

High-Piled Storage (Non-Sprinklered Buildings)

There are a number of hazards and risks associated with high piled combustible storage, which can increase the potential for property damage and business interruption.

This document aims to provide guidance to minimise such risks within buildings that are not protected by automatic sprinkler systems.

High-Piled Storage (Non-Sprinklered Buildings)

Introduction

High-piled storage, which, for the purposes of this document, is defined as stacked, shelved, or racked goods over 3 metres in height, is common in many storage and warehouse locations, allowing for efficient utilisation of storage space and reduced storage costs.

However, there are risks associated with high-piled combustible storage in non-sprinklered buildings. These risks are discussed in this document, along with practical guidance to help reduce the potential for loss, damage, and business interruption.



Note: This Loss Prevention Standard relates to high-piled storage, excluding the enhanced exposures of Automated Storage Retrieval Systems (ASRS), and is focussed on property loss prevention and related risk management guidance. It is not intended to address liability exposures. The presumption is that all regulatory requirements, such as fire risk assessments and compliance with local building regulations, codes, or standards, have or will be met.

Understanding the Risks

Storage and warehouse environments are exposed to a number of potential hazards. These include, but are not limited to:

- **Charging Areas.** Forklift charging equipment can be damaged or become faulty. Batteries can be overcharged, which can lead to ignition. Batteries can also develop faults and go into thermal runaway, a condition that typically results in fire events. Other equipment on charge can also overheat and ignite, such as stock scanners, personal devices, etc.
- **Electrical.** Electrical equipment can become damaged or faulty, often leading to overheating, sparking or arcing, which can ignite combustible materials.
- **Lighting.** Some lighting systems, such as high-density discharge and halogen types, can radiate heat to combustible materials or stock, creating an ignition hazard.
- **Equipment.** Equipment such as shrink-wrapping machines, computers and printers at desk stations, motors on mechanised conveyor systems, etc., can overheat and ignite. Compacting and baling equipment presents a number of fire-related challenges requiring careful management.
- **Maintenance.** Maintenance work, particularly hot works, can ignite combustible materials.
- **Heating.** Some heating systems can become damaged or faulty and overheat or ignite materials in proximity.
- **Water Damage.** Localised flooding and escape of water events can damage equipment and stock.

Factors can impact the development and spread of fire include:

- **Building Features.**
 - ✓ Height.
 - ✓ Pitch and nature of roof.
 - ✓ Combustibility of construction materials.
 - ✓ Fire and smoke compartmentation.
 - ✓ Air conditioning and ventilation systems.
 - ✓ Heat and smoke venting.
- **Material and Goods.**
 - ✓ Hazardous goods such as aerosols, flammable liquids, etc.
 - ✓ Combustibility of material.
 - ✓ Smoke susceptibility.
 - ✓ Packaging including within any of the unit loads.
 - ✓ Coverings to external packaging, such as shrink wrapping to the sides of the unit load, or to all sides and including the top. This can be called encapsulation.
 - ✓ Pallets: Plastic, wooden or metal. Size and arrangement of pallet in relation to the rack width.
- **Storage Arrangements**
 - ✓ Height (maximum/minimum).
 - ✓ Clearance to the roof.
 - ✓ Expected trends or seasonal fluctuations.
 - ✓ Uneven rack loading - such as loading on the upper tiers with the lower ones empty, heavier loads on upper tiers and lighter loads on lower tiers; loads on one side of a rack, etc.
 - ✓ Temporary storage - In the context of a fire scenario, any 'temporary storage' should be regarded as storage and treated as permanent.
 - ✓ Racked:
 - What type of racking and the number of tiers. Single row, double row, multi-row, flow through, cantilever, bin box, etc.
 - Length and width of bays and racks.
 - Shelving: solid/slatted/grated.
 - Rack leg protection and damage to the racks and especially the rack legs.
 - Damaged rack legs can fail prematurely in a fire, leading to collapse and a domino effect with adjacent racking being toppled.
 - ✓ Solid piled:
 - Pile sizes and stability - Ignited/alight stocks can collapse and spread fire?
 - ✓ Aisle spaces between piles or racks can be used for temporary storage and allow fire bridging.

Fire-fighting response to fires involving high piled storage can often be challenging. Areas of concerns include:

- Storage heights.
- Potential for racking or stock collapse.
- Hazardous materials.
- Lack of available space.
- Narrow or blocked aisles.
- Materials of building construction.
- Lack of fire compartmentation.
- Lack of smoke and heat removal.
- Inadequate firefighting water supplies.
- Lack of appropriate equipment to fight fires at the highest levels of storage, etc.

Without any automatic sprinkler protection, fires in open-plan storage areas and warehouses can rapidly escalate in size and intensity. Fire and Rescue response, assuming there are no life safety concerns, is likely to focus on limiting the potential for spread externally to adjacent buildings via defensive firefighting, which typically results in significant, if not catastrophic fire losses. Business interruption losses and environmental damage losses are also likely to be significant.

In addition, building elements, storage racking, shelving and stock can be vulnerable to impact damage from lift vehicles, escape of water events, flooding, and security breaches which can result in theft incidents.

Management Programmes

Risk Assessments

Ensure relevant fire/explosion related risk assessments have been completed and are reviewed regularly. In the United Kingdom this is typically addressed within:

- The various home nation fire risk assessment-based legislation.
- The Dangerous Substances and Explosive Atmospheres Regulations (DSEAR).
- Control of Major Accident Hazards Regulations (COMAH).

The requirement to consider any risks under the COMAH Regulations is dependent on the materials and volumes stored. Further detail is published by the Health and Safety Executive [here](#).

Note: Statutory risk assessments are deemed the minimum requirement, and following the recommendations in this document can help further reduce the risk and exposures.

Material Damage Risk Assessment

Before initiating risk management controls or installing any additional fire detection and protection systems, an assessment of the anticipated/potential financial losses, for both material damage and business interruption exposures, in the event of a significant or catastrophic loss event, should also be undertaken.

This helps ensure that risk controls, detection and protection systems, etc., are sufficient and reflective of the potential property loss estimates.

Refer to the Aviva Loss Prevention Standards **Material Damage Risk Assessment** and **Business Impact Analysis** for further guidance.

Managing Change

Any proposed changes to the premises for risk management purposes should be managed through a formal Management of Change process. This helps ensure all stages of the change are progressed with minimal exposure to the existing arrangements.

These proposed changes should also be discussed with your Property Insurer and Insurance Broker.

Refer to the Aviva Loss Prevention Standards **Managing Change** for further guidance.

Hot Works

Hot works are tasks or equipment that use or create heat, flame or sparks. Examples include but not limited to welding equipment, blowtorches, grinders, drilling and brazing.

- Hot works should be prohibited within storage and warehouse areas and removed to a safe location, or if this is not possible only be completed via 'cold' methods.
- Where this is not possible, the hot works should be conducted in strict accordance with the Aviva Loss Prevention standard **Hot Work Operations**.
- Thermographic cameras should be used throughout the process and during the required fire watches.
- Fire watches should be undertaken for up to 240 minutes after the hot works and only reduced where supported by a specific risk assessment.

Housekeeping and Waste

Poor housekeeping standards and associated storage and management of waste or other combustible materials can increase the risk of fire and its subsequent impact on an organisation. Fires can be prevented by introducing robust controls and effective management standards for the storage and management of these materials.

- Storage of waste materials should be kept to a minimum and utilise dedicated external combustible waste storage areas including for the storage of idle pallets, skips and wheelie bins, with such items positioned at least 10 metres clear of any buildings.
- Storage containers should be non-combustible, fitted with secure lids and kept in locked compounds.
 - ✓ When compounds are not possible, chaining/padlocking storage containers to fixed posts or other infrastructure is recommended.
- Aerosols, flammable liquids and gases should be stored separately in proprietary non-combustible and secure normally closed containers/cages, with suitable spillage containment provided.
- Internally, the use of bins, waste sacks, vehicle chargers and workstations, e.g. desk areas with computers, printers, etc., should be expressly prohibited within storage racking.
- Locate waste areas in clear areas away from ignition hazards, such as charging areas, electrical hardware, etc.
- Ensure smoking areas are located at least 10 metres from buildings and are cleaned daily. Smoking waste should be segregated from other combustible waste within separate non-combustible receptacles.

Refer to Aviva Loss Prevention Standards **Housekeeping - Fire Prevention, Arson Prevention, Management of Combustible Waste** and **Smoking and the Workplace** for further guidance.

Self-Inspection

There should be a formal and audited recorded self-inspection programme of warehousing areas to ensure:

- Property and equipment, including buildings, plant, associated services, such as the electrical installation, guttering, doors, fire shutters, impact barriers, etc., are undamaged/unhindered and operating normally.
- Site rules and policies on storage and handling are being followed, and any arising issues are appropriately addressed.
- Housekeeping arrangements comply with site rules and procedures.
- Detection and protection equipment are functioning normally and not impaired.
- Thermographic cameras are used to check for unusual heat patterns from powered equipment, battery stocks, etc.

Refer to Aviva Loss Prevention Standards **Self-Inspections, Use of Thermographic Cameras - General Considerations and Use of Thermographic Cameras - Checklist** for further guidance.

Maintenance

An appropriate maintenance programme should be in place for buildings and equipment including lift vehicles and chargers, shrink-wrapping plant, chargers, conveyors, pallet beam racking, fire shutters, fire detection and fire protection systems, etc., based on Original Equipment Manufacturer (OEM) instructions, installer recommendations and industry best practice.

Refer to Aviva Loss Prevention Standard **Maintenance Regimes** for further guidance.

Electrical Equipment

The fixed electrical installation should be inspected and tested in accordance with national or local regulations, standards and codes. In the United Kingdom this is as prescribed in the most up to date version of **BS 7671 (Institution of Engineering & Technology (IET) Wiring Regulations**, and an Electrical Installation Condition Report issued.

The work should be carried out by a competent contractor who is preferably a member of an appropriate UKAS (United Kingdom Accreditation Service) nationally accredited third-party inspection body for companies able to perform independent inspection and testing in accordance with the IET regulations.

Any corrective actions should be addressed within the recommended timescales.

Portable appliances, which include radios, computer workstations, charging devices, etc., should also be inspected, tested and cleaned, and any defective equipment removed from use until satisfactorily repaired.

Aviva Loss Prevention Standard **Electrical Installations - Inspection and Testing** provides further guidance.

Emergency Response

An emergency response plan should be specifically developed to outline key responsibilities and actions in an emergency event. The emergency response plan should include responses to all likely property and business interruption related events as described in this Loss Prevention Standard. It should also include the actions key individuals should take during emergency events.

The emergency response rules should be documented and training provided.

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

Business Continuity Planning

Business Continuity Plans should be reviewed to ensure disaster recovery and continuity arrangements remain adequate. Any actions generated should be addressed promptly.

Refer to the Aviva Loss Prevention Standards, **Business Continuity Management** for further guidance.

Training

Training for workers and other personnel associated with warehouse or storage operations is a key component, and should cover:

- What is normally expected to happen.
- What could happen in a number of typical and unusual emergency situations.
- How they are expected to respond.
- Own personnel and contractors or third parties.
- Hazards associated with the substances being stored.

Construction and Compartmentation

Construction

The use of non-combustible construction materials can significantly help reduce the potential for fire related damage. Consideration should be given to removing and replacing any combustible construction elements, such as polystyrene or polyurethane cored composite panels or wall/ceiling linings with non-combustible materials.

Any new buildings, extensions or repairs should utilise non-combustible materials, for example, mineral fibre/glass wool, and achieve a rating of A1 or A2 under **BS EN 13501-1. Fire classification of construction products and building elements - Classification using data from reaction to fire tests.**

Refer to Aviva Loss Prevention Standard **Composite Panels** for further guidance.

Compartmentation

Storage and warehouse areas should be separate to any production, manufacturing or other areas in commercial use, including plant rooms or rooms housing services such as inverters, electrical equipment, etc., shrink-wrapping areas, compacting and baling halls, etc. Ensure appropriate sub-division and fire compartmentation between such areas. At least 90 minutes fire-resistance (insulation and integrity) is recommended.

Important: The compartment fire resistance rating may need to be increased based on the values exposed and hazards. Consult your Property Insurer and Broker for further guidance.

Refer to Aviva Loss Prevention Standards **Fire Compartmentation** and **Fire Doors, Shutters, Dampers and Collars** for further guidance.

Managing the Risks

General Storage Arrangements

- **Hazardous Goods.** Hazardous goods such as aerosol products, flammable liquids, etc., should be stored separately from other goods. The use of dedicated sheds, containers, etc., located at least 10 metres from main buildings and valuable assets are recommended. Where this is not feasible, the use of separate fire compartmented storage within the storage/warehouse building should be considered, providing at least 90 minutes fire resistance (insulation and integrity).

Storage cages can also be installed for storing aerosol products. These are designed to prevent ‘propelling’ of aerosol cannisters in the event of ignition and reduce the potential for fire spread. Smoke and other fire by products will however contaminate other stocks in store.

Refer to the Aviva Loss Prevention Standards **Storage and Handling of Pressurised Aerosol Containers** and **Flammable Liquids** for specific guidance.

- **Packaging.** Bulk storage of packaging materials should be located separately to the general goods in storage, e.g., within a dedicated store building or storeroom.
- **Pallet Storage.** Ensure idle pallets are removed from main storage and warehousing areas. Ideally these should be located externally and at least 10 metres from buildings or valuable assets, or within a compartment having at least 90 minutes fire resistance (insulation and integrity).

Idle pallets should not be stored within any racking used for storage of stock and other goods.

Limit pallets stack heights to 2 metres wherever possible. This helps reduce the risk of fire spread in the event of alight pallet stacks toppling.

- **Firefighting.** Ensure adequate clearance is maintained between the top of stored goods and ceilings/roofing to allow firefighting water penetration. A minimum clearance of 1.5 metres is recommended.

Consider how full shrink-wrap encapsulation of goods could impact any firefighting attempts. If access to the building is possible, firefighting personnel may attempt to cool goods adjacent to the fire to prevent or limit fire spread. Full encapsulation of stored goods may prevent efficient cooling.

- **Pallet Beam Racking.** Ensure racking is appropriate for the dimensions and weight of goods to be stored and anchored in accordance with manufacturer’s guidance.

Racking should be uniform and different types not used in the same configuration. Using different racking types can affect the stability and stress loadings of the racking.

Racking legs should be protected from the risks of vehicular impact where vehicle movements may compromise racking safety.

- **Weight Loads.** Ensure balanced loading across pallet beam racking/shelving, e.g., storing heavier goods at lower levels, prohibiting loading on upper tiers whilst lower tiers are clear, etc. This helps prevent strain and potential collapse.
- **Signage.** Ensure appropriate signage is displayed on pallet beam racking. This should detail safety warnings, clearances and weight capacity of shelves and the whole rack.
- **Aisle Spaces.** Ensure aisles are maintained clear of stock, lift trucks, pallets or other materials. This may help slow fire development.
- **Temporary Storage.** Treat all storage as permanent and allocate to appropriate racking or shelving areas.

- **Marshalling areas.** Goods awaiting collection should be grouped into smaller ‘islands’ of up to 50 m³, with aisles between storage islands of at least 3 metres. Stock heights should be limited to a maximum of 2.4 metres. Following this guidance may help prevent or slow the spread of fire and potentially aid firefighting efforts.
- **Smoke Contamination.** Ensure any stock that is especially vulnerable to smoke contamination, such as food, clothing, sensitive electronic components, etc., is packed to minimise the risks of smoke damage, e.g. individual cellophane bags with sealed outer carton packaging. Even small fire incidents can generate significant smoke and steam levels from firefighting water, the residues and odours of which can damage goods via odours, residues, etc.
- **Stillages.** Ensure adequate clearance is allowed between floor levels and stock. At least 150mm stillages are recommended. This helps prevent water damage to stock in the event of localised flooding or escape of water/water/fluid incidents.
- **Escape of Water.** Pipework containing water or other fluids can escape due to leaks, damage, etc. Some building types feature valley guttering between roof pitches, which can overflow into the building when blocked or faulty.

Consider the vulnerability of stock types stored beneath pipework containing water or other fluids and valley guttering. Re-locate more susceptible goods to unexposed areas and ensure pipework and valley guttering are subject to regular self-inspections.

Refer to the Aviva Loss Prevention Standards **Escape of Water and Other Fluids**, **Escape of Water - 10 Top Tips** and **Escape of Water - Installation and Maintenance** for further guidance.

Storage of Lithium-ion Batteries

Stocks of lithium-ion batteries or goods containing such batteries should be stored in a separate small building or fire-resistant storeroom remote from other sales stock, wherever possible. Where this is not viable, the stock should be separated as far as achievable from other stock items and combustible goods. At least 5 metres separation is recommended for free standing goods.

Where pallet beam racking or shelving systems are utilised, stocks of lithium-ion batteries/goods containing such batteries 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.

Further detailed guidance on storage including storage temperatures and ventilation can be found in the Aviva Loss Prevention Standard **Lithium-ion Batteries - Storage and Transit**.

Battery Charging - Vehicles

Various types of lift vehicles are used in storage/warehouse environments. These are typically battery powered although less commonly hydrogen, liquified petroleum gas (LPG) and diesel vehicles can also be used.

Battery powered forklift trucks present a number of risk exposures that require careful management in warehouses and storage areas and should be undertaken in a separate building or fire compartment, where possible. Where not achievable, ensure dedicated charging areas are created and located as far from combustible construction elements and storage locations as possible.

Siting forklift charging equipment within storage racking should be expressly prohibited.

Detailed guidance can be found in Aviva Loss Prevention Standards **Battery Powered Forklift Trucks - Property** and **Lithium-ion Batteries - Storage and Transit**. LPG and diesel-powered vehicles are also discussed in **Forklift Trucks - 12 Top Tips**.

Battery Charging - General

There are numerous types of battery powered equipment that can be present in warehouse or storage environments, including stock scanners/readers, portable computers and tablets, handheld two-way radios, mobile phones, portable tools, floor scrubbers, workers e-bikes, etc.

Ensure formal charging arrangements are in place, reflecting the potential for fire spread to other goods or equipment in proximity due to battery size, battery numbers etc., via risk assessments. Control measures to consider include:

- Segregating battery charging and storage within fire resisting (insulation and integrity) rooms or compartments to help contain fire events can help reduce the potential for catastrophic fire spread throughout the premises. This is especially recommended for larger batteries or large stock scanner/reader charging hubs.
- Charging/storing removeable batteries/smaller battery powered items in [proprietary storage/charging cabinets and containers](#) with recognised fire resistance (insulation and integrity) periods.
- E-bikes should not be charged or stored within 10 metres of buildings. The condition of batteries cannot be verified and may have suffered damage or wear, making them vulnerable to self-ignition.
- Charging smaller individual items, such as mobile phones, only in occupied areas equipped with automatic fire detection, ensuring they are placed on non-combustible surfaces and adequately separated from combustible goods and combustible construction elements.
- Ensuring any charging equipment that is damaged or faulty is immediately removed from use, repaired, or discarded and the charging equipment isolated safely as necessary.
- Ensuring chargers are suitably rated and compatible for the usage.
- Having a formal emergency response plan in the event of an emergency event involving battery charging.

Refer to the Aviva Loss Prevention Standard **Lithium-ion Batteries - Storage and Transit** for specific detailed guidance.

Compacting and Baling Equipment

Compacting and/or baling equipment presents a number of risk concerns requiring careful management, and such activities should be located in a detached, dedicated building wherever possible, or where this cannot be achieved, a dedicated fire compartment.

Refer to Aviva Loss Prevention Standards **Fire Compartmentation** and **Fire Doors, Shutters and Dampers** for further guidance.

Robust housekeeping procedures relating to storage, housekeeping and waste management are also critical along with properly designed fire detection and protection systems.

Refer to Aviva Loss Prevention Standard **Compacting and Baling Processes - Property** for further guidance.

Shrink-Wrap Equipment

This equipment is used to heat cellophane wrap that has been wrapped around palletised stock, either manually or automatically via a powered turntable or robotic wrapping equipment before conveying through a heated enclosure to shrink the wrap material. This process provides more stability to palletised stocks along with weatherproofing and protection from contamination, e.g., dust, moisture, etc.

The machinery can become damaged or safety devices faulty and the following risk guidance should be considered:

- **Location.** Locate shrink-wrap tunnels in a dedicated fire compartment.
- **Segregate Combustible Materials.** Ensure separation of at least 5 metres from combustible goods and any hazardous processes. The use of fixed barriers and floor hatching can help ensure combustible goods are not located in proximity.
- **Palletised Stock.** Limit goods awaiting wrapping to low volume, ideally single pallet loads at a time. This prevents potentially combustible stock accumulating in proximity to the equipment. Ensure wrapped goods are immediately removed and located in an appropriate storage area awaiting further handling/allocation, etc.
- **Temperature Control.** Ensure high temperature safety controls are installed to the shrink-wrapping equipment along with visual and audible alarms. At least two high temperature devices should be installed both of which should be interlocked to power supplies to isolate safely upon high temperature thresholds being achieved.
- **Conveyor Interlocks.** Install interlocks to any conveyor equipment to ensure the power supply to the shrink-wrapping equipment isolates safely if the conveyor systems fail or stop moving.
- **Ventilation.** Ensure appropriate airflow around the equipment to help prevent heat build-up and reduces the risk of ignition from trapped hot air or fumes.
- **Fire Detection.** The equipment should be located in an area of the premises covered by the automatic fire detection system.

Important: The use of handheld LPG or hot air powered burner equipment to shrink-wrap palletised goods must be prohibited within or near buildings, valuable assets and combustible or flammable goods or materials. Where deemed necessary, ensure the work is conducted in a safe area in the open at least 10 metres from buildings, assets combustible or flammable goods or materials and in strict accordance with the Aviva Loss Prevention standard **Hot Work Operations**, with appropriate risk assessment, permits, supervision and fire watches implemented.

Lighting

Lighting systems should be low heat emitting and suitable for use in storage/warehouse environments.

- Halogen or high intensity discharge lighting is heat emitting and not considered suitable for use in storage/warehouse environments and should be removed. Temperatures with these bulbs can be an ignition source.
 - ✓ Failures of bulbs result in hot elements being scattered directly below, potentially igniting any combustible materials.
 - ✓ Capacitors within the units retain enough charge to create an ignition source.
- Light fittings should be positioned above sterile, clear areas, e.g., walkways.
 - ✓ Lights should never be positioned over stock stores, including temporary storage.
- At least 1.5 metres separation should be maintained horizontally between lighting units and stock.

- Fluorescent lighting can overheat, typically as a result of age-related wear and tear or damage. Failure of tubes can result in fracturing, with hot glass scattered below, potentially igniting any combustible materials. Ensure:
 - ✓ Any damaged or faulty light tubes are removed immediately from use.
 - ✓ Protective covers are fitted to all lights in use.
 - ✓ Non striking safety starter motors are used to prevent damaged bulbs from continually trying to start.

Refer to Aviva Loss Prevention Standard **Electrical Lighting - Property** for further guidance.

Heating

Heating systems should be suitable for use in storage/warehouse environments, and subject to regular inspections and formal maintenance.

- All heaters should be fixed. Portable heaters of any kind should not be used in storage areas and warehouse premises.
- Space heaters should be located at least 2 metres from combustible materials and not be directed towards combustible stock. The use of floor hatching is recommended to prevent combustible goods being stored in close proximity.
- Where floor mounted, ensure the flooring is non-combustible.

Roof Mounted - Solar Photovoltaic (PV) Installations

Solar PV systems are often installed on warehouse roof systems and should be closely managed. The following are just some of the key risk management issues:

- Ensure experienced and competent designers/installers are utilised.
- Do not install Solar PV installations on combustible roof materials, this includes composite or built-up systems with combustible insulation.
- Locate inverters, isolators, switchgear, etc., on non-combustible surfaces. If installed internally, locate within a fire rated compartment.
- Ensure framing is secured to the building, rather than ballasted frame mountings, which can be less resilient to adverse weather.
- Solar PV installations should be fitted with voltage optimisers which increase energy yield and automatically reduce the voltage within faulty panels to safe levels, reducing the potential for fire events.
- Create a number of separate roof arrays with at least 1 metre separation. This acts as a fire break.
- Install skirting around the underside of the solar PV panels to help prevent combustible waste accumulating and deter nesting birds.
- Regularly inspect the installation for damage, faults and shading (which can lead to internal damage, shorting and possible ignition).
- Ensure a formal maintenance plan is in place with an experienced and competent company.
 - ✓ Aviva Specialist Partner [Solarsense](#) can assist with your maintenance needs.

The following Aviva Loss Prevention Standards provide useful guidance in managing Solar PV systems:

- **Roof Mounted Photovoltaic Solar Panel Systems - General Considerations**
- **Roof Mounted Photovoltaic Solar Panel Systems - Planning for Installation**
- **Roof Mounted Photovoltaic Solar Panel Systems - Installation and Construction**
- **Roof Mounted Photovoltaic Solar Panel Systems - Installed and Ongoing Care**
- **15 Top Tips for Roof Mounted Photovoltaic Solar Panel Systems**

Battery Energy Storage Systems (BESS)

BESS are used to capture and store energy, whether electrical power purchased from the grid at lower demands for later use, or from renewable energy sources such as photovoltaic solar panel systems.

Whilst proprietary BESS, installed and maintained in accordance with manufacturers' guidelines and national or local regulations, standards or codes are generally safe and reliable to use, the risks, which include fire and explosion, need to be carefully managed including siting at least 10 metres from buildings and other valuable assets, interlocked gas detection, etc.

Note: BESS systems should not be installed within buildings.

Refer Aviva Loss Prevention Standards **Small Scale Battery Energy Storage Systems** and **Planning a Battery Energy Storage System - 12 Top Tips** for further guidance

Fire Detection and Protection

Sprinkler Systems

While this standard is for non-sprinkler protected storage areas and warehouses, it should be acknowledged that an appropriately designed and installed automatic sprinkler system with accompanying dedicated and reliable fire water supply, to internationally recognised standards, by listed/approved organisations, is the most effective means of fighting fires in storage/warehouse environments, particularly those with high piled storage.

Based on the values and business impact exposed in the risk assessment, automatic sprinkler protection fed by a dedicated and reliable fire water supply should also be considered.

- This should be designed in accordance with an internationally recognised standard, such as the **LPC Rules for Automatic Sprinkler Installations Incorporating BSEN12845** in the United Kingdom.
- All designs and installations should be completed by approved/listed companies using equipment that is approved/listed to internationally recognised standards.

Refer to Aviva Loss Prevention Standard **Sprinkler Systems - How They Operate** for further guidance.

Automatic Fire Detection

Installing a remotely monitored automatic fire detection and alarm system can provide early discovery of fire and help reduce the potential for fire development and spread.

The fire detection and alarm system should conform to local or national regulations, standards or codes, such as **BS 5839-1: Fire detection and fire alarm systems for buildings - Design, installation, commissioning and maintenance of systems in non-domestic premises. Code of practice** in the United Kingdom.

Category P1 systems provide the highest level of property protection with fire detectors installed throughout all areas of the building (except small low risk areas as specified in BS 5839-1).

Note: Discuss any plans to install automatic fire detection and fire protection systems with your insurer or broker.

Heat and Smoke Venting

Consider installing automatically (and manually) actuated heat and smoke vents to the storage/warehouse areas. These are designed to exhaust heat and smoke from a building during and/or after a fire, and are typically installed in ceilings, roofs or high-up in walls, and can help prevent the accumulation of flammable gases and slow the development and spread of fire and smoke.

Refer to Aviva Loss Prevention Standard **Heat and Smoke Venting Systems** for further guidance.

Smoke or Draft Curtains

Smoke or draft curtains can also help prevent heat and smoke spreading at high level between fire zones within the storage area/warehouse. These may be rigid barriers or heat-resistant fabric, fixed to the ceiling or roof deck, and can be located permanently in position or be manually or automatically operated. Typically, a smoke curtain has a drop from a ceiling or roof of up to 2 metres only.

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

Fire and Rescue Service

Local Fire and Rescue Services are often amenable to inspecting storage and warehouse premises to evaluate fire risk exposures, firefighting response and offer guidance. Please invite local team(s) to familiarise themselves with the building and its activities.

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 to use and the amount of water

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

Please refer to the Aviva Loss Prevention Standard **Manual Fire Fighting Water Supplies** for further guidance.

Checklist

A generic **High Piled Storage (Non-Sprinklered Building) Checklist** is presented in Appendix 1 which can be tailored to your own organisation.

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.

- Solar PV servicing and maintenance [Solarsense](#)

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

Sources and Useful Links

- [LPC Rules for Automatic Sprinkler Installations](#)
- [BS EN 12845: Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance](#)
- [LPS 1208: LPCB fire resistance requirements for elements of construction used to provide compartmentation](#)
- [LPS 1271: Requirements for the LPCB Approval and Listing of Companies Installing Fire or Security Doors, Door-sets, Shutters and Active Smoke/Fire Barriers.](#)
- [LPS 1197: 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.](#)
- [BS 5839-1: Fire detection and fire alarm systems for buildings - Design, installation, commissioning and maintenance of systems in non-domestic premises. Code of practice](#)

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

Additional Information

Relevant Aviva Loss Prevention Standards include:

- **Arson Prevention**
- **Housekeeping - Fire Prevention**
- **Smoking and the Workplace**
- **Material Damage Risk Assessment**
- **Lithium-ion Batteries - Storage and Transit**
- **Fire Compartmentation**
- **Fire Doors, Fire Shutters and Fire Dampers**
- **Self-Inspections**
- **Heat and Smoke Venting Systems**
- **Electrical Installations - Inspection and Testing**
- **Electrical Lighting - Property**
- **Hot Work Operations**
- **Maintenance Regimes**
- **Managing Change - Property**
- **Self-Inspections**
- **Property and Business Impact Risk Assessment.**
- **Electrical Installations - Inspection and Testing.**
- **Business Continuity**
- **Small Scale Battery Energy Storage Systems**
- **Planning a Battery Energy Storage System - 12 Top Tips**
- **Roof Mounted Photovoltaic Solar Panel Systems - General Considerations**
- **Roof Mounted Photovoltaic Solar Panel Systems - Planning for Installation**
- **Roof Mounted Photovoltaic Solar Panel Systems - Installation and Construction**
- **Roof Mounted Photovoltaic Solar Panel Systems - Installed and Ongoing Care**
- **15 Top Tips for Roof Mounted Photovoltaic Solar Panel Systems**
- **Emergency Response Teams**

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.

Appendix 1 - High Piled Storage (Non-Sprinklered Building) Checklist

Location	
Date	
Completed by (name and signature)	

	Management Programmes	Y/N	Comments
1.	<ul style="list-style-type: none"> Have risk assessments been completed for all storage areas? Have any and all actions to reduce the risks been addressed? Are these reviewed regularly? 		
2.	<ul style="list-style-type: none"> Are proposed changes to storage and warehouse arrangements managed through a formal Management of Change process? Have any proposed changes been discussed with your Property Insurer and Insurance Broker. 		
3.	<ul style="list-style-type: none"> Is an impairment management programme in place? Is the programme routinely audited to ensure impairment management procedures are being followed appropriately? 		
4.	<ul style="list-style-type: none"> Is there a formal hot work management system in place? Are hot works conducted in strict accordance with the Aviva Loss Prevention standard Hot Work Operations. Are thermographic cameras used throughout the process and during the required fire watches? Are Fire watches undertaken for up to 240 minutes after the hot works and only reduced where supported by a specific risk assessment? 		
5.	<p>Are adequate written self-inspections completed and all actions completed for:</p> <ul style="list-style-type: none"> Combustible building materials, e.g. condition, exposed insulation materials, etc? Fire? Security? Housekeeping? Environmental? 		

	Management Programmes Cont'd	Y/N	Comments
6.	<ul style="list-style-type: none"> Is the racking system regularly inspected for damage by trained individuals? Frequency? Are there any signs of rack leg/racking damage? How are these repaired and is the work undertaken promptly? <p>Note: Racks can collapse and fail prematurely when rack legs are damaged.</p>		
7.	<ul style="list-style-type: none"> Is there a formal Emergency Response Plan, to ensure the resilience of the business? Is the plan purely for evacuation? Is anyone trained to use fire extinguishers or hose reels in a fire involving the storage? 		
8.	<ul style="list-style-type: none"> Has a business interruption assessment been completed to assess what affect a fire in the storage areas might have on the business operations and profitability of the facility? Could this impact any manufacturing facilities? 		
9.	<ul style="list-style-type: none"> Is a Business Continuity Plan in place? Is this routinely reviewed? 		

	Storage Arrangements	Y/N	Comments
10.	<ul style="list-style-type: none"> Are inspections undertaken of all goods on arrival to identify and segregate dangerous/hazardous goods immediately? Are these goods stored in designated areas of the premises? Are stocks of aerosol products stored in proprietary cages <p>Note: Dispensing of flammable liquids should not be carried out in storage areas.</p>		
11.	<p>Is pallet beam racking:</p> <ul style="list-style-type: none"> Suitably anchored to the floor? Of uniform type and manufacture (no mixed types)? Fitted with adequate impact protection? 		
12.	Are goods in the racking adequately balanced, e.g., heavier goods stored at lower levels and lower tiers fully utilised before upper tiers?		
13.	Are the front faces of the stored commodities/units/boxes aligned and in line?		
14.	<p>Are aisles between the racks kept clear of stock and obstructions?</p> <p>Note: Storage in aisles should be prohibited.</p>		
15.	Is weight capacity signage displayed on the racking?		

	Storage Arrangements Cont'd	Y/N	Comments
16.	<ul style="list-style-type: none"> Are storage piles stable and secure for their expected heights? No signs of leaning? No damage to any lower-level units? 		
17.	<ul style="list-style-type: none"> Are goods in marshalling areas/awaiting collection should be grouped into smaller 'islands' of up to 50 m³? Are aisles maintained between storage islands of at least 3 metres? Are stock heights limited to 2.4 metres? 		
18.	<ul style="list-style-type: none"> Are any stocks containing lithium-ion batteries stored in a separate building or fire-rated room? If this is not possible, is at least 5m separation maintained from other stock in storage? 		
19.	Are rack legs protected against vehicle or impact damage?		
20.	<ul style="list-style-type: none"> To minimise the impact of water damage is all storage maintained at least 100mm off the floor, e.g. on pallets? Are any goods likely to react with water and create additional hazards? 		

	Compartmentation	Y/N	Comments
21.	<p>Are utility, office, manufacturing, compacting/baling equipment and other process areas/rooms and welfare areas in separate fire compartmented areas to the storage and warehousing, providing at least 90 minutes fire resistance (insulation and integrity)?</p> <p>Note: Increased fire resistance periods may be required for some locations based on hazards and values exposed.</p>		
22.	<ul style="list-style-type: none"> Are automatically closing fire doors, shutters, dampers, etc. installed to openings in fire compartment walls? Are they closed when the storage and warehousing areas are unoccupied? Do they provide a fire resistance rating consistent with the compartment wall fire resistance rating? Are these regularly inspected, tested and maintained? 		
23.	Is storage maintained at least 6m clear of fire compartment wall openings (both sides)?		
24.	<ul style="list-style-type: none"> Are there structural steel columns within the storage areas? If so, should these be protected with fireproofing, encapsulation, or coatings? If already protected, do these coatings require maintenance? 		

	Battery Charging	Y/N	Comments
25.	Is forklift charging undertaken in a separate building or fire compartment?		
26.	<ul style="list-style-type: none"> Is any charging equipment sited within storage racking? If so, has this been relocated to a safe charging building or area? 		
27.	<ul style="list-style-type: none"> Are smaller lithium-ion battery powered items charged in a fire-resistant room or fire-resistant cabinet? Where this is not possible, are clear demarked areas for charging provided, maintained clear of combustible goods? Are chargers adequately rated and compatible? Is damaged/faulty battery charging equipment removed from use immediately? 		
28.	Is an emergency response plan for battery incidents in place?		

	Housekeeping and Waste	Y/N	Comments
29.	Are housekeeping arrangements satisfactorily managed?		
30.	Is all waste/materials for recycling removed from the storage areas at regular intervals?		
31.	Are waste bins/sacks prohibited within or in immediate proximity to pallet beam racking?		
32.	Are workstations prohibited within racking (they should be)?		
33.	Are external waste storage areas located at least 10m from buildings?		
34.	Are smoking areas located at least 10m from buildings and cleaned at least daily?		
35.	<ul style="list-style-type: none"> Are stores of gas cylinders or bulk gas tanks located at least 10 metres from buildings or other valuable assets? Are these areas adequately protected from impact damage? Is adequate warning signage displayed? 		

	Housekeeping and Waste Cont'd	Y/N	Comments
36.	<ul style="list-style-type: none"> • Are any waste compactors and balers within a separate dedicated building or fire compartment? • Are adequate check processes in place to ensure foreign objects are prevented from entering equipment? • Is metal detection in place, interlocked to isolate power to equipment upon activation and alarm? • Are they appropriately maintained? 		

	Fire Detection and Protection	Y/N	Comments
37.	<ul style="list-style-type: none"> • Is there a comprehensive automatic fire detection system connected to a constantly attended location or Alarm Receiving Centre? • Are all areas adequately covered including storage and warehousing, charging rooms/areas, compacting/baling halls, etc? 		
38.	<ul style="list-style-type: none"> • Are automatically closing fire doors, shutters, dampers, etc. actuated by automatic fire detection? • Are these regularly tested? 		
39.	<ul style="list-style-type: none"> • Is there heat and smoke venting provided? • Automatic or manually activated? 		
40.	<ul style="list-style-type: none"> • Are smoke curtains installed to slow the rate of smoke spread through the storage and warehousing areas? • If not, should this be considered? 		
41.	Has automatic sprinkler protection, installed and managed to recognised standards been considered?		
42.	<ul style="list-style-type: none"> • Are the building/internal walls protected against impact damage from being used as back stops for the storage? • Is there any damage to any walls? 		

	Firefighting	Y/N	Comments
43.	Do you have a good working relationship with your local Fire and Rescue Service and do they complete regular familiarisation visits?		
44.	<ul style="list-style-type: none"> Are you aware of the location of the fire hydrants around your building and in the local public streets? Is there appropriate coverage? Is there appropriate flow and pressure? 		

	Electrical Systems and Fittings	Y/N	Comments
45.	Is there formal electrical inspection, testing and maintenance regimes in place for all electrical items in the storage areas? <ul style="list-style-type: none"> Fixed wiring? Portable appliance testing? Thermographic imaging surveys? 		
46.	<ul style="list-style-type: none"> Are electrical panels prohibited from within the storage? If not, is a 1½m clear space provided around them? 		
47.	Are all light fittings positioned above sterile, clear areas, e.g. walkways? Note: No storage, even temporary, should be housed below lighting.		
48.	Have any halogen/high-intensity discharge lighting fittings been removed?		
49.	Are damaged light fittings, tubes etc., removed immediately?		

	Hazards	Y/N	Comments
50.	<ul style="list-style-type: none"> • Does the building have adequate fixed heating provided with frost-stat temperature operating and no portable heaters? • Is heating appropriate in winter? • Are fixed permanent heaters prohibited from within the storage areas? • Are these located in sterile areas? • Is a 1-1½m clear space provided around them? 		
51.	<p>Where shrink-wrap equipment is installed:</p> <ul style="list-style-type: none"> • Is it located in a dedicated area or compartment, at least 5 metres from combustible goods and remote from any hazardous processes? • Are goods awaiting wrapping to one pallet load only? • Are wrapped goods immediately removed and located in a dedicated storage area awaiting further handling/allocation, etc? • Are two high temperature heat detection devices installed to the shrink-wrapping equipment along with visual and audible alarms? • If so, are these interlocked to power supplies to isolate safely upon high operating temperature thresholds being achieved? • Are interlocks also installed to conveyor equipment to ensure the power supply to the shrink-wrapping equipment isolates safely if the conveyor systems fail or stop moving? • Is adequate ventilation provided around the equipment? • Is the equipment located in an area of the premises covered by the automatic fire detection system? 		
52.	<ul style="list-style-type: none"> • Is portable shrink-wrap equipment prohibited? 		

	Hazards Cont'd	Y/N	Comments
53.	Where LPG powered forklift trucks are in use, are: <ul style="list-style-type: none"> • Only appropriately trained workers allowed to change LPG cylinders. • Hoses and connectors checked for damage when changing cylinders. • Starting problems treated as an emergency event and the vehicle immediately taken out of use and segregated in a well-ventilated area, pending repair and the LPG cylinder isolated/shut off? 		
54.	<ul style="list-style-type: none"> • Are vulnerable areas of the building protected against impact damage, e.g., openings for vehicle access, etc? 		
55.	<ul style="list-style-type: none"> • Are the goods stored particularly attractive as a theft risk? • Has a security risk assessment been completed? • Is a specialist security audit required? 		

56.	Additional comments:
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