A comprehensive safety design was also taken into consideration. The inclusion of corresponding sensors allowed continuous room monitoring. Whether it's gas detection or temperature sensing - accident prevention is vital!

A pressure relief panel in the roof allows for controlled pressure equalisation in the event of an incident. High performance technical ventilation also ensures that any harmful and potentially explosive gases are removed from the room. And if the worst should happen, contaminated cooling water is collected in a spill pallet. An acid resistant, anti-static inliner gives an additional level of safety. A separate connection is provided for emptying the WHG spill pallet. This ensures that cooling water can be properly disposed of.

### Result and customer benefit

An innovative, turnkey solution offering repeatable measurement results! All this was done without a separate climate chamber in the test room!

### Would you be interested in a similar solution?

Do you need to test large lithium energy storage devices at various temperatures? Do you want to do this without extra construction costs and within existing buildings? Our technical room systems offer the perfect solution. Get in touch!

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### Lithium cell manufacturer relies on safety from DENIOS



Manufacturers of lithium-ion cells are expanding worldwide. In order not to waste valuable time when setting up new production facilities, the focus is on modular and turnkey solutions. A lithium cell manufacturer commissioned a test room from DENIOS to carry out product tests. The closed system offers national technical approval, 90 minutes fire protection from inside and outside, a working environment that is climatically adapted to the sensitive technology and customer-specific equipment for demanding activities.

#### Integrated air dehumidification minimises the risk of fire

To ensure high product quality, the manufacturer plans to conduct regular tests. This also includes the dismantling of the lithium cells into their basic components. As contact with humidity in the air is sufficient for lithium compounds to catch fire, these tests must take place in a controlled working environment. In close cooperation with the customer, DENIOS has created a self-contained, technical technical room system for these demanding activities. A customer-specific solution has been developed on the basis of the standardised hazardous materials store WFP-X 22 Li-Ion, which already has F 90 fire protection and flexible equipment options.

The equipment is adapted to suit the planned activities and the technical room system is divided into an entrance and a dismantling area. The dismantling area is connected to an air dehumidification system in order

to keep the air humidity low and reduce the risk of fire to a minimum. Air conditioning ensures a constant 20 C +/- 2K. A partition wall with personnel airlock ensures separation of the two areas. Access authorisation is controlled by the level of humidity in the entrance area so as not to influence the climate in the dismantling room when the door is opened. An additional exit door in the working area serves as an escape route in an emergency. Four mobile hand-held fire extinguishers are mounted in different places for quick access.



View through the entrance door into the airlock area, behind it is the working area and at the end the escape door



View of the dismantling area - the AT Compact worktable is in the background of the test room

Test environment

**Safety is in every component**

All components of the test room are designed for safety. Windows in the doors and in the outer walls as well as video surveillance provide monitoring from outside, ensuring additional personal safety. The external cladding, including the windows and the cable and pipe breakthrough points, is fire-resistant (F 90). The floor is antistatic and resistant to chemicals. Emergency lighting makes it possible to complete work with care, even during power failures. Emergency signalling can be triggered by three manual call points and two fire detectors. Both audible and visible signals are given. In the event of an accident, further protective measures are provided by a complex control system.

For the dismantling workstation, the customer opted for a DENIOS AT Compact worktable with air extraction. The work surface is specially made of plastic for this application. Powerful fans ensure an airflow from the environment towards the extraction vents. With air speeds up to 0.5 m/s at the entry, harmful substances and emissions in the work area are safely captured, effectively retained and extracted. The Compact worktable's folding front safety screen protects employees from emissions. A gas detector signals an alarm as soon as a hydrogen concentration is detected. Three additional worktables without air extraction for hazard-free activities extend the working area. Several 230 V sockets and dimmable LED lighting complement the individual interior design.

**One order - full support**

As a rule, many different trades and contractors are involved in construction projects. This means there is always a risk of coordination problems and information gaps. As a supplier and manufacturer of turnkey technical technical room systems, DENIOS has all the required expertise in-house. In the project described, the customer benefited from a central contact person right from the start. A project engineer coordinated the entire project for the customer, from requirements analysis to turnkey delivery. With direct communication and internal coordination between the various departments, the customer's requirements were recorded and implemented with no loss of information. The joint discussion made a decisive contribution to the production of a meaningful and economic concept. The customer also made the decision to award the project to DENIOS because of our market leading position in hazmat storage, our existing fire protection approvals and extensive references for storage and test rooms for lithium energy storage devices, going back many years.

# Equipment



## Comprehensive, safe

We aim to optimise your technical room system to exactly meet your requirements in an uncomplicated and efficient manner. As a manufacturer we know exactly what our customers need and have included the right modules in our comprehensive range of equipment and accessories. Choose suitable options for your safety and convenience from a wide range of proven components.

In addition we offer over 12,000 proven standard products in our main catalogue to complete your safety design. Whatever you need to make your work safer and more convenient, DENIOS has the right solution.

You'll find more information on equipment and services for the "safe storage and testing of lithium energy storage devices" on the following pages.



Equipment

**"The equipment from DENIOS is unbeatably versatile and needs-oriented."**

# Equipment

## Convenient equipment

### Making use of the space



Regardless of whether you need a technical room system or a racking system - there are many options when it comes to how you adapt the space in your technical room system to suit your requirements.

#### Walk-in technical room system

The walk-in technical room system offers almost limitless ways to use the space. The inner room can be fitted with shelving, the floor can be used for storage or as a work area.

The walls can be used for mounting components using anchor bars. Wheeled trolleys can be used to move heavy loads around inside the technical room system. Narrow mesh grids ensure a pallet truck can be used. Partitions and complete dividing walls can be built in so that you can separate your technical room system into various storage/access areas.

#### Shelving system

A shelving system offers flexibility in the number and arrangement of the shelves as well as their load capacity and type. In the standard version the storage levels are equipped with grids. In the special design versions, we offer special shelf supports which help you to optimise work processes and minimise the risk of accidents involving heavier loads: roller conveyors for continuous and slide-in storage, support rails or trolley rail systems. Do you need a lot of space? Storage containers for lithium energy storage devices can be made in extra deep versions if required (approx. 2500 mm inside).

#### Overhead crane beam with crane trolley

Make it easier for you to lift heavy loads in walk-in Technical room systems with a lifting device. A load carrier is mounted in the ceiling area for this purpose. A crane trolley and an electric chain hoist are operated by pendant control and provide a lifting height of max. 2.5 m with a maximum load of 100 kg.

#### What other ideas do you have for using the space inside your room?

Just get in touch! We'll find the solution together.

🇩🇪 0800 753-000-3 [info@denios.de](mailto:info@denios.de)  
🇦🇹 06225 20 533 [info@denios.at](mailto:info@denios.at)  
🇨🇭 056 417 60 60 [info@denios.ch](mailto:info@denios.ch)

## Room access



Equipment

When it comes to room access, door closing technology makes a decisive contribution to comfort and security when operating the doors\*. This isn't an area to cut corners, as selecting the right door closing technology pays off during use.

### Electronic access systems

The doors can be locked with a mechanical lock as standard to prevent unauthorised access. By fitting the system with an electronic access system, you can make access easier and considerably simplify the control of access rights.

Electronic access systems (keyless) are also available for 1 and 2-wing doors, enabling access via RFID transponder, code, fingerprint or handheld device with Bluetooth. Sliding doors can be fitted with remote control. This allows the doors to be operated conveniently and quickly e.g. from a forklift truck.

### Traffic route and impact protection

Protect your employees from passing vehicles when accessing the technical room system by using railings. To prevent greater damage to the technical room system, we also offer various impact protection devices, such as bollards and barriers.

\*To simplify, the term "doors" also includes "gates".

### Communication Bar

The latest in-house development from DENIOS combines maximum ease of use with modern technology. The Communication Bar allows you to operate all electronic components of the technical room system, e.g. the controls, lighting and electronic access control via RFID.

### Door hold-open systems and door damper (SoftClose)

With the help of a magnetic door hold-open system, the doors are kept open and do not interfere with loading processes. Even higher retaining power is provided by electromagnets, which keep the door open even when the wind blows. When the door closing button is operated or if there is an alarm, the power to the electromagnet is cut and the door closes.

For outdoor installation, we also recommend the use of door dampers for personal and property protection.

# Equipment

## Personal safety

### Provision of information for preventive work safety



The provision of safety and health-related information is of great importance for preventive work safety. Clear labelling of hazards helps to reduce risks in the workplace and prevent occupational accidents.

#### Information display

Appropriate work instructions and information for work safety must be provided in accordance with the risk assessment for the use of the technical room system. For this purpose, information can be displayed on the outside of the technical room system in a weather-resistant, lockable info box in silver-anodised aluminium, with ESG safety glass. The back wall is a magnetic writing surface. A4 printouts can be attached with magnets or you can write important short messages directly on the board.

#### Digital information system

The ongoing change process for information provided must also be taken into account when choosing an information system in order to ensure that information is up-to-date and correct. Electronic systems can make this task much easier. With the DENIOS Cloud solution, all the information can be bundled into one application, for example quick access to operating instructions, operator's instructions, safety data sheets, etc. The application also allows you to integrate DENIOS Connect Condition Monitoring (see page ➔ 56).

#### Signage and marking

Clear, adequate signage increases safety during operation. Legally-required GHS markings and a large number of warning signs and markings for escape routes or hazard areas are mandatory. We would be pleased to plan appropriate signage and markings around your technical room system together with you.

## Personal safety in the work room



Walk-in technical room systems can be designed as working areas with various equipment options for maximum personal safety. Our technical room systems offer various options for lighting. In addition, the technical room system can be equipped with windows so that a line of sight to the outside can be created. For walk-in fire-rated stores, the viewing windows meet the statutory fire protection requirements.

### Video surveillance

Under certain conditions, it can be useful to monitor the hazard area in the technical room system with a video camera. Proportionality is an important criterion here. Users must give preference to alternative measures if they serve the same purpose and achieve the same objective, unless the benefits of the monitoring technology outweigh the resulting limitations. If surveillance is to be used in the inner room, the consent of the persons concerned or an agreement between the employee and the company is required.

### Personal safety in case of danger

In the event of danger, (technical) aids can help raise the alarm quickly, prevent danger, provide first aid or ensure evacuation, for example with

- An emergency signal, which is triggered by a manual alarm call point and is audibly given by a siren and/or visually e.g. by a signal tower
- Mobile hand-held fire extinguishers, which can be mounted at various locations in the technical room system for quick access.
- Emergency lighting that allows safety-relevant work to be completed with care or the danger zone to be left quickly and safely, even during a power failure.
- A first aid station equipped with, for example, a plaster dispenser, eyewash bottle and fire blanket.



**According to the German Workplace Ordinance (ArbStättV), the daylight and lighting situation in work rooms must be considered as part of the risk assessment and appropriate measures determined. The lighting systems must be selected and arranged in such a way that the safety and health of employees is not endangered. A direct line of sight to the outside is generally required. However, this regulation does not apply to rooms where, for operational, production or structural reasons, daylight or a line of sight to the outside are obstructed.**

### Test bench for lithium batteries



The AT Li-Ion worktable offers the highest level of personal safety during testing procedures on lithium-ion batteries. A water basin integrated into the table and a smoke extraction system provide immediate evacuation of the working area in case of battery failure. Due to its sturdy construction, the worktable is optimally designed for use in a tough industrial environment and is also ideal for use in a laboratory.

#### Fire protection

The liquid-permeable work surface of the test bench is mounted above a water basin and can be lowered into the basin by a motor in an emergency. High-quality actuators ensure a rapid lowering speed of up to 50 mm/s. The lithium battery is covered and cooled by the water bath. The basin has a centrally arranged drain with stop valve.

#### Smoke extraction

The smoke extractor can be switched on in an emergency or triggered by a smoke detector. Alternatively, the workstation can be permanently ventilated to provide continuous employee and room protection.

The horizontal displacement flow ensures the air flows from the inlet opening towards the extraction vents. This ensures an air speed of up to 0.5 m/s at the free cross-section at the inlet opening.

In this way, improved workplace protection for both people and the room can be ensured.

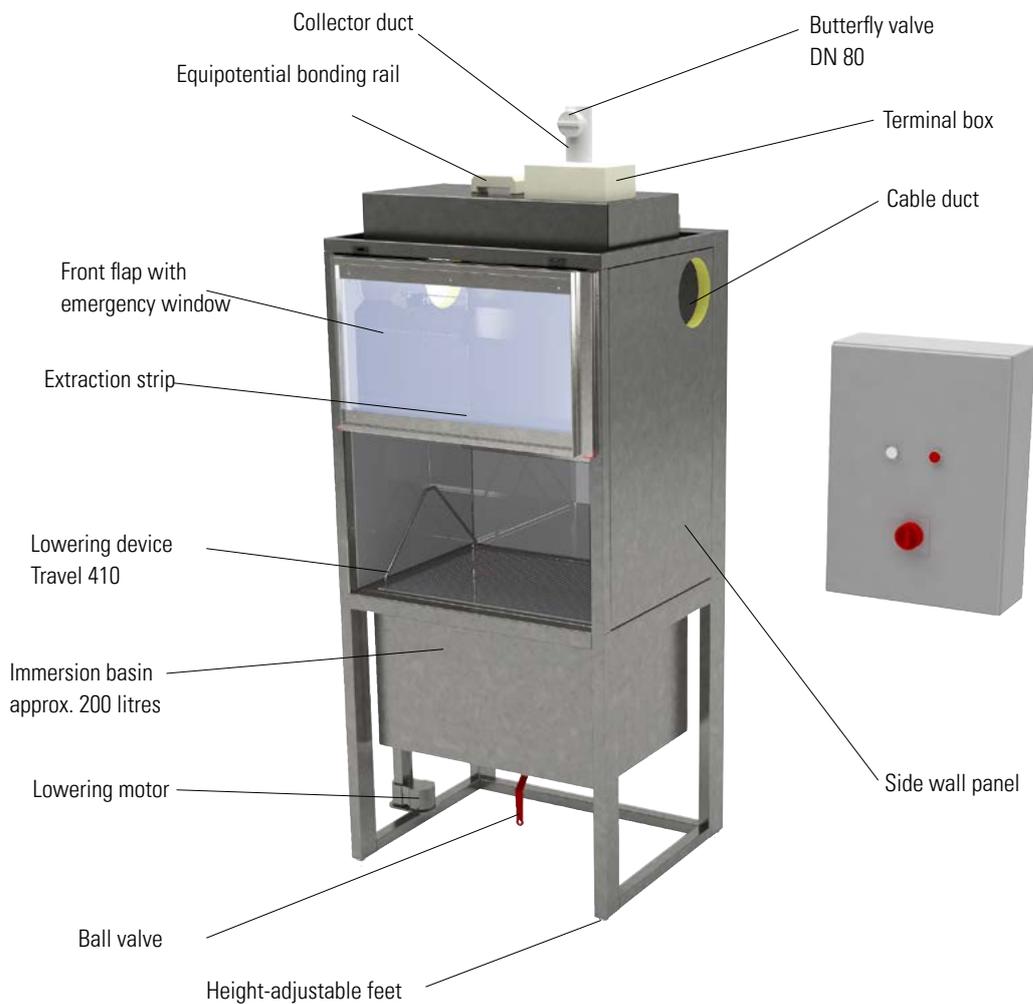
#### User-friendly system

DENIOS designs ensure both optimum work safety and user-friendliness.

- Easy to clean material and clean finish: stainless steel design (corrosion-free) with cleanly-welded joints and evenly ground seams
- Safe working and placement of even bulky objects on the worksurface
- Manually hinged front safety panel in safety glass allows unrestricted access to all working materials even in the safe position and also serves as a splashguard
- Separate, fixed worksurface for measuring technology and tools
- Height-adjustable feet (30 mm)
- Flush-mounted LED workstation lighting with diffuser for uniform illumination, protection class IP 65

### Emission control

The hinged safety panel and the smoke extraction function protect your employees from emissions, such as toxic smoke gases, even in the event of rapid smoke and flame formation. The system is designed for passive smoke extraction. Optionally, a fan can be connected for active smoke extraction.



### Customer connections

The system is prepared for connection to an on-site air extraction network (connection diameter DN 80). You will also find exhaust fans, filter technology etc. in our range. All components are connected in accordance with the VDE regulations with equipotential bonding for connection to the customer-side earthing point.

### Additional options

Extraction fans, integrated filter technology, Ex proof design etc. – with a wide range of additional options we can meet your individual requirements. Let our engineers show you how an optimised worktable solution could work.

 0800 753-000-3    [info@denios.de](mailto:info@denios.de)  
 06225 20 533    [info@denios.at](mailto:info@denios.at)  
 056 417 60 60    [info@denios.ch](mailto:info@denios.ch)

# Equipment

## Fire protection

### Preventive fire protection measures

Preventive fire and explosion protection measures aim to identify risk (fire detection or gas detection), raise the alarm (visible/audible) and assist with evacuation. They are a useful addition to other technical fire protection measures, to structural and organisational measures and to fire protection measures by the fire brigade.

#### Fire detection

Our industrial fire detectors are intelligent, platform-based and microprocessor-controlled. They function indoors and outdoors, in the immediate vicinity of the facility to be protected, as well as from greater distances. They can be used in clean room areas as well as under harsh process conditions and in potentially explosive atmospheres, offering solutions for all requirements.



Industrial fire alarms

#### Gas detection and air extraction

If flammable vapours occur in the internal room, the air extraction system can be turned on to remove the contaminated atmosphere. The extraction system can be operated manually or timer-controlled.



Air extraction monitoring



Air extraction

#### Alarm systems, warning lights and sirens

Alarm systems such as warning lights and sirens can be used for fire warning or for system monitoring e.g. air extraction monitoring (controls the air flow) or air humidity. Various solutions are available - just get in touch!



Signal lights

#### Explosion pressure relief

A pressure relief device can be fitted in the roof area to relieve pressure in the event of an explosion. It will close again automatically when the pressure wave has been dissipated to seal the store so that the fire protection properties are maintained. This has been successfully demonstrated in a 120 minute long fire test.



Roof pressure relief panel

## Preventive fire protection

The targeted, preventive fire protection measures aim to prevent fires and explosions or to contain them until the fire brigade arrives. Unwanted changes in the chemical and / or physical properties of the stored goods due to temperature influence or contact with extinguishing agents should be excluded. The same applies to collateral damage (smoke damage, fire water damage, environmental damage and damage following equipment breakdown). The ultimate aim is to restore operational readiness as quickly as possible.

### Hold-open systems for fire-rated doors and gates

- A device approved by the building supervisory authority which ensures that door openings between fire compartments may remain open by means of a hold-open device (e.g. electromagnet)
- Automatic release: in the event of a fire, the fire-rated door closes automatically after the integral smoke detector has been triggered or can easily be manually closed



Maintenance, inspection and servicing are required by law

**Request a service or retrofit now!**

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 🇦🇹 06225 20 533 [info@denios.at](mailto:info@denios.at)  
 🇨🇭 056 417 60 60 [info@denios.ch](mailto:info@denios.ch)

### Fire bulkheads

Fire-rated bulkheads for breakthrough points in fire-rated store walls for

- Cabling and pipes (bulkheads),
- Ventilation piping and ducts (fire protection flaps).



Fire protection flaps for ventilation system

### Aerosol extinguishing technology

- Permanently operational technical equipment used for suppression of a fire until the fire brigade arrives to extinguish it.
- Extinguishing technology with aerosol according to EN 15276-1, without addition of water.
- The aerosol extinguishing generator is triggered by temperature (see sprinkler system) and effectively interrupts the chemical combustion process within 4.5 - 15 seconds (depending on model).
- The extinguishing agent technology is environmentally friendly and human-compatible (not harmful to health, does not displace oxygen). Among other things, it is listed as an official "HALON replacement extinguishing agent" by the United States Environmental Protection Agency (U.S.EPA).
- Easy and quick installation thanks to low weight / installation volume and because no piping is required.
- Low investment and follow-on costs due to low testing requirements (maintenance-free over the lifetime, no pressure vessels and no pressure tests) and long product life.



### Semi-fixed extinguishing systems



In contrast to stationary extinguishing systems, semi-fixed extinguishing systems do not have their own extinguishing agent supply, but use a connection to the fire brigade's extinguishing agent supply. They enable the emergency services to carry out a rapid and targeted extinguishing action. DIN 18230 "Structural fire protection in industrial buildings" states that a semi-fixed extinguishing system can only be considered in an industrial fire protection design with the approval of the public fire brigade if no works fire brigade is available.

### Air conditioning technology

The room climate can be clearly defined so that your stored goods or sensitive technology can be optimally housed and also so that your employees are protected. Air quality, humidity and temperature are optimally adjusted to meet the legal requirements and your needs.

#### Insulation

The construction principle of technical room systems with thermal insulation is based on 5-sided cladding with special panels. Depending on the application, non-combustible mineral wool panels (building material class A) or flame-retardant polyurethane rigid foam/PUR panels (building material class B) are used.



Section through non-combustible mineral wool panels (building material class A)



Section through flame-retardant PUR panels (building material class B)

#### Technical ventilation

To ensure permanent air extraction from your technical room system, the air exchange is ensured by high performance technical ventilation, in accordance with local technical requirements. This ensures that the possible risk of harmful or even explosive gases being created is taken care of. The air flow is monitored by an airflow monitor in accordance with the law. We will also be happy to fit additional technical ventilation, which switches on automatically in the event that the air extraction limits are exceeded.



Air extraction



Air extraction monitoring

#### Air dehumidification and air lock technology

If you need an exactly defined room climate, we offer the possibility to connect your technical room system to a dehumidification system. By installing partition walls with air lock technology, we enable a clearly defined room climate to be accessible in a controlled manner. We have already implemented this equipment in the test room of a lithium cell manufacturer (see pages ➔ 40-43).



#### System monitoring

DENIOS offers many monitoring and warning systems for monitoring temperature, air extraction and air humidity as well as protection against gases which pose a risk to health using gas warning detectors.

Gas warning detector, optionally in Ex-proof design



**Finned tube heaters**

Our finned tube heaters are fitted with an integral safety temperature limiter. This protects the heater surfaces from overheating. Accessories also include appropriate impact protection as this heater is usually fitted near the shelf guard. Available as Ex and nEx versions, each with an output of 1 or 2 kW.



**Additional ventilation**

For large technical room systems which are fitted with finned tube heaters, additional ventilation is provided. Connected to the heating system, the system takes the warmed air from inside the room and distributes it evenly across the storage area.



**Heating fan**

In contrast to finned tube heaters, heating fans ensure active, targeted convection. The effective heating produced is higher than for heating media with a natural heat flow.

Heating fans are therefore the ideal choice for larger, walk-in hazardous materials stores with insulation. Heating fans also have a recirculating function ensuring a uniform temperature distribution in the store.



**Air conditioning system**

In the standard design, the air conditioning system ensures internal temperatures of +5 °C at an external temperature down to -15 °C, or an internal temperature of +25 °C at an external temperature up to +35 °C. Modular cooling and air conditioning solutions enable precision temperature control of the storage room. Ex designs are also available.



# Equipment

## Smart condition monitoring



### Simple – smart: from sensor to data portal

The sensor equipment, e.g. temperature sensor, fire/smoke detector, gas detector, etc. forms the basis for the smart condition monitoring ("DENIOS connect") of your technical room system. Depending on your functional requirements, you can choose between two control variants for data acquisition and processing. These can be individually extended in their functional range by additional options. Data transfer can be conveniently implemented via USB, Modbus or mobile telephone connection.

#### Measured variables for condition monitoring

Permanent status recording is possible for the following safety-relevant components of the technical room system:

- Internal and external lighting (ON / OFF)
- Technical ventilation (operating/fault)
- Heating (operating / fault)
- Door control unit (fault)
- Air conditioning system (operating / fault)
- Door (open / closed)
- Room temperature
- Runtimes
- Operating cycles (door)

In addition 1-2 signals can be integrated by the customer.

#### Mobile phone connection made easy

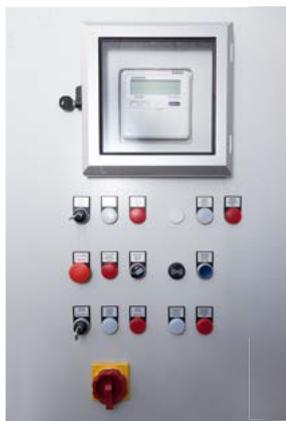
Connection of your technical room system's status monitoring system to a mobile phone network enables you to access the data and alarm messages independently of your company network. NarrowBand IoT is currently the most efficient mobile network technology for this application. This global industry standard is based on LTE and uses the associated 3GPP security mechanisms. As the technology is specially designed for smaller data volumes and dispenses with unnecessary LTE functions, it offers particularly cost-effective and reliable mobile communication.



#### The basic control system

##### Function: Data acquisition and processing

- Acquisition and processing of current measurement data
- Switching logic optimally matched to DENIOS storage and process technology
- Electromechanical control components in the switch cabinet
- Illustration of all electronic and sensor modules via operating and display elements in the front of the control cabinet in line with industrial standards



#### Functional features of the basic control system



- Actual measurement values are continually captured by the sensors and compared with setpoint values
- Visible and / or audible alarm signals
- DENIOS remote diagnosis possible
- Transmission of sensor data to customer connection, e.g. to a mail server
- Automatic triggering systems: e.g. automatic door closing or extinguishing systems in the event of fire and switching off all consumers in the event of fire

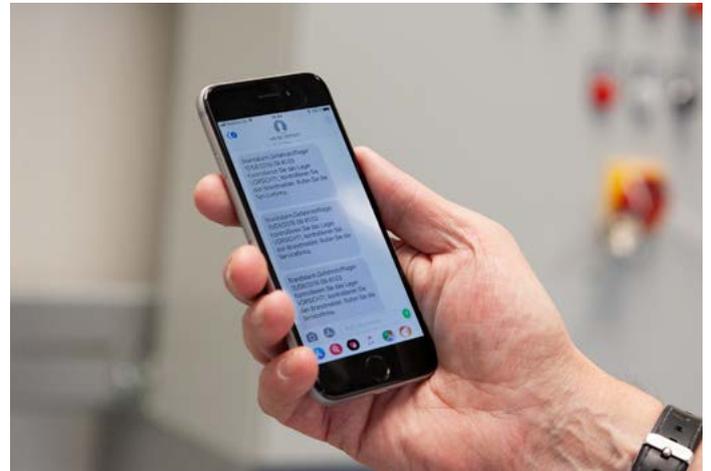


**Our systems have benefited from our condition monitoring expertise for many years. Our own innovations and experience as well as technological progress are continuously incorporated. No other manufacturer offers a comparable range of possibilities. Request your personal consultation: +49 5731 753-211.**

### Comfort control system



### Functional features of the comfort control system



#### Function: Data acquisition, processing, recording and output

In addition to recording current measurement data, the extended configuration DENIOS digital also offers data recording of operating states and fault messages as well as additional information on running times and maintenance intervals. This gives you an overview of all the safety-relevant data for your technical room system. For remote access, you establish a data connection easily and securely with a free VPN application and your Internet browser.

- Actual measurement values are continually captured by the sensors and compared with setpoint values
- System parameters are stored for 12 months
- Mapping of running times and maintenance intervals
- Error or alarm messages for setpoint value deviations and alarm delays configurable via the control panel
- Visible and / or audible alarm signals
- DENIOS remote diagnosis possible
- Transmission of sensor data to customer connection, e.g. to a mail server
- Automatic extinguishing systems: e.g. the automatic door closing system or extinguishing system in the event of a fire, or automatic switching on of a technical ventilation system if air extraction limit values are exceeded

### Comfort control system hardware and software

- Modern touch panels/displays for indoor or outdoor use with high operating comfort
- High-performance controller connected to the operating unit via Modbus maintains its function even if the operating unit fails, thus ensuring reliable process control and documentation
- The control software developed by DENIOS and coordinated hardware components are optimally designed for the hazmat storage technology and are continually expanded with new innovations
- Simple data transfer via USB interface
- Modbus interface for connection to higher-level systems, such as the customer's process control system
- Modern control cabinet technology incl. potential-free contacts for providing fault messages for evaluation by the customer
- Customer-specific versions coordinated by our developers



# Equipment

## Outdoor installation

### Protected from wind and weather

Extreme weather conditions are becoming more frequent. This must be taken into account in the design and statics of a technical room system for installation outdoors. DENIOS technical room systems are stable and resistant to the effects of external forces. Additional equipment options also offer protection from the elements for both personnel and the product. A site-specific coating provides the steel structure with optimum corrosion protection.

#### Statics for wind, snow and earthquake loads

DENIOS technical room systems are suitable for outdoor installation. Structural analysis to Eurocode 3 (DIN EN 1993) measured for a characteristic wind load with a dynamic pressure of  $qk_w = 0.585 \text{ kN/m}^2$  and a characteristic ground snow load of  $s_k = 2.5 \text{ kN/m}^2$

- Available with additional equipment for up to wind load zone 4, terrain category I ( $qk_w = 1.064 \text{ kN/m}^2$ ) and for up to ground snow load  $s_k = 5.86 \text{ kN/m}^2$
- Structural analysis sufficiently measured in accordance with DIN 4149/EN 1998-1:2004 for earthquake zone 3



Technical room system with snow load

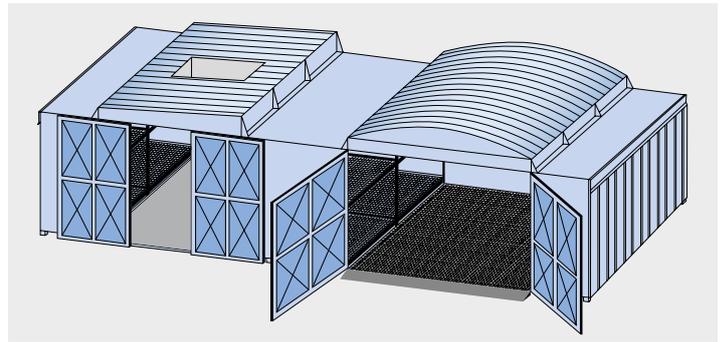
#### Extendable entrance canopy

Practical canopy for the entrance area of your walk-in fire-rated store for bad weather protection. The canopy is mounted on rails and fitted above the entrance area. Assembly takes place in our factory and is therefore an integral part of the turnkey system.



#### Weather-protected large-scale system

Technical room systems from DENIOS can be combined into installations of any size. Traffic routes and picking areas can be provided with a roof light strip to ensure weather protection for workers in the plant. Any requirements regarding temperature specifications, ventilation technology, etc. can be implemented. Legal regulations and fire protection standards are observed.



#### Varnishing

Technical room systems from DENIOS are usually painted in RAL 9002 (grey white) or RAL 5010 (gentian blue). Cooling and air-conditioning systems are painted in RAL 9002 as standard. This colour is especially suitable for preventing the absorption of sunlight and consequent heating of the external surfaces. This gives better protection for the room from the influence of external temperatures. Other colours are of course available on request.



## "Think Green" - use your green fingers

Sustainability begins with the responsible use of hazardous production materials. Technical room systems from DENIOS offer reliable protection during storage. Combine sustainability with individuality with the wide range of equipment and individual solutions from DENIOS. We also implement demanding, sustainable projects for our customers and with their cooperation.

### "Think Green" roof greening

Use your green fingers and increase the insulation value of your hazardous materials store at the same time. A living layer of insulation for the roof of the store makes a significant contribution to the environment, increasing insects, retaining rainwater and binding fine dust. The design brings a sense of wellbeing to the workplace.

Your hazardous materials store will be fitted with a tray on the roof, including basic filler and planting. The rot-proof basic filler protects the roof seal and also has a separation and water storage function. For the basic planting, make a selection from different planting options, for example perennials and ground cover or grasses and shrubby plants.



### Mains power-independent energy supply

To demonstrate the newest renewable energy technologies, Hoppecke needed a demonstration room. In close consultation with the customer, DENIOS designed an individual, two-part technical room system that meets a wide range of requirements for safety, fire and explosion protection. The first area was used as a technical room for batteries and fuel cells; the other area was used as a gas cylinder storage area for the hydrogen cylinders. This technical room system made possible the sensitive storage of hydrogen bottles for the operation of fuel cells and also the storage of lithium-ion batteries, which were to be charged via the fuel cells and the photovoltaic panels fitted on the roof.

On the one hand, we have shown that we can realise challenging, sustainable projects together with our customers. On the other, it's clear to see there's a wide range of possible applications for technical room systems from DENIOS. With a broad range of equipment and experts for individual solutions, we've got everything you need.



**HOPPECKE, is the largest manufacturer of industrial batteries, systems and charging equipment in Europe. The increasing use of renewable energy and the conversion to emission-free drives has made rechargeable energy storage units increasingly important. HOPPECKE has developed marketable designs for the future and is making an important contribution to solving the commercial challenges we must address in the face of global climate protection goals. Company description: [www.hoppecke.com](http://www.hoppecke.com)**



### PyroBubbles® extinguishing medium

PyroBubbles® is an extinguishing medium positive tested by MPA Dresden according to DIN EN 3-7 for solid and liquid combustible substances (fire classes A, B, D and F). The hollow glass granules are classified as building material class A1 (DIN 4102). The product is very light and highly suited for use as an inert filler.

PyroBubbles® are temperature resistant to approx. 1050 °C. After a fire has been extinguished, the extinguishing granules can be simply collected up again and for the most part reused. PyroBubbles® extinguishing medium is also excellent for preventive fire protection, especially for filling hollow spaces, cable ducting and installation shafts (horizontal and vertical) when used as a bulk good.

#### PyroBubbles®

- Ideal filler for storing and transport of lithium ion batteries (UN 3480, UN 3090), mainly consisting of silicon dioxide with an average grain size of 0.5 to 5 mm.
- Non-combustible building material (A1, DIN 4101, EN 13501)
- 100% environmentally-friendly
- Absorbs electrolyte (BAM tested).
- Low thermal conductivity and electrically insulating
- Approx. 8-10 times lighter than sand, (approx. 230 kg/m<sup>3</sup>)
- Specific heat capacity of just 0.7 kJ/(kg.K), porosity of 85%
- Mounting provides vibration protection
- Floats on the surface of liquids therefore especially suitable for fighting liquid fires regardless of polarity.

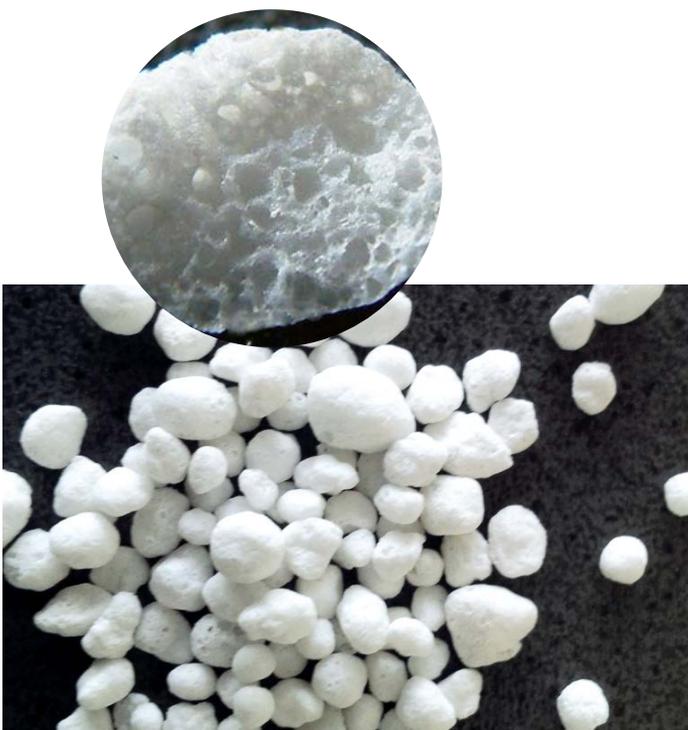


#### Expert tip

- Powerful lithium-ion batteries are the driving force behind modern electric mobility. Lithium batteries are however hazardous goods. They therefore come under the hazardous goods regulations. Lithium batteries are classified in ADR and RID as hazardous goods in class 9 (various hazardous substances and objects) with the following UN numbers:
- UN 3090: Lithium metal batteries (including batteries in lithium alloys)
- UN 3480: Lithium-ion batteries (including lithium-ion polymer batteries)
- (UN approvals for batteries in equipment are not listed here)

Using the steel and plastic containers in combination with the PyroBubbles filler, you will meet the comprehensive requirements of the numerous packaging and special regulations for dispatch of lithium-ion batteries.

**The PyroBubbles® filler material in conjunction with the UN certified stainless steel containers is one of the safest systems to handle and transport lithium-ion batteries, and has been approved by the relevant authorities (German Federal Institute for Materials Research and Testing, BAM) as a packaging method for the transport of damaged and dangerously reactive lithium-ion batteries.**



## Transport containers for hazardous goods

Safety systems for storage and transport in accordance with Special Provision 376 ADR for damaged, faulty (Packaging Instructions P 908 and LP 904) and unsafe lithium-ion batteries (Packaging Instructions P 911 and LP 906). For transport for recycling purposes as defined by Special Provision 377, Packing Instruction 909, for non-damaged and non-defective or EOL (End of Life) lithium-ion batteries. Transport of prototypes according to Special Provision 310, Packing Instructions P 910, LP 905.

### In stainless steel

- Includes PyroBubbles® fire-protection media packed in paper bags, each 12.5 kg (approx. 50 l).
- Certified, tested, with UN approval
- Scientifically supported by real fire tests

100% control of any possible thermal runaway. Effective containment of environmental hazards. Even during and after thermal runaway of the battery, the temperature of the external walls remains well under 100°C



Model	S-Box X1	S-Box X2	M-Box X1	M-Box X2	XXL Box
Equipment	4 paper bags of PyroBubbles®	6 paper bags of PyroBubbles®	10 paper bags of PyroBubbles®	16 paper bags of PyroBubbles®	50 paper bags of PyroBubbles®
External dimensions W x D x H [mm]	799 x 599 x 734	799 x 599 x 1114	1199 x 799 x 792	1199 x 799 x 1252	2500 x 1484 x 1029
Internal dimensions W x D x H [mm]	676 x 476 x 580	676 x 476 x 960	1076 x 676 x 640	1076 x 676 x 1100	2376 x 1356 x 808
Maximum load hazardous goods [kg]	66	110	155	360	400
Maximum gross weight [kg]	160	240	350	630	1212
Volume [l]	187	309	466	800	2603
Order number	261-759-L0	261-760-L0	261-761-L0	261-762-L0	261-763-L0

### In plastic

- Includes PyroBubbles® fire-protection media packed in paper bags, each 12.5 kg (approx. 50 l).
- Tested boxes, with UN approval.

The made to measure, powder coated metal basket ensures a distance of 3 cm from the inner edge of the transport box. The batteries can be easily removed using the basket.



Model	S-BOX 1 Advanced	S-BOX 2 Advanced	XS-BOX Advanced	XS-BOX 2 Advanced
Equipment	Metal basket, 1 paper bag PyroBubbles®	Metal basket, 2 paper bags PyroBubbles®	Metal basket, 1 paper bag PyroBubbles®	Metal basket, 1 paper bag PyroBubbles®
External dimensions W x D x H [mm]	600 x 400 x 295	600 x 400 x 441	400 x 300 x 235	400 x 300 x 285
Internal dimensions W x D x H [mm]	492 x 292 x 196	492 x 292 x 341	298 x 198 x 135	297 x 195 x 190
Maximum load hazardous goods [kg]	30	24	7	6
Maximum gross weight [kg]	45	45	13	13
Volume [l]	28	49	8	11
Order number	261-769-L0	261-771-L0	261-765-L0	261-767-L0

## Your service partner



### **Comprehensive and worry-free service: from advice to maintenance**

We see ourselves as your partner, providing a comprehensive and worry-free service. And we take this seriously: for us, service means taking the best care of our customers before, during and after their purchase.

Before you decide on a technical room system, you need the certainty that it will exactly meet your needs and will also meet all the requirements of the law as well as from your insurers. We therefore offer comprehensive and personalised advice, on site if needed, and support you with additional full information on the desired solution. During the design and production phase, professional project management ensures that everything is covered. We'll be there for you after your purchase too, for example with our professional maintenance service and many years of experience to help answer any questions or offer training.



**"Good support makes  
the difference."**

Your service partner

# Your service partner

## Our service concept

### One order - full support!

Our job is not just to supply an approved technical room system for your company's premises. Our service concept has a holistic approach and covers the whole order process. You'll receive excellent quality services, all from one supplier. As a manufacturer we are aware of our responsibility to our customers and ensure the highest levels of quality and best advice at every step along our journey together.



#### Step 1: Needs analysis and advice

Special projects need specialist advice. As requirements and risks can vary massively from company to company, a technical room system must always be adapted to suit your individual needs. Working together with you, our engineers will develop the optimum design for your storage or test system. Not everything can be solved by a telephone call. That's why it's important that we can offer personal advice, on-site if needed. As part of the professional needs analysis, we'll evaluate your individual company circumstances, requirements and processes. On the basis of this analysis we'll produce a customised design and firm quote. Efficient advantage: many solutions are already part of our digital configurator. Your customised technical room system can be planned in just a few clicks. But individual solutions are not a problem. Personalised advice is always important: one of our experienced engineers will take charge of your project right from the start and will be available as a direct contact from the initial offer phase to final acceptance.



#### Step 2: Design and project development

Our standardised technical room systems cover many application fields and already have General Technical Approval. This allows for quick design as well as easy processing with building authorities and insurers. But individual projects (e.g. tailor-made solutions) are also not a problem: as part of the design phase we can use proven modules to put together a customised solution. You'll be able to take advantage of the combination of cost effective standard production and individual design. We have many years of experience with legal requirements, approval authorities and insurers and will work alongside you throughout the project. Working closely with the customer, the technical room system is planned in accordance with applicable regulations. At the end of the design phase an approval drawing is produced. As soon as this has been checked and approved, your technical room system will go into production.



#### Step 3: Production and factory acceptance

Your technical room system will be manufactured in our own production facilities by certified specialists to meet international quality standards. Bought-in components undergo strict quality controls at goods-in. This means we can guarantee the same high level of quality for every product. Our technical room systems are pre-assembled in the factory and provided with all the necessary connections so that they are quick to set up at the customer's premises. A Factory Acceptance Test checks your system conforms with all specifications and quality requirements. In addition to the Factory Acceptance Test (FAT), you may also monitor the progress of production phases in person at any time.



#### Step 4: Transport to the installation site

Our worldwide logistics network ensures smooth travel arrangements for delivery. Whether we use our own DENIOS flat bed trailer or a trusted freight forwarder, we ensure your technical room system is transported safely and arrives on time. Even special transport (extra wide or extra high) and overseas deliveries are no problem. We will take care of all the arrangements including obtaining the necessary special permits. Appropriate transport packaging is of course ensured. If required we can also provide suitable lifting equipment for unloading and final assembly.



#### Step 5: Installation and commissioning

DENIOS technicians will ensure the professional installation of your technical room system and will work with you to complete the Site Acceptance Test including all installation and operational tests. Our standardised solutions can be commissioned immediately, as they have General Technical Approval. For customised projects approval from the authorities needs to be obtained. But there's no need to worry: right from the design and production phase, we are in continual contact with the relevant authorities, so individual approvals can be obtained with the minimum of fuss. Our specialist staff will then instruct the users directly on the product and comprehensive product documentation will be handed over. DENIOS technical room systems: set up, commission, stay safe!



#### Step 6: Maintenance and repair

If your technical room system is already in operation, you're not left on your own. Our technicians know all there is to know about DENIOS systems and can take over regular maintenance for you. This leaves you free to concentrate on your business - we'll look after the rest. More information on our maintenance services can be found on the following pages.

# Your service partner

Quality throughout the whole process

## Our quality promises



A DENIOS hazmat store ensures the customer can rely on tested, certified quality. All our DENIOS hazmat stores are produced in-house. This is why we had our production conditions certified in accordance with DIN EN 1090 at an early stage - comprehensively and completely. The three-part Euronorm DIN 1090 has been valid since July 2014 for all manufacturers of load-bearing structures made of steel and aluminium and sets Europe-wide quality standards. EU trade is not permitted without EN 1090 certification. Right from the planning stage, we ensure that all requirements are met and that our solutions are both highly efficient and economical. So that you as a customer can be sure of this, we have ourselves and our products regularly certified by independent institutes. These include DEKRA, TÜV NORD, DVS, IBS and the Deutsches Institut für Bautechnik in Berlin.

### DENIOS is ISO certified

Energy and the environment are key components of DENIOS' history and its self-image. Efficient, careful and economical use of all resources is a matter of course. At our headquarters in Germany, we have been certified in accordance with international standards ISO 9001, ISO 14001 and ISO 50001.

### Demonstrably sustainable

Sustainability is one of our key company values. At the same time, sustainable management is a necessary responsibility that affects all areas of a company, from development and production to human resources. In the first DENIOS Sustainability Report, we not only show that we are already very well positioned in many areas and are acting sustainably. We also recognise our potential and set concrete goals for the future.



Your service partner



## Quality control

The motto "Trust is good - control is better" sounds somewhat negative. We'd rather say: control and evaluation are the basis for continuous quality and product improvements. The better and more reliable the quality, the greater and more sustainable our customers' trust in DENIOS and their satisfaction with our services.

That's why we don't just rely on random sampling. Every technical room system that leaves our production facilities is thoroughly inspected and functionally tested before it is handed over to the customer. Every detail is recorded in a digital acceptance report and extensive photo documentation. In addition to the technical drawing, we then have an exact picture of the delivered product and can use this information later on for servicing. If we come across something during acceptance that does not correspond to the expected product quality, it will be repaired immediately. The test reports

are evaluated and the assembly personnel interviewed in regular quality rounds. Any error factors are therefore sustainably eliminated. In a dynamic business environment in which not only laws and regulations but also operational processes are subject to change, we have always attached great importance to the continuous improvement of production conditions and product quality. In this way, we are able to sustainably meet the company's goals of meeting delivery dates and customer satisfaction.

# Your service partner

## Transport and assembly

### Set up, commission, stay safe!



After successful factory acceptance, it's important that your technical room system is quickly delivered to the installation site and put into operation smoothly. Our professional transport and assembly service ensures that your technical room system is ready for use on time and without fuss. We ensure a smooth logistical process and keep interruptions to your internal processes during assembly as short as possible. Unloading, installation and commissioning of your technical room system are usually completed in just 3.5 hours.

#### Transport? We'll take care of it!

Whether to the Mosel or Shanghai: Just let us know where and we'll get your technical room system to you safely and on time. Special oversized load transport for oversize widths or heights can also be arranged. Our professional management team will accompany the shipment from start to finish. We take care of all logistical tasks for you, including obtaining the necessary special permits. Transport and installation of your technical room system is carried out by a qualified and experienced team of drivers and fitters. Our technical room systems are already pre-assembled at the factory and are delivered to you in almost one piece by a special lorry from our own fleet or by a trusted forwarding agent. This considerably shortens the assembly time needed on your site.

#### Safe transport to your site:

- DENIOS takes over the complete logistical handling process for you
- Delivery takes place with our own fleet of vehicles or through long-standing forwarding partners
- Special oversized load transport - oversize widths or heights are not an issue
- Delivery worldwide

#### Safe unloading

You are welcome to unload your technical room system yourself - however, many of our customers use our convenient unloading service. Our trained employees will then ensure safe, damage-free unloading for you. On request, we can also organise suitable lifting equipment, e.g. forklift trucks, truck-mounted cranes or aerial work platforms. We will inform you in good time about any preparatory work to be carried out by the customer, such as the preparation of the floor, so that the commissioning can be carried out on schedule.

#### Our unloading service at a glance:

- Provision of suitable lifting equipment
- Safe unloading of the technical room system by trained personnel



**Professional assembly**

DENIOS technical room systems are pre-assembled at the factory and equipped with all the necessary connections so that final assembly at the installation site can be carried out quickly and easily. Trained and experienced fitters ensure that your technical room system is installed professionally and to your complete satisfaction. A Site Acceptance Test (SAT) can of course also take place on request and after prior agreement. Only after final acceptance by you as the operator is our assembly task complete.

**Assembly services:**

- Installation and alignment of the system
- Compensation for up to 10 mm unevenness (not for fire-rated storage containers)
- Removal of transport safety devices
- Securing the system to the prepared floor
- If necessary, assembly of additional components on the supplied system

**Technical training**

Technical training is needed for the safe, professional operation of your technical room system. This will be carried out by our specialist personnel after the assembly work has been completed. In this way, your employees get to know all the functions directly on site and receive practice-oriented handling instructions. This ensures processes and functions run properly right from the start. This is accompanied by comprehensive technical documentation.

**This is how we get you ready to use your technical room system:**

- Professional, practical technical training
- Handover of technical documentation

# Your service partner

## Customer service and maintenance

### Securing your investment in the long term

With a DENIOS product, you can rest assured that you are safe. Right from the design and production stages all laws, standards and required certifications are taken into account. There's a simple way to make sure that you and your employees remain safe in the long term: regular maintenance. Equipment and tools for the storage and transport of hazardous materials are complex. In addition to design-based tests, the technical components also need to be regularly inspected. The functionality of each component can have an important effect on the construction as a whole. Regular inspections will increase your productivity and the life of your investment. You choose: for long term safety we offer an attractive maintenance contract - or you can book just a single inspection.

#### Maintenance from the manufacturer - advantages!

There's more than one good reason to choose maintenance direct from the manufacturer:

- Minimise the risk of downtime and extend the life of your equipment
- Repairs are carried out exclusively by qualified and trained DENIOS AG service technicians
- As the manufacturer we ensure high quality original parts are supplied quickly
- You'll save travel costs and time - our technicians always carry materials for small repairs
- Service with that little extra: our technicians will alert you to any changes in legislation and show you the necessary adjustments on currently available or future products. Our professional technicians will recognise possible accident risks straight away and be able to deal with them quickly and professionally.

#### It's all covered: Service from DENIOS

When our technicians come to your site, every important detail is taken into consideration. Is the air exchange rate still ensured? Do the fire protection flaps operate correctly? Are the sensors supplying all the necessary data? Only when all the safety-relevant components have been extensively tested will we assign the proverbial tick. The process may vary, depending on the product to be inspected. For your technical room system, the following are of special importance:

- Inspection of general condition
- Visual inspection for damage and defects
- Safety testing of all functions
- Inspection of the switch cabinet
- Testing of the signalling technology (e.g. fire recognition, gas warning sensors)
- Inspection of heating and air conditioning technology
- Functional inspection of mechanical parts and doors
- Inspection of spill pallets for damage



## Sign up & start saving!

When you take out a service contract, you'll benefit from our attractive all-inclusive offers as well as an extension of the DENIOS warranty of up to 5 years\*. Get your Carefree Card today and apply for your DENIOS Premium Service Card.

🇩🇪 0800 753-000-9



Your service partner

\* Applies when a service contract is taken out within the first year after the date of delivery.

### Membership pays!

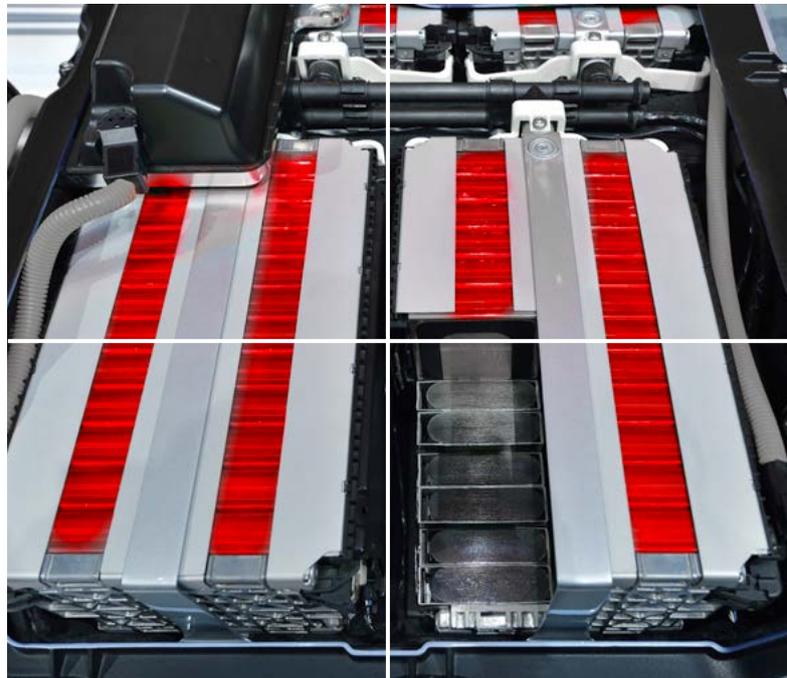
When you sign a maintenance contract, you'll have access to the following benefits:

- Regular service intervals mean that expensive repairs can be avoided
- Legal requirements for maintenance intervals are observed
- Maintenance of your insurance protection including limitation of company liability in the event of a loss
- Extra long protection: we'll extend your warranty by up to 5 years\*
- Accurate cost control: we offer an attractive all-inclusive bundle
- Don't worry about tiresome scheduling. With a maintenance contract, we'll remind you in good time when maintenance is due

### Maintenance at an all-inclusive price

The security of long term maintenance with full control of costs - our all-inclusive maintenance bundle has everything you'll need for an all-inclusive price:

- ✓
- ✓ Reminder service: making sure you don't miss an inspection date
- Regular inspection of your entire room system and the technical components
- ✓
- **Costs for travel, expenses, overnight accommodation and incidentals already included**
- ✓
- **Small repairs carried out directly on site, more involved repairs will be quoted for separately**
- ✓
- Production of a service report and test report
- Fitting the test sticker



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