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RC59: Recommendations for fire safety when charging electric vehicles

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Summary of key points

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Fire risk assessment	• Practical passive, active and managerial control measures should be considered as part of the fire risk assessment for the premises when selecting and designing areas for use as electric charging points. (5.1.2)
Fire safety management	• When selecting sites for charging points, sufficient space must be allowed for vehicles to be parked safely in the designated charging area, and for connection to be made to the charging equipment. Adequate space should be allowed to manoeuvre other vehicles around charging vehicles safely when necessary. (5.3.2 and 5.3.3) • All relevant staff should be trained in the safe use of the chargers for vehicles that they may be called upon to drive. (5.3.6)
General considerations	• Where multiple chargers are in use, there should be clear and prominent notices at each charging point, indicating for which equipment or vehicle(s) it is suitable. (5.4.7) • Charging areas should be well ventilated, with the temperature not being such that overheating may occur during the charging process. (5.4.9)
Electrical provisions	• Where rapid charging points – known as DC fast charge and operating at 500V DC – are provided, they should be clearly differentiated from conventional charging points because of the hazards associated with the direct current. (5.5.2) • A circuit intended to supply an electric vehicle must be fit for purpose and suitable for the electrical load. The circuit should be dedicated to the use of the chargers, and not be part of a ring main or used for other purposes. (5.5.5)

Symbols used in this guide

Good practice

Bad practice

Discussion topic

Frequently asked question

1 Introduction

Advances in technology and concern for the environment have created an increasing demand for electric vehicles across both private and commercial uses. While mobility scooters have been in common usage for many years, they have been joined by electric cars, electric motorcycles, electric bicycles, hybrid cars and innovative designs of lorries and coaches, as well as recreational machinery such as hoverboards, scooters and Segways. In addition to road going vehicles, various forms of semi autonomous electric trucks employing modern battery technology now also have wide application in warehouses and on industrial sites. Electric vehicles are also encountered as shuttles for visitors and for running errands at sports events, agricultural shows and similar venues.

The increasing use of electric vehicles has necessitated the provision of charging facilities that – if not managed appropriately – can introduce potential ignition hazards into the workplace, or public areas, such as motorway service areas and car parks. Commerce and industry has not been slow to recognise the benefits of electric vehicles and their much reduced carbon footprint, compared with vehicles powered solely by an internal combustion engine provides a powerful message for politicians. This has had the benefit of encouraging the provision of charging points in town centres, on public highways, and in railway stations and supermarket car parks.

The charging technology referred to in this document continues to be developed and remains without a form of connector that is recognised by an international standard, although BS EN 62196-2 (ref. 1) connectors are commonly in use in the UK. This seven-pin 'Type 2' DIN connection is increasingly recognised, as it provides for data communication as well as power transfer. CCS connectors (Combined Charging System, which can allow both AC and DC charging) and CHAdeMO connectors (CHArge de MOve, which allow DC charging only) are also now widely available with a range of adaptors for some specific vehicle types. In the long term, charging by means of inductive power transmission via a pad buried in the ground – which does not require any physical connection between a vehicle and the charger – is an attractive technology and may hold promise for the future, although one major manufacturer has halted work on developing a similar (but much smaller) device for charging phones and pads due to problems associated with overheating.

These recommendations are intended to give practical advice regarding fire safety aspects of the provision, management and use of electric transport charging points, and do not aim to repeat the technical requirements concerning their installation that are addressed in the *IET Code of Practice: EV Charging Equipment Installation* (ref. 2).

Modern forms of transport, ranging from scooters to vans, tend to use lithium ion batteries. In these batteries, ions move from one electrode to another through a liquid electrolyte. In some batteries the liquid electrolyte is replaced with a solid conductor. While several forms of new technology are becoming available, some vehicles still use traditional lead acid batteries. The guidance in these recommendations is not specific to any particular form of battery or technology, and is designed to form best practice where charging of any form of reusable battery is undertaken.

Further information regarding fire safety aspects of the bulk storage of batteries is addressed in a separate RISCAuthority document which is in the course of preparation, and is intended for publication in 2021.

2 Scope

This document aims to provide practical guidance to insurers and their clients on fire hazards and appropriate control measures associated with the charging of electric vehicles, bicycles and similar devices in public places; on commercial and industrial premises; and within or in the vicinity of residential premises such as blocks of flats, care homes and sheltered accommodation.

The modes of transport concerned include modern electric cars, vans and buggies. The latter are now frequently used at sports events, and seen on the roads around commercial and industrial sites. A separate section considers mobility 'scooters'. Reference is also made in

these recommendations to electric bicycles, two wheeled scooters and Segway type devices.

The charging of pallet trucks, fork lift trucks and similar equipment not designed as modes of passenger transport are outside the scope of these recommendations, as they are addressed in RC11: *Recommendations for the use of lift trucks* (ref. 3). These recommendations however do make reference to large, electric two wheeled scooters and hoverboards, as designated forms of e-scooters are now permitted to be used on the public highway.

This document refers to the charging process relating to vehicle batteries, and is not dedicated to fire safety in car parks.

3 Synopsis

These recommendations provide practical guidance on fire hazards and appropriate control measures associated with the provision, management and use of charging points for various forms of electrically powered transport in public areas, commercial and industrial premises. Advice is provided concerning the charging provisions, the areas where this process should be undertaken and appropriate fire protection measures that should be considered.

A separate section sets out recommendations relating to the charging of mobility scooters in residential premises.

4 Definitions

Battery

A device consisting of one or more cells in which chemical energy is converted into electrical energy for use as a source of power.

Each cell consists of an anode (or negative electrode) and a cathode (or positive electrode) separated by an electrolyte. The electrodes cause negatively charged ions (anions) and positively charged ions (cations) to migrate to their respective electrodes.

Batteries may be primary, which are designed for a single use and may not be recharged, or secondary, which are of a different design and may be recharged multiple times for reuse. These recommendations only apply to secondary batteries.

Electric bicycle

A bicycle with an integrated electric motor that can be used to provide, or assist in, the provision of propulsion.

Electric vehicle

The term electric vehicle is used generically in this document to relate to any form of passenger transport, be it a car, mobility scooter, electric motorcycle, van or truck, whether powered exclusively or in part by electric (battery) power.

E-scooter

Large, electric two wheeled scooters, designated forms of which are permitted to be used on the public highway.

Hoverboard

A motorised, personal form of transport consisting of a platform mounted on two small wheels controlled by the distribution of the rider's weight.

Hybrid vehicle

A vehicle powered by more than one form of energy. Cars with internal combustion engines fuelled by petrol or LPG and electric motors are the most common form of hybrid vehicle.

Mobility scooter

In this document, the term mobility scooter is used to refer to both Class 2 and Class 3 machines as defined in the Use of Invalid Carriages on Highways Regulations 1988 (ref. 4) (Class 2 scooters are designed for use on the footway, travelling at speeds of up to 4 mph, while Class 3 scooters may be used on the footway at speeds of up to 4 mph or on the road, where they may travel at up to 8 mph).

Segway

A brand name for an electric vehicle similar in operation to a hoverboard, but with a larger platform and wheels. The rider stands on the platform and holds onto a bar at about waist height.

5 Recommendations

5.1 Compliance with fire safety legislation

The following paragraphs relate to charging points provided in the workplace or in residential environments.

5.1.1 In premises to which the Regulatory Reform (Fire Safety) Order 2005 (or equivalent legislation in Scotland and Northern Ireland) (refs 5–8) applies, the fire safety management strategy should consider practical passive, active and managerial control measures as part of the fire risk assessment for the premises when selecting and designing areas for use as electric charging points.

5.1.2 The nature of the equipment requires it to be installed in the immediate vicinity of vehicles. The assessment should therefore also include the suitability of the location and the nature of the equipment for the intended purpose.

5.1.3 Where appropriate, an assessment in compliance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (ref. 9) should be undertaken, to ensure that charging areas are sufficiently remote from any hazard zones and locations used for the storage of hazardous or flammable liquids and gases.

5.1.4 The risk assessments should consider the risk from charging electric vehicles when premises are unoccupied, or where people may be asleep. The measures to be considered should include:

- physical segregation of the charging areas from process and storage areas (see section 5.6)
- provision of suitable power supply, control and isolation systems, which will allow isolation of the charging points from a safe location without having an impact on business production and process functions
- suitable automatic fire detection and warning installations in case of fire
- provision of portable firefighting equipment, together with fixed fire suppression systems where the latter may be proportional to the risk
- development of an emergency action plan to protect life and property, and ensure the continued functioning of the business in the case of fire
- staff training in the safe use of charging equipment and the actions to take in the event of fire, including the safe isolation of power from the charging station and evacuation of the premises

5.2 Business continuity

Even a small fire can have a disproportionate effect on a business if it occurs in a critical area. Electric vehicles are becoming increasingly sophisticated and expensive, and in many cases are becoming relied upon for the efficient functioning of a business.

- What are the fire and safety implications when selecting charging areas for use during the night or over weekends when no, or very few, staff are present? (5.2.1)

5.2.1 In commercial premises where the batteries of electric vehicles are charged, the fire hazards and thus the threats to the business are increased by the need for the charging process to continue during the night or over weekends, when very few or no staff are present. It is therefore paramount that careful consideration be given to all fire and safety implications when charging areas are being selected and designed. Further information is set out in RISCAuthority Recommendations RC42: *Unattended processes* (ref. 10).

5.2.2 All organisations should take steps to ensure the continued smooth running of their business by making a suitable emergency plan. Guidance for this is set out in *Business Resilience: A Guide to protecting Your Business and its People* (ref. 11). The emergency plan should address the implications of a fire, flood or other perceived disaster on all facets of the business model. It should indicate the lines of communication that should be followed and the contact details for specialist assistance, providers of alternative accommodation and suppliers of manufacturing plant.

5.2.3 When complete, the emergency plan should be rehearsed by means of a table top exercise, with the results being assessed and amendments made to the plan as necessary.

5.2.4 Consideration may be given to applying commercially available computer programmes, such as the free of charge ROBUST software (resilient business software toolkit) (ref. 12) or another appropriate product, to develop and check the adequacy of the plan.

Consideration should also be given to utilising the free, online RISCAuthority Supply Chain Risk Management Toolkit (ref. 13). Reference should also be made to *A simple guide to supply chain management for small and medium-sized businesses* (ref. 14), which is also available from the RISCAuthority website.

- What are the implications of some forms of batteries having the capacity to burn for prolonged periods of time? (5.2.5)

5.2.5 Business continuity implications also have to be considered in respect of fires involving batteries having the capacity to burn for prolonged periods of time.

5.2.6 Suppliers of replacement batteries and chargers should be identified, and consideration given to potential prolonged lead times in their delivery.

5.2.7 The initial stage of business continuity is to minimise fire spread, by providing clear and concise information for the fire and rescue service on their arrival. The firefighters' box should therefore include plans that identify the locations of charging points and facilities for their electrical isolation.

5.3 Fire safety management

5.3.1 When selecting sites for charging points, sufficient space must be allowed for vehicles to be parked safely in the designated charging area, and for connection to be made to the charging equipment.

5.3.2 When vehicles are being left on charge unattended, a check should be made to ensure that the charger is working satisfactorily; that there is sufficient space to manoeuvre other vehicles around them safely; and that foreseeable potential fire hazards in the immediate vicinity have been identified.

5.3.3 Hatching to show the vehicle parking area should be clearly marked on the ground – this should include sufficient space to gain entry or access to the vehicle, especially where access may be required for a person with a disability.

5.3.4 No flammable or combustible material, other than those which form parts of the vehicle and their associated chargers, should be stored within the designated charging area.

5.3.5 Security or other responsible staff on site who may be called to take action in an emergency should be made aware of the location of the charging area, the means for isolating the power and the actions that should be taken to raise the alarm and fight the fire if safe to do so.

- Wherever possible, two wheeled electric scooters and electrically assisted bicycles should be stored and charged outside the premises. (5.4.1)

- Charging points for electric road vehicles should not normally be located within premises. (5.4.1)

- Can staff charge their own vehicles using company charge points? (5.4.5)

- Care should be taken not to discharge lithium ion batteries below 0.50V, otherwise they will not recharge effectively and will need to be replaced. (5.4.13)

- How should batteries be safely disposed of at the end of their working life? (5.4.14)

5.3.6 All relevant staff should be trained in the safe use of the chargers for vehicles that they may be called upon to drive. This training should include the undertaking of visual inspections of the charging equipment prior to each use.

5.4 General considerations

5.4.1 Charging points for electric road vehicles operated by a company, together with those provided for visitors' transport, should normally be located outside the premises. Outdoor charging areas should be adequately lit, and provided with emergency lighting complying with BS 5266 (ref. 15).

5.4.2 Charging facilities for lift trucks, and similar vehicles designed solely for use within the premises, should be carried out in a separate building of non combustible construction reserved for this purpose, or in a specially designed charging area. The charging area should be away from escape routes, and be separated from other areas by fire resisting doors with fire resistance in accordance with insurer recommendations set out in *Approved Document B to the Building Regulations incorporating insurers' requirements for property protection* (ref. 16). Enclosed charging areas should also be adequately lit, and provided with emergency lighting complying with BS 5266 (ref. 15).

5.4.3 It will normally be appropriate for electric bicycles and two wheeled scooters owned by staff to be charged in a secure, detached single storey structure (see Section 5.6).

5.4.4 Segways and similar devices provided by the company may be charged in a suitable designated area within a building (see Section 5.6).

5.4.5 Where relevant checks have been made, private cars may be authorised to use external company charging points, but should not be permitted to use any charging facilities that have had to be located within the premises (see 5.4.1).

5.4.6 Vehicles must only be charged in accordance with the manufacturer's instructions.

5.4.7 Where multiple chargers are in use, there should be clear and prominent notices at each charging point indicating for which equipment or vehicle(s) it is suitable.

5.4.8 Care should be taken that existing chargers are suitable for their intended use before they are first used to charge batteries. Thereafter, a visual inspection of the charger should be made prior to each use. Any damaged equipment should be prominently labelled to indicate that it is no longer serviceable, and not be used until it has been inspected by a competent electrician.

5.4.9 The temperature of the charging area should not be such that overheating may occur during the charging process. Lithium ion battery cells should not be subject to temperatures in excess of 60°C in operation or 70°C during storage.

5.4.10 Where charging points are to be provided in multi storey car parks, consideration should be given to locating these in the open air at roof deck level to minimise potential for fire spread within the structure.

5.4.11 Where car parks are located beneath ground level, careful consideration should be given to providing appropriate fire protection provisions at the planning stage (see 5.6.6).

5.4.12 It is important that cells in a battery are balanced during the charging process to avoid overcharging, and thus overheating of individual cells. The manufacturer should be contacted if a vehicle battery, or cell(s) within the battery, appears to be overheating.

5.4.13 Care should be taken not to discharge lithium ion batteries below 0.5V, otherwise they will not recharge effectively and will need to be replaced.

5.4.14 To protect the environment, at the end of their working life batteries should be recycled and not sent to landfill. Although there are only trace amounts of heavy metals in most batteries and little scrap value in lithium, the recovery of copper, nickel and cobalt makes the recycling process economic. Waste batteries should be stored safely outside the premises, and protected from the effects of the weather while awaiting disposal by a specialist contractor or the supplier, in accordance with the requirements of EU Directive 2006/66/EC (ref. 17). Terminals of waste batteries should be protected to prevent shorting between batteries occurring.

- Due to their association with a number of serious fires, it is strongly recommended that hoverboards be stored and charged in a suitable outbuilding and not be charged indoors. (5.4.15)

5.4.15 While hoverboards are domestic devices designed mainly for use by children, due to their association with a number of serious fires it is strongly recommended that they be stored and charged in a suitable outbuilding, and not be charged indoors.

5.4.16 Care should be taken where products to reduce land heave have been used in the construction phase of areas where the charging of vehicles is to be undertaken. The suitability of these areas for the location of charging points, and the need for installing methane detectors, should be carefully assessed.

5.5 Electrical provisions

Systems for the distribution of electricity to public areas are outside the scope of BS 7671 (ref. 18) and IEC 60364 (ref. 19); this document therefore considers publicly and privately available supplies separately.

Charging points in public areas

There is now a growing network of charging points being made available for electric vehicles in public car parks and at supermarkets or similar locations. The use of many of these is free, although some electric car charging scheme memberships are subscription based. These subscriptions provide a charging lead and in some cases free parking, but the charging points are fitted with meters to allow the electricity to be paid for.

Although the basic technology has become established and takes the form of a secure post or box – normally with a single socket accessed by an electronic tag – variations on this theme may be encountered. These can allow charging for two cars, fast charging, different outputs, electronic displays and consumption monitoring software. Some outlets are connected electronically to a central control point to allow monitoring of use and associated billing.

There is not as yet an agreed International standard design of plug for use at roadside charging points, so variations may be encountered which accept more than one style of plug. There is pressure in Europe for the adoption of a special seven pin plug, known by the IEC as the Type 2 plug. This provides for transmission of data as well as power. In the UK an industrial type of socket outlet complying with BS EN 60309-2 (ref. 20), which is similar to those used on caravan sites, may be encountered.

Charging points of a similar style to those for public places are available commercially, and may be installed in business and industrial premises, on private driveways, in private car parks and in vehicle yards. Some have the advantage of automatically using a low cost, night time electricity tariff; the capacity to charge at either 3 kw (13A) or 7 kw (32A); or to charge two electric vehicles simultaneously.

5.5.1 External vehicle charging points and those provided within a building (other than battery chargers fitted with a 13A plug) must be installed by a competent electrician (such as those recognised by the NICEIC, the Electrical Contractors Association (ECA), NAPIT, or SELECT in Scotland).

Alternatively, the work should be undertaken by a competent contractor who meets the definition of a “Skilled Person (Electrically)” in BS 7671, i.e.: ‘A person who possesses, as appropriate to the nature of the electrical work to be undertaken, adequate education, training and practical skills, and who is able to perceive risks and avoid hazards which electricity can create.’ It should be recognised that not all electricians are competent to carry out all types of electrical work; there is a need to ensure that the electrical contractor being considered has the relevant technical knowledge, practical skills and experience, and has successfully completed an assessed training course run by an accredited training organisation for the type and complexity of electrical installations involved.

- What are fast charging points? (5.5.2)

5.5.2 Where rapid charging points – known as DC fast charge and operating at 500V DC – are provided, they should be clearly differentiated from conventional charging points because of the hazards associated with the direct current, Measures should be taken to ensure that signs and labels associated with these chargers are not removed or defaced.

5.5.3 All chargers and associated equipment should be installed, used and maintained in accordance with the manufacturer's instructions. Internal installations should comply with the requirements of BS 7671 (ref. 18), especially with regard to the bonding and earthing arrangements. Servicing and maintenance should be carried out by a competent electrician.

An important reason for this is that the installation of a charger suitable for a road vehicle may not involve a simple connection to an existing circuit, but may require the provision of a power supply outside the bonding zone, involving some reconfiguration of the electrical supply to the premises. In technical terms, the Electrical Safety, Quality and Continuity Regulations 2002 (ref. 21) do not allow a combined neutral and protective conductor (a PME installation) to be connected to exposed conductive parts, such as the metalwork of vehicle.

5.5.4 Although BS 7671: *Requirements for electrical installations (The IET Wiring Regulations)* (ref. 18) does not address issues concerning the connection of an electric vehicle to a fixed electrical installation, all elements of the wiring to the charger – including the conductors residual current device (RCD) protection, and other safety measures – should comply with this standard. In particular, RCDs must now take account of the DC fault current.

Where a BS 1363-2 (ref. 22) socket outlet is used for electric vehicle charging, it must be marked 'EV' on the back of the socket unless there is no possibility of confusion, and a label must be put on the front face or adjacent to the socket outlet or its enclosure stating 'suitable for electric vehicle charging'.

5.5.5 A circuit intended to supply an electric vehicle must be fit for purpose and suitable for the electrical load. The circuit should be dedicated to the use of the chargers and not be part of a ring main or used for other purposes.

5.5.6 An RCD should be installed by a competent electrician as additional protection for vehicle charging supplies.

5.5.7 Charging bays should be signed and marked prominently on the ground to allow vehicles to park close to the charging point, and prevent the stretching of charging cables. The length of charging cables should be sufficient to allow their use with the intended equipment without risk of damage.

5.5.8 Charging points should be protected against mechanical damage by vehicles. They should be installed above ground level and be located on a raised island, or be protected by kerbs, bollards or metal barriers. Charging points should also be protected against the ingress of water and foreign objects.

FAQ

- How can parking in charging bays, other than for charging vehicles, be discouraged? (5.5.11)

5.5.9 A risk assessment should be undertaken to consider forms of damage, either accidental or deliberate, to which charging points may be subject, Where appropriate, external charging points may need to be protected against deliberate damage out of working hours by being located in a secure area, equipped with security lighting and monitored by CCTV cameras. Dedicated power supplies for external charging points should be run in metal trunking, steel conduit and/or underground ducting.

5.5.10 An adequate area should be available around chargers to allow safe vehicle movement. While many electric cars and vans are currently small, future developments are likely to see the production of much larger electric vehicles, with bigger delivery vans and trucks becoming more commonly encountered.

5.5.11 The parking of other vehicles in charging areas should be prohibited. In some cases the introduction of barriers, or other physical measures to prevent charging bays being used as conventional parking spaces, may need to be considered.

- All wiring and equipment must be suitable for its location, and able to operate satisfactorily without deterioration throughout its working life. Charging points may therefore require protection from the environment during installation and use. (5.5.12)

5.5.12 All wiring and equipment must be suitable for its location, and be able to operate satisfactorily without deterioration throughout its working life. Charging points may therefore require protection from the environment during installation and use.

5.5.13 Provision must be made for isolating each live conductor linked to the charging equipment manually, for use both in an emergency and for maintenance purposes. Provisions should allow the cables from both the mains supply and the vehicle battery to be isolated.

5.5.14 Emergency manual isolation of charging points should be provided to ensure safe shutdown of equipment in the event of failure of the mains electrical supply, or a fault within the equipment. The isolation point(s) should be prominently signed and strategically located, for example at a manned kiosk or similar location where it will be readily accessible to trained staff and firefighters.

Emergency isolation switches should incorporate lock out facilities to prevent unauthorised reinstatement during maintenance and emergencies.

Power circuits should be configured to require manual resetting of the isolator when the power is restored.

5.5.15 Where socket outlets are required as part of a small internal installation, they must be fit for purpose. They should be suitable for the load and provide protection against external influences, such as mechanical damage and ingress of water.

5.5.16 When a charger is found to be faulty, its use should cease immediately and it should be isolated and locked out, with a suitable warning sign being displayed prominently until satisfactory repairs have been made by a competent engineer.

- Rather than using time switches to turn chargers on and off, the process should be started manually and monitored for a short period before being left to operate unattended. A timer may be used to isolate the power at the end of the charging cycle. (5.5.17)

5.5.17 Rather than using time switches to turn chargers on and off, the process should be started manually and monitored for a short period before being left to operate unattended. A timer may be used to isolate the power at the end of the charging cycle.

5.5.18 Where a portable charger or other electrical equipment is in use, it should be inspected periodically (PAT tested) at least in accordance with HS(G)107 (ref. 23) and the *IET Code of Practice for In-service Inspection and Testing of Electrical Equipment* (ref. 24). In commercial premises it may need to be tested more often, as determined by a risk assessment.

5.5.19 The use of extension cables when charging vehicles should be avoided. Their use in public areas should be prohibited, and on an enclosed site they should only be used as a temporary arrangement where there is no practical alternative. Any extension lead that is kept on site should be inspected visually before use, and be subject to routine, in service inspection (PAT testing).

5.5.20 Proprietary cable retractors offer a practical alternative to extension leads. The equipment may be ceiling mounted where no interaction by the user is required.

5.5.21 In some cases, charging cables may be vulnerable to theft. The users of electric vehicles should be made aware of simple deterrents, such as the use of padlocks, to protect cables when used off site. The practice of parking with a wheel on the charging cable as a security measure may lead to damage, and is not advocated.

5.5.22 The provision of adaptors to allow the use of a single charger with multiple forms of vehicles or equipment should be avoided. Charging leads should be of an appropriate type, and chargers clearly labelled as to which vehicles they may be used with.

5.5.23 No attempt should be made to use a charging point other than for charging batteries designed for use with the equipment.

5.5.24 No attempt should be made to modify charging equipment for any other use, or to charge a vehicle for which it is not designed.

Installing and changing batteries

5.5.25 Batteries should be installed in accordance with the manufacturer's instructions. The mounts are designed to prevent deformation and mechanical stress on cells. No attempt should be made to introduce temporary or secondary clamps onto the cells, as to do so may restrict the cell rupture vents at their ends.

5.5.26 All high voltage components in automobiles (i.e. greater than 54 V), including cables and connectors, must be coloured orange.

5.5.27 At the time of battery installation, a visual inspection should be made of the wiring, and any damage or chafing of electrical components or high voltage cables should be repaired by a competent automotive engineer.

5.5.28 No attempt should be made to repair or bypass cells in order to extend the life of a battery.

5.5.29 Cells should not be subject to reverse polarity or be short circuited (in the event of this occurring as a result of cell failure, fuses are incorporated into the design of the unit to prevent all the energy in one string being dumped into its neighbours).

5.5.30 No attempt should be made to modify or bypass a crash sensor designed to isolate the battery in an emergency.

Storage and transport

5.5.31 Where vehicle batteries are stored, they should not be exposed to water or other liquids. They should be kept in good condition.

5.5.32 Damaged lithium ion batteries should not be disposed of with general waste or in recycling containers. Any damaged batteries should only be handled while wearing suitable PPE (goggles, gloves, aprons etc). Damaged batteries should be packaged in a plastic bag, removed from the building and placed in a container of sand or similar inert material located away from buildings and combustible materials. Waste batteries should be protected from the environment while awaiting collection or safe disposal. It is important that the terminals of the batteries be covered while stored to protect against accidental shortcircuiting.

5.5.33 Where batteries have to be transported, the packaging should be designed to ensure that they are not punctured, dented or crushed as a result of any foreseeable accident.

5.5.34 The packaging of batteries received for forwarding may be relabelled, but otherwise should not be altered in any way.

5.6 Compartmentation and segregation

Charging points for vehicles in the workplace may require more consideration than chargers provided for pallet and forklift trucks, due to their use with hybrid vehicles which may carry propane cylinders, or tanks of petrol or diesel fuel.

5.6.1 On commercial and industrial sites where it is not possible to provide external, roadside style charging points – or where an increased level of security is required – a dedicated, enclosed area for the charging of electric vehicles should be provided.

5.6.2 Where possible, charging points should be located in a detached, single storey structure with lightweight external walls and roof.

5.6.3 Where a detached structure is not available, internal charging areas for electric vehicles should be single storey with lightweight external walls. There should be direct access for roadgoing vehicles from outside the building. The enclosure should provide at least 60 minutes fire resistance between the charging area and any other part of the premises in the event of a fire. Where there is access to the premises from the charging area, the doorset(s) or shutters should provide the same degree of fire resistance as the element of structure in which they are located (i.e. at least 60 minutes fire resistance).

5.6.4 Enclosed charging areas must not be used as work areas, and must be free from storage, including stored waste materials.

5.6.5 Where it is not practicable to provide this degree of physical separation of a vehicle charging area within a building as indicated in paragraph 5.6.3 (and also outside the premises), no charging should be undertaken within 10m of any combustible materials: be they waste materials, stock or combustible elements of the structure. Similarly, no charging should be undertaken within 15m of hazardous installations such as transformers, flammable liquid stores and liquefied petroleum gas tanks.

5.6.6 The charging area should be well ventilated at high and low level to ensure that there is no build up of toxic gases – when charging some forms of battery, these can include hydrogen fluoride. In some cases, this may be achieved by air bricks located in an external wall – but where large lithium ion batteries such as those used to power vehicles are to be charged, mechanical ventilation should be provided.

Advice should be sought from the supplier of the batteries to determine the number of air changes required, but these should be sufficient to maintain the volume of the most flammable gas produced to less than 25% of its lower flammable limit.

5.6.7 Because of the intense and prolonged nature of fires involving lithium ion batteries, where it is necessary to locate charging areas in basements careful consideration should be given to the design of the sprinkler system and ventilation arrangements. There should also be liaison with the fire and rescue service concerning access for firefighting. Any basement charging area should be separated from other parts of the premises by elements of structure that provide at least 120 minutes fire resistance.

5.7 Mobility scooters

5.7.1 While it is recognised that the users of this equipment have mobility difficulties, in blocks of flats and similar sleeping accommodation mobility scooters should not be taken to floors above access level.

5.7.2 Mobility scooters should not be left parked or stored in escape routes where they may form a fire hazard, or an obstruction in the event of the building being evacuated.

5.7.3 Sheltered living projects and similar accommodation should have a policy for the use of mobility scooters in communal areas. The charging of these vehicles in communal areas should be prohibited.

5.7.4 Wherever possible, mobility scooters should be stored and charged in locations designed for this purpose.

5.7.5 Storage/charging areas for mobility scooters should have direct access from outside the building, and provide at least 60 minutes fire resistance in the event of a fire in the room. Where there is a door allowing access to the premises from the scooter store, the doorset should also provide at least 60 minutes fire resistance.

5.7.6 The site policy relating to mobility scooters should recognise that there will be a maximum number of scooters that may be safely used, charged and stored on the premises: careful management, including a fair and transparent waiting list procedure, may be necessary in the best interests of both residents and staff.

5.7.7 Where a dedicated mobility scooter storage area is not provided, it is preferable for mobility scooters to be charged during the day rather than at night, when people may be asleep in the building. Where this is not practicable, the process should be started manually and monitored for a short period before being left to operate unattended. A timer may be used to isolate the power at the end of the charging cycle.

5.7.8 All users and owners of mobility scooters should be instructed in the charging and maintenance of their machines at the time of purchase or leasing.

5.7.9 Where portable chargers are in use for mobility scooters in commercial premises, they should be inspected periodically (PAT tested) at least in accordance with HS(G)107 (ref. 23) and the *IET Code of Practice for In-service Inspection and Testing of Electrical Equipment* (ref. 24).

5.7.10 Chargers intended for use with mobility scooters should be supplied from a dedicated circuit, rather than from one of the ring mains in the premises. This is for electrical safety purposes, and to minimise inconvenience in the event of a fault in a charger. It will also allow for control of a circuit by a timer if required. A metered supply may also be necessary to allow residents to be charged for the facility.

5.7.11 A competent electrician, such as one recognised by the NICEIC, the Electrical Contractors Association (ECA), NAPIT or SELECT in Scotland, should be engaged to install dedicated power points for charging mobility scooters.

5.7.12 The charging circuit should be linked so as to be automatically isolated in the event of actuation of the automatic fire detection (AFD) and alarm system in the building, or failure of the mains power supply. Power circuits should be configured to require manual resetting of the isolator when the power is restored.

5.7.13 Residual current devices should be installed where necessary in compliance with the requirements of BS 7671 (ref. 18) and the *Code of Practice for Electric Vehicle Charging Equipment Installations* (ref. 2). A competent electrician should be consulted to ensure that suitable protective devices are provided.

5.7.14 The use of temporary extension leads and block adaptors for charging mobility scooters should be prohibited in all circumstances.

5.7.15 The batteries of mobility scooters should not be covered by blankets or similar insulating materials when being charged.

5.8 Fire protection

5.8.1 Internal charging and storage areas for electric vehicles should be protected by AFD installations designed, installed and maintained by an engineer with appropriate certification by an independent, UKAS accredited third party certification body. The installation should be to a recognised category of installation in accordance with BS 5839-1 (ref. 25) as determined by a risk assessment.

5.8.2 The AFD should be monitored, either on site or by an off site alarm receiving centre with accreditation by an independent, UKAS accredited third party certification body, and operating in accordance with BS EN 50518 and BS 8591 (refs 26 and 27) or to BS 5979 (ref. 28) where appropriate.

5.8.3 The AFD installation should be tested weekly in accordance with BS 5839-1, with suitable records being kept.

5.8.4 The AFD installation should be periodically serviced and maintained in accordance with BS 5839-1 (ref. 25), by a competent engineer with appropriate certification by a UKAS accredited third party certification body.

5.8.5 The AFD installation should be interfaced so as to isolate the power supply to all vehicle chargers in the event of the fire alarm actuating. The interface arrangement should not allow charging to recommence automatically when the fire alarm is silenced.

Firefighting

5.8.6 An appropriate number of portable fire extinguishers suitable for use on electrical equipment (such as carbon dioxide extinguishers) should be available near charging points, and be immediately accessible for use in case of fire. Such portable extinguishers should be approved and certificated by a third party certification body, with the provision and installation in accordance with BS 5306: Part 8 (ref. 29). The extinguishers should be inspected and maintained in compliance with BS 5306: Part 3 (ref. 30).

5.8.7 In commercial premises where chargers are to run unattended, the installation of an automatic fixed fire suppression system within the fire compartment in which the charging process is being undertaken is strongly recommended.

5.8.8 In most commercial and industrial battery charging installations, the risk assessment may indicate the provision of a water sprinkler installation to be appropriate. In all such cases the sprinkler system should provide a suitable degree of discharge throughout the whole compartment in which vehicle charging is undertaken.

Sprinkler systems should be designed, installed, commissioned and maintained in accordance with the *LPC Sprinkler Rules incorporating BS EN 12845* (ref. 31) by engineers having appropriate certification from an independent UKAS accredited third party certification body.

5.8.9 Where charging points are to be installed in an area with an existing sprinkler installation, the level of protection provided by the sprinkler system should be reviewed, with any remedial actions necessary being implemented prior to charging commencing.

5.8.10 The design of the sprinkler system should include an interface to allow the power supply to all vehicle chargers to be automatically isolated in the event of sprinkler activation.

5.8.11 A fire involving a lithium ion car battery can burn for a prolonged period of time (for several hours). This will have an impact on the water supplies necessary and the provisions for the retention of firefighting water. These will therefore have to be reviewed if necessary.

5.8.12 In circumstances where sprinklers may not be appropriate, an alternative suppression system may have to be considered. In this case, the most effective agent for the particular application should be selected following a risk assessment, and taking into account the effectiveness of the agent as well as toxicity, asphyxiation potential and environmental and contamination issues.

5.8.13 Alternative fire suppression systems should be tested and maintained according to the requirements of the relevant British Standard and/or the installer's recommendations, by a competent engineer with appropriate certification by a UKAS accredited third party certification body.

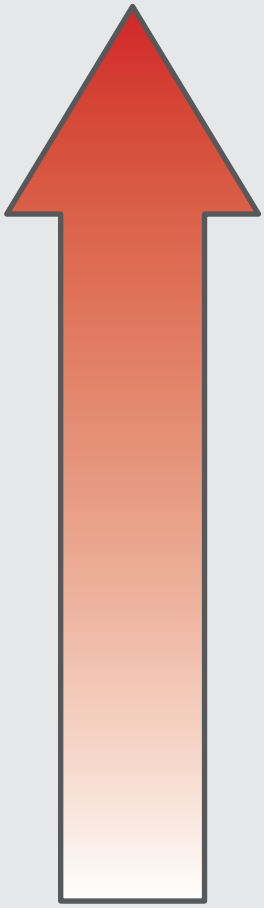
Location	Fire and security protection	Risk level
Basement	• automatic fire suppression • ventilation • access for firefighters • provisions for run off of firefighting water	
Public outdoor area	• mechanical protection (kerbs, bollards or barriers) for charging points • securing point for charging cable • CCTV monitoring	
Within building (ground floor and above)	• automatic fire detection (multi sensor heads) • automatic fire suppression system • ventilation • fire extinguishers • fire compartmentation	
Roof top level	• fire extinguishers • provisions for run off of firefighting water	
Detached purpose built building	• automatic fire detection • fire extinguishers • lightweight construction (including roof) • ventilation • adequate separation from other buildings	
Secure outdoor area	• mechanical protection (kerbs, bollards, or rails) for charging points • securing point for charging cable • fire extinguisher	

Table 1: Protecting charging points in various locations

6 Checklist

This checklist is based on the guidance and certain recommendations made in RC59: *Recommendations for fire safety when charging electric vehicles*, and designed for use by premises operators – and in particular members of the maintenance or facilities team – as an audit tool for use on site. It is recommended an audit using this checklist be undertaken at least every six months.

The checklist can be printed and a hard copy used, or alternatively it can be completed electronically and printed off (if needed). Checklists created electronically will be saved with the document on closing as a digital record. The references accompanying each question below and shown in brackets relate to the relevant sections of RC59.

Additional blank copies of the checklist may be created as required for printing or electronic completion.

		Yes	No	N/A	Action required	Due date	Sign on completion
6.1	**Compliance with fire safety legislation (section 5.1)**						
6.1.1	Has a fire risk assessment of the premises been carried out, and does this consider practical passive, active and managerial control measures? (5.1.1 and 5.3.1)						
6.1.2	Does the assessment address the continuing suitability of the location and any changes to the charging equipment? (5.1.2)						
6.1.3	Has an assessment been made to ensure that the charging area remains sufficiently remote from any hazard zones identified in a DSEAR assessment? (5.1.3)						
6.1.4	Does the risk assessment consider the hazards of charging electric vehicles when premises are unoccupied, or where people may be asleep? (5.1.4)						
6.2	**Business continuity (section 5.2)**						
6.2.1	Has an emergency plan been prepared, is it up to date and has it been rehearsed? (5.2.2 and 5.2.3)						
6.2.2	Does the emergency plan address the problem of fires involving batteries having the capacity to burn for prolonged periods of time? (5.2.5)						
6.3	**Fire safety management (section 5.3)**						
6.3.1	Has sufficient space been allowed for vehicles to be parked safely in the designated charging areas, and for connections to be made to the charging equipment in a safe manner? (5.3.1)						
6.3.2	Prior to vehicles being left on charge unattended, are checks made to ensure that the charger is working satisfactorily; that there is sufficient space to manoeuvre other vehicles in the vicinity safely; and that foreseeable potential fire hazards in the immediate vicinity have been identified? (5.3.2)						
6.3.3	Is hatching to show the vehicle parking area clearly marked on the ground, and does it include sufficient space for a person with a disability? (5.3.3)						
6.3.4	Are charging areas free of flammable and combustible materials other than those which form parts of the vehicle and their associated chargers? (5.3.4)						
6.3.5	Are security and other responsible staff on site who may be called to take action in an emergency aware of the location of the charging area; the means for isolating the power; and the actions that should be taken to raise the alarm and fight the fire if safe to do so? (5.3.5)						
6.3.6	Are all relevant staff trained in the safe use of the chargers for vehicles that they may be called upon to drive? (5.3.6)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.4	**General considerations (section 5.4)**						
6.4.1	Are charging points for electric road vehicles located outside the premises, with those for lift trucks and similar equipment designed for use inside the premises suitably constructed and located? (5.4.1 and 5.4.2)						
6.4.2	Are private cars prohibited from using charging points within the buildings? (5.4.5)						
6.4.3	Are vehicles only charged in accordance with the manufacturer's instructions? (5.4.6)						
6.4.4	Where multiple chargers are in use, are there clear and prominent notices at each charging point indicating which equipment or vehicle(s) it is suitable for? (5.4.7)						
6.4.5	Is a visual inspection of the charger made prior to each use, with any damaged equipment being prominently labelled to indicate that it is no longer serviceable? (5.4.8)						
6.4.6	Are charging areas well ventilated, with the temperature not exceeding 60°C during charging operations or 70°C where batteries are stored? (5.4.9)						
6.4.7	Where charging points are provided in multi storey car parks, are these located in open air at roof deck level to minimise potential for fire spread within the structure? (5.4.10)						
6.4.8	Are procedures in place to contact the manufacturer if a vehicle battery or cell(s) within a battery appear(s) to be overheating? (5.4.12)						
6.4.9	Is care taken not to discharge batteries below 0.50V so that they will recharge effectively, and will not need to be replaced? (5.4.13)						
6.4.10	Are measures in place to protect the environment by recycling batteries at the end of their working life, rather than sending them to landfill? (5.4.14)						
6.4.11	Has the need for methane detectors been considered in charging areas, where appropriate? (5.4.16)						
6.5	**Electrical provisions (section 5.5)**						
6.5.1	Have all chargers been installed by a competent electrician? (5.5.1)						
6.5.2	Where rapid charging points – known as DC fast charge and operating at 500V DC – are provided, are they clearly differentiated from conventional charging points because of the hazards associated with the direct current? (5.5.2)						
6.5.3	Are all chargers and associated equipment installed, used and maintained in accordance with the manufacturer's instructions? (5.5.3)						
6.5.4	Are electrical supplies to chargers protected by a suitable fixed residual current device (RCD), which has been installed by a competent electrician? (5.5.6)						
6.5.5	Are charging bays signed and marked prominently on the ground to allow vehicles to park sufficiently close to the charging point to prevent the stretching of charging cables? (5.5.7)						
6.5.6	Are charging points protected against mechanical damage by vehicles? (5.5.8)						
6.5.7	Is there an adequate area available around chargers to allow safe vehicle movement? (5.5.10)						
6.5.8	Is the parking of vehicles in charging areas other than for charging purposes prohibited? (5.5.11)						
6.5.9	Do the charging points have adequate protection from the environment during use? (5.5.12)						
6.5.10	Have suitable provisions been made for isolating each live conductor linked to the charging equipment manually, for use both in an emergency and for maintenance purposes? (5.5.13)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.5.11	Are appropriate devices in place to ensure the safe shutdown of the equipment in the event of failure of the mains electrical supply, or a fault within the charger, with the isolators easily accessible and prominently signed? (5.5.14)						
6.5.12	Where plug in chargers are in use, are the socket outlets undamaged and providing protection against mechanical damage and ingress of water? (5.5.15)						
6.5.13	When a charger is found to be faulty, does its use cease immediately until satisfactory repairs have been made by a competent engineer? (5.5.16)						
6.5.14	Are chargers turned on manually prior to being monitored, even where a timer is used to isolate the power at the end of the charging cycle? (5.5.17)						
6.5.15	Do all portable chargers receive periodic, in service inspections (PAT testing) in accordance with best practice? (5.5.18)						
6.5.16	Is the use of extension cables when charging vehicles avoided? (5.5.19)						
6.5.17	Are chargers only used for the purposes for which they were intended? (5.5.23 and 5.5.24)						
6.5.18	Are all batteries installed according to the manufacturers' instructions? (5.5.25)						
6.5.19	Are all high voltage automobile components and cables coloured orange? (5.5.26)						
6.5.20	Has all damage to high voltage cables been repaired by a competent engineer? (5.5.27)						
6.5.21	Are damaged batteries removed from the building, isolated away from buildings and combustible materials, and their terminals covered and protected from the environment to await collection or safe disposal? (5.5.31)						
6.6	**Compartmentation and segregation (section 5.6)**						
6.6.1	Has a suitable dedicated, enclosed area for the charging of electric vehicles been provided? (5.6.1, 5.6.2 and 5.6.3)						
6.6.2	Where there is access to the premises from a charging area, do the doorset(s) or shutters between this area and any other part of the premises provide at least 60 minutes fire resistance? (5.6.3)						
6.6.3	Are enclosed charging areas not used as work areas, and free from all forms of storage? (5.6.4)						
6.6.4	Are all charging operations carried out at least 10m away from combustible materials? (5.6.5)						
6.6.5	Are charging areas suitably ventilated at high and low level? (5.6.6)						
6.6.6	Are any basement charging areas separated from other parts of the premises by elements of structure that provide at least 120 minutes fire resistance, with careful consideration having been given to the design of their ventilation and sprinkler systems? (5.6.7)						
6.7	**Mobility scooters (section 5.7)**						
6.7.1	In blocks of flats and similar sleeping accommodation, are mobility scooters prohibited from being taken to floors above access level? (5.7.1)						
6.7.2	Are escape routes free from parked or stored mobility scooters? (5.7.2)						
6.7.3	Is the charging of mobility scooters in escape routes prohibited? (5.7.3)						
6.7.4	Do dedicated charging areas for mobility scooters have direct access from outside the building, and do they provide at least 60 minutes fire resistance between the charging area and the remainder of the building? (5.7.5)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.7.5	Where a timer is used to isolate the power at the end of a charging cycle, is the charging process started manually and monitored for a short while before being left unattended? (5.7.7)						
6.7.6	Where portable chargers are in use for mobility scooters in commercial premises, do they receive periodic, in service inspections (PAT testing) in accordance with best practice? (5.7.9)						
6.7.7	Are all chargers intended for use with mobility scooters supplied from a dedicated circuit rather than from one of the ring mains in the premises? (5.7.10)						
6.7.8	Are charging circuits linked so as to be automatically isolated in the event of actuation of the automatic fire detection and alarm system in the building, or failure of the mains power supply (with power circuits configured to require manual resetting of the isolator when the power is restored)? (5.7.12)						
6.7.9	Are RCDs installed where necessary in compliance with the requirements of BS 7671 and the Code of Practice for Electric Vehicle Charging? (5.7.13)						
6.7.10	Is the use of temporary extension leads and block adaptors for charging mobility scooters prohibited? (5.7.14)						
6.8	**Fire protection (section 5.8)**						
6.8.1	Has the automatic fire detection and alarm (AFD) system been installed in all charging areas to a recognised category of installation in accordance with BS 5839-1? (5.8.1)						
6.8.2	Is the AFD monitored either on site or by an off site alarm receiving centre? (5.8.2)						
6.8.3	Is the AFD installation tested weekly in accordance with BS 5839-1, with suitable records being kept? (5.8.3)						
6.8.4	Is the AFD installation periodically serviced and maintained in accordance with BS 5839-1 by a competent engineer, with suitable records being kept? (5.8.4)						
6.8.5	Is the AFD installation interfaced so as to isolate the power supply to all vehicle chargers in the event of the fire alarm actuating? (5.8.5)						
6.8.6	Are a suitable number of appropriate portable fire extinguishers available and immediately accessible in the case of fire? (5.8.6)						
6.8.7	Where chargers run unattended, has an automatic fixed fire suppression system been installed within the fire compartment in which the charging process is being undertaken? (5.8.7)						
6.8.8	Where a sprinkler system is installed, does it provide a suitable degree of discharge throughout the whole compartment in which vehicle charging is undertaken? (5.8.8)						
6.8.9	Where charging points have been installed in an area with an existing sprinkler installation, has the level of protection provided by the sprinkler system been reviewed? (5.8.9)						
6.8.10	Does the design of the sprinkler system include an interface to allow the power supply to all vehicle chargers to be automatically isolated in the event of sprinkler activation? (5.8.10)						
6.8.11	Have the provisions for the retention of firefighting water been reviewed in the light of a prolonged fire involving a lithium ion car battery? (5.8.11)						
6.8.12	Are any alternative fire suppression systems tested and maintained according to the requirements of the relevant British Standard and/or the installer's recommendations by a competent engineer, with suitable records being kept? (5.8.10)						

7 References

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Further reading

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RISCAuthority

administered by FPA Fire Protection Association

Fire Protection Association
London Road
Moreton in Marsh
Gloucestershire GL56 0RH
Tel: +44 (0)1608 812500
Email: info@riscauthority.co.uk
Website: www.riscauthority.co.uk

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