

Sprinkler Systems – Storage of Lithium-ion Batteries

Version: 1.0

Date: 31st March 2025

Lithium-ion batteries are used in a wide variety of products and goods including toys, appliances, personal devices and electric vehicles. Manufacturing defects or damage during transportation, can result in fire events whilst batteries are held in storage.

This Loss Prevention Standard discusses the main risks and the best practice guidance for sprinkler protection.



Sprinkler Systems – Storage of Lithium-ion Batteries



Introduction

Lithium-ion batteries are used in a wide range of products and equipment and their use has steadily increased over recent years.

With such demand, it is inevitable stocks of new lithium-ion batteries are being stored in warehouses awaiting onward distribution or use within product manufacturing. Additionally, damaged, faulty and/or returned batteries are stored pending repair/recycling or return to manufacturing plants for reprocessing.

Whilst acknowledged as an efficient, clean, and generally safe means of powering equipment, damaged, faulty, misused, modified, or aged batteries can be more vulnerable to ignition with the resultant fires being particularly volatile and difficult to suppress, and often automatically reigniting sometime after the original fire has been extinguished.

Physical, thermal or electrical damage to a battery cell can lead to an internal short which can create an undesired chemical reaction within the battery cell. This may lead to a phenomenon known as 'Thermal Runaway' whereby the chemical reaction propagates producing flammable gas buildup within the cell. As the gas builds, the cell will vent or rupture and any source of ignition, including the heat from the chemical reaction, will likely lead to a fire. Once the chemical reaction is in thermal runaway, it is incredibly difficult to control as the gases produced include those needed for combustion. The heat from one defective cell can transfer to adjacent cells where the process may then repeat. A similar process may take place if the battery cell is incorrectly charged or subjected to excessive temperatures.

The resultant fire can spread to buildings, contents, and impact trading, as well as potentially leading to contamination and pollution as a result of fire water run-off.

In early 2024, [a fire at a large lithium-ion battery recycling warehouse 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 May 2024 [a fire at a storage unit in Surrey](#) was believed to have been caused by a faulty battery.

Automatic sprinkler systems are acknowledged as the best means of containing and controlling a fire, however there are accepted challenges with protecting environments used to store lithium-ion batteries. International sprinkler standards have not yet developed clear and specific guidance on fully suppressing lithium-ion battery fires in all scenarios, and the intention of this document is to provide best practice guidance pending formal standardisation.

Note: This document is focussed on Property loss prevention in relation to sprinkler protection of premises used to store lithium-ion batteries. It is not intended to address Liability exposures. The presumption is that all regulatory requirements, Fire Risk Assessments, and compliance with requirements placed by the local authority having jurisdiction which would include licencing, building permissions, regulations, codes, or standards, have or will be met.



Understanding the Risks

Lithium-ion batteries are generally safe and reliable to use. The risks of fire in new batteries or goods containing new batteries are very low, however manufacturing faults or defects; the storage of inferior quality or faulty/damaged products or batteries; poor handling and damage incurred in transit or by warehouse operatives, drivers etc., can lead to fire events.

Fires involving these batteries are likely to spread rapidly to other combustible contents or goods in proximity and throughout the warehouse building or area, potentially leading to a very significant loss event.

The amount of firefighting water used in tackling a large lithium-ion battery fire incident can be significant with contaminated run off water presenting environmental risks requiring careful management due to the contaminated fire water run off being considered in many territories as 'hazardous waste'. Aviva are aware of significant incurred costs for removing and processing such contaminated run off water and this **MUST** be factored into any emergency response and recovery plans.

Refer Aviva Loss Prevention Standard **Contamination Following a Fire** for further guidance.

Managing the Risks

Despite the challenges of controlling a lithium-ion battery fire, automatic sprinkler protection remains an essential component of any fire risk management strategy. When correctly designed, detected promptly, and operating in conjunction with other fire risk mitigation measures, fires can be controlled and the resultant damage potentially limited to specific areas only.

The following guidance summarises the most appropriate current means of sprinkler protecting storage buildings/areas housing lithium-ion batteries.

Note: Aviva Loss Prevention Standard **Lithium-ion Batteries – Storage and Transit** provides guidance on general fire risk management in relation to lithium-ion battery storage and the use of lithium-ion battery powered equipment e.g. lift trucks etc.

Sprinkler Strategy

Fires involving lithium-ion batteries are very difficult to suppress using water based fire suppression protection. The sprinkler design should therefore aim to delay and prevent fire growth by effective wetting and cooling of all combustible materials and surfaces in proximity to the fire location, and where goods are stored in pallet beam racking by installing physical barriers.

The sprinkler strategy should include the following components:

Sprinkler System Design

The lithium-ion battery storage area should be treated as a high hazard storage exposure and the ceiling sprinkler system design density should be determined considering the building height and the packaging used for the stored batteries. The water supply needs to have a minimum duration of 120 minutes, including capacity for a hose stream allowance (the water required to adequately supply any firefighting hose connections) of 1900 L/min in addition to the calculated sprinkler water demand.

Post & Beam Pallet Racking

Where practical, lithium-ion batteries should be stored within beam pallet racking. The in-rack sprinkler protection delivers higher concentrations of water locally, which improves the potential to limit fire spread.

In-rack sprinklers should be located at each rack beam level, with a maximum vertical distance of 1.8m between each level. A clear space of 150mm is to be maintained between the top of the storage and the sprinkler heads.

Single row racking requires a single row of sprinkler protection over, and in the centre of, the stored goods whereas double row racking needs 'face and flue' sprinklers. The sprinkler design data sheets (Manufacturer produced documents that provide essential information about the fire sprinkler components, performance and installation requirements) detail exact sprinkler head spacing and clear flue requirements and these should be referred to during the design of the sprinkler protection.

Solid barriers (at least 0.7mm thickness for steel and 10mm thickness for plywood) are to be installed above every rack beam level and including above the top level of storage. Nothing must be stored above this top level barrier.

Hydraulic calculations should be carried out to ensure there is a minimum flow of 227L/min out of each of the sprinkler heads in the determined hydraulically remote locations. The hydraulic calculations should include six heads operating if a single level of protection is provided or eight sprinklers if more than one level of in-rack protection is present.

Sprinkler heads with a minimum K-factor of 160, operating at a minimum pressure of 0.7 Bar should be used to ensure prompt wetting of surrounding goods and surfaces.

It is not necessary to include the ceiling sprinkler protection demand in the hydraulic calculations for the in-rack sprinkler protection.

Floor Storage/ Marshalling Areas

Stocks of lithium-ion batteries should be stored separately in different 'blocks' or 'islands.' This helps reduce the risk of catastrophe fire losses to whole consignments of goods.

- Storage 'islands' should be no more than 50m².
- Each storage island should be separated by aisles of at least three metres on all sides.
- Storage height of goods in marshalling or floor storage areas should not exceed 1.8 metres, depending on roof height and roof sprinkler design.

Important: Refer to your Property Insurers and Broker for formal guidance on storage heights and design density.

Compartmentation

When the lithium-ion battery storage area is within a building used for other trade activities such as manufacturing, office functions etc., a compartment wall should be installed between the warehouse and other areas of the building achieving at least 90 minutes fire resistance.

- Any openings should be fitted with automatically operating fire shutter assemblies achieving a fire resistance (insulation and integrity) rating commensurate with the fire compartment walling and ceiling and meeting the requirements of national regulations, standards or codes, such as **BS EN 16034:2014 Pedestrian Doorsets, Industrial, Commercial, Garage Doors and Openable Windows. Product Standard, Performance Characteristics. Fire Resisting and/or Smoke Control Characteristics** and certificated to LPCB Loss Prevention Standard **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** in the United Kingdom.

- ✓ The fire shutters should only be held open with specific interlocked devices that automatically release when the automatic fire detection, manual break glass alarm or fire sprinkler system are activated on either side of the fire compartment wall.
- ✓ The fire shutters should also be manually operable in an emergency from either side of the fire compartment wall.
- The installation of fire shutters and fire doors should be completed by an accredited company, such as one 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** in the United Kingdom.
- Installation of other passive fire protection products such as fire stopping should be completed by a company, in the United Kingdom, 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, In the United Kingdom, 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 to [redbooklive](#) for details of approved contractors.
- Unprotected steelwork within / attached / adjacent to the compartment wall whose failure during a fire would affect the integrity of the compartment wall should be protected to the same fire resistance level as the wall. Any fire protection cladding used should conform to LPCB Loss Prevention Standard **LPS 1107 Requirements, tests and methods of assessment of passive fire protection systems for structural steelwork** in the United Kingdom.
- A protected zone of 2.5 metres is to be created on each side of the walling where it meets the roof or walls to provide at least 60 minutes fire resistance.
 - ✓ The protected zone is the sections of non-combustible walling and roofing either side of a compartment wall, which are designed to support the fire compartmentation strategy.
- Rooflights within 2.5 metres of the compartment walling should have a fire resistance to the same level as the protected zone.
- Clearance of at least 2 metres should be maintained on each side of any compartment wall openings.

Refer to Aviva Loss Prevention Standard **Fire Compartmentation** for further guidance.

Other Guidance

Packaging

Batteries should be packaged in card or timber, wherever possible, rather than metal. This will allow the water released from the sprinklers to penetrate the packaging and help delay or prevent fire growth.

Ventilation

To minimise the potential for fire, explosion and/or undue smoke contamination, appropriate mechanical means of ventilating the warehouse or storage areas should be installed.

- The potential explosivity of emitted gases during a thermal runaway event should be assessed, and ventilation systems rated as suitable for use in explosive atmospheres as appropriate.
- This should be interlocked to operate only once the sprinkler systems have operated.
 - ✓ Sprinklers require significant heat accumulation to operate. Should the building vent prior to activation, the sprinklers may be delayed.

Self-Inspection

Batteries in storage should be subject to a recorded inspection programme, carried out at least monthly.

- This can help identify damage; unusual odours, swelling, fire protections and ventilation equipment etc.
- Thermographic camera inspections can also be used to check for hot spots or overheating within stored batteries.

Refer to Aviva Loss Prevention Standards **Self-Inspections** and **Thermographic Surveys** for further guidance.

Emergency Response

Produce an emergency response plan to outline key responsibilities and actions in an emergency event involving stocks of lithium-ion batteries.

- Ensure workers and other relevant stakeholder are aware of the plans/procedures including emergency evacuation.

Refer to Aviva Loss Prevention Standards **Emergency Response Teams** for further guidance.

Damaged, Faulty, Returned Batteries

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

Segregation should be:

- External and as far away from the main warehouse building, 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 (insulation and integrity), including the ceiling of 90 to 120 minutes.
- If a storeroom is not available, a segregated and sprinkler protected area at least five metres from other goods and building surfaces.
 - ✓ Demarcation of the area using barriers and/or floor marking and warning signs is recommended.

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

Refer to Aviva Loss Prevention Standards **Damaged, Returned or Rechargeable Batteries** for further guidance.

Fire and Rescue Service

Whilst there are no defined requirements to notify the local Fire & Rescue Service of the presence of lithium-ion batteries, this may be prudent if battery numbers in storage are significant. Such disclosure can aid the Fire & 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:

- Battery stock.
- Damaged battery storage.

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

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

Refer to Aviva Loss Prevention Standards **Manual Firefighting Water Supplies** for further guidance.

Impairments

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

Refer to Aviva Loss Prevention Standards **Impairment Management** for further guidance.

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.

For more information please visit:

[Aviva Risk Management Solutions – Specialist Partners](#)

Sources and Useful Links

- [FM Property Loss Prevention Data Sheets 7-112 Lithium-ion Battery Manufacturing and Storage](#)

Additional Information

Relevant Loss Prevention Standards include:

- **Sprinkler Systems - Design Proposals Required Information for Review**
- **Sprinkler Systems - How They Operate**
- **Sprinkler Systems - Review of Hazards**
- **Lithium-ion Batteries – Storage and Transit**
- **Damaged, Returned, Recycled and Rechargeable Batteries**

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

Email us at 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.

Please Note

This document contains general information and guidance only and may be superseded and/or subject to amendment without further notice. Aviva has no liability to any third parties arising out of ARMS' communications whatsoever (including Loss Prevention Standards), and nor shall any third party rely on them. Other than liability which cannot be excluded by law, Aviva shall not be liable to any person for any indirect, special, consequential or other losses or damages of whatsoever kind arising out of access to, or use of, or reliance on anything contained in ARMS' communications. The document may not cover every risk, exposure or hazard that may arise, and Aviva recommend that you obtain specific advice relevant to the circumstances.

31st March 2025

Version 1.0

ARMSGI2372025

Aviva Insurance Limited, Registered in Scotland Number SC002116. Registered Office: Pitheavlis, Perth PH2 0NH.

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