

# Lithium-ion Batteries – General Considerations

Version: 1.1

Date: 22<sup>nd</sup> October 2024

Lithium-ion batteries are a power storage source used by businesses in a variety of ways. As with any battery equipment, fires can occur, and careful management is required to reduce the potential for such incidents and impacts to business trading.

This Loss Prevention Standard provides guidance to help identify, and mitigate the risks related to lithium-ion batteries and other rechargeable battery use, charging, storage and disposal.



# Lithium-ion Batteries – General Considerations



## Introduction

The use of lithium-ion batteries has steadily increased in recent years, and they are now found in a range of commercial applications including:

- Uninterrupted power supplies (UPS).
- Stock scanning equipment.
- Communications equipment.
- EPOS equipment.
- Cameras.
- Buggies, carts, and other forms of personnel transport.
- Floor scrubbing plant.
- Lift trucks and other material handling equipment.
- Torches and other temporary lighting.
- Workshop and manufacturing tools.
- Battery energy storage systems.
- Sales stock awaiting distribution.



In addition, devices such as mobile telephones, portable computers, and tablets; many domestic appliances such as vacuum cleaners, lawnmowers, hair, and beauty accessories and of course leisure items such as e-bikes, e-scooters, golf trolleys and toys can all feature lithium-ion batteries.

The benefits of lithium-ion batteries are numerous. In general terms they:

- Have a high energy density and low self-discharge rate, meaning they can store more energy and operate longer between charges.
- Have a long lifespan, in some cases supporting up to five years plus of use before needing to be replaced.
- Are low maintenance e.g., refilling, or periodic discharging, in comparison with some other battery types.
- Are lightweight and compact, which can improve operational efficiency.
- Are suited to hot and cold environments, making them more adaptable than some other battery solutions.
- Have steady load characteristics in comparison with other battery types, meaning they provide constant voltage before falling off as charge reduces.

However, whilst acknowledged as an efficient and clean means of powering equipment, the use and storage of lithium-ion batteries, or goods containing lithium-ion batteries in the workplace introduces a fire hazard that, as with any energy generating equipment, requires careful management to help reduce the potential for fire events. The following information illustrates some of the issues facing firefighters and businesses.

The London Fire Brigade has described fires involving Lithium-ion batteries as “the fastest growing fire risk in London”. [Fire services in the UK recorded 239 fires linked to electric vehicles in the period 2022/23](#), an 83 per cent increase from the 130 recorded in the previous year. They also reported a [60% rise in e-bike fires alone in 2023](#). E-scooters and E-unicycles have been banned from Transport for London (TFL) public transport since December 2021, and other national public transport services have, and continue to, adopt this position.

The British Safety Council recently reported that since 2020, [13 people in the UK have died from fires linked to lithium-ion batteries, and 190 people have been injured](#) and The National Fire Chiefs Council (NFCC) have recently stated that some [6bn batteries were disposed of in 2023, over 3,000 a minute, including over 1.1bn electricals containing hidden lithium-ion batteries](#). This correlates with data in the article showing that battery fires in bin lorries and at waste sites in the UK reached an all-time high with over 1,200 battery fires in bin lorries and waste sites across the UK in 2023, an increase of 71% from 700 in 2022.

## LOSS PREVENTION STANDARDS

In early 2024, [a fire at a large lithium-ion battery recycling plant in France](#) took two days to bring under control. The building and its contents including some 900 tonnes of batteries were lost to fire.

In February 2022 [a fire, alleged to have started within a lithium-ion electric vehicle battery, on a car carrier with nearly 4000 vehicles on board](#), broke out and resulted in the loss of the vessel and all stock.

This Loss Prevention Standard discusses some of the concerns underlying this data, outlining the main risk exposures in the use and handling of lithium-ion batteries, and provides some general considerations that can help reduce the potential for significant loss and consequences to business trading.

This document is one of a series of battery related Loss Prevention Standards. Other documents in the series provide guidance for specific battery applications or settings.

Note: This standard does not address any Liability exposures. It only focusses on Property loss prevention and risk management guidance.

## Understanding the Risks

Lithium-ion batteries are generally safe and reliable to use. If batteries are of good quality and are used, charged, stored, and discarded of properly, the risks of fire are low. The consequences of a fire involving these batteries however can be significant with volatile and widely dispersed flaming; a ‘chain reaction’ effect as fire spreads between individual cells within the battery or batteries prolonging the burn time; potential explosion risks, particularly if contained in an enclosed environment and the potential for reignition from ongoing chemical decomposition after the initial fire.

When poorly manufactured, misused, or damaged, or when used with incompatible or faulty equipment, the rechargeable battery cells within a lithium-ion battery can create unseen and unstable conditions that can result in overheating and a condition known as ‘**thermal runaway**’.

Thermal runaway can occur whether the battery is on charge, idle or it is in use and is characterised by:

- An increase in internal battery temperature.
- The creation of flammable gases, that are readily ignitable.
- An intense fire event, sometimes with associated explosions.

The resultant fire normally emits significant quantities of dense smoke, which can be prolonged by the continued cascade of thermal runaway across the battery cells within the battery. Because of this effect, a fire involving a lithium-ion battery powered device is extremely difficult to extinguish and can reignite in some cases due to ongoing chemical decomposition.

Conventional fire suppression measures can be severely compromised and overtaxed by such fire events. The **amount of fire water needed even for ‘small’ events can be significant in demand and duration** and the post event contamination and pollution including acid gases, smoke and any fire water run off can be significant and can require specific management.

For most businesses the risk of such a fire occurring presents significant concerns, including:

- The potential for fire within a lithium-ion battery spreading to other combustible items in proximity and developing into a catastrophe fire event.
- Prolonged and expensive clean-up operations.
- Impacts to trading during repairs and/or rebuilding works.
- Loss of key customer contracts and market position during prolonged down time.

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- Impacts to Environmental, Social and Governance (ESG) programmes and associated exposure.

Even a small and managed fire is likely to lead to temporary closure or isolation of areas within buildings whilst decontamination and cleaning is undertaken.

The following general considerations are not exhaustive, however will help with the design and implementation of management systems.

## Risk Assessment and Management of Change

A [survey of 500 UK organisations undertaken by Safety and Health Practitioner](#) in 2024 found that only 15% of the businesses surveyed had undertaken a workplace fire risk assessment in respect of lithium-ion batteries use, handling and storage, despite the publicity and increasing awareness of losses involving such batteries.

The premises Fire Risk Assessment should therefore be reviewed as soon as possible, by a suitably competent person, to assess the lithium-ion battery related exposures and ensure fire safety arrangements are or remain adequate. Any actions generated should be addressed promptly. Guidance on containment, segregation, inspection, fire protections etc., are provided in this document, and other Aviva Loss Prevention Standards.

Use and charging of lithium-ion battery powered equipment in areas of the premises may create additional duties under explosive atmospheres regulations, depending on the nature and extent of other activities undertaken. In the United Kingdom this is currently addressed via The Dangerous Substances and Explosive Atmospheres Regulations 2002. Any obligations under these Regulations, or other corresponding International Regulations/Directives if based overseas, should be investigated and any actions generated should be addressed promptly.

Should the use of lithium-ion batteries be part of a change programme, or a significant change to business activities, this should be managed through a formal Management of Change to review how the introduction of the batteries, or equipment utilising such batteries, could alter the risks that threaten your business, e.g., changes to layout to accommodate charging stations and risk management controls. These proposed changes should also be discussed with your Property Insurer and Insurance Broker.

## Management Policy

A management policy should be introduced detailing the company/site arrangements in relation to the use, charging, storage and disposal of lithium-ion batteries, or goods featuring such batteries. This policy should be clearly communicated to all workers, and other applicable stakeholders e.g., visitors etc., along with corresponding Standard Operating Procedures (SOPs) outlining rules and protocols including emergency procedures.

Reporting systems should be implemented for the reporting and response to any incidents or evidence involving neglect: use of damaged, aftermarket, recycled or modified batteries; inappropriate handling or poor charging practices, including the use of aftermarket charging equipment and accessories etc.

Adequate information and training should be provided to **employee's, contractors, visitors, and other stakeholders**, ensuring they understand the hazards relating to the use, charging and storage of lithium-ion batteries; the importance of inspections; good housekeeping; compliance with site rules; emergency procedures etc.

**Employee's and other relevant persons** should be actively encouraged to report any incidents or issues involving lithium-ion batteries, such as unusual odours, swelling, vibration, heat etc., to a responsible person within the business for urgent review and implementation of site rules and procedures.

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## Standard Operating Procedures

Following a review of the fire and explosion related assessments and to support management policies, Standard Operating Procedures (SOPs) detailing key responsibilities; charging, handling and storage requirements and rules; rules around third-party owned equipment e.g., contractor's tools; training and retraining frequency; end of life and damaged battery management, emergency arrangements etc., should be produced, shared with relevant staff, and reviewed regularly.

The formalisation of clear rules and procedures within SOPs helps ensure consistent and safe processes and procedures are adopted across all departments for use by relevant personnel, therefore reducing the risks of unplanned and unexpected fire events, and mitigating the losses associated with poor or unclear emergency planning.

## Misuse and Modifications

The rules and consequences of the misuse of lithium-ion batteries should be outlined in the Management Policy and Standard Operating Procedures. Workers should be actively encouraged to report any incidents involving neglect; use of damaged, aftermarket, recycled or modified batteries, inappropriate handling or poor charging practices including the use of aftermarket charging equipment accessories etc., to a responsible person within the business for urgent review and implementation of site rules and procedures.

Under no circumstances should lithium-ion batteries be modified, repaired, or re-purposed within the workplace. This includes power tools and batteries which can be readily modified to accommodate incompatible components.

## Procurement

Lithium-ion batteries should be manufactured to a recognised safety standard, such as those issued by the International Electrotechnical Commission (IEC) - IEC 62619, IEC 62133, and IEC 60086-4, and adopted by participating member countries. Whilst most batteries are produced by recognised manufacturers to strict manufacturing quality standards, inevitably cheap imported batteries, typically bought online from unaccredited suppliers, may not be as reliable or as safe to use. Therefore lithium-ion batteries and equipment or sales stock containing lithium-ion batteries should only be procured from reputable sources with appropriate quality control processes in place. Adoption of a formal procurement policy, written and implemented by a competent person, will assist in ensuring the risks of purchasing poor quality and/or potentially unsafe products are minimised.

The purchase and use of aftermarket and/or recycled batteries and associated accessories for existing equipment should be prohibited as far as possible and this should be formally stated within the procurement policy. Instead, compatible replacement batteries and accessories should only be sourced from the original manufacturer of the equipment or an official agent of the manufacturer.

Clearly some equipment containing lithium-ion batteries and associated accessories will be bought into the workplace by workers, visitors or contractors and are not the direct responsibility of the business. This includes portable tools, tablets, mobile phones, vaping equipment, portable speakers, e-scooters, and e-bikes etc. Whilst it would be impractical and unnecessary to implement safety procedures for the general possession and use of all third party owned devices and equipment, charging activities, which present the main risk concern, should be carefully managed. Guidance is provided within this document – see Charging.

## Acceptance Arrangements

When stocks of lithium-ion batteries or goods containing such batteries are delivered to the premises the goods should be immediately stored in a segregated area, remote from other stocks or combustible goods and inspected for signs of damage. Any stocks appearing damaged, or displaying signs of damage such as odours, high temperature, leaks, smoking, or vibration should be rejected and either segregated/quarantined pending removal or collection by the haulier or reputable waste recycling company. A thermographic camera can assist with check procedures.

Segregation should be:

- External and as far away from buildings, valuable assets, and combustible goods as possible. In most cases at least 10 metres separation is recommended. If the goods are contained, this should be within a non-combustible receptacle.
- If external storage is not possible, a dedicated and sterile storeroom, specifically for the storage of damaged/faulty or returned, or recycled batteries, or goods featuring such batteries etc. should be provided, and which should be of non-combustible construction providing a fire resistance rating, including the ceiling of 90 to 120 minutes.

Daily thermographic camera inspections of damaged or faulty batteries, or goods featuring such batteries are recommended.

## Charging

Whilst guidance around the charging of specific equipment is provided in other documents in this series, the following general points should be considered within the premises Risk Assessments and Standard Operating Procedures.

Safe arrangements for all charging activities should be considered and formalised, reflecting the size and nature of the various battery related activities, and the associated hazards and exposures.

The charging of e-bikes, e-scooters and other personal transportation devices should be prohibited, and if necessary, should only be allowed externally in a safe area clear from buildings, valuable assets, and combustible goods, or within a fire resistance rated room or containment. This reflects the risks associated with the common use of modified and aftermarket batteries in such equipment; poor quality and potentially unsafe batteries used in cheap imported goods and the risks of batteries being damaged in accidents or exceeding end of life and lifecycle expectations. Refer to Aviva Loss Prevention Standards Electric Bicycles – Property Risk Management and Electric Scooters – Property Risk Management for specific guidance in this regard.

The charging of vaping equipment should also be prohibited internally, given the prevalent use of poor quality, aftermarket, counterfeit, and incompatible charging equipment, often with limited or no inherent safety features.

Where provided or recommended, Battery Management Systems should be installed, used at all times, and never bypassed. These systems monitor the battery performance, heat output, ensures cells are used within their safe working parameters, detect faults, and isolate the charging equipment if required, reducing the potential for fire related events.

Overcurrent and undercurrent protection should be provided to all charging equipment.

Note: It is important that where any consideration is being given to the storage and/or charging of batteries that any additional risks posed must be fully assessed, with consideration given to the use of the building and its layout and be subjected to review within the premises Fire Risk Assessment.

## External Charging

External charging areas are recommended for larger sized items and/or higher risk exposures where possible. These include E-Scooters/E-Bikes, loaded electric/hybrid delivery vehicles, multiple numbers of lithium-ion battery powered lift trucks or where space restrictions prevent the installation of internal charging halls etc.

Such charging areas should be located as far from buildings or other valuable assets, and combustible goods as possible. In most cases at least 10 metres separation is recommended. Where adequate separation distances cannot be achieved, the installation of a fire barrier providing a fire resistance rating of at least 60 minutes should be considered between the charging area and the valuable assets or goods.

Weather resistant canopies or protective enclosures may be necessary for certain equipment e.g., fork-lift trucks, mechanical handling equipment etc., and the construction of any such structure should preferably be of non-combustible materials. No other storage or activities should be undertaken within, and in proximity to such a structure. Charging equipment should be mounted at least 150mm from the ground to reduce the risks of water ingress during a water related event e.g., flooding, heavy rainfall etc.

Charging of lithium-ion battery plant mounted on refrigerated vehicles is not recommended in close proximity to buildings and should instead be relocated to a clear area away from the buildings, other valuable assets, or combustible goods. In most cases at least 10 metres is recommended, however this should be increased where significant numbers of vehicles are present within close proximity. Consideration should be given to the spacing between charging bays/areas and arranged to minimise the impact of fire spreading between vehicles. The bays should also be protected from impact damage via barriers, kerbs, bollards etc., where the risks of vehicular impact are present/increased.

In summer months or warmer climates, the upper safe operating temperatures of the batteries being charged should also be considered. In uninsulated or exposed charging areas, excessive or prolonged temperatures may have an impact on the batteries and may even initiate a thermal runaway event.

## Internal Charging – Charging Cabinets

For small items of lithium-ion battery powered equipment or removeable batteries, such as tools, individual stock scanner charging bases, batteries from floor scrubbing plant or powered pallet trucks etc., a [proprietary storage/charging cabinet](#) should be considered, and which should be:

- Specifically designed for the storage and charging of a small number of batteries,
- Independently tested and approved by a third-party accredited testing organisation and rated to provide a defined fire resistance period of at least 60 minutes. Note: increased fire resistance periods are available if preferred.
- **Located in a defined ‘safe’ area of the premises, preferably a separate fire compartment but** otherwise remote from combustible building linings; at least three metres clear of combustible goods, traffic movements and hazardous trading activities. Demarcation using hatching to specify clearance distances is recommended. Additional impact protection may be necessary in areas with significant vehicular movements.
- Fitted with overcharge isolation devices.
- Subject to appropriate electrical appliance testing of charging equipment.

Laptop charging cabinets used for the overnight charging of multiple appliances should be of a similar specification where possible, however any non-fire rated laptop cabinets should be located in a dedicated storeroom during charging operations, rated to provide a defined fire resistance period of at least 60 minutes, and maintained clear of combustible goods.



The use of non-fire rated cabinets for charging is not recommended. Aviva Loss Prevention Standards Lithium-ion Batteries – Storage and Transit and Lithium-ion Batteries – Portable Tools provide further guidance.

### Internal Charging – Charging Rooms/Halls

Where external charging is not possible, or for medium to large exposures such as significant numbers of lithium-ion batteries/battery powered equipment, racks of stock scanning equipment; several lithium-ion battery powered fork-lift trucks and/or powered hand trucks etc., a charging room or hall is recommended, and which should be:

- Of non-combustible construction providing a fire resistance rating, including the ceiling of at least 60 minutes and,
- Fitted with an appropriately tested and accredited fire door, providing at least 60 minutes fire resistance, and kept closed when not in use.
- Fitted with lighting and any necessary electrical fittings with an appropriate explosivity rating to reflect the potential presence of explosive vapours.

Additionally, the store should not feature any other openings, such as windows and deposit/collection slots which open internally unless fitted with fire shutters certificated to LPCB Loss Prevention Standard - LPS 1056: Issue 6.2 Requirements for the LPCB Approval and Listing of Fire Door-sets, Lift Landing Doors, and Shutters, providing at least 60 minutes fire resistance.

External openings, such as windows etc., should be assessed and similarly protected if there is potential for vertical fire spread across the external fascia of the building or fire entering the building via other openings above; valuable and/or combustible infrastructure located directly adjacent; or life safety concerns such as public highways, fire escape routes in proximity, as stipulated in the premises Fire Risk Assessment.

Any openings for cabling and pipework etc., should be adequately fire stopped and/or fitted with intumescent collars to ensure the 60 minutes integrity of the store is maintained in the event of ignition.

Intumescent collars should be used to protect pipework which could collapse or melt in the event of fire filling any voids created and providing a fire barrier.

The installation of fire shutters and fire doors should be completed by a company certificated to LPCB Loss Prevention Standard LPS 1271: Issue 2.3 Requirements for the LPCB Approval and Listing of Companies Installing Fire or Security Doors, Door-sets, Shutters and Active Smoke/Fire Barriers.

Installation of other passive fire protection products such as fire stopping should be completed by a company certificated to LPCB Loss Prevention Standard - LPS 1531: Issue 1.2 Requirements for the LPCB approval and listing of companies installing or applying passive fire protection products.

Maintenance of such protections should be completed by a company certificated to LPCB Loss Prevention Standard - LPS 1197: Issue 4.2 Requirements for the LPCB approval and listing of companies inspecting, repairing, and maintaining fire and security doors, door-sets, shutters, and active smoke/fire barriers.

Refer [redbooklive](#) for details of approved contractors.

The store or hall should be maintained sterile and not used for any other purpose. A clear distance should also be maintained around the store and its openings. At least five metres is recommended and marking the flooring to specify the specified clearance distance is recommended.

The maximum storeroom temperatures should be assessed, and cooling/heating systems configured to automatically operate prior to recommended battery temperature thresholds being met. Automatic heating/



cooling systems should be suitable for use in areas where thermal runaway events could release potentially explosive environments and be subject to routine testing to ensure safe operation when required.

Depending on the number and size of batteries on charge, explosion relief systems may be necessary. This should be assessed by a suitably competent person and any recommended actions implemented.

Increased fire resistance ratings of 90 to 120 minutes should be considered for multiple fork-lift truck battery charging, or other higher risk charging activities, or as advised within the premises Fire Risk Assessment.

### Internal Charging – Segregation Only

The installation of a charging room or hall may not be viable in all buildings. For premises featuring single or smaller numbers of larger items of lithium-ion battery powered equipment such as fork-lift trucks etc., a dedicated charging area should be established and located at least five metres clear of combustible building linings, contents, or stock. Demarcation of the charging area using floor hatching is recommended, and the area routinely inspected for breaches of storage rules. Impact protection devices may be necessary to protect against the risk of vehicular damage to charging equipment, and ideally equipment should only be charged during periods of occupancy.

The charging of multiple large items of such equipment is not recommended unless within a fire resisting compartment and it would instead be prudent to charge externally within a dedicated charging shed or replace with alternatively powered equipment.

Internal charging of delivery vehicles is not recommended. Electric vehicle battery fires generate significant flaming over a prolonged period as fire passes between individual battery cells/modules and firefighters are unlikely to enter buildings to tackle such fires unless there are life safety concerns. As such, any fire event involving an electric vehicle within business premises is likely to lead to a catastrophe level of damage and significantly impact business trading.

### Internal Charging – Contractors Equipment

Ideally any contractor's tools and work equipment should be charged in line with the guidance provided above, particularly larger items of plant such as mobile elevated lifting equipment etc. Charging of equipment where a charging room or hall is not available, should only be undertaken:

- In a dedicated area preferably five metres, but in the case of portable tools at least three metres from combustible goods.
- On a non-combustible surface at least 150mm above flooring surfaces to prevent any water related damage or fire events.
- Only undertaken during hours of occupancy.

Additionally, Permit to Work management policies and Permits should be extended to include checks to lithium-ion battery powered tools to ensure they are in good working condition, with no visible signs of modification or damage. The contractor should also be able to confirm power tool batteries are within recommended lifecycle rating, or less than three years old. Batteries exceeding three years of age are likely to be nearing end of life and Permit Issuers should be given the authority to prohibit their use if they have any concerns regarding working condition and fire safety.

## Charging and Electrical Hazards

Charging places stress on batteries and is one of the main fire related concerns. The increased load on the electrical supply, which if not well maintained or capable of supplying the demand safely, is also a potential source of ignition.

The following guidance can help reduce the risk of electric faults during charging operations.

- In all cases all manufacturers' recommendations and local regulatory requirements should be followed.
- All charger points should be installed and maintained in accordance with manufacturer's instructions and by a competent trained electrician (In the UK - such as those with current NICEIC, ECA, NAPIT accreditation).
- The circuit(s) supplying the charging points should be checked to ensure it has capacity for the proposed additional electrical load.
- All chargers should be suitably rated for the devices they are due to charge.
- Surge protection safety devices should be installed and regularly tested.
- Where possible as much of the wiring should be hard wired.
- Routing of cabling should be carefully considered, particularly if multiple cables are running through cable trays, as current draw may cause excessive heating within trays or conduits.
- All chargers should be clearly labelled and if different chargers or chargers with different ratings are proposed to be in use in the same area, the chargers should be grouped to help avoid confusion. Users should ensure the right charger with the correct rating is being used to charge the corresponding battery/device in question.
- The design and layout of the area should ensure charging cables do not become overstretched, tangled, or can be damaged.
- All chargers should be arranged with a clearly labelled and readily accessible master isolation switch that is not in the same fire area as the charger itself.
- Depending on the nature of the arrangements and chargers used, these should be considered within all required electrical fixed wiring or portable appliance testing.
- If any charging equipment is damaged or is faulty it should immediately be removed from use, repaired, or discarded and the charging equipment isolated safely as necessary.
- The use of extension leads and/or multi plug adaptors should be prohibited.
- Thermographic cameras should be routinely used on the batteries and the charging equipment to check for hot spots and overheating components.
- An annual formal infra-red thermographic inspection of the charging infrastructure is also recommended.

## Storage

Whilst not presenting as significant a risk as charging activities, storage arrangements should be carefully assessed to help reduce the risks of fire damage arising from impact damage, inherent manufacturing faults etc.

### E-Scooters, E-bikes etc.

The storage of E-Scooters, E-bikes etc., internally should be prohibited, and if necessary, should only be allowed externally in a safe area clear from buildings, valuable assets, and combustible goods. Where permitted, a clear policy should be introduced around the permittance of E-Scooters, E-Bikes etc., on sites, and the subsequent thresholds, storage and charging arrangements. This policy should be clearly communicated to all workers, and other applicable stakeholders e.g., visitors etc., along with corresponding Standard Operating Procedures (SOP's) outlining rules and protocols. More information is available in Aviva Loss Prevention Standards Electric Bicycles – Property Risk Management and Electric Scooters – Property Risk Management.

## Storage of Workplace Equipment

Equipment not under charge should ideally be stored in their respective charging cabinets, rooms, or halls when not in use, and always during periods of unoccupancy e.g., outside working hours. This helps limit the potential for fire spread to other contents in the event of a fault or incident leading to ignition. Where this is not viable during working hours, such equipment should be safely placed, clear of vehicular or busy personnel routes, and clear of edges thereby minimising the risks of falling, accidental damage, impact incidents etc.

## Uninterrupted Power Supply Systems (UPS)

Lithium-ion battery powered UPS systems are typically located in dedicated rooms. These rooms can often be used for the storage of other goods including combustible items which would support fire growth in the event of ignition.

UPS rooms should ideally achieve a fire resistance rating of at least 60 minutes, as detailed above, and be maintained sterile/clear of other combustible goods.

## Stock Storage

New lithium-ion batteries or lithium-ion battery powered equipment invariably features a 'state of charge' usually in the region of 30%. This is for international transportation safety purposes. As such new equipment arriving at the premises will be at least partially charged. Sales stock containing lithium-ion batteries should ideally be stored in a separate fire rated room or hall from other sales stock. The fire resistance guidance provided above in respect of charging rooms or halls is applicable.

Where this is not viable, stocks should be separated as far as achievable from other stock items and combustible goods. Five metres separation is recommended for free standing goods.

For stock held in pallet beam racking or on shelving systems, the stocks of lithium-ion battery containing stocks should be separated to reduce the accumulation of risk and stored on higher levels of racking/shelving to help reduce the risk of vertical fire spread to other stock.

The maximum storeroom/warehouse temperatures should be assessed, and cooling/heating systems, which should be suitable for potentially explosive environments, configured to automatically operate prior to recommended battery temperature thresholds being met. Automatic heating/cooling systems should be subject to routine testing to ensure safe operation when required. Stock should also not be stored directly underneath warehouse roof lights, or in proximity to hot water pipework or other heating sources if there is a danger of heat transfer to packaged lithium-ion batteries or goods containing such batteries.

More information is available in Aviva Loss Prevention Standard Lithium-ion Batteries – Storage and Transit.

Note: Under no circumstances should lithium-ion batteries be stored in recycled battery bins, as seen in many retail outlets, with other battery types.

## Ventilation

In addition to preventing the spread of fire, the safe management of smoke and gas emissions resulting from lithium-ion battery combustion, off gassing or thermal runaway should be considered.

To minimise the potential for fire, explosion and/or undue smoke contamination you should arrange for appropriate, mechanical means of ventilating storage or charging rooms or halls to be installed. The potential explosivity of emitted gases should be assessed, and where a credible explosion risk is present, ventilation systems rated as suitable for use in explosive atmospheres as appropriate. This is of additional concern given the production of hydrogen gas that can be generated when firefighting water is applied to lithium-ion battery fires.

The exhaust point of the ventilation system should be to a safe area in the open, and not located in an area where any exhausted smoke could compromise the air intake of the building or that of neighbouring properties.

The ventilation system should be continuous and not actuated or stopped by performance of any fire protections and be subject to a formal inspection and maintenance programme by appropriately qualified and competent personnel.

## Damaged, Faulty or Returned Batteries

Damaged or faulty batteries, or goods featuring such batteries including lift trucks should not be stored at the premises longer than is necessary, and a strict rule to this effect should be established within the Standard Operating Procedures, detailing arrangements, and responsibilities for prompt collection by a reputable lift truck supplier or waste recycling company. Such batteries should be segregated and quarantined pending collection.

Segregation should be:

- External and as far away from buildings, valuable assets, and combustible goods as possible (in most cases at least 10 metres separation is recommended).
- If external storage is not possible, a dedicated storeroom should be provided, and which should be of non-combustible construction providing a fire resistance rating, including the ceiling of 90 to 120 minutes.
- If a storeroom is not available, a segregated area at least five metres of combustible building linings, other contents, or stock. Demarcation of the area using temporary barriers or warning signs is recommended.

Daily thermographic camera inspections of damaged or faulty batteries, or goods featuring such batteries are recommended pending collection.

The charging of damaged or faulty batteries, or goods featuring such batteries internally is not recommended.

Refer to the Aviva Loss Prevention Standard Damaged, Returned, Recycled and Rechargeable Batteries for more detailed and specific guidance.

## End-of-Life Battery Management

All rechargeable batteries have a recommended lifecycle rating. The recommended life of lithium-ion batteries is also affected by the depth of discharge, or **the amount of a battery's storage capacity that is utilized**. This information will be available in the product specifications or the supplier/ maintenance company for larger battery powered equipment, such as lift trucks or other mechanical handling plant.

**Batteries should only be removed in accordance with manufacturers or supplier's instructions** and handled/stored in accordance with the guidance provided in this Loss Prevention Standard. Replacement batteries and accessories should only be sourced from the original manufacturer of the equipment or an official agent of the manufacturer.

You should not exceed recommended lifecycle charging, unless approved by your supplier.

Batteries that have reached end-of-life should be clearly labelled and stored separately to avoid re-purposing and collected by a reputable waste recycling company.

## Self-Inspection

The batteries within lithium-ion battery powered equipment in use, accessories and charging areas should be subject to a recorded inspection programme to help identify damage, modifications, use of aftermarket or incompatible batteries or accessories, housekeeping concerns, and adequacy of charging arrangements. Ideally this should be undertaken at least weekly and the use of photographic evidence with such inspections can prove invaluable.

Thermographic camera inspections can also prove invaluable for such inspections. They can also be used to check for hot spots or overheating for both batteries in storage and whilst on charge.

Any batteries, equipment or goods exhibiting damage etc., should be removed from the premises to a cordoned area in the open, and as far from buildings, other assets, and combustible goods as possible, and collection/disposal arranged with a licenced waste handling company.

Regular self-inspections and visual checks should also be undertaken of battery storage and charging rooms/halls for signs of damage or fault to the structure, fittings, fire protections or ventilation equipment. This includes rooms used to house UPS systems.

## Emergency Response

Given the risks associated with lithium-ion battery fires, an emergency response plan should be produced specifically developed to outline key responsibilities and actions in an emergency event involving lithium-ion batteries.

The emergency response rules should be formally documented, and appropriate training provided.

Note: The explosive potential of lithium-ion batteries is increased when enclosed within compartments, particularly when oxygen levels increase suddenly, such as when compartment doors are opened. Access into such compartments during a fire event should ideally be limited to appropriately trained persons.

## Fire Protections

### Automatic Fire Detection

Charging and storage undertaken internally should be within an area of the premises covered by the sites automatic fire detection system. Detection should also be extended to any external charging areas where canopies or protective enclosures have been installed.

Where not installed, automatic fire detection should be provided in all areas/rooms of the buildings to include the storage/charging areas. In the UK this should ideally be compliant with Category L1 or P1 of BS 5839-1:2017 - Fire detection and fire alarm systems for buildings - Code of practice for design, installation, commissioning, and maintenance of systems in non-domestic premises. This is vital for life safety and early notification to the Fire and Rescue Service.

The use of thermal and aspirating detection technology can provide very early warning of issues such as overheating batteries or initial gas releases however guidance on the most appropriate detection technology should be obtained from an accredited fire alarm installer.

A means of manually raising the fire alarm should also be provided, especially in the storage/charging area if it exposes any other assets.

Any plans to change the existing fire detection system or install a new fire detection system should be discussed with your Property Insurer and Insurance Broker.

### Automatic Sprinkler Protection

Where an existing automatic sprinkler system is installed, the design should be adequate for any changes in risk profile. A suitably accredited sprinkler maintenance company, such as one approved to LPCB Loss Prevention Standard LPS 1048: Requirements for the approval of sprinkler system contractors in the UK and Ireland, should be asked to confirm the sprinkler density, water supply demand and water supply duration are likely to be adequate and provide recommendations for enhancing the protection where necessary. For storage premises, the

storage methods and **packing materials used should support ‘wetting’ of stored stock in proximity to the seat of the fire, to help hinder fire growth and spread.**

Note: International sprinkler standards have not yet developed clear and specific guidance on protecting against the risk of lithium-ion battery fires in all scenarios, and any recommended solutions are likely to be based on the judgment and experience of the sprinkler company. Any recommendations in relation to automatic fire protections should be discussed with your Property Insurer and Insurance Broker as early as possible for advice and guidance.

## Alarms

Alarms associated from the above should raise a site fire alarm to ensure there is an appropriate emergency response and escalation if needed. If not already in place you may wish to consider connecting the alarm to a constantly attended location or an approved Alarm Receiving Centre. An accredited fire alarm installer can provide further guidance and assistance.

## Off-Gassing Detection

These systems provide sensor and gas detection for stationary lithium-ion battery systems such as Battery Energy Storage Systems, data centres and electric vehicles whilst under load, and work by detecting gases released in the early stages of battery failure, **commonly known as ‘off gassing’**. The system can be interlocked to the power supply to isolate upon the detection of gases and prior to thermal runaway. Whilst beneficial such systems are unlikely to be suitable for the applications discussed in this document. An accredited fire alarm installer can provide further guidance and assistance if required.

## Interlocks

The use of interlocks may help reduce the potential for an overheating lithium-ion battery or cell to enter thermal runaway. As such, the actuation of any of fire protections and alarms should be interlocked to de-energise the power supplies and isolate charging equipment. The interlocks should be tested at least annually and restored following any impairment to the fire protection and alarm systems.

## Fire and Rescue Service

Whilst there are no defined requirements to notify the local Fire and Rescue Service of the presence of lithium-ion batteries at your premises, this may be prudent if battery numbers in use or storage are significant. Such disclosure can aid the Fire and Rescue Service with deployment of firefighting resources and allow for any pre-emptive planning in respect of run off containment to be undertaken. As a minimum you should update any emergency fire information left at the premises for the emergency services to confirm the presence and location of:

- Any large items of lithium-ion powered lifting/mechanical handling plant.
- Battery charging rooms or containers (firefighters may opt to leave these environments sealed to prevent oxygen ingress).
- Damaged battery storage.

Local Fire and Rescue Services are often amenable to inspecting premises to evaluate fire risk exposures and offer guidance.

It is also important to maintain suitable access for the Fire and Rescue Services and consider the distances and location to the nearest source of fire water or hydrant that they may need use. The location and number of fire hydrants in the proximity of the premises should be documented in an emergency response plan or shown on appropriate drawings.

It is also good risk management practice to know what water supplies are available for the Fire and Rescue Service to use. Therefore, site management should always establish:

- What fire water is available.

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- Static pressure flows and residual pressure test results.
- Whether additional resources, such as a private hydrant system or water storage tanks are necessary.

## Fire Extinguishers

Fire extinguishers specified for use in tackling lithium-ion battery fires are available, however whilst potentially providing some benefit require very early application and, may not fully extinguish a developing fire involving larger lithium-ion battery arrangements or prevent the batteries reigniting. The volatility of lithium-ion battery fires and their explosive characteristics also presents significant injury risks to persons tackling such a fire in proximity, and as such their use should be carefully considered within the premises Fire Risk Assessment.

## Impairments

Ensure any impairments relating to fire detection and protection systems are reported to your Property Insurer and Insurance Broker. Temporary changes may be necessary to some arrangements whilst impairments are ongoing.

## Business Continuity

Every business should have a formal Business Continuity Plan in place. This should be reviewed to ensure disaster recovery and continuity arrangements remain adequate. Any actions generated should be addressed promptly.

## Key Action Steps

- Ensure relevant Risk Assessments have been reviewed to include lithium-ion battery use, charging, storage and disposal.
- Write clear rules within a Management policy and Standard Operating Procedures.
- Use reputable suppliers only.
- Inspect all incoming deliveries of lithium-ion batteries or goods containing such batteries for signs of damage.
- Prohibit the use or storage of aftermarket or recycled/re-purposed equipment.
- Ensure safe storage and charging measures are in place to minimise the risk of fire damage or fire spread in the event of ignition. Contain any internal storage and charging within fire resistance rated enclosures e.g., cabinets and compartments.
- Complete regular self-inspections to ensure:
  - Equipment and charging locations are in good order (Use thermographic camera where appropriate).
  - Fire detection and fire protections are in normal working order.
  - Housekeeping arrangements are satisfactory.
- Adopt contractor equipment checks and rules. Prohibit damaged, modified, and aged equipment.
- Store damaged, faulty and end of life batteries in a safe location, at least 10 metres from buildings, valuable assets, and combustible goods, and arrange for urgent collection by reputable handler.
- Introduce emergency procedures and provide appropriate training to workers and other relevant persons such as visitors and contractors.
- Ensure fire detection systems and other fire protections are appropriate.
- Review Disaster Recovery and Business Continuity plans.



## Checklist

A generic Battery Checklist is available, which can be tailored to organisation's needs. For more information please visit: [Aviva Risk Management Solutions - Loss Prevention Standards](#).

## Specialist Partner Solutions

Aviva Risk Management Solutions can offer access to a wide range of risk management products and services at preferential rates via our network of Specialist Partners, including:

- Fire risk assessment: [Cardinus Risk Management](#)
- Explosion/DSEAR Risk Assessments: [Bureau Veritas](#)
- Charging cabinets: [Denios](#)
- Thermographic imaging and PAT testing: [PASS](#)
- Automatic fire detection and portable extinguishers: [SECOM](#)
- Business continuity: [Horizonscan](#)

For more information please visit: [Aviva Risk Management Solutions – Specialist Partners](#)

## Sources and Useful Links

- [The Dangerous Substances and Explosive Atmospheres Regulations 2002.](#)
- [The Regulatory Reform \(Fire Safety\) Order 2005.](#)
- [The Fire Safety \(Scotland\) Regulations 2006.](#)
- [The Fire \(Scotland\) Act 2005.](#)
- [The Fire and Rescue Services \(Northern Ireland\) Order 2006.](#)
- [BS 5839-1:2017 - Fire detection and fire alarm systems for buildings - Code of practice for design, installation, commissioning, and maintenance of systems in non-domestic premises.](#)
- [LPS 1056: Issue 6.2 Requirements for the LPCB Approval and Listing of Fire Doorsets, Lift Landing Doors and Shutters.](#)
- [LPS 1271: Issue 2.3 Requirements for the LPCB Approval and Listing of Companies Installing Fire or Security Doors, Door-sets, Shutters and Active Smoke/Fire Barriers.](#)
- [LPS 1531: Issue 1.2 Requirements for the LPCB approval and listing of companies installing or applying passive fire protection products.](#)
- [LPS 1197: Issue 4.2 Requirements for the LPCB approval and listing of companies inspecting, repairing, and maintaining fire and security doors, door-sets, shutters, and active smoke/fire barriers.](#)
- [LPS 1048 approved sprinkler contractors - UK and Ireland.](#)
- [LPS 1048: Issue 5.0 Requirements for the approval of sprinkler system contractors in the UK and Ireland.](#)
- [INDG139 Using electric storage batteries safely.](#)
- [The Chartered Institute of Procurement and Supply.](#)
- [British Standard BS5306 – Fire Extinguishing Installations and Equipment on Premises.](#)
- [RiscAuthority document RC61 Recommendations for the Storage, Handling, and use of Batteries.](#)
- [RiscAuthority document RE2 Need to Know Guide Lithium-ion Battery Use and Storage.](#)
- [Sold Secure.](#)
- [BS EN 14470-1:2023 - Fire safety storage cabinets - Safety storage cabinets for flammable liquids.](#)
- [Redbooklive.](#)

## LOSS PREVENTION STANDARDS

Note: Whilst UK standards and legislation are referenced in this document, other international standards and legislation should be referenced where applicable.

## Additional Information

Relevant Loss Prevention Standards include:

- Electric Bicycles - Property Risk Management.
- Electric Scooters - Property Risk Management.
- Lithium-ion Batteries - Storage and Transit.
- Lithium-ion Batteries - Portable Tools
- Damaged, Returned, Recycled and Rechargeable Batteries.
- Business Continuity.
- Contamination Following a Fire.
- External Building Areas - Usage and Safety.
- Fire Compartmentation.
- Fire Doors, Fire Shutters and Fire Dampers.
- Fire Safety Inspections.
- Fire Safety Legislation.
- Heat and Smoke Venting Systems.
- Managing Change - Property.
- Smoke Contamination.
- Thermographic Surveys.
- Managing Contractors.

To find out more, please visit [Aviva Risk Management Solutions](#) or speak to one of our advisors.

Email us at [riskadvice@aviva.com](mailto:riskadvice@aviva.com) or call 0345 366 6666.\*

\*The cost of calls to 03 prefixed numbers are charged at national call rates (charges may vary dependent on your network provider) and are usually included in inclusive minute plans from landlines and mobiles. For our joint protection telephone calls may be recorded and/or monitored.



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22<sup>nd</sup> October 2024

Version 1.1

ARMSGI2032024

Aviva Insurance Limited, Registered in Scotland Number 2116. Registered Office: Pitheavlis, Perth PH2 0NH.

Authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority.

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