# Risk control

## EV Safety Briefing

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# EV Safety Briefing

## Introduction

This document has been developed to bring together a number of guidance publications into one single information source.

It will consider risk management for alternative fuel, which are increasing in prevalence in both a domestic and commercial setting. Within England, in June 2022, the Building Regulations Part S [1] were put in place to ensure that buildings undergoing renovation or construction need to have EV charging points installed. Due to the UK government setting deadlines of 2035 it has focused attention into how fleets can convert to meet legislation, but also reduce fuel costs through improved efficiency and lower environmental emissions targets. Vehicles initially comprised of a small selection of cars, but more recently the choice has become far wider to include all types of commercial vehicles and even two wheeled alternatives.

This has not come without its challenges such as payload, range, cost, charging availability and safety. The media has highlighted a number of property and vehicle fires, which has raised the profile further.

## Vehicle definitions

*Battery Electric Vehicle (BEV).* These have no internal combustion engine (ICE) so are powered only by a rechargeable battery, linked to the electric motor.

*Mild Hybrid Electric Vehicle (MHEV).* In many ways this is similar to a vehicle powered by a standard combustion engine. The difference is that the MHEV will have a small battery designed to improve efficiency such as when pulling away in an electric mode. These vehicles do not need charging.

*Hybrid Electric Vehicle (HEV).* This vehicle is powered by an internal combustion engine in combination with electric motors. The vehicles have low tailpipe emissions making them a compromise before full electric.

*Plug in Hybrid Vehicle (PHEV).* These will have a small ICE alongside an electric powertrain. The electric battery is charged from an external power source.

*Hydrogen Fuel Cell Vehicle (FCEV).* These vehicles produce electricity from a fuel cell powered by hydrogen rather than the extraction of electricity from a battery. These have zero tailpipe emission with only water as the waste product.

## Charging Types

Slow Chargers (3kW). These typically take 8 hours to fully charge and are more likely to be in locations where the vehicle can be left such as an office or home environment.

Fast Chargers (7kW – 22kW). These will take around 3 – hours to fully charge and will be most often placed at a public charging station.

Rapid Chargers (42 – 50kW). This will allow compatible vehicles to be charged in around 30 minutes to 80% and are being installed at a number of public locations such as service stations and EV hubs.

Superchargers (150kW). This will be able to charge a vehicle in approximately 10 minutes.

## Battery risk

A Lithium Ion battery (Li-ion), which provides regenerative braking, powers the vehicles apart from the FCEV. This helps to add charge back into the battery thereby reducing energy use and recharging costs. It is often gained where the driver starts to brake or simply take their foot off the accelerator depending on the vehicle.

These batteries work by storing energy and the sudden or rapid release of this energy can cause fire or explosion. It can be at any time and can be without any warning. The most common reason is caused by 'thermal runway' [2]. This occurs when the heat generated in the battery exceeds the amount of heat that has been dissipated to the surroundings. Once the process has started it cannot be stopped and results in dramatic events, with extensive damage to vehicles, property and sadly loss of life. It is possible for flammable and toxic gases to be released such as hydrogen fluoride (toxic and corrosive), hydrogen (flammable) and carbon monoxide (toxic, asphyxiate and flammable). When the battery develops the fault it will release a jet of flammable gas from the vehicle underside, which ignites. This can be 2 – 3 metres in length and the direction depends on battery design and the failure mode.

This reaction has been seen in very small batteries such as vapes, E-bikes and scooters through to large vehicles.

If the batteries are used according to manufacturer specification then they will be safe. However when operation is deviated from then issues may occur. This could include extended age, modification, electrical malfunction through charging. Through impact or vibration the Li-ion batteries can also be subject to damage such as from the result of a collision. This damage may not be obvious but the internal structure suffers damage which could overtime lead to a release of flammable gases.

If a Li-ion battery is exposed to water it will produce by products such as lithium hydroxide and hydrogen. Water run off can damage the environment, and the generation of hydrogen could exacerbate the fire. Once the fire has been extinguished there are cases where the battery has reignited some considerable time later due to the thermal

runway. This could occur if the vehicle is moved or shaken such as being taken to a different location.

Further information can be found at *DoT: recovery operators: working with electric vehicles* [13].

## Fire risk

In addition to the fire risk created by thermal runway, the vehicles themselves are pose a risk. In our drive to have vehicles which are lighter, and cheaper to build, materials are now estimated to be 50% plastic, with foam interiors and an increase use of electronics.

It is important to note that vehicle fires where there is an electric battery are not common, when compared to the number of standard vehicles on the road but that is not to suggest it does not happen.

One report suggested that between July 2022 and June 2023 there were 239 fires in the UK linked to an EV. This was an 83% increase year on year. By comparison, Bedfordshire Fire and Rescue Service reported that in 2019 1,898 fires were from petrol and diesel vehicles (ICE) whilst 54 were from EV's [3].

## Car Park Fires Examples

There have been a number of large car park fires in recent years and whilst these may not have started from a Li-on battery, the presence of EV's in close proximity could have exacerbated the spread more quickly or intensely.

Examples include:

Kings Dock 2018 [4]

Luton Airport Car Park 2023 [5]

## Building Fire Rating [6]

Any fire rating should be a minimum of **120 minutes** in a new project to protect the ceilings and floors. For existing buildings if the fire rating does not meet this level then it should be enhanced at the planning stage. Consideration should be given to doors and shutters where fire resistance should be **60-minutes** as a minimum requirement.

Where a multi-level car park is involved consideration should be given to using a level which is open and unenclosed such as the roof.

Chargers that are placed outside should be **10m from a building** or critical infrastructure where possible.

Through the risk of fire, harmful gases may be emitted so adequate ventilation must be installed. This will allow the gases, smoke and heat to dissipate.

## Risk Assessment

All assessments must consider potential risks such as fire, evacuation, damage and charging. All staff should be aware of the process in the event of an incident. The aim is to minimise the spread of fire between vehicles or to buildings and critical infrastructure. Property fire risk must be adequately assessed to identify and manage all known factors.

## Charging point locations

The location of charging points should be carefully managed to take into account ways to minimise fire risk and increase the possibility for manual firefighting.

Charging points located against walls are required to have a defined amount of space as shown below in Figure 1 and 2.

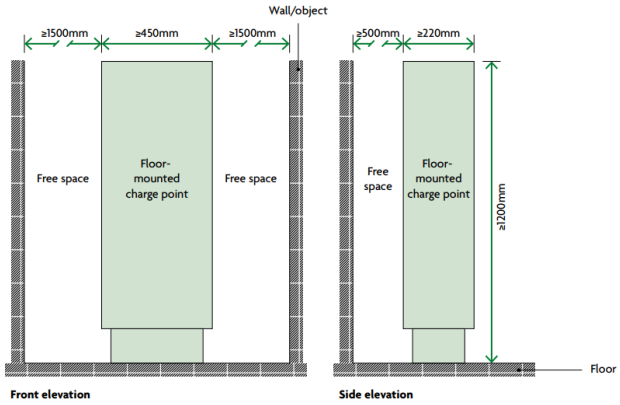



**Figure 1: Minimum space requirements for floor mounted charge point location (source Gov.uk [1])**

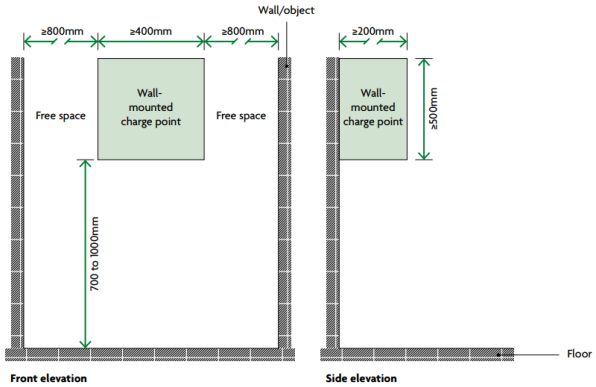



**Figure 2: Minimum space requirements for wall-mounted charge point location (source: Gov.uk [1])**

When charging equipment is installed it should be located on a **raised island of at least 100mm** and protected from impact using measures of kerbs, bollards or even barriers.

It would be preferable to avoid using **underground car parks** but if this is necessary measures should be in place. This would include the design of an appropriate sprinkler and ventilation system. These are covered under the LPC Sprinkler Rules for Automatic Sprinkler Installations Rules within BS EN 12845.

The Fire and Rescue Service should be involved at the earliest opportunity to ensure that they will be able to gain access with their equipment should a fire break out. The bays should be separated from all structural elements by at least **120-minutes** of fire resistance.

An evaluation of the building fire rating should be established where the charging is to be installed. Any fire would be intense and fire containment measures should be fitted such as sprinkler systems and separation measures between bays. Further, the charging points should be close to access and egress points.

Extreme temperatures and humidity can pose a risk within covered charging locations. Temperatures should be monitored.

Further information can be found in *RICS guidance RC42: Unattended processes,* and the *IET Code of Practise for Electric Charging Equipment Installation* [7].

## Charging installation and electrical safety devices

All charging points must be installed by a competent person who is recognised by the National Inspection Council for Electrical Installation Contracting (NICEIC).

The measures that they must include encompass:

- Emergency isolation switches in a location where they can be easily accessed such as building entrances with clear signage.
- Activation of the sprinkler systems should automatically isolate electrical supply to the chargers.
- Locate power cables which lead to the charging that are in appropriate trunking
- Clear notices at charging points direct which are rapid or standard chargers
- Provide RCD protection for both AC and DC fault currents. These should be inspected every 6 months as per the IET code of practise.
- Charging units should be set to only provide 80% of full battery charge
- Provide protection from damage or sabotage through active CCTV, sufficient lighting, and perimeter fencing.

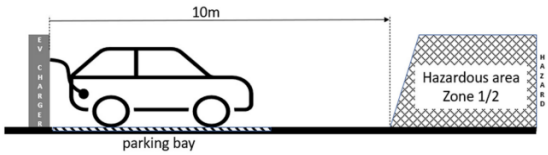
## Charging bays

Charging bays should have a **5m minimum separation distance** between each one. If it is not possible to achieve this then there should be at least **1m** over and above a standard vehicle parking bay size.

Consideration should be given for spaces to allow for those who require **disability access**. It is recommended that these bays are **1.2m wider** than a standard bay and if the site allows to make all spaces these dimensions where there will be EV points, for inclusivity.

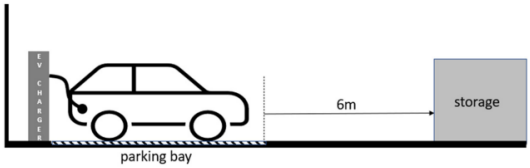
It is also recommended that between each bay is a separation wall. To provide a robust fire prevention measure each should have a minimum 60-minute fire line made from materials such as twin skin plasterboard. Where possible a 120-minute fire line would provide even greater protection such as that given by a concrete or brick wall. Whichever is installed it should be around 3 sides of the bay.

A hazardous area is defined as any place in which an explosive atmosphere may occur. Consideration should be given around the storage of **flammable materials which should be placed at least 10m** from either chargers or vehicles on charge. These materials include flammable liquids, gas stores, tanks, foliage etc. Where the vehicle is greater than 5m long then the separation should be the length of the vehicle plus 5m.




**Source: RC59 Recommendations for fire safety when charging electric vehicles [6].**

Where there are general storage areas within an enclosed space with charging points the vehicles should be at least 6m.




**Source: RC59 Recommendations for fire safety when charging electric vehicles [6].**

It may be entirely possible that car parks have mixed occupancy of both electric and standard cars. It is recommended that areas are grouped together with a 120-minute fire separation.

Best practise is to build all new car parks that have 120-minute fire resistance as standard and this should include the structure of the building, floors, ceilings and walls.

Each dedicated space should have enough capacity to be able to not only park, but also safely charge the vehicle and manoeuvre other vehicles in the vicinity taking into account the above margins.

## Floors

In the event of a vehicle fire, it is possible that fuel will spill so the positioning of bays should ensure slopes do not allow the flammable liquids to spread. Drainage should therefore be appropriate to avoid this occurrence.

## Charging Cables

Cables should not be stretched to be able to reach the charging position on the vehicle itself. These will alter by vehicle due to the charging inlets being in varying positions. It is preference that charging cables are tethered to the charging unit to avoid theft with a suitable place to return it so that it is not damaged by being left on the floor. Regard should be given to trip hazards.

Vehicles themselves will have a number of charging types such as UK 3 pin plug, Type 2, CCS, CHAdeMO. The 3-pin and Type 2 are for AC charging, and CCS and CHAdeMO for DC charging. There are also specific Tesla chargers which are slightly modified Type 2 and CCS. Visitors if possible should have a charging location off site from the premises. Where there is availability for multiple chargers each should be clearly signed to show which charger is appropriate.

3-pin plugs are for a short back up of additional miles and are not designed to be used every day. This is due to the high amount of heat generated which also means that extension cables should be avoided.

## Fire Prevention

Automatic fire detection systems can provide essential early warning of the outbreak of a fire. It will ensure the alarm is raised early and the Fire Service called, along with a safe evacuation and suitable emergency response procedures. This should be linked to an approved and 24 hour attended alarm receiving centre.

The installation of sprinkler systems can limit the impact or spread of a fire but is important that own Insurers are aware of this prior to installation to ensure it meets their own requirements. The EV chargers will change the risk profile so it is important this is addressed with the Insurer at an early stage.

## Risk Control

For businesses, vehicles will often be charged overnight or at weekends where the premises may be unoccupied. Careful consideration must be given to early fire warning systems within the risk control measures. For daytime occupation businesses should develop an emergency action plan including evacuation routes.

Ensure all staff have received training in safe charging of the vehicle they have been assigned. They should be made aware of actions to take in the event of a fire and the location of the power isolation switch. Training should be extended to all staff including security. Processes need to be in place that provide a reporting structure should damage, faults or the need for repair identified. Isolation should be managed until a suitable resolution is found with warning notices and barriers provided.

Many of these measures have business premises in mind but they can equally apply to domestic properties.

## Maintenance

Batteries that are no longer required should be disposed of correctly.

*See RICS R2: need to know guide, Lithium-Ion battery use and storage*

Charging points should be maintained and serviced in according to manufacturer recommendations. Rapid and Fast Charge DC type chargers should be inspected and serviced annually. This work must be carried out by contractors who are suitably qualified which can include MICEIC, ECA, SAFed, NAPIT and SELECT accreditation. Chargers with DC current must only be inspected by those who are certified on this specific current type.

## Additional risks

The HSE [8] advise there are a number of risks:

The electrical systems on the vehicles may affect medical devices like pacemakers.

People may be unaware of vehicles moving due to silent operation.

The vehicle may move unexpectedly due to the motors magnetic forces.

The vehicles contain a dangerous voltage even when the engine is switched off. This can be fatal.

Trailing cables across the floor may result in slips, trips and falls.

## General considerations

- All installations should plan for the current situation but be future proof for additional need
- Charging bays should be well marked such as coloured floor surfaces, and signage. Information should be given to users should there be an issue identified.
- Emergency isolations switches should be well signed and in a readily accessible location
- The isolation switch should not be situated on a combustible surface. If it is placed on a board it must have a minimum fire rating of 60 minutes and this must extend at least 1 metre from the switch.
- Where a site stores combustible materials these must be at least 2 metres from the switch including underneath.
- If there are concerns over an electric or hybrid vehicle and in particular battery damage an area should be available where it can be safely 'quarantined'. Runway can take a number of hours or even days to commence. This area should be a good distance from any buildings, vehicles or critical infrastructure.
- Access to fire hydrants or a firewater source should be available close to charging areas and its location known. The Fire and Rescue service will require access at all times and be aware of water pressure and flow.
- The location of any charging point should be considered in conjunction with areas where heavy rain, surface water or river water may pool. This could be through poor weather or a flood risk. If there are no other locations the business or land owner will need to install suitable drainage or flood defences.
- Location is also a consideration in relation to slopes, the volume of traffic and distance from neighbouring properties.
- Ensure the operation has an up to date business continuity plan should an emergency occur with mitigation measures.

## Electric Bikes and E-scooters

Many organisations have cycle to work schemes or bikes available to staff involved in community activities. These must be stored safely when not in use within a fireproof compound or separate detached building away from the main premises or other vehicles.

These should only be charged if they have their original equipment manufacturers (OEM) factory fitted batteries. Any replacement batteries must be compatible and fitted by a competent person.

## Liability

There is clearly a potential risk posed by electric cables being run over footpaths, even with cable protectors. The risk may be increased for the elderly, infirm, and those with mobility issues and / or poor eyesight. The safety of the pedestrian may well be challenged by having to navigate a high number of electric cables trailing across busy pathways. At night, the challenge may be even greater.

Some Local Authorities prohibit running cables across their pavements [9/10], even with a cable protector and insist that express permission be sought from them before doing so. Others illustrate that it is illegal to cause an obstruction on roads, pavements and footpaths and that the householder may be liable for any resulting damage or injury. They go further by not permitting the installation of pavement channels [4] by householders to accommodate the laying of charging cables.

Yet other Local Authorities do allow the laying of cables across a footpath [11] and issue guidance for householders: *'Cables should be laid flat and never be extended from an upper storey to a vehicle, nor should they be hung from any street furniture including lamp columns or trees. A cable should only be placed over the footway when the vehicle is charging and should always be removed when not in use'.* They do make it clear that responsibility lays with the householder. This shows that householders need to consult their own Local Authority as there are large differences in approach across the country.

The Local Government Association (LGA) states that there is no known legislation that would make the inconsiderate use of a cable an offence. However, should someone trip over a cable then liability could rest with the owner or controller of the vehicle (with implications for their home or car insurers).

However, **the Highways Act 1980** (section 178 (1)) [12] states:

'No person shall fix or place any overhead beam, rail, pipe, cable, wire or other similar apparatus over, along or across a highway without the consent of the highway authority for the highway, and the highway authority may attach to their consent such reasonable terms and conditions as they think fit.'

In addition to the above, section 137 of the Highways Act 1980 creates an offence of wilful obstruction of the highway, whilst section 137(a) provides powers to the courts to order the removal of the obstruction.

Of course, it is to be established whether an electrical cable placed across a footpath would be considered as an obstruction by the courts.

We must also give consideration to section 149 of the Highways Act 1980 which provides Highway Authorities with the power to request by notice the removal of things so deposited on the highways that cause a nuisance. Where the notice is not complied with, a removal order may be obtained from a magistrates' court. Whether this power can be utilised to assist in the removal of nuisance cables from the highway has not been established.

What seems fairly certain from the above is that Highway Authorities can insist that their consent is received prior to the placing of electric cables across the highway. What is not specified is what criteria they should use when considering applications for consent, and how they will enforce non-compliance of the requirement. This approach could potentially be challenged by households if licences aren't granted in a consistent manner.

## Resources


1. **Building Regulations Part S**

   https://assets.publishing.service.gov.uk/media/6218c5d38fa8f54911e22263/AD_S.pdf

2. **Thermal Runway**

   https://www.mitsubishicritical.com/resources/blog/thermal-runaway/

3. **Risk of an EV Fire**

   https://www.autocar.co.uk/car-news/electric-cars/how-much-fire-risk-are-electric-vehicles#:~:text=Electric%20car%20fire%20statistics%20UK&text=According%20to%20Honeywell%20Safety%20and,2023%20were%20linked%20to%20EVs

4. **Kings Dock Car Park Fire – Merseyside**

   https://www.bafsa.org.uk/wp-content/uploads/bsk-pdf-manager/2018/12/Merseyside-FRS-Car-Park-Report.pdf

5. **Luton Airport Car park**

   https://www.bedsfire.gov.uk/news/fire-airport-car-park-started-accidentally

6. **RC59: Recommendations for fire safety when charging electric vehicles**

   https://www.thefpa.co.uk/advice-and-guidance/free-documents?=%20Medium-sized%20Businesses,%20MAINTENANCE%20CHECKLISTS%20-%20APPENDIX%20TEMPLATE%20FORMS,%20CONTROL%20OF%20DUST%20EXPLOSIONS&q=RC59%20FIRE%20SAFETY%20WHEN%20CHARGING%20ELECTRIC%20VEHICLES

7. **IET Code of Practice for Electric Charging Equipment Installation 5th Ed**

   https://electrical.theiet.org/wiring-matters/years/2023/97-september-2023/fifth-edition-of-the-iet-code-of-practice-for-electric-vehicle-charging-equipment-installation/

8. **Risks of EV's**

   https://www.hse.gov.uk/mvr/topics/electric-hybrid.htm#risks

9. **Prohibiting use of cables across the pavement**

   https://hackney.gov.uk/electric-vehicles

10. **Pavement channels**

    https://www.merton.gov.uk/streets-parking-transport/ev/charging#toc-running-cables-over-pavements

11. **Cables permission**

    https://www.hants.gov.uk/transport/electric-vehicles/ev-charging-guidance

12. **Highways Act 1980 s178**

    https://www.legislation.gov.uk/ukpga/1980/66/section/178#:~:text=E%2BW,conditions%20as%20they%20think%20fit

13. **Recovery Operations: Working with electric vehicles**

    https://www.gov.uk/government/publications/recovery-operators-working-with-electric-vehicles

## Further information

For access to further RMP Resources you may find helpful in reducing your organisation's cost of risk, please access the RMP Resources or RMP Articles pages on our website. To join the debate follow us on our LinkedIn page.

## Get in touch

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