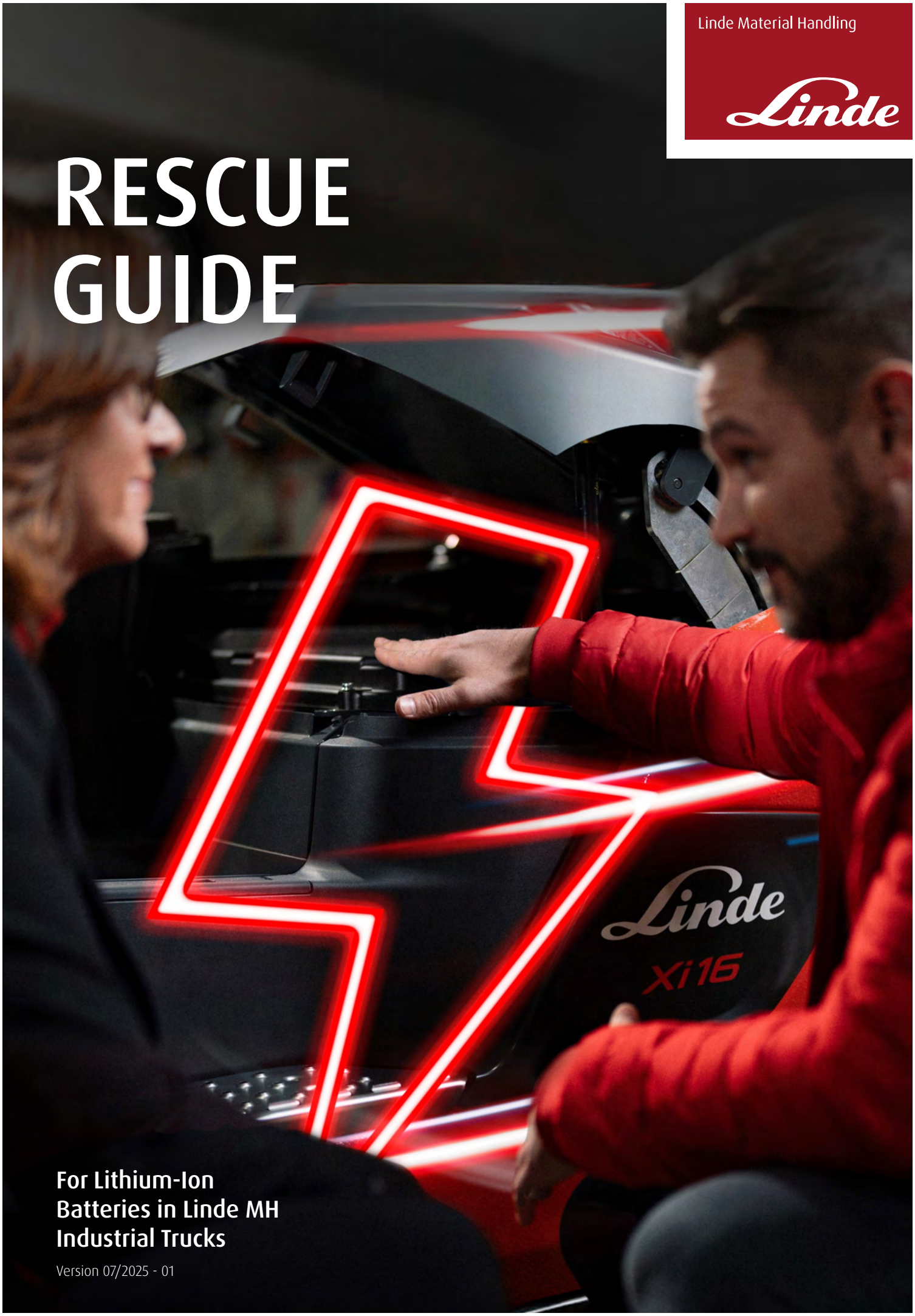
Linde Material Handling

RESCUE GUIDE



For Lithium-Ion Batteries in Linde MH Industrial Trucks

Version 07/2025 - 01

Contents

INTRODUCTION AND RESPONSIBILITIES

Lithium-ion batteries are an integral part of modern industrial trucks. The maintenance-free and durable technology supports exceptional loading and unloading performance, and plays a key role in the electrification and decarbonization of intralogistics. Industrial trucks with modern electric powertrains are a high-performance alternative to industrial trucks powered by combustion engines, even in demanding applications.

But the lithium-ion technology also presents new challenges: There are concerns about the safety of the technology. This primarily relates to the low-quality lithium-ion-based battery systems used in some cheap consumer goods and a lack of experience in handling lithium-ion batteries. In response, Linde Material Handling developed the Multi-Layer Safety approach, a safety concept with multiple layers that contributes to safe use at every level of the battery system. This makes the Linde MH lithium-ion batteries among the safest systems in the industry.

This guide was created based on ISO 17840-3 "Road vehicles – Information for first and second responders: Part 3: Emergency response guide template" (International Organization for Standardization, 2020). The guide intends to support rescue services confronted with the highly unlikely event of an emergency involving a lithium-ion industrial truck.

Beyond this, the guide also contains important information for operators of industrial trucks with lithium-ion batteries. This complements the instructions issued by rescue services on handling damaged batteries and contains, among other things, rules on their transport and storage. The information intends to provide clear handling instructions to ensure the safe handling of the damaged battery after the deployment of rescue services.

Fire department/rescue services provide technical assistance and fight fires.

Operator (e.g., production manager) arranges storage (and any necessary removal)

Linde MH offers a wide range of industrial trucks with various fields of application in intralogistics. As a result, this guide cannot cover all the details for the entire product range. Instead, it describes how to handle lithium-ion batteries in the most popular models. For specific information on individual industrial trucks, the respective operating instructions should always be consulted.

We recommend using the rescue guide as a preventive source of information and actively integrating it in the preparation of fire safety concepts.

Legal Notice

The firefighting measures were exclusively prepared for rescue services with specific training in the field of technical assistance to execute the activities described in this guide.

Linde MH expressly reserves the right to amend and adapt the contents of this guide at any time. The information reflects the level of knowledge on the date of creation.

EMERGENCY CARD IN CASE OF FIRE: Linde MH Lithium-Ion Industrial Trucks

1. RECOGNIZE

1. **IDENTIFY: Linde logo, "ION TECHNOLOGY" lettering,** in case of doubt, check the battery type plate.
2. **CHECK BATTERY INVOLVEMENT! Signs:**
   → Thick smoke, flying sparks, shooting flames
   → Abnormal, aromatic odor
   → Noises (hissing, whistling, popping)
   → Rise in temperature on the battery tray

2. DISABLE & SECURE

1. **WEAR PPE!** Insulating gloves and arc flash visor/eye protection
2. **DISCONNECT THE BATTERY FROM THE CHARGER:**
   1. Press the **stop button**
   2. Disconnect the plug.
   Alternatively, **disconnect the charger's power plug.**
3. **DISCONNECT THE BATTERY FROM THE TRUCK:**
   Disconnect the battery plug on the industrial truck.
   Important: No locking as is the case for electric cars!
4. **EVACUATE:** If the hazard situation permits, evacuate the industrial truck from enclosed spaces.
5. **SECURE THE TRUCK AGAINST ROLLING:** With chocks!

3. CONDUCT IN CASE OF FIRE: EXTINGUISH BATTERY

1. **WEAR PPE!**
2. **Use of fire blanket**
3. **Use of large quantities of extinguishing water** to cool the lithium-ion battery

✕ **Non-cooling extinguishing agents (e.g., powder or CO_2) are not recommended.**

4. **Use a fog nozzle** to direct the water at the battery and, if applicable, into the battery tray.
5. **Prevent the return of extinguishing water**
6. **Use a thermal imaging camera/thermometer.** Continuously monitor the temperature of the battery tray until the temperature is close to the ambient temperature. **Attention:** Due to battery trays, the interior temperature can be higher than the measured exterior temperature!

4. MEASURES AFTER FIREFIGHTING

1. **Contact a LINDE MH service partner:** for storage, transport, and recycling
2. **REMOVE THE BATTERY FROM THE INDUSTRIAL TRUCK.** Observe the manual.
3. **SET UP DRY QUARANTINE:**
   → **Damaged/extinguished battery = always critical!**
   → Isolate the truck/battery (min. 10 m away from buildings, flammable materials, and other trucks)
   → **Protect from weather (direct sunlight, frost)**
4. **CONDITION CHECK: Rule out reheating**
5. **TRANSPORT AS DANGEROUS GOODS** as per ADR regulations
6. **Transport contaminated equipment and extinguishing water to appropriate waste management facilities**

ⓘ **This emergency card is not a substitute for the full rescue guide, compliance with operating instructions for the specific industrial truck, or tactical firefighting decisions on site.**

APPLICATION

Linde MH offers a wide variety of models ranging from pallet trucks to forklift trucks. The models can be operated using different energy sources. These include:

- → Diesel/HVO
- → Natural gas/propellant
- → Hydrogen
- → Lead-acid batteries
- → Lithium-ion batteries

The current Linde MH model range can be accessed at ⓘ https://www.linde-mh.com/en/ or the country-specific websites.

IDENTIFYING THE INDUSTRIAL TRUCK TYPE

Identifying the industrial truck model and power unit type after an accident is essential. Specific procedures for the rescue measures need to be observed depending on the type of industrial truck and power unit. The following only looks at the measures for industrial trucks with lithium-ion batteries.

DISTINGUISHING FEATURES OF LINDE MH INDUSTRIAL TRUCKS

Besides the "Linde Material Handling" logo, the individual models can be recognized by their body shape and color. Linde Material Handling industrial trucks usually have the classic Linde red color (RAL 2002), as shown below. But individual color designs are possible on request.
In addition, the model name and type plate of the industrial truck can help with identification. But these may be missing if they were excluded during purchase or subsequently removed.

Attachment of the logo and industrial truck model name

Linde MH logo and industrial truck color

Example attachment of the Li-ION symbol

DISTINGUISHING FEATURES OF LITHIUM-ION INDUSTRIAL TRUCKS

A lithium-ion battery is usually identified by the "ION TECHNOLOGY" symbol shown below. Depending on the configuration, not every industrial truck may have this marking or it may have subsequently been removed.

Other distinguishing features are the battery type plate and the completely enclosed design of the battery tray (cf. page 11).

DIFFERENCES TO ELECTRIC VEHICLES

Reports of fire department call-outs due to traffic accidents or car fires involving hybrid and electric vehicles lead to prejudice when it comes to the use of lithium-ion batteries. But the use of lithium-ion batteries in industrial trucks differs from electric vehicles in road traffic.

BATTERY TRAY

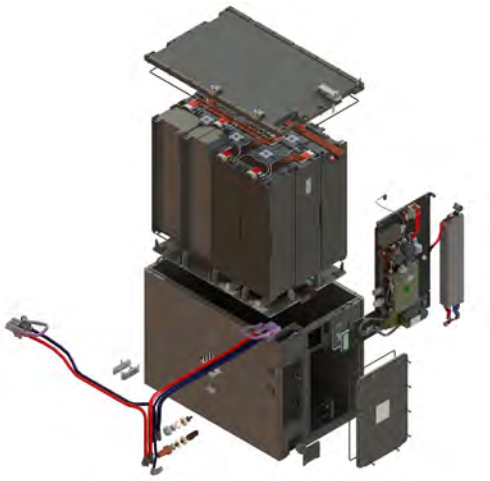
Depending on the version, solid steel trays with wall thicknesses up to 20 mm are used in industrial truck batteries. This protects the battery module from external influences and ensures the necessary industrial truck weight. What's more, industrial trucks move at much slower speeds than cars, resulting in a much smaller deformation of the battery tray in case of an accident. This significantly reduces the likelihood of mechanical damage to the lithium-ion cells of an industrial truck.

MEASURING THE BATTERY TEMPERATURE

The wall thickness of the trays makes it difficult to measure the battery temperature with a thermal imaging camera. Due to the wall thickness, the temperature measured on the outside may not necessarily match the temperature inside the tray. **The battery temperature on the inside may therefore be higher, which needs to be considered when interpreting the external temperature measurement.**

In addition, batteries may also be fitted with a brake resistor (brake chopper), which converts the kinetic energy when braking to heat and stores this for a short period. This is found in the technical compartment of the battery, which is separated from the cells so that the cells are not heated directly. After braking, however, the brake resistor emits the stored energy to the surrounding components, increasing the battery temperature in this area. A recently activated brake resistor can therefore distort the battery temperature measurement, as the actual battery temperature is lower.

The temperature measured in the area of the battery resistor does not reflect the cell temperature, which is a critical factor in case of a fire. **This allows the excessive heating of the lithium-ion battery, even under the influence of the brake resistor, to be reliably detected.**



Example configuration of the lithium-ion battery of a counterbalanced forklift truck (top) and a pallet truck (bottom). The modules are installed in the completely enclosed tray.

BATTERY VOLTAGE AND DISCONNECT POINT

Linde Material Handling industrial trucks are operated at nominal voltages of 24 volts, 48 volts, and 90 volts. The technology therefore differs from that of electric cars, which are generally equipped with battery systems with voltages exceeding 400 volts.

The lithium-ion battery is disconnected from the industrial truck via the unlocked battery plug, which can be pulled out if needed in order to disconnect the battery system from the industrial truck. Electric cars, due to the higher battery voltage, require an additional high-voltage disconnect point. Electric industrial trucks do not have these disconnect points due to the low voltage (< 120 V DC).

IMMOBILIZING AND STABILIZING

In contrast to (electric) cars, industrial trucks do not have a handbrake. Industrial trucks are usually automatically secured against rolling when switched off or when the battery is disconnected. The industrial truck operating instructions provide more information on whether additional measures, such as removing the key, are required.

Depending on the situation, we recommend additionally securing the industrial truck against unwanted movement using chocks, appropriate supports, or by attaching slings.

EMERGENCY RELEASE

While charging, the charging plug in some electric cars is locked to the vehicle. This locking does not exist in electric industrial trucks, so there is no need for an emergency release. If necessary, the charging plug can be disconnected after first switching off the charger so as to disconnect the battery system from the charger.

SWITCHING OFF DIRECT HAZARDS

The following chapter uses an example to explain how lithium-ion batteries can be disconnected from the industrial truck. Please note that the procedure can vary depending on the industrial truck type or option. The relevant operating instructions should be consulted for information specific to the industrial truck.

ACCESS TO THE BATTERY

Depending on the situation, access to the battery may be required.
Three different types of access are possible:

1. Horizontal access to the battery

The battery is accessed either via the battery door or a lateral recess on the industrial truck. Counterbalanced forklift truck batteries are under the driver's seat. In warehouse trucks, they are often between the driver's workstation and the fork arms.

For counterbalanced forklift trucks (example):

For warehouse trucks (example):

2. Vertical access to the battery

The battery is accessed from above via a hinged battery hood.

For counterbalanced forklift trucks (example):

For warehouse trucks (example):

In industrial trucks, the battery can also be accessed by flipping up the driver's seat. Please note the associated release mechanism in the operating instructions for your industrial truck.

3. Access to an integrated battery

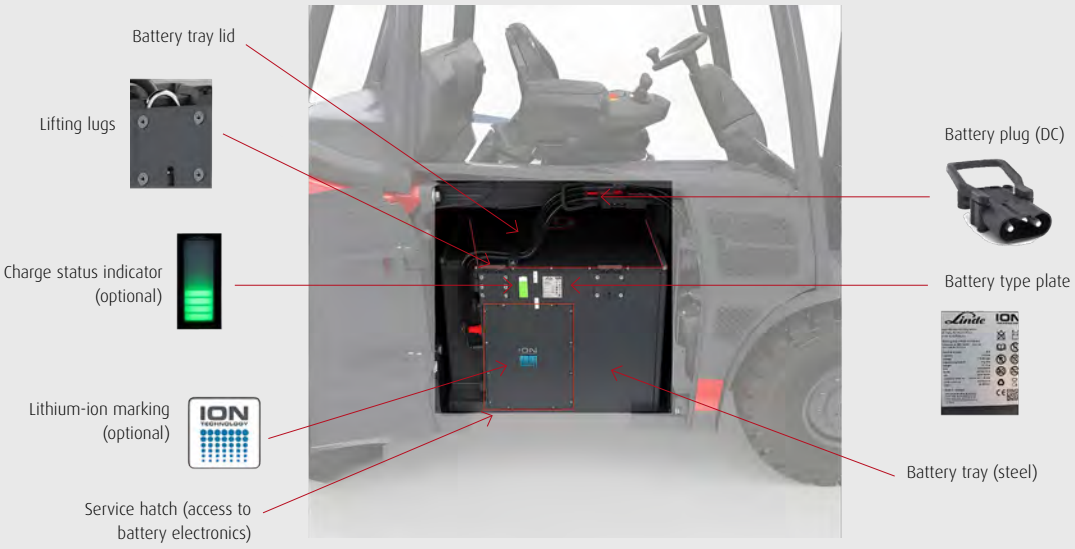
Access to an integrated battery differs from the first two cases. An integrated battery is mounted on the industrial truck, which may restrict direct access.

Further information is described in the operating instructions for the specific industrial truck.

Linde Xi20 P (left) and T14 (right) industrial trucks with integrated lithium-ion battery

COMPONENTS INSIDE THE BATTERY COMPARTMENT

The figure below shows an example battery compartment including its components. The position of the individual battery components can vary between the models. Further information is described in the operating instructions for the specific industrial truck.



If the lettering described on page 6 (bottom) is missing, the lithium-ion battery can usually be identified by the marking on the battery tray. If this marking has been removed as well, the battery can always be clearly identified by the battery type plate.

In addition, the lithium-ion battery (left) looks different to the lead-acid version (right), as shown in the pictures below. Lithium-ion batteries are always sealed by a closed tray or a cover on top, while lead-acid batteries are usually open at the top and can be distinguished by visible water refill valves.

Lithium-ion battery

Lead-Acid Battery

DISCONNECTING THE BATTERY FROM THE CHARGER

To disconnect the charging plug from the industrial truck, the standard requires the charger stop button to be pressed before carefully removing the plug from the battery charging socket.

Disconnecting the charging plug

If the charger cannot be switched off using the stop button, alternatively, the charger power cable can be disconnected from the socket. If there is an integrated charger (On-Board Charger, OBC), the corresponding power cable must be disconnected from the industrial truck.

Charging cable of an integrated charger

Make sure that the plug and charging socket are not visibly damaged.
Further information is provided in the operating instructions for your lithium-ion battery

DISCONNECTING THE BATTERY FROM THE INDUSTRIAL TRUCK

The lithium-ion battery may only be disconnected from the industrial truck if it is no longer connected to the charger. If the battery is still at the charging station, there is a risk of electric arcs when performing the following steps.

1. Ensure that the industrial truck is stable

→ Make sure that the industrial truck is on a level surface and has been secured against rolling.
→ Additional notes are provided on page 8 under "Immobilizing and Stabilizing"

2. Open the battery door/flap (page 9)

3. Disconnect the battery

→ Disconnect the DC plug connection as per the operating instructions

DC plug connection

Please carry out the steps described only if you can reliably rule out a fire. In case of a malfunction with suspected abnormal heating, we recommend wearing suitable personal protective equipment, including insulating gloves and arc flash visor, to protect yourself against electric hazards and any discharging gases and liquids.

The battery disconnection procedure differs for integrated batteries. Please note the operating instructions for your industrial truck or contact a Linde MH service technician for further support.

Subsequently removing the battery from the industrial truck may require the use of a suitable device to lift and remove the battery. This particularly applies for batteries in counterbalanced forklift trucks, which typically weigh over 500 kg. Detailed battery removal measures are contained in the operating instructions for your industrial truck and battery.

Example mechanical removal of an industrial truck battery

ACCESS TO OCCUPANTS

Access to occupants is vital during rescue activities after an accident. This chapter relates exclusively to Linde MH industrial trucks equipped with doors and/or seat belts. In other models, the industrial truck usually does not prevent access to occupants.

The door of an industrial truck is not locked during use by an occupant. It can therefore be opened simply by pushing or pulling on the door handle.

If the driver's seat belt cannot be undone using the customary method, it must be cut using cutting tools (rescue shears, belt cutter, etc.). Special rescue situations may arise for some industrial truck models due to the higher driver's cab, for example. This may necessitate the use of additional rescue equipment.

STORED ENERGIES/ LIQUIDS/GASES

Linde MH models have a range of operating materials on board. The hazards associated with their use must be identified in order to take suitable hazard prevention measures as necessary.

Main Operating Materials On-Board

Hydraulic oil

Brake oil

Grease

Transmission oil

Refrigerant

Flammable Materials

This includes, for example

→ Synthetics

→ Electrolytes

→ Resins

→ Gases or other flammable liquids

Safety Markings on Lithium-Ion Batteries

Lithium-ion batteries may self-combust or reignite after a fire has been extinguished. Wear suitable protective equipment!

Incorrect use can result in electric arcs and associated burns.

The electrolyte fluid in a lithium-ion battery is highly flammable.

Leaking electrolyte fluid can burn the skin. Avoid skin and eye contact!

Devolatilization of the lithium-ion battery can cause toxic vapors. Wear suitable protective equipment!

Further information on the lithium-ion battery is provided in the operating instructions for the specific industrial truck and battery.

The operating instructions for the specific industrial truck also contains a list of all on-board operating materials.

MEASURES IN CASE OF FIRE

The following describes measures that were prepared in accordance with the operating procedures and guides of fire department associations and authorities. But they are merely recommendations. A final decision on the specific extinguishing agent and extinguishing method to be used can only be made at the place of application and depends heavily on the specific situation and available equipment.

FIREFIGHTING MEASURES FOR LITHIUM-ION BATTERIES

Handling lithium-ion industrial trucks is generally no more dangerous than handling industrial trucks powered by combustion engines, but there are some differences. A distinction must be made between whether the lithium-ion battery is (case 1) or is not (case 2) involved in a fire. The following indicators can help to assess the situation.

Possible indicators for the involvement of a lithium-ion battery in a fire (DGUV, 2023)

- → Thick smoke (light gray to jet black)
- → Flying sparks
- → Shooting flames from the lithium-ion battery/battery compartment
- → Abnormal, aromatic odor
- → Noise development (hissing, whistling, popping)
- → Rise in temperature of the battery tray

It goes without saying that the risk of a lithium-ion battery fire is extremely low. Fire tests have shown that lithium-ion batteries only trigger an internal reaction after extended external heating or significant mechanical damage. So, a battery first needs to be seriously mishandled before a fire can occur.

The Multi-Layer Safety concept for Linde MH lithium-ion batteries combines various protection mechanisms at the cell and module level with an internally developed battery management system (BMS). Tough battery trays and the seamless integration in the industrial truck ensure maximum operational safety and optimal protection against improper handling.

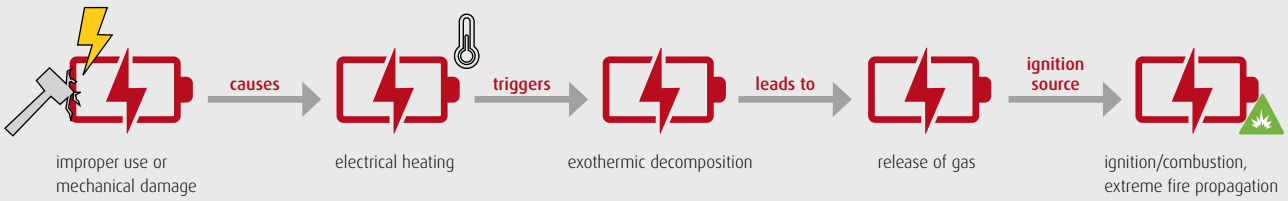
WITH lithium-ion battery fire

CASE 1

Fire involving a lithium-ion battery

The figure below shows a diagram of the fire behavior of a lithium-ion battery.

If a cell is placed in a critical state due to serious misuse or considerable mechanical damage, exothermic reactions may cause a rapid, self-reinforcing temperature increase and gas formation (thermal runway) leading to temperatures of over 800°C at the cell surface. Hot, flammable, and harmful gases as well as fine particles are released under high pressure, which spontaneously combust due to the high cell temperature or external ignition sources and can lead to the formation of (shooting) flames. This can trigger a chain reaction (propagation) that destroys other cells.



Source: DGUV, 2020

WITHOUT lithium-ion battery fire

CASE 2

Fire not involving a lithium-ion battery

Just like an industrial truck powered by a combustion engine, in the case of a "conventional" fire in a lithium-ion industrial truck, all common and established extinguishing agents such as water, foam, CO_2, or powder can be used as required and/or available.

If the industrial truck is in a building, it should, where possible, be evacuated outdoors because a thermal or mechanical load can cause the subsequent ignition of the battery.

FIGHTING LITHIUM-ION BATTERY FIRES IN INDUSTRIAL TRUCKS

In the unlikely event of a fire, an industrial truck with lithium-ion battery and a burning lithium-ion battery can be extinguished as follows:

Personal protective equipment

Just like conventionally powered industrial trucks, fires involving lithium-ion batteries cause harmful smoke. **Appropriate protective equipment** is therefore recommended.

Fire blanket

If extinguishing activities cannot commence immediately, the use of a fire blanket as per DIN SPEC 91 489 is recommended. This can, with suitable protective equipment, be placed over the burning lithium-ion battery or the burning industrial truck to slow the spread of the fire. The blanket does not extinguish the fire, but limits its spread and protects the environment. **It is important to note that the fire can flare-up again after the blanket is removed and the use of extinguishing water is still necessary.** In addition, the fire blanket can be placed over objects in the immediate vicinity of the burning lithium-ion battery to prevent the fire from spreading to them.

Extinguishing water

Water is the preferred extinguishing agent. In case of lithium-ion battery fires, large quantities of extinguishing water are required to ensure effective cooling and extinguishing. **Extinguishing agents other than ABC or BC powder, metal fire powder, or carbon dioxide (CO_2) are not recommended** (BVFA, 2021). The presence of adequate water inside the battery is critical. We recommend the use of fog nozzles to ensure the targeted application of the extinguishing water via the battery lid (DGUV, 2023). Some versions also have a steel battery lid, for structural reasons, which only allows a limited amount of extinguishing water into the battery. Due to the thermal insulation of the battery cells, external cooling is not very efficient and can increase the required extinguishing water and cooling period.

Temperature monitoring

After a reaction, the lithium-ion battery should be cooled with water until it is roughly at the ambient temperature. The use of a thermal imaging camera or IR thermometer is recommended (DGUV, 2023). Please note the **limitations of detecting the temperature due to the battery tray and brake resistor,** which are listed on page 7.

MEASURES AFTER FIREFIGHTING

A lithium-ion battery can react immediately or even with a **delay** as a result of severe damage (e.g., compressed, broken, or cracked housing), exposure to (extinguishing) water, or the effects of fire.

Attention must therefore be paid to signs of a reaction (e.g., development of thick smoke, heating, noises, or sparks) when working on an industrial truck with lithium-ion battery that has suffered an accident.

Disabling

If possible, disconnect the battery from the industrial truck no later than after completion of the firefighting activities and remove the battery from the truck. The procedure is described on page 12.

Dry quarantine

Damaged batteries should be monitored in dry quarantine. The battery temperature should be regularly monitored as long as it is in this state. Preventive wet quarantine if there are no signs of an actively reacting battery must be avoided (DGUV, 2023).

Recommended quarantine conditions

- → Protected from direct weather influences such as sunlight or rain
- → At least 10 m away from buildings
- → The use of fire blankets or storage in fire-resistant containers can reduce the necessary distance. Coordinate with your local insurer to determine the applicable requirements.
- → Further information is provided on page 20.

Wet quarantine

In exceptional cases, the battery can be stored in a water-tight container and immersed up to its top edge. But this method requires a significant amount of logistical time and effort and should only be used in an emergency or if no dry quarantine options are available (DGUV, 2023).

Deployment site hygiene

Treat contaminated protective clothing and equipment as specified in the hygiene regulations to prevent cross-contamination (DGUV, 2020-05).

Handling contaminated water

Extinguishing water can be contaminated with lithium as well as the heavy metals cobalt, nickel, and manganese. There is also a risk of formation of hydrofluoric acid. Consequently, the extinguishing water needs to be retained and transported to an appropriate waste management facility.

If extinguishing water reaches the sewage system after a lithium-ion battery fire, the competent environmental authorities and wastewater management company must be notified.

If the lithium-ion battery was in wet quarantine, the water collected in the container is considered contaminated. As a result, this cannot merely be treated as wastewater, it must also be transported to an appropriate waste management facility. Please note the applicable safety and environmental requirements.

TOWING, TRANSPORT, AND STORAGE

Linde Material Handling has established a proven process throughout Europe to ensure the safe and sustainable handling of defective lithium-ion batteries.

The process starts by contacting Linde MH Service and includes the following steps:

- → Initial assessment of the battery condition based on checklists provided
- → Support with safe storage until collection
- → Return transport by qualified logistics partners in appropriate transport containers
- → Integration in a modern recycling process to recover valuable raw materials

As a manufacturer of lithium-ion batteries, Linde MH fulfills the statutory and environmental obligations of the EU Battery Regulation.

The "black mass" is a key intermediate product when recycling lithium-ion batteries. It contains valuable raw materials that are recovered in additional process steps.

After completing the extinguishing work, the local Linde MH service partner should be informed. The following steps assume that the lithium-ion battery was involved in a fire. If possible, we recommend removing the battery from the industrial truck to enable separate transport and storage.

Condition check

The condition of the lithium-ion battery needs to be checked again prior to the outgoing transport of the industrial truck. Irrespective of whether the battery is in the industrial truck or not, it may only be loaded if there are no signs of a reaction over an extended period.

Transportation

Suitable transport trucks with an adequate load capacity and securing devices must be used to transport the industrial truck on public roads. The industrial truck must be firmly secured to prevent shifting during transport.

The lithium-ion battery must be removed from the industrial truck and transported separately. If this is not possible, the Linde MH service partner must be contacted.

Special requirements for transporting lithium-ion batteries on public roads

- → Lithium-ion batteries are dangerous goods and must be assessed and transported in line with the applicable regulations (e.g., ADR, IMDG Code).
- → Depending on the assessment, transport trucks must be marked as per the ADR regulations.
- → Lithium-ion batteries to be transported outside the industrial truck must be transported in approved and secure packaging that protects against short-circuit, vibrations, and damage.
- → All necessary accompanying documents that contain information on the transported batteries and safety measures must be included.

To determine the transport requirements for your battery, please use the checklists for determining the condition of industrial lithium-ion batteries provided by Linde MH. Linde MH cooperates with transport companies that can provide suitable transport solutions.

ⓘ For more information, please contact your Linde MH service partner.

Storage

Irrespective of whether the lithium-ion battery is still in the industrial truck or has already been removed, outdoor storage at an adequate distance to other trucks, buildings, etc., is recommended.

Special requirements for storing defective lithium-ion batteries

- → We recommend storing the battery in a quarantine area outside the building. A distance of at least 10 m to other buildings should be observed. The battery must also be protected against unauthorized access.
- → The batteries should be stored in a location that is protected against frost and direct sunlight in order to avoid extreme temperatures.
- → We recommend performing regular inspections to monitor the condition of the battery and other components.

INSPECTING THE BATTERY

Determining the degree of damage of a lithium-ion battery is critical for safe handling and transport. Linde MH provides appropriate checklists for this purpose.

The checklists provide a structured approach to the visual inspection and to determining the functional limitations of the battery. Based on the "Agreement concerning the International Carriage of Dangerous Goods by Road (ADR)", the checklists divide the damage into three levels:

→ Non-critical
→ Non-critical defect
→ Critical defect

In case of imminent danger due to a battery with a critical defect (as described on page 15), please note the measures described on pages 17 and 18.

If a defective battery does not present an immediate hazard, please contact your Linde MH service partner. Discuss the relevant repair, storage, and transport measures and follow the instructions for further action.

Please contact your Linde MH service partner.

CONCLUSION

The Fraunhofer ISE (2024) confirms that lithium-ion batteries with certified cells are fundamentally safe. DEKRA (2024) adds that electric vehicles pose a lower risk of fire than those with combustion engines. But, if a fire does occur, it can be extinguished using conventional means and methods.

With that in mind, industrial trucks with lithium-ion batteries provide at least the same safety level as industrial trucks powered by a combustion engine in case of fire.

EXPLANATION OF THE PICTOGRAMS USED

BIBLIOGRAPHY

Bundesverband Technischer Brandschutz e.V. (BFVA) (2021). Sicherheitshinweise zum Löschen von Lithium-Ionen-Akkus.

DEKRA (2024). Brandgefahr bei E-Fahrzeugen.

Deutsche Gesetzliche Unfallversicherung e.V. (DGUV) (2020). Hygiene und Kontaminationsvermeidung bei der Feuerwehr.

Deutsche Gesetzliche Unfallversicherung e.V. (DGUV) (2020). Hinweise zum betrieblichen Brandschutz bei der Lagerung und Verwendung von Lithium-Ionen-Akkus.

Deutsche Gesetzliche Unfallversicherung e.V. (DGUV) (2023). Hinweise für die Brandbekämpfung von Lithium-Ionen-Batterien bei Fahrzeugbränden.

Fraunhofer Institut für Solare Energiesysteme (ISE) & Forschungsvereinigung Antriebstechnik e.V. (2024). Sicherheit von Lithium-Ionen-Batterien [Online-Seminar]

International Organization for Standardization. (2020). ISO 17840-3:2020 - Road vehicles — Information for first and second responders: Part 3: Emergency response guide template

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