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Lithium-Ion Batteries

Lithium-ion batteries have rapidly become an integral part of modern commercial operations. In facilities, batteries are now commonplace in tools, forklifts, backup power systems, and material handling equipment. In fleets, the shift toward electric vehicles (EVs) and hybrid platforms brings high-capacity batteries into yards, garages, and on-road service.

Their high energy density, compact size, and fast-charging capabilities make lithium-ion batteries ideal for supporting efficiency and electrification goals across multiple sectors. However, their widespread use introduces a distinct fire hazard that differs from conventional combustibles.

As adoption accelerates across both facilities and fleets, understanding these risks and implementing appropriate controls is essential to safeguarding people, assets, and business continuity.

Fire Hazard Explained

The central risk associated with lithium-ion batteries is a phenomenon known as thermal runaway. This is a self-accelerating reaction that occurs inside a cell when the heat it generates exceeds its ability to dissipate it. As internal temperature and pressure rise, the cell can enter an unstable state, releasing flammable gases that may ignite and, in many cases, spread to adjacent cells or battery modules.

Once initiated, thermal runaway can escalate rapidly. The affected cell releases hot, flammable gases that can ignite, producing high-temperature flames and intense heat. This heat can propagate to neighbouring cells, creating a chain reaction that dramatically increases the size and intensity of the fire. Dense, toxic smoke and explosive gas mixtures can accumulate in confined spaces, complicating firefighting efforts, and re-ignition may occur even after the initial fire appears extinguished.

A range of factors can trigger these events, including:

- Physical damage (e.g., crushing, puncturing, dropping, etc.) can compromise a cell's internal structure.
- Manufacturing defects can lead to issues that surface under normal operating conditions.
- Overcharging, deep discharging, or using incompatible chargers, can push cells beyond their safe limits.
- External heat exposure or improper storage can further elevate risk and increase the likelihood of failure.

Implications for Businesses

The growing use of lithium-ion batteries across commercial operations has created new risk considerations for both fixed facilities and fleet environments. While these batteries enable cleaner and more efficient operations, they also introduce potential for significant property damage, business interruption, and safety challenges when not properly managed.

Key implications include:

- Fire and property damage resulting from improper charging areas, lack of separation, or incompatible equipment.
- Operational downtime where critical production or transportation assets are unavailable following an incident.
- Business interruption losses due to facility shutdowns, equipment replacement delays, or contaminated spaces.
- Employee safety concerns from smoke, off-gassing, or exposure to damaged or overheated batteries.
- Environmental impacts if electrolyte materials or damaged cells are improperly handled or disposed of.
- Fleet management challenges involving post-collision handling, charging-station safety, and coordination with first responders.

Recognizing these implications allows businesses to address vulnerabilities before an event occurs and strengthens overall resilience. The following section outlines practical mitigation strategies aligned with Canadian codes and recognized best practices.

Mitigation Strategies

Lithium-ion battery risks can be effectively reduced through proper equipment selection, installation, storage, charging, and maintenance practices. The objective is to prevent thermal runaway events and minimize potential impact to people, property, and vehicles.

Key risk mitigation strategies include:

Equipment and certifications

- Only use batteries and chargers that have one of the recognized Canadian certifications, such as CSA, cUL, or cETL; uncertified or counterfeit products often lack required safety features and increase fire risk.
- Ensure EV charging equipment complies with CSA C22.2 No. 280:22 – Electric Vehicle Supply Equipment.
- Incorporate a battery management system (BMS) with overcharge, temperature, and short-circuit protection.
- Verify installations comply with CSA C22.1 – Canadian Electrical Code (CEC) and are inspected by licensed electricians.
- Avoid using modified, damaged, or unapproved charging devices.

Charging area design and layout

- Designate dedicated, fire-rated charging and storage zones constructed of non-combustible materials (minimum 1-hour separation).
- Maintain a clearance of 3 to 5 meters between chargers, vehicles, and building walls or combustibles.
- Provide continuous mechanical ventilation in enclosed charging or storage areas to dissipate heat and gases.
- Never charge batteries in corridors or means of egress.
- Use impact-protection bollards and clear emergency-disconnect signage at charging points.

Storage and handling

- Store batteries below 25°C away from heat sources, direct sunlight, or ignition hazards.
- Separate damaged, recalled, or end-of-life batteries in metal containers with non-combustible absorbent material.
- Maintain an approximate 50% state of charge for long-term storage.
- Prevent stacking, compression, or puncture of battery packs.

Fire detection and suppression

- Protect charging and storage areas with automatic sprinklers in accordance with NFPA 855 – Standard for the Installation of Stationary Energy Storage Systems.
- Consider clean-agent, water-mist, or aerosol systems for enclosed or critical installations.
- Install heat, smoke, and off-gas detection capable of identifying early signs of thermal runaway.
- Keep Class D fire extinguishers readily available for small-cell incidents.

Operations and training

- Integrate lithium-ion charging infrastructure into the site's preventive-maintenance program, including infrared inspection of electrical connections.
- Establish written procedures for charging, inspection, and emergency isolation.
- Train employees and drivers to recognize signs of battery distress (swelling, hissing, heat) and isolate affected units immediately.
- Incorporate lithium-ion hazard awareness into onboarding and recurring safety meetings.

Facility and infrastructure controls

- Provide fire-rated charging bays with mechanical ventilation in enclosed garages or warehouses.
- Extend sprinkler coverage above EV parking and charging areas.
- Use non-combustible flooring and wall finishes in battery storage and charging zones.
- Install outdoor charging units on level, non-combustible surfaces with bollard protection.

Post-incident and emergency planning

- Establish procedures to isolate and cool damaged or overheating batteries or vehicles.
- Maintain outdoor quarantine areas for suspect units, monitored for at least 24 hours.
- Coordinate with local fire departments on lithium-ion and EV fire response protocols.

Disposal and recycling

- Follow Transport Canada's Transportation of Dangerous Goods (TDG) regulations for transporting damaged batteries.
- Partner with certified e-waste recyclers; never dispose of lithium-ion cells in regular waste streams.
- Retain records of all collection, shipment, and disposal activities.

References

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