



# Lithium-ion Stacker Trucks

*This hazard info sheet is about (forklift) trucks specifically engineered for handling substantial loads in challenging environments such as ports, pulp and paper mills, and lumber yards.*

## What is the hazard?

Forklifts powered by lithium-ion batteries are popular in various industries due to their high energy efficiency. However, heavy-duty forklifts come in various models, including the vertical mast type, designed for outdoor use on rough terrains, and the variable reach type, which features a telescopic boom for handling loads at varying distances and heights. The adoption of lithium-ion batteries in these forklift trucks is growing due to their efficiency, reduced maintenance, and environmental benefits. However, these forklifts, especially the heavy-duty types, pose significant fire risks because of the large lithium-ion battery packs. It is well known that fires involving these batteries are notoriously hard to put out, even by skilled firefighters. The larger the battery pack, the greater the danger and impact of a fire. The duration of lithium-ion battery fires can vary, and in some cases they can burn for hours and even days. It is important to note that, while the forklift itself may not always start a fire, it can greatly fuel one if it occurs. This risk makes it crucial to incorporate specific fire safety measures for these vehicles in the planning of industrial fire protection strategies.

It's crucial to understand that the dangers of lithium-ion batteries extend beyond fire risks. They're also prone to vapor cloud explosions (VCEs), which occur when toxic and flammable gases released by the failing battery ignite or find an ignition source, leading to an explosion. This kind of explosion can cause widespread damage, even breaching



firewalls when larger battery packs are involved. Additionally, when these batteries fail, they release hydrogen fluoride (HF) gas, a toxic substance that poses a serious inhalation hazard. The volume of dangerous gases produced in a lithium-ion battery fire can significantly exceed that of a typical fire, highlighting the need for specific safety measures and awareness.

Please note that this Hazard Info Sheet only covers risks associated with lithium-ion forklift stacker trucks, and no other lithium-ion battery powered equipment.

## How to reduce the risk

### Procurement of trucks

- When acquiring heavy-duty lithium-ion stacker trucks, only use well-known and reliable suppliers.
- Make sure your trucks have a smart Battery Management System (BMS). This system helps avoid the dangers of overcharging or draining the battery too much. It works by communicating with the charger, as each type of lithium-ion battery needs to be charged to the correct (max) level and at the correct speed to prevent overheating. It is therefore crucial to use the charger that comes from the truck's original manufacturer (OEM) to ensure that everything charges correctly and safely.
- Use parts only in accordance with the Original Equipment Manufacturer's (OEM) instructions.
- Prefer acquiring trucks that have safety features such as anti-collision and condition monitoring technology.
- Make sure the personnel have or receive the training needed to safely operate the stacker trucks.

### Maintenance

- Make sure the vehicle, battery, and charger are inspected and maintained according to OEM instructions.
- Any external damage such as penetration by an object or crash collision damage near the battery system should be reported. The battery should be investigated for safety before it is taken into use again.
- Keep your trucks clean by regularly removing any build-up of grease, oil, or other flammable materials like dust.
- Use non-combustible cleaning solutions to clean the stacker trucks, ensuring they're not just clean, but also safe from potential fire hazards.
- Protect the cables and connectors from damage by using load balancers (spring reels) to keep them from touching the floor.
- The hydraulic oil used in lithium-ion forklifts can become a fire hazard if it leaks or sprays into the air and comes into contact with an ignition source. Ensure regular maintenance checks for leaks and prefer fire-resistant hydraulic fluids.



## Charging and parking

- In general, indoor charging is not recommended. When it's necessary to charge the stacker truck batteries indoors in a heated space, the building should be of non-combustible construction materials and located at least 10 meters away from the surrounding buildings and any material storage.
- When the building is attached to main building range the charging station itself should be fire separated at least with the EI60 fire classification and have automatic fire detection and sprinkler protection installed. The power supply to the charging unit(s) should be controlled from the fire alarm with the chargers being de-activated upon a fire alarm.
- Charging stations should be located against an external wall, easily accessible from the outside. Locating the charging locations near an exit door will allow the fire brigade (if possible) to tow the vehicle to the outside after extinguishing the fire.
- If the battery is charged on the forklift truck, charging is not recommended indoors and especially inside production buildings or near storage facilities. A safety distance of 10 meters should be maintained from surrounding buildings and storage materials, even when charging in the open or in an open building (such as a canopy).
- The power supply to the charging station should have an emergency shut-off option near the entrance of the charging room/building or further away from the station.
- Signs should be provided indicating where Li-ion charging areas are present in the building, to inform first responders about this hazard in case of a fire.
- The area above the charging stations should be kept clear of any combustible materials, including ceiling materials, cables and cable trays.
- Ensure proper ventilation in areas where lithium-ion batteries are charged and stored to prevent the accumulation of flammable gases that could result in a vapour cloud explosion.
- The ventilation system should exchange air at a minimum of one room volume per hour and be linked to battery chargers that can cut the power in the case of ventilation failure. Natural ventilation requires at least 400 cm<sup>2</sup> of opening per 50 m<sup>3</sup> of room volume, both at floor and ceiling levels.
- Never park and leave forklift stacker trucks near the storage of highly combustible materials or where combustible materials accumulate.



## Containing a potential fire

- Establish a pre-fire plan that is adapted for large lithium-ion battery fires. Detailed guidance on proper firefighting tactics should be included.
- Communicate your pre-fire plan with the fire brigade. The fire brigade should be regularly invited to the site with the purpose of ensuring that the firefighters know where lithium-ion powered equipment are in use. Fire brigades are still in the process of establishing the best possibilities to control and extinguish a fire in Li-ion batteries. Methods that have been proposed but have not yet been confirmed as a good practice include:
  - Using dedicated large fire blankets for electric vehicles and trucks. However, note that manual firefighting in large lithium-ion fires is still extremely challenging and requires the correct tools, trained personnel, and methods to be highly effective.
  - Using lithium-ion fire extinguishers, deploying a water-based vermiculite solution. This is assumed to coat a damaged lithium battery, potentially limiting fire spread. The underlying thermal runaway is supposedly not stopped. That process remains active under the vermiculite layer ready to reignite. The primary advantage of these extinguishers is the time they buy for evacuation and for emergency services to respond.
- Discuss with the local fire brigade which extinguishing methods are approved before applying them.

*This Hazard Info Sheet is and is intended to be a presentation of the subject matter addressed. Although the authors have undertaken all measures to ensure the correctness of the material, it does not purport to list all risks or to indicate that other risks do not exist. If P&C Insurance does not give any guarantee thereof and no liability is assumed by reason of this Hazard Info Sheet as it is only advisory in nature and the final decisions must be made by the stakeholder. It shall not be applied to any specific circumstance, nor is it intended to be relied on as providing professional advice to any specific issue or situation.*

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