Loss prevention standards

Fire Safety:

Electric Scooters, Electric Bikes & Other Battery Powered Movement Devices – Property Risk Management Guidance

The use, storage and charging of battery powered movement devices is rapidly developing, introducing both new benefits and challenges to users, property owners and emergency services. This document provides practical property protection advice on this evolving topic.

AVIVA

Electric Scooters, Electric Bikes & Other Battery Powered Movement Devices

Introduction

In a world where means of travel are challenged from their environmental footprint, their efficiency and their cost, rechargeable battery powered scooters (e-scooters) and battery powered bicycles (e-bikes) are becoming increasingly popular.

Both e-scooters and e-bikes are constructed with a mixture of metallic and plastic components; they are usually powered with lithium-ion rechargeable batteries (or similar battery technologies) which require regular recharging and therefore require an associated electrical charging infrastructure. As a result, there are three possible fire events associated with these types of devices and this loss prevention standard discusses:

1. Electrical fire
2. Rechargeable battery - thermal runaway and subsequent fire
3. Fire on the combustible elements of the e-device itself

Of these three events, items 1 and 3 are fires most people will be familiar with: electrical fire or combustible items burning are common. It is the 2nd item above that poses the biggest unknown and is the principal risk with this technology.

In addition, with the growth of the consumer market for such devices, there is a move away from 'managed' public hire schemes to personal owned devices. These items are becoming an accepted normal sight, and as a result, the potential for poorer quality devices to be in circulation; the lack of appropriate inspection, testing and maintenance regimes; and/or the careful disposal of damaged items means the exposure to fire is only increasing and will continue to increase.

As with every technology, the availability of 'aftermarket' components and accessories; poorly made or lower standard non-Original Equipment Manufacturer made components; counterfeit items; incorrectly rated components; through to second hand/used markets, batteries, battery chargers or other components will further increase the risk of faults and therefore subsequent fires.

As these devices continue to gain popularity, the cost price will inevitably decrease, making them more widely available. It is naïve to think that everyone who owns or uses such a device will be a 'responsible' owner. Therefore, simply by having a greater number of battery-powered items in circulation, with a range of quality and care, increases the likelihood of associated fire incidents.

Users and businesses that allow such devices onto their sites, within their buildings or wish to provide the infrastructure for their use, storage and any associated charging should be aware of the risks and how to manage and mitigate them.

Note: While this standard does not specifically identify other 'ride along devices', the loss prevention and risk mitigation guidance herein could be extrapolated to:

- Mobility scooters
- Ride along cleaners, scrubbers & driers
- Ride along lawn mowers
- Passenger or work caddy carts
- Golf carts
- Manual low loaders
- E-fork lift trucks
- Children's toys and public amusements rides etc.

Note: This standard does not address any Liability exposures. It only focusses on Property Loss Prevention and Risk Management guidance.

The potential hazard that these devices can cause are well documented in the media and clearly underlines the lack of awareness; the speed of fire development; the size of fire and the amount of smoke generation that can occur.

Understanding The Risks

Acceptance of the Risk

Management personnel of any building or facility should have a clear policy around battery powered devices and whether they will permit them to be bought on site, and their subsequent storage and charging on their site. Management should make it very clear whether they accept this or not. This should be clearly communicated to all employees, visitors, contractors etc.

In addition, allowing such devices in by stealth, i.e., not having a policy or turning a blind eye, is incompatible with good Risk Management practice. Just because they are not seen does not mean they are not present. As such a certain diligence is needed to manage this exposure.

Higher risk items should not be permitted to be brought on to any site without the management knowing and without adequate controls in place for their storage, use and charging.

Depending on the existing occupancy of the building and the number of devices any management permits to be stored or charged on site, also may be seen as a change to the inherent risk profile of a site. Regardless, these devices whether stored or charged are seen as higher hazard exposures and as such any proposal to permit acceptance on any site should be discussed with Property Insurers and Brokers as early as possible before they are permitted on site.

The most effective way to mitigate this exposure is to prohibit them from a site. The exclusion/removal of any risk is always the best way to manage the risk.

From a Property Risk Management standpoint it is unacceptable to permit such devices to be located in general areas of any building or site; at desk side; in workshops; in lockers etc. This should be prohibited. Any e-bikes and e-scooters should only be located in appropriately arranged and permitted storage areas.

Permitted Number of E-Devices

As part of the proposed permission and acceptance of allowing such items on any site, and the foundation of any risk assessments, management should agree a maximum number of devices that are permitted to be stored and/or charged on site.

- ✓ It is not acceptable to allow an unmanaged or uncontrolled number of devices on site.
- ✓ The maximum permitted number allowed on site should be prescribed in all management controls and therefore monitored, even if required to be verified on a daily basis.
- ✓ Management should control who is permitted to bring such devices onto a premises and this should be monitored.

Risk Assessment & Management of Change

Prior to starting any work on developing an e-device storage or charging area, all proposals should be formally presented to and discussed with your Property Insurer and Broker.

Based on any proposed change of occupancy or the addition of such enhanced risks/exposures, formal and detailed documented risk assessments should be completed prior to any works being completed to accommodate such devices.

All proposed changes should also be managed through a formal Management of Change process to help ensure all stages of the change are progressed with the minimal exposure to the existing arrangements.

Any changes to buildings, services, plant/utilities, machinery, storage, protection systems, supply chains, business activities, maintenance budgets, or key personnel could alter the risks that threaten your business.

A change such as this should be thoroughly reviewed – see the Aviva Loss Prevention Standard 'Managing Change'.

- ✓ With such proposals, any regulatory requirement or other completed risk assessments (such as a Fire Risk Assessment) should also be thoroughly reviewed and revisited.

Depending on the occupancy of the existing building/site and the number of devices proposed to be stored and/or charged, any permission permits for the site to operate may also need to be reviewed. The addition of such items may be seen as a change to the inherent risk profile of a site. This should be discussed with Local Authorities, Property Insurers and Brokers.

Electrical Fire

As with everything electrical, appropriate care and attention is needed with the use and inspection, testing and maintenance of electrical devices, the associated cables, plugs and charging network. Attention should be on:

- Wear, tear, and damage
- The correct rated devices for the items being charged
- Portable appliance testing
- Fixed wiring testing
- Thermographic surveys
- Disposal of old or damaged equipment etc.

It is widely recognised that electrical ignition sources are one of the primary causes of fire. The Aviva Loss Prevention Standard 'Electrical Installations - Inspection and Testing' discusses these exposures in more detail.

Rechargeable Battery - Thermal Runaway & Subsequent Fire

When poorly manufactured, misused (such as overcharging or lack of appropriate maintenance), or damaged (e.g., an external impact), the rechargeable battery cells within a battery can create unseen and unstable conditions that mean a resultant fire is very likely. However, when and where this event may happen is not predictable.

An unstable charged or charging battery pack can go into a condition called a 'thermal runaway'. Thermal runaway can occur whether the battery is on charge, it is idle or it is in use and is characterised by:

- An increase in internal battery temperature to the point where the heat created inside the cell, cannot be dissipated and the temperature increases exponentially.
    - This effect can domino through the adjacent battery cells increasing the internal temperature further and causing the effect to spread from cell to cell.
    - The internal battery temperature increases to the point where the battery chemistry is affected creating gases (normally flammable) within the battery casing.
    - The increase in internal pressure from the increasing battery temperature and internal gas evolution eventually causes the battery casing to over pressurise.
- This is seen when the battery casing ruptures and releases the gases being evolved. These gases are a cocktail of flammable gases that are heavier and lighter than air (e.g., gases including hydrogen, methane (other halo carbon gases) and carbon monoxide).
- These ignite very easily and quickly once they come into contact with an ignition source, such as the electrical device charging the battery.
- Culminating in a dramatic and intense event, sometimes with an associated explosion and always with a fire.
- The resultant fire normally emits significant quantities of dense smoke and due to the continued cascade of thermal runaway within the remaining battery cells within the battery it can be prolonged. Because of this effect, a fire involving a battery powered device is extremely difficult to extinguish and even when appears to be extinguished can be thermally unstable and reignite sometime after.
    - Any battery cells not directly damaged by fire can then become unstable and so could repeat the above thermal runaway at any time in the future.
    - 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.
    - The post event contamination and pollution including acid gases, smoke and any fire water run off can be significant and can require specific management.

In addition, because of the nature of the fire, anything a fire exposes, is also then very likely to ignite and so the fire can spread.

Note: It is important to note that thermal runaway can occur hours and even days after the battery is first damaged or develops a fault, even though it might appear to operate 'normally' in the meantime. The heat growth within the battery cells is unseen and can develop over time at different rates.

Note: Regardless of the initiating event to start the fire on a battery powered device, if the battery pack becomes involved the fire will be very smoky, intense, and prolonged. These are difficult fires to control and extinguish.

Fire & E-Device

When e-bikes and e-scooters are in storage it should be borne in mind that regardless of the exposures from the electrical supply charging the device or the potential for the battery power pack to cause a fire, these devices can contain a percentage of combustible material in their build. As a result, any fire involving such items will grow based on their materials of construction. Add to that the impact of an exposing fire on any associated battery packs it readily causes the internal battery chemistry to become unstable, and a thermal runaway situation may ensue, exacerbating the fire situation further.

Any fire exposing any rechargeable battery powered device will result in a larger and more hazardous fire situation.

Note: The performance and behaviours of any rechargeable battery that has been exposed to a fire or an increased temperature, may itself be developing an unstable internal battery chemistry. The eventual outcome could be thermal runaway and fire as above.

Storage & Charging Location

Based on the exposure caused by such rechargeable battery powered devices, the storage and charging of battery powered e-bikes and e-scooters inside any existing building should normally be prohibited. If this is not possible then it should be considered the last resort when all other options have been exhausted.

When considering the potential for storage/charging areas, the nature of the construction of any existing buildings or any proposed new buildings should be clearly understood. This should be included within any risk assessments.

The presence of any combustible materials of construction must be clearly identified, understood, and documented.

External Location

Based on the thermal runaway and fire exposure, an external storage and charging area is the recommended arrangement. This should be located as far away from the following as possible:

- Buildings
- External exposures
- External storage
- Critical infrastructure etc.

In an ideal situation and based on good Risk Management guidance, the external area should be configured as followed:

- The area should be at least 10 metres from the exposures, buildings etc.
- There should be no exposed window, door, vent/grille openings or penetrations.

If this cannot be achieved, then it can be closer to the buildings/exposures but with additional:

- Passive fire protection measures located between or on the building and charging/storage area.
    - If the charging/storage area is roofed this provision should be extended to the roof.
- This should provide at least 1 hour fire resistance (insulation and integrity) rating.

An alternative provision could be exterior façade type automatic and manually activated exposure protection with a minimum design density of 12.2mm/m^2 of exposing wall area. This should be installed at the eave height of the exposed building and spray down the exposing wall.

Also, one should consider the likely smoke emission from any fire, the prevailing wind conditions, and any building ventilation arrangements. Any assessment should consider the potential impact of smoke generation, its movement and potential entrainment into the building and internal contamination.

The area should also be a similar distance clear of any other combustible materials/yard storage; waste storage; critical infrastructure; hazardous materials stores; escape routes and vehicles.

- If the storage/charging area has to be protected against the weather or arranged to afford a level of security then a 'low cost' non-combustible structure, purpose built for the storage and charging of devices should be provided.
    - Again, if 10m clear space separation cannot be achieved, then the rating of this structure should be at least 1 hour fire resistance (insulation and integrity) – including the roof.
- Within the structure the distance between charging or stored units should be as large as possible.
    - Radiant heat from an exposing fire can result in adjacent batteries going into thermal runaway.
- If the storage/charging area is within 10m of any structure, then the nature of the materials of construction of the existing building must be considered.
- Any combustible elements of construction, including insulation or facades should be:
    - Ideally removed and replaced with a non-combustible alternative.

  If this is not possible then protected with a:
    - Passive fire barrier or
    - Dedicated fixed water-based exposure protection.

Where unavoidable any exposing:

- Windows, doors, or ventilation grills etc. should also be appropriately protected or changed for approved/listed devices consistent with the existing fire resistance rating (insulation and integrity).
- Penetrations will also need to be fire stopped by a competent third-party contractor using approved and/or listed materials or arrangements.

Ambient Temperature

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 the thermal runaway event.

Internal Location

If external storage/charging is not a viable option and all other options have been exhausted, then the only solution left, if such provision is really needed, is an internal arrangement. If this is the case, then the following should be followed:

Construction Materials & Fire Compartmentation

If storage or charging has to be completed internally in a building or within a basement, the key element to prevent fire spread is segregation, fire compartmentation and smoke management.

The fire resistance rating and fire compartmentation strategy of the existing structure should be fully understood, confirmed and formally documented before any acceptance of these devices should be permitted. This includes the proposed storage/charging area itself.

- In addition, the presence of any combustible elements of construction should be clearly identified and documented.

The minimum fire resistance rating for any area proposed to be used for internal storage/charging should be at least 120 minutes (insulation and integrity) for walls, floors, ceilings/roofs. As a result;

- For existing structures and as part of a retro fit this may require structural upgrades.

Or

- For new construction this should be considered within the design stage.

The fire compartmentation strategy should extend to all penetrations and all openings. In such circumstances, all should be fire stopped or provided with appropriately rated fire doors, fire dampers, glazing etc. In all cases, the equipment or products used should only ever be listed/approved for their intended use with a fire resistance rating consistent with the existing structure.

- See Aviva Loss Prevention Standard 'Fire Compartmentation'.

Heat & Smoke Management

In addition to preventing the spread of fire, a critical risk management feature is also the management of smoke and gas emission from such fires. These effects should be managed to prevent contamination elsewhere in any building. As a result, this should form part of the proposal discussions and arrangement designs:

- There should be a mechanical means of removing the heat and smoke out of the charging/storage area.
- The exhaust point of the vented smoke and gases should be to an area that reduces the exposure and not increases it.
    - It should not be located in an area where the exhausted smoke can be entrained into a building air intake or into a neighbour's air intake.
- If the building is:
    - Automatic sprinkler protected, the actuation of the heat and smoke extraction system should only ever be manual.
    - Fitted solely with automatic fire detection, then the heat and smoke extraction system should actuate automatically and manually.
- The design of this arrangement should not compromise the fire compartmentation strategy.

- See Aviva Loss Prevention Standard 'Smoke Contamination'

Detection, Protection & Interlocks

Fire Detection

Based on the nature of such a smoky fire, at a minimum automatic fire detection should be provided in all areas/rooms of the buildings. This includes the storage/charging areas.

In the UK this should be compliant with Category L1 or P1 of BS5839-1 (latest edition). This is vital for life safety and early notification to the Fire and Rescue Service.

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

Gas Detectors

Based on the number of devices in storage or charging, their location and arrangement and the exposures to this, automatic gas detection should also be considered. Based on the exposure, this should be discussed with Property Insurers and Brokers.

Because of the nature of the gases that can be evolved in the thermal runaway event, the gas detectors provided should be located at ground and ceiling level, for the expected mixture of flammable gases emitted.

Automatic Sprinkler Protection
Where not already installed within the building and based on the Property Damage and Business Interruption values exposed automatic sprinkler protection may also be warranted. This should be discussed with Property Insurers and Brokers as early as possible.

Where there is an existing automatic sprinkler system is installed, it is important to understand whether the design is adequate for this change in risk profile. Based on the nature of the fire created by such devices the following should be confirmed as being appropriate:

- Automatic sprinkler density
- Associated water supply demand
- Associated water supply duration. This last point is just as important as the previous two. These fires are known to burn for long durations, therefore having an undersized water supply that is exhausted only part way into the fire means essentially the area is not adequately protected.

Regardless, any site will need to engage with Approved Sprinkler Contractors and Property Insurers and Brokers at the earliest possible opportunity.

This will ensure that any installation or changes in protection design can be considered, costed, agreed, and implemented alongside the change in risk.

Alarms
Alarms associated from all of the above should raise a site fire alarm to ensure there is an appropriate emergency response and escalation if needed. This would include but not limited to:

- ✓ Manual fire alarm
- ✓ Automatic fire alarm
- ✓ Waterflow or drop in pressure alarms associated with any sprinkler systems
- ✓ Gas detection
- ✓ Any other fire alarm on site

In many cases alarms should also be connected to a constantly attended location or an approved central station monitoring service.

Interlocks
The actuation of any of the above alarms should be interlocked to de-energise the power supplies and actuate the electrical isolators for any device charging circuits.

This interlock should be tested at least annually and from experience careful management is required when testing and maintenance is completed of the fire alarm systems. Aviva has seen on many occasions, interlocks being impaired for testing or maintenance and then not restored and in a fire event they do not operate as required.

Fire Brigade & Available Firewater
As part of any approach to Risk Management it makes sense to establish a good relationship with the public fire authorities.

With such exposures as this, 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.

- ✓ Management should know the location and number of fire hydrants in the proximity of their site. This 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 brigade to use. Therefore, site management should always establish:

- ✓ What fire water is available
- ✓ With static pressure, flows and residual pressure test results.

The addition of battery charging facilities such as this could warrant approximately 4000 to 5000 litres per minute.

When lithium-ion battery fires are suppressed with water, they will produce amongst other by-products, lithium hydroxide and hydrogen. As a result, these need to be considered to prevent event exacerbation, and contamination from fire water run-off. There may be a need for some form of firewater containment to protect the environment.

- The generation of hydrogen or other gases needs to be considered in relation to the potential exacerbation of any fire.
- Aviva has seen fires where environmental considerations and fire water run off management have dramatically changed the way the incident developed and was mitigated.

Note: Depending on the nature of any storage/charging enclosure, if automatic protection is not provided, it may be appropriate to provide a safe means of manually drenching any potential fire. As an example:

- ✓ A series of open sprinkler heads at the roof/ceiling above the storage/charging area.
- ✓ Designed to provide 12.2mm/min/m^2 area.
- ✓ Connected to a dry riser arrangement, with a connection outside of the enclosure

So, in any fire the brigade can connect a hose to the dry riser inlet and drench the enclosure internals in a safe way for as long as they want/need.

Detachable Batteries

Detachable batteries feature on some e-bikes and e-scooters. Whilst this reduces the challenges around parking of the units and in situ charging and it may improve logistics for charging, it is important to understand that:

- The batteries are still the element that can thermally runaway, and they still catch fire.
- There is more potential for battery damage with repeated handling and dropping etc.

The risk of fire and the implications of fire spread still exist with the same failure modes as previously stated, whether the battery is charged on the scooter or bike or while detached.

Therefore, it is imperative that any 'battery only' charging infrastructure is appropriately arranged using the philosophies presented elsewhere in this standard. Regardless of whether the storage and charging are internal or external, all of the previous measures are still pertinent.

If a charging area is provided for detachable batteries, it should ideally be placed in a non-combustible specifically designed proprietary charging cabinet with:

- ✓ A fire resistance rating of at least 1 hour (insulation and integrity).
- ✓ Appropriate ventilation
- ✓ Automatic fire detection
- ✓ Automatic fire protection/suppression
- ✓ Interlocks to shut down the charging power supply.

Ideally, this should be located outside. But if not, then the proprietary charging cabinet itself should then be placed within an appropriate area:

- ✓ Fire resistance rating – at least 1 hour insulation and integrity.
- ✓ Totally clean and sterile.

If a specifically designed proprietary charging cabinet is not provided, then the charging area should be segregated within its own dedicated 2 hour rated fire compartment etc. as discussed elsewhere in this document.

Misuse and/or Modification of Lithium-ion Battery Devices

The misuse or modification of lithium-ion powered devices can lead to unintended consequences, including increasing the potential risk of fire and/or injury to users and those in the vicinity.

- ✓ Owners of lithium-ion powered devices should always follow the manufacturer's instructions when experiencing a fault.
- ✓ Always use the original battery supplied with the device, or a replacement approved by the original equipment manufacturer.
- ✓ Repairs and battery replacement should only be undertaken by a reputable repair workshop which has been approved by the original equipment manufacturer.
- ✓ The use of self-made or modified devices should be strictly prohibited.

Particular vigilance should be exercised when purchasing pre-used devices in the 'aftermarket', as devices may have been altered from their original manufactured specification.

Occupancy

Regardless of the location of the storage/charging area, the occupancy of the existing building and what is located on the inside of any exposed buildings should be considered and fully risk assessed:

- Combustible materials or stock
- Critical machinery
- Smoke sensitive products
- Soft furnishings/offices
- High numbers of people

All the above, and more, should be considered and be adequately protected against the effects of a possible fire or smoke exposure and spread from the storage/charging area.

Note: Consider the thermal runaway event has occurred and a very smoky fire is burning for a long time. What is the impact of this on the existing occupancy? This should include the location of any fire evacuation routes and their point of exit from a building.

Exposure

Regardless of the exposures on the site, the wider exposure created should also be thoroughly investigated and detailed:

- Neighbouring properties including storage in their yard areas
- The environment

From fire, smoke, and fire water runoff… what are the exposures, how will these be controlled and managed?

✓ See Aviva Loss Prevention Standard 'External and Internal Third-Party Exposures - Property Protection'

Charging & Electrical Hazards

The one certainty about owning an e-bike or e-scooter is that it will need regular charging. Charging any battery puts stress on the battery and is a period of time where the risk of an incident is at its highest. Aside from the thermal runaway risk, the increased load on the electrical supply, which if not well maintained or capable of supplying the demand safely can itself become a source of ignition.

Most e-scooters and e-bikes can be charged using conventional 3 pin domestic plug points. Therefore, before establishing any storage/charging area, the following should be considered as critical:

- In all cases all manufacturers' recommendations and local regulatory requirements should be followed.
- All chargers / electricity 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.
- The use of the following should be prohibited:
    - Multi-plugs / gang sockets.
    - Portable extension leads.
- 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.
- There should be appropriate identification and warning signs provided.
- 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.
    - At all times providers and users should ensure the right charger with the correct rating is being used to charge the corresponding battery/device in question.

Note: Aviva has seen fires where chargers with common fittings have been connected to batteries with a lower rating to the charger. Batteries have been overcharged and caused a fire.

- The design and layout of the area should ensure the charging cables connected to the battery 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.
    - One must assume the charging area is on fire and with this assumption the manual isolation should be accessible.

    - All electrical isolations should be clearly understood and documented.
    - In the area of the electrical isolation switch - combustible materials should be maintained at a distance of at least 2 metres from the isolator switch.
        - The area underneath the switch should be kept entirely clear of any combustible materials at all times.
- Regular self-inspections and visual checks should be undertaken, to ensure the electrical network, chargers, charging cables, connectors etc. are not damaged or otherwise showing signs of wear.
    - Ideally this should be daily, but at the minimum weekly.
    - The use of photographic evidence with such inspections can prove invaluable.
- 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 a charger appears damaged in any way or becomes faulty, it should immediately be:
    - Physically removed - if possible OR until removal or repair
    - Mechanically and electrically isolated (locked-off).
    - Clearly labelled as not to be used.
    - Provided with a cover or mechanism to prevent the charging fitting from being used.

Note: The potential for such an item to be turned back on by an end user should be managed to prevent this occurrence.

- The provision of an owned thermographic camera could prove invaluable for such areas. These are relatively inexpensive and can be used on the following regularly:
    - Batteries/e-devices themselves being charged
    - Charging network.
    - Chargers etc.
- An annual formal infra-red thermographic inspection should be completed at a minimum.
    - By a competent and trained thermographer.
    - These inspections should incorporate isolator switches, the local electrical supply network, connections, cables as well as the e devices themselves.
    - Further information can be found in the Aviva Loss Prevention Standard *Thermographic Surveys*

Note: More information can be found in the Aviva Loss Prevention Standard ‘Electrical Inspections – Inspection and Testing’

Damage or Faults

As part of the management of e-devices on any site, a formal procedure should be in place for items known or suspected to be damaged, and if there is any doubt the public fire brigade should be contacted. Whatever the procedure, this should be clearly understood by:

- ✓ Management
- ✓ Individuals bringing in their own e-devices
- ✓ Individuals responsible for inspections and audits of the storage/charging area

If an e-device or associated battery:

- Is suspected to be damaged or is actually seen to have damage
- Is not performing or charging in the expected way
- Shows higher than expected temperatures - if a thermographic camera is being used
- Is hot to the touch when not expected… etc.

Then the device should be removed immediately from the storage/charging area and segregated within a quarantined area. If there is any doubt or concern about any e-device, it should be segregated and quarantined.

Segregation should be:

- ✓ Outside of all buildings.
- ✓ As far away from other assets or exposures as possible.
- ✓ If possible housed in a 2-hour fire rated dedicated enclosure specifically established for damaged rechargeable devices or batteries.
- ✓ Maintain the security of the device

Security

A security assessment of the storage/charging arrangements should also be considered and drive the provision needed. This will be based on many factors, such as:

- Geographic location of the site
- Perimeter security e.g., fences, walls
- Guarding provision
- Whether there is a secure compound
- Closed Circuit TV
- Alarm provision
- Security lighting etc.

In addition, the location/arrangement to which the e-devices are locked/secured should also be of appropriate quality and robustness. These can be very expensive devices and if left unsecured could attract an unwanted security exposure.

Also, based on the nature of the site there may be a need to support all of this provision with a requirement for each device to be locked with a minimum standard of lock and/or chain, based on a sites own requirements, liability and defensibility if a device is stolen or tampered with.

Finally, these devices can be attractive to theft and as such the addition of these on a site may also change the security profile of a site. Therefore, existing security assumptions and risk assessments should also be reviewed and where needed, changes should be made accordingly.

General Considerations

Regardless of whether storage and charging are permitted inside or outside any building, there are a number of general considerations that should be provided:

- A thorough check should be completed once the storage/charging area is established and/or any changes have been made, including:
  - Quality of the installation
  - Electrical connections
  - Weather protection (if external), etc.
- Individual charging spaces should be spaced and arranged to minimise the impact of fire spreading from one to another.
  - The distance between individual devices charging or stored should be as large as possible.
- Charging areas should be conspicuously marked, with adequate signage in place.

- This could also include a contact number for individuals to report damage or other issues.
- Scooters / bikes and all installations in the area should be protected from impact damage from barriers, kerbs, bollards or similar.
- The charging/storage area should always be kept entirely clear of any combustible materials or waste.
  - The area should only house the equipment being stored or charged and be as clean as possible.
- The storage/charging area should be provided with good ventilation and air flow.
- The impact of high ambient temperatures (e.g., in summer) on the devices and charging, and the implications to battery temperature and heat dissipation should be considered, especially in exposed or uninsulated enclosures.
- Regular (ideally daily) visual inspections of charging areas and associated infrastructure, look for damage, rust, impact, combustible waste or detritus accumulation, signs of vandalism, signage and markings are still in place and conspicuous, etc.
- Heavy rain and flood – the location of charging areas externally or in basements should be considered in relation to the potential for heavy rain accumulations (surface water) or flooding. If exposed and where required, attention should be paid to local drainage and flood defences
- Consider the implications if neighbours start to install storage/charging areas and the exposure this creates.
- Adequate information and training should be provided to those employees who wish to use e-scooters and e-bikes.
  - It is important that they understand the hazards in relation to the exposures at work, at home etc.
  - Employees should also be educated as to buying from the wider after-market, 2nd hand market; non-OEM devices etc. and to ensure they properly maintain their e-device.
- Future requirements for possible expansion should be considered. The number of such or similar devices will only increase

Emergency Response

With the introduction of such a storage or charging area an appropriate emergency response plan should be specifically developed for this area. Existing plans should be revised accordingly.

This should be formally documented, have appropriate training and be practiced.

It should also specifically look at the impact on site access/egress in the event of a fire.

Business Continuity

Every business should have a formal Business Continuity Plan developed and underpinned as a result of a Business Impact Assessment.

As a result of this or any change, this should be reviewed and updated.

One should also consider the implications if the provision of the storage/charging area is compromised or impaired then what contingency plans are in place in that period?

- Will they still be permitted on site?
- Where will they go etc.
- Or will they be prohibited?

Checklist

A generic e-scooter and e-bike 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, including:

- Electrical inspections and thermographic imaging: Bureau Veritas
- Fire stopping and passive protection: Checkmate Fire
- Charging cabinets: Denios
- Thermographic imaging and PAT testing: PASS
- Automatic fire detection and portable extinguishers: SECOM
- Security bollards: ATG Access
- Security marking: Selectamark
- Business continuity: Horizonscan

For more information please visit: Aviva Risk Management Solutions – Specialist Partners

Additional Information

Relevant Loss Prevention Standards include:

- Business Continuity
- Composite Panels
- Contamination Following a Fire
- Control and Management of Combustible Waste Materials
- Electrical Installations - Inspection and Testing
- External and Internal Third Party Exposures - Property Protection
- External Building Areas - Usage and Safety
- Fire Compartmentation
- Fire Doors, Fire Shutters & Fire Dampers
- Fire Safety Inspections
- Fire Safety Legislation
- Heat and Smoke Venting Systems
- Housekeeping - Fire Prevention
- Managing Change - Property
- Manual Fire Fighting Water Supplies
- Smoke Contamination
- Thermographic Surveys

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 – E-Scooter and E-Bike Checklist

Location	
Date	
Completed by (name and signature)	

	E-Scooter and E-Bike Checklist	Y/N	Comments
1.	Has site management reviewed the internet and searched for e-bike/e-scooter fires to see the speed, severity and nature of a fire associated with these devices? Note: Understanding the exposure caused by these devices is critical in being able to assess the risk these devices can pose to a site.		
2.	Does the site have a formal Management of Change process? • Have the proposed changes to allow e-bikes or e-scooters (or similar) on site been through this process? • As the number of such or similar devices will only increase, does this consider future requirements for possible expansion should be considered?		
3.	Have the proposed changes been formally risk assessed for fire, explosion and smoke: • For life safety exposures? • For Property Damage/Business Interruption exposures? Have all appropriate existing risk assessments, such as a Fire Risk Assessment, been revised and updated?		
4.	Has the proposed change been formally risk assessed for the impact this may have on security? Both to the: • Site itself? AND • For the devices being stored/charged?		

	E-Scooter and E-Bike Checklist	Y/N	Comments
5.	Is there a clear management policy around battery powered devices? Does this prescribe the maximum number of devices allowed to be stored or charged on site? Has this been clearly communicated to all employees, visitors, contractors etc.? Does this prescribe that such devices should: • Only be permitted in specifically designated areas? • Prohibited from general areas of any building or site; at desk side; in workshops; in lockers etc.?		
6.	Has the proposed permission to allow battery powered devices on site been discussed with: • Property Insurers? • Insurance Brokers? • Local authorities, Fire & Rescue Services etc.?		
	External Storage & Charging	**Y/N**	**Comments**
7.	Is the storage/charging of e-bikes/e-scooters prohibited from within any building(s)? If this is not possible then please ignore this section.		
8.	Is the external location at least 10m away from the following: • Buildings? • External exposures? • External storage? • Critical infrastructure? Etc. If not, is it as far away as possible?		

9.	If the storage/charging is within 10m of the above are any of the following provided: • Passive fire protection barrier (at least 1 hour fire resistance (insulation and integrity) rated) located between or on the building and charging/storage area? • If the storage/charging area is enclosed and roofed is this provision extended to this construction? • Are all combustible elements of construction identified (including insulation or facades) and are these: ○ Removed and replaced with a non-combustible alternative? • Exterior façade to the building automatic and manually activated exposure protection for the exposing wall area?		
10.	Are any exposing: • Windows, doors or ventilation grills etc. appropriately protected or changed for approved/listed devices consistent with the 1 hour fire resistance rating (insulation and integrity)? • Wall penetrations fire stopped by a competent third-party contractor using approved and/or listed materials or arrangements?		
11.	Do risk assessments consider the upper safe operating temperatures of the batteries being stored/charged?		
12.	Are there any combustible materials of construction present in or on the building? If so, is this clearly identified, understood and documented in risk assessments etc?		
	Internal Storage & Charging	**Y/N**	**Comments**
13.	Is internal storage/charging the only remaining solution after all external solutions have been exhausted?		
14.	Is the existing fire resistance rating and fire compartmentation strategy fully understood, confirmed and formally documented? Does this include heat and smoke venting/movement?		
15.	Are any elements of construction combustible? Is so, are these clearly identified and documented?		

16.	Is the area proposed to be used for internal storage/charging at least 120 minutes (insulation and integrity) fire resistance rated for walls, floors, ceilings/roofs? Does this extend to all penetrations and all openings? Are all fire stopping or provided rated fire doors, fire dampers, glazing etc. listed/approved for their intended use?		
17.	In the event of a fire is there a mechanical means of removing the heat and smoke out of the charging/storage area and building? Is the exhaust point to an area that reduces the exposure and not increases it? • Is the exhausted smoke located so it cannot be entrained into a building air intake or into a neighbour's air intake? Does the design of this arrangement compromise the fire compartmentation strategy? If the building is: Automatic sprinkler protected – Is the actuation of the heat and smoke extraction system manual only? Fitted with automatic fire detection only – Is the heat and smoke extraction system actuated automatically and manually?		
18.	Is the generation of hydrogen or other gases considered in relation to exacerbation of any fire or an explosion?		
19.	At a minimum is automatic fire detection provided in all areas/rooms of the building? Is a means of manually of raising the fire alarm provided? Does this include the storage/charging area?		
20.	Is automatic gas detection provided within the storage/charging area? If so, are the gas detectors provided located at ground and ceiling level, for the expected mixture of flammable gases emitted?		

21.	Is automatic sprinkler protection already installed within the building? If so, has the design density been assessed based on this change of occupancy? If not, based on the Property Damage and Business Interruption values exposed, is automatic sprinkler protection now warranted? • Has this been discussed with Property Insurers and Brokers?		
22.	Does the actuation of any of the above gas, fire or sprinkler alarms interlock to de-energise the power supplies and actuate the electrical isolators for the device charging circuits? Is this interlock tested: • At least annually? • And after any change to or maintenance on the fire alarm system?		
	Detachable Battery Charging	Y/N	Comments
23.	Is charging of the batteries completed in a separate area from the actual bike or scooter storage? If yes, continue in this section. If no, ignore this section.		
24.	Is any 'battery only' charging infrastructure located outside? Is this greater than 10m from the building or other important assets?		
25.	Ideally the charging area should be located outside. But if not, is the proprietary charging cabinet itself located within an appropriate area? • With a fire resistance rating of at least 1 hour (insulation and integrity)? • Maintained totally clean and sterile?		

26.	If a specifically designed proprietary charging cabinet is not provided, then is the charging area: • Within its own dedicated 2 hour rated fire compartment? • As arranged with ventilation, fire detection, suppression etc. as discussed elsewhere in this document?		
	Occupancy & Exposure	**Y/N**	**Comments**
27.	Regardless of the location of the e-bike/e-scooter location, has the exposure to the existing building and what is located on the inside been fully risk assessed? For exposure to any: • Combustible materials or stock? • Critical machinery? • Smoke sensitive products? • Soft furnishings/offices? • High numbers of people? • Vulnerable persons etc.? Does this include the location of any fire evacuation routes and their point of exit from a building?		
28.	Has the potential for thermal runaway and the fact that a very smoky fire can burn for a long time been considered? Has this impact been considered on the existing occupancy?		
29.	Regardless of the exposures on the site, has the wider exposure created been thoroughly investigated and assessed? To • Neighbouring properties including storage in their yard areas? • The environment?		
30.	Have you considered the implications if neighbours install storage/charging areas and the exposure this creates to your assets?		

	Charging & Electrical Hazards	Y/N	Comments
31.	In all cases are all manufacturers' recommendations and local regulatory requirements followed? Are all chargers and electricity points installed and maintained in accordance with manufacturer's instructions? Was this completed by a competent trained electrician with appropriate accreditation? In the UK - such as those with current NICEIC, ECA, NAPIT accreditation.		
32.	Has the circuit(s) supplying the charging points been checked to ensure it has capacity for the proposed additional electrical load?		
33.	Have all chargers been verified as being suitably rated for ALL the devices they are due to charge?		
34.	Are surge protection safety devices installed on all circuits? Are these regularly tested?		
35.	Is as much of the wiring as possible hard wired? Are the following prohibited: • Multi-plugs / gang sockets? • Portable extension leads?		
36.	Has the routing of the cabling and grouping of cables been carefully considered to prevent excessive heating in cable trays or conduits?		
37.	Does the design and layout of the area ensure the charging cables connected to the battery do not become overstretched, tangled, or can be damaged?		
38.	Are appropriate identification and warning signs provided?		

39.	Are all chargers clearly labelled? If there are different chargers or chargers with different ratings are these: • Grouped together? • Clearly labelled as to the rating?		
40.	Do all chargers have a readily accessible and clearly labelled master isolation switch? Is this located in a different fire area? Would this be accessible if the charging area was on fire?		
41.	Are all electrical isolations clearly understood and documented in drawings/procedures?		
42.	Is the area of the electrical isolation switch free from combustible materials? Is there a sterile/clear area of at least 2m maintained at from the isolator switch? Is the area underneath the isolator switch kept entirely clear of any combustible materials at all times?		
	Inspection, Testing & Maintenance	**Y/N**	**Comments**
43.	Are the device storage and charging areas inspected on a daily basis? • Does this ensure the maximum number of e-bike/e-scooter devices are not exceeded? • To ensure there are no abnormal circumstances?		

44.	Are there informal and formal inspection, testing and maintenance regimes for all of the electrical devices, the associated cables, connectors, plugs and charging network? Is attention focussed on: • Wear, tear and damage? • The rating of the chargers with the rating of the devices being charged? Is this completed: • Daily, or at the very minimum weekly? • With the use of photographic evidence?		
45.	Depending on the nature of the arrangements and chargers used, are these included within all required: • Portable appliance tests? • Fixed wiring tests?		
46.	Does the site have its own thermographic camera? If so, is this camera used on a regular basis (at least monthly) on the charging and stored devices: • Batteries/e-devices themselves being charged? • Charging network and cabling? • Chargers etc.? If not is the site considering purchasing such a device? Thermographic cameras can be purchased from Aviva Specialist Partner, PASS		
47.	At a minimum is an annual formal infra-red thermographic inspection completed? • By a competent and trained thermographer? • Do these inspections incorporate the isolator switches, the local electrical supply network, connections, cables as well as the e-devices themselves?		

48.	Are damaged or old/obsolete equipment (chargers, cables, fittings etc.): • Identified in regular inspections? • Physically removed and safely disposed of immediately? If it is not possible to remove it immediately… until removal or repair is it: • Mechanically and electrically isolated (locked-off)? • Clearly labelled as not to be used? • Provided with a cover or mechanism to prevent the charging fitting from being used? • Verified as part of an increased daily inspection?		
49.	Are regular (ideally daily) visual inspections of charging areas and associated infrastructure completed? Do these look for: • Damage? • Rust • Impact? • Combustible waste or detritus accumulation? • Signs of vandalism • Signage and markings still in place and visible?		
	Damaged or Faulty Devices	**Y/N**	**Comments**
50.	Is a formal procedure in place for items known or suspected to be damaged? Is this procedure clearly understood by: • Management? • Individuals who bring in their own e-device? • Individuals responsible for inspections and audits of the storage/charging area?		

51.	If an e-bike/e-scooter or the associated battery is: • Suspected to be damaged • Actually seen to have damage • Not performing or charging in the expected way • Shows higher than expected temperatures • Hot to the touch when not expected… etc. Then is the device removed immediately from the storage/charging area and segregated within a quarantined area? Note: If there is any doubt or concern about any e-device, it should be segregated and quarantined.		
52.	Is the segregated/quarantined area: • Outside of all buildings? • As far away from other assets or exposures as possible? ○ Is this at least 10m away? • Housed in a 2-hour fire rated dedicated enclosure? • Secured?		
53.	Due to nature of Li-ion battery thermal runaway and fire, if there is real concern over the device, does the quarantine procedure include contacting the public fire brigade?		
	Security	**Y/N**	**Comments**
54.	Has a security risk assessment been revised/completed for the storage/charging facility? Has this included: • Geographic location of the site • Perimeter security e.g., fences, walls • Guarding provision • Whether there is a secure compound • Closed Circuit TV • Alarm provision • Security lighting etc. • The fact the addition of these devices can be attractive to theft and as such their addition on site may change the security profile. • Challenging any existing security assumptions?		
55.	As these devices can be very expensive and if left inappropriately or unsecured, they could attract an unwanted security exposure does the security policy prescribe the minimum standard on how these devices are locked/secured?		

	General Considerations	Y/N	Comments
56.	Once the storage/charging area is established and/or any changes have been made, are through checks and inspections made: • Quality of the installation? • All electrical connections? • Weather protection (if external)?		
57.	Are individual charging spaces be spaced and arranged to minimise the impact of fire spreading from one device one to another? Is the distance between individual devices charging or stored as large as possible?		
58.	Are charging and storage areas cleared marked, with adequate signage in place? Does this include a contact number for individuals to report damage or other issues?		
59.	Are all e-scooters/e-bikes installations protected from impact damage?		
60.	Is the charging/storage area always be kept entirely clear of any combustible materials or waste? Is it as clean as possible?		
61.	Is the storage/charging area provided with good ventilation and air flow?		
62.	Is the impact of high ambient temperatures (e.g., in summer) on the devices and charging, and the implications to battery temperature and heat dissipation been considered, especially in exposed or uninsulated enclosures?		

63.	Has the location of charging/storage areas externally or in basements been considered in relation to the potential for heavy rain accumulations (surface water) or flooding? If exposed and where required, has attention focussed on local drainage and flood defences?		
64.	Has adequate information and training been provided to those employees who wish to use e-scooters and e-bikes? • Do they understand the hazards in relation to the exposures at work, at home etc.? • Do they understand how to properly maintain and care for their device? • And the exposures of buying from the wider after-market, 2nd hand market; non-OEM devices etc.?		
	Public Fire Rescue Services	**Y/N**	**Comments**
65.	Does the site have a good working relationship with the public fire authorities?		
66.	With this provision is there suitable access for the Fire and Rescue Services?		
67.	Does the site know the distance and location to the nearest source of fire water or hydrant that the Fire and Rescue Services may need use? Is this formally documented an emergency response plan or shown on appropriate drawings?		
68.	Does site management know what fire water is available? • With static pressure, flows and residual pressure test results. Does this reach approximately 4000 to 5000 litres per minute?		
69.	Do the risk assessments include the potential impact on the environment? Does this include the need for firewater run off containment? Has this been discussed with the Fire & Rescue Services?		

	Emergency Response & Contingency Plans	Y/N	Comments
70.	With the introduction of such storage and/or charging areas has an appropriate emergency response plan been specifically developed for this area? • Have existing emergency response and evacuation plans should be revised? • Does this consider ingress and egress? • Have these plans been formally documented? • Has there been appropriate training for employees? • Have the plans been practiced?		
71.	Does the site have a formal Business Continuity Plan developed and underpinned as a result of a Business Impact Assessment? As a result of this (or any change) has this been reviewed and updated?		
72.	Do site plans consider the implications if the storage/charging area is compromised or not accessible? Are there contingency plans in place for that period? • Will e-devices still be permitted on site? ○ If so, is it known where they will be permitted without forgoing a consistent approach to risk management? • Or will they be prohibited?		
Other Comments			

Please Note

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LOSS PREVENTION STANDARDS