Installer Guide

How you can connect electric vehicle charge points

Brought to you by UK Power Networks and ECA

Contents

List of Acronyms

AC	Alternating current
BNO	Building Network Operator
CT	Current transformer
DNO	Distribution network operator
ECA	Electrical Contractors Association
EESS	Electrical energy storage system
ENA	Energy Networks Association
ESQCR	Electricity safety, quality and continuity regulations
EV	Electric vehicle
EVCP	Electric vehicle charge point
EVCE	Electric vehicle charging equipment (may offer multiple EVCPs)
GSM	Global system for mobile communications
HSE	Health and Safety Executive
IET	Institute of Engineering & Technology

MET	Main earthing terminal
MOCOPA	Meter operation code of practice agreement
Ofgem	Office of gas and electricity markets
OZEV	Office for zero emission vehicles (previously OLEV)
PEN	Protective earthed neutral
PME	Protective multiple earthings
RCD	Residual current device
SME	Small to Medium Enterprises
SPDs	Surge protection devices
SPN	Single Phase network
TPN	Three phase network
UKPN	UK Power Networks
UMC	Un-metered connection
V2G	Vehicle to grid

Introduction

UK Power Networks

We are the UK's largest distribution network operator (DNO). We own, maintain and operate all of the wires, cables and substations of the electricity distribution network across London, the South East and East of England. Our core role is to keep power flowing safely, efficiently and reliably while providing excellent customer service to more than eight million homes and businesses in their areas.

We also have a critical role at the heart of the future energy landscape, enabling the transition to Net Zero carbon emissions by connecting renewable energy, electric vehicles and heat pumps.

ECA

ECA is the UK's largest trade association representing electrical, electrotechnical and other engineering contractors in England, Wales and Northern Ireland at regional, national and European level. ECA Member companies are rigorously assessed before membership is approved.

They have a combined turnover in excess of £6 billion annually. Member firms carry out design, installation, inspection, testing, maintenance and monitoring activity across the domestic and commercial and industrial sectors. This ranges from power and lighting to data communications, to energy efficiency and renewables, as well as the design and installation of cutting-edge building control technologies.

ECA's 2,700 members range from SME electrical firms to nationwide engineering contractors and building services firms that employ thousands of professionals on major UK projects. ECA Members also support over 5,000 apprentices annually.

In this Guide

This is a technical guide for electric vehicle charge point (ECVP) installers. Based on their feedback, the guide will help installers through the connection process and highlights the main considerations when installing electric vehicle chargers. View the current IET code of practice for electric vehicle charging equipment installation'.

Connection requirements from DNOs

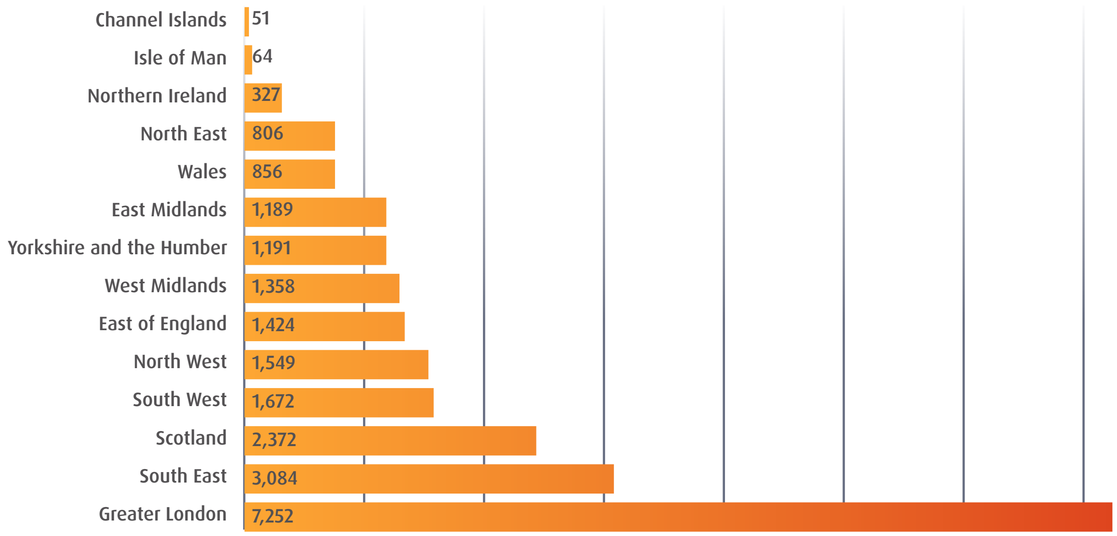
DNO connection types for EV chargers

There are nine different type of supplies that can be used for EV charge points on UK Power Networks. These are summarised in Table 1 on page 8. Check what DNO supplies any property by checking here:

Find your energy supplier - Energy Networks Association (ENA)

Brief on the changing electrical landscape regarding future electrical systems

In the UK, the sale of new petrol and diesel cars and vans will end by 2030. This is one of the major actions cementing the UK's global leadership on tackling climate change. There are already over half a million EVs registered in the UK. UK Power Networks' distribution area is currently at the forefront of the switch, with an estimated 29% of all vehicles in our licence areas. Despite the impacts of the COVID-19 pandemic, 2020 saw the biggest annual rise in the number of EV registrations; increasing the total number of EVs by over 70% within one year.



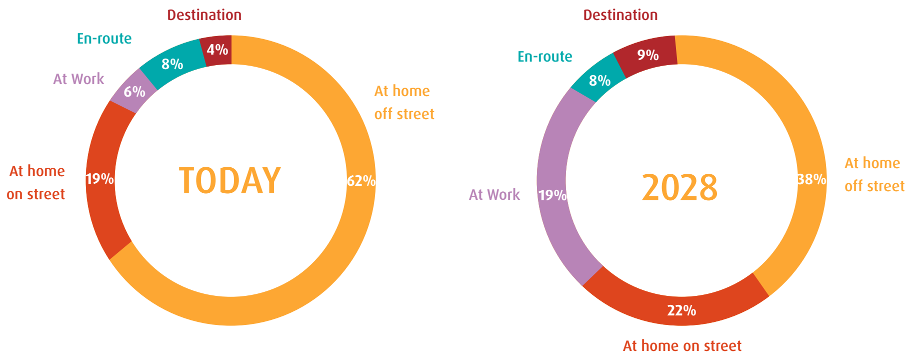
SOURCE: ZAP MAP STATS

Figure 1 Number of devices per region (April 2021)

Brief on the changing electrical landscape regarding future electrical systems

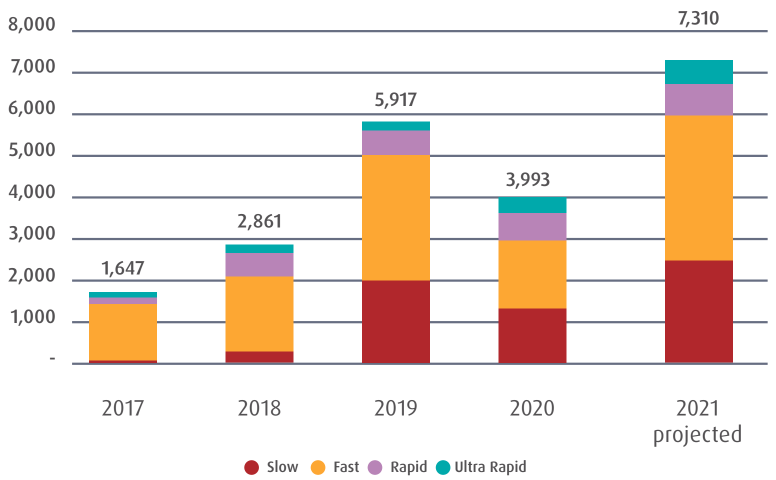
The vast majority of EV charging takes place at home, with only 18% of charging happening at work, en route or at destination. This is projected to change slightly over the next decade, with more charging happening at work or at destination.

Figure 2 Charging segments in 2019 vs charging segments in 2028



There are now 40,000 public charge point connectors spread across 15,000 locations in the UK. The rate of installation in 2021 is on track to deliver almost 7,500 new chargers, which is twice as many charge points as were installed in 2020. Despite this improvement, a survey by the Electric Vehicle Association revealed that overall satisfaction rating with the state of public charging infrastructure was just 2.16 out of 5.

Figure 3 Public charge devices installed in the UK per annum



SOURCE: ZAP MAP STATS

Installation processes

DNO process for a single EV charger

Whilst each Distribution Network Operator has their own technical standards, they all follow the same process which is published by the Energy Networks Association. The customer or a competent tradesperson must assess their installation to determine what is required. The two possibilities are:

- Connect and notify
- Apply to connect

The same form is used in both instances. However, for any installations in the UK Power Networks licence area, Smart Connect can be used.

Table 1: EVCP supply overview (replicated from EDS 08-5050)

Type	Total MPR Available (kVA)	Max Single EVCP (Typical CPs)					Sections
		3kW	7kW	15kW	22kW	50kW+	
UMC	5.75	✓	x	x	x	x	5.1
100A SPN Highway	23	✓	✓*	✓†	✓†	x	5.2
100A TPN Highway	69	✓	✓*	✓†	✓†	✓†	5.3
100A SPN Domestic	23	✓	✓*	✓†	x	x	5.4
100A TPN Domestic	69	✓	✓*	✓†	✓†	x	5.4
Large LV	≤1500*	✓*	✓*	✓*	✓*	✓*	5.5
HV Supplies	Limited by MPR	✓*	✓*	✓*	✓*	✓*	5.5
EHV Supplies	Limited by MPR	✓*	✓*	✓*	✓*	✓*	5.5
Multi-Occupied Building	Limited by MPR	✓*	✓*	✓*	✓*	✓*	5.5

x Not possible from this connection type.
✓ Possible to connect without additional assessment.
✓† Possible to connect subject to thermal capacity and harmonic assessment, refer to section 5.5.
✓* Possible to connect multiplr EVCPs available subject to thermal capacity and harmonic assessment of an existing or proposed connection type.

SPN – single phase network **TPN** – three phase network **UMC** – unmetered connection

Summary of ENA process: Installer Checklist

1. **Features of the connection**
   - **a.** Do you know the DNO cutout rating? If the cut out rating is unknown or uncertain, it can be established by speaking to your supplier. The supplier is responsible for providing this information and organising the safe isolation if required.
   - **b.** Is the service looped? Some DNO cut-outs have more than one DNO service cable terminated in the cut-out. Looped services can be found anywhere but are often found in rural areas and terraced housing.
   - **c.** Is the supply unmetered?
2. **Safety check**
   - a. Do you have any concerns over the adequacy of the DNO service equipment? Any concerns should be reported to the DNO. Guidance can be found in the MOCOPA document on the specifics, and examples of various cut-outs in the ENA document
3. **Maximum demand**
   - **a.** Does the max demand exceed the cut-out rating? Maximum demand is the highest level of new demand that could occur on the whole customer connection and includes all new HP and EV devices. The maximum cut-out rating may be visible on the cut-out. Ratings below 60 A are possible (e.g. 30 A, 40 A and 45 A), especially in rural areas. Note that the cut-out rating will be reduced from its stated value if the ambient temperature at the cut-out location is high e.g. due to inadequate ventilation, adjacent heat sources etc.
   - **b.** Is the max demand greater than 13.8k VA per phase? IET Guidance Note 1, Appendix H gives qualified electricians guidance on the assessment of Maximum Demand for the whole customer connection.

Note: No diversity is permitted for the EVCP circuit although load curtailment (either reduction or disconnection) may be taken into account as per regulation 722.311.201

If any of these are applicable, you must apply to connect

- Customer has a looped or unmetered supply
- It is a DC EV charge point
- Max demand above 13.8 kVA without a CT metered supply
- Max demand above 13.8 kVA and max AC output of the EVCP is greater than 30% of the Max Import Capacity. (note:this is specific to UK Power Networks)
- Alternatively, if there is not the required capacity and the client isn't willing to pay for additional capacity, then the maximum charge capacity could be restricted within the EVCE, to allow the total energy demand to remain within the limits of the supply. This is often a simple procedure such as altering the setting of a potentiometer.

Smart Connect

Smart Connect can be used for EV Charge Point connections within a single premise or domestic property, which has an existing electricity connection of up to a three-phase supply with 100 A per phase. It can be used for regular charge points as well as vehicle-to-grid (V2G) charge points. It can also be used for installing battery storage, solar PV or a heat pump.

Smart Connect has all of the requirements from the ENA process built into it, and includes an automated assessment to reduce processing times.

More information including a link to register and access the tool:
Smart Connect | UK Power Networks

DNO Process for installing large or multiple chargers

Whether you are installing Electric Vehicle Charge Points as part of your development or looking to build a standalone charging hub, UK Power Networks can help ensure you get the most efficient, cost effective connection to the network. We have introduced specialist pre-application support to make sure you get your application right first time.

More information here:
Installing larger or multiple chargers | UK Power Networks

Installing chargers on the public highway

DNOs provide metered electricity connections to electric vehicle charging points on the public highway. For safety and reliability, it is vital the appropriate standards are followed. To set up an electric vehicle charging point on the highway you should complete a Highway Metered Services Request form.

More information can be found at:
Highways | UK Power Networks

Town and country planning order 2015

This is an important rule for charging installers. It states that planning is not required for installation of an upstand with an electrical outlet mounted on it for recharging electrical vehicles so long as the area is lawfully used for off-street parking. However local controlling authority permission may be required depending on the circumstances of the installation.

For on-street public charging equipment a Traffic Management Order (TMO) may be required, which can result in a long lead time.

Technical Considerations

EVCP Location

It is important to carefully consider the following points when deciding on the location of an EVCP:

- Potential trip hazards, such as trailing charging leads should be avoided
- Tethered cable storage should be made available
- Space should be considered for suitable ventilation particularly for rapid and ultra-rapid DC charging equipment
- Ease of access and maintenance should be factored in to any design
- Chargers should be provided with mechanical protection from impact by a vehicle through such measures as, bollards, tyre stops or a protective cage
- Adequate lighting should also be available for safe connection and use of an EVCP
- Public charging points need to be sited so as to accommodate the widest diversity of need as per the Equality Act 2010. This will include wheelchair users, parents and those with mobility issues.

Installing EVCPs in potentially explosive atmospheres

EVCP should not be located in areas where a potentially explosive atmosphere exists. It is essential that any EVCP equipment and potential connected vehicles are located outside of defined hazardous zones.

For installations on Petrol Retail Forecourts, installers are required to be trained and qualified under the Petrol Retail Forecourt Contractors Safety Passport Scheme, and / or under CompEx.

If a separate electricity supply is provided for the EVCP, it is important that the EVCP equipment is connected to the same TT earthing system as the forecourt (note PME is not permitted in forecourts). This supply must also be interlocked with the filling stations main switch.

Determining Maximum Demand

To identify maximum demand, please refer to existing records if they are available, these will often contain the information required.

If existing records are unavailable, the DNO should be contacted to ascertain the available supply.

UK Power Networks and suppliers do not permit anyone other than authorised staff to open cutouts. Once the fuse size has been confirmed, if you need to arrange for a fuse upgrade please see our webpage here : Fuse upgrade | UK Power Networks

Alternatively, follow the process of design of the installation for maximum demand calculated with diversity. The IET Guidance Note 1: Selection & Erection contains guidance on completing a maximum demand calculation.

Note: No diversity is permitted for the EVCP circuit unless load management is in place.

A power and energy logger could also be employed over a period of time to ascertain the load balance for a 3-phase supply.

Clamp meters can be used across each phase, with the client switching on all equipment (within reason) to give an indication of the demand on the phases. This reading could then be compared with the design information if available.

Site survey and permissions

It is important to gain permission from the client when conducting site surveys.

Notify the client or the tenant when the power will be turned off and consider any mission critical or medical equipment.

Regulation 132.16 states:

Additions and alterations to an installation

No addition or alteration, temporary or permanent, shall be made to an existing installation, unless it has been ascertained that the rating and the condition of any existing equipment, including that of the distributor, will be adequate for the altered circumstances. Furthermore, the earthing and bonding arrangements, if necessary for the protective measure applied for the safety of the addition or alteration, shall be adequate.

Check the origin of the installation:

- Service Cable
- Service head
- Earthing arrangement
- Meter tails
- Metering equipment
- Isolator (where present)

Check for parallel or switched alternative sources of supply such as:

- Solar PV
- Generation equipment
- Electrical Energy Storage System (battery)

Ensure that any additional generation equipment is capable for the additional EV loading.

Is Automatic Disconnection of Supply (ADS) present?

Inspect the existing electrical installation and ascertain whether there are issues which should be resolved prior to the installation of the EVCE. If this is the case do not do the work until these are rectified

Note: Make use of the comments box on an installation certificate highlighting existing works which wouldn't impede the installation but that the client should be aware of.

If connecting the EVCP to a public supply that is unmetered, contact the DNO for a new metered supply. Examples include on-street parking or carparks where the supply is through distribution network operator or a building network operator (BNO).

If supply is metered and provided by a landlord then permission will be needed by them prior to the installation to the supply. If this is refused, then an alternative connection will need to be applied for from the BNO or DNO.

If the EVCP will require payment for charging, then tariff metering will need to be provided as per the Electricity at Work Regulations 1989. The selling of electricity for charging will require Ofgem compliance as well as making the installation not applicable for OZEV funding.

Metering may also be required for energy management as per Building regulations approved documents:

L2A: Conservation of fuel and power in new buildings other than dwellings

L2B: Conservation of fuel and power in existing buildings other than dwellings

Considerations for communication connectivity

For increased functionality, such as smart control (programming charge times) Wi-Fi or GSM connectivity may be required. In areas of poor signal, a hard-wired data connection could be made back to the router. Special cables are available combining both power and data. It is recommended to consult with the manufacturer to verify the suitability and conformity of cables used.

Surge Protection Devices

SPDs are a consideration (see sections 443 / 444 in BS 7671 The Wiring Regulations) and are required where being provided as a publicly accessible service.

A risk assessment according to Regulation 443.5 shall be carried out to determine if SPDs are required except for a single dwelling unit where SPDs may be omitted where the total value of the installation and equipment therein does not justify such protection.

For commercial installations, SPDs may already be installed. It is important to check the length of the circuit providing the EVCP and if in excess of 10 m a local SPDs should be used. These would likely need to be type 2 due to the limitations of current rating and cable size attributed to type 3 SPDs.

Earthing Arrangements

TN-C-S and TN-S

The IET Wiring regulations BS 7671 has specific requirements regarding installing an EVCP on PME earthed systems. Whilst an EVCP is essentially supplied by a straight-forward radial circuit, additional protection is required to protect against a potential open-PEN event. An open-PEN event is where a break occurs in the Protective Earthed Neutral (PEN) on the distribution network supplying the building. Neither circuit breakers, nor RCDs are able to detect and provide protection against these events. It should be noted that open-PEN events are infrequent and risk of shock from such an event is minimal.

Section 722 of BS 7671 explicitly states that PME isn't permitted unless certain conditions are met.

Regulation 722.411.4.1 has specific requirements for when PME earthing can be used which are summarised on the next column.

(i) relies on the principle, that in balanced three phase systems, the current balance will 'hold the neutral' in place, with respect to reference earth, provided that certain issues such as power factor and harmonics are considered.

The designer will have to consider these values in detail, especially the likelihood of the load balance being sustained during the usage and life of the installation as it is difficult to protect against future changes to the electrical system, including external influences for other buildings. Long term power monitoring recommended for commercial installations to correctly identify the loading and balance.

(ii), relies on the principle of an additional earth electrode – supplementing the TN-C-S earthing facility, and providing sufficiently low earth loop impedance at all material times to limit shock voltages, should the main PME pen conductor fail to open circuit.

BS7671 A722.3 gives a useful equation that may be used in this respect as well as useful information in AnnexG of IET code of practice for electric vehicle charging equipment installation 4th edition

The designer will however have to ascertain the maximum demand current of the whole installation if single phase, or the maximum neutral current for the whole installation if three-phase.. Once this has been assessed and the equation applied, suitable maximum earth impedance for the supplementary electrode(s) can be arrived at. It will be found however, that this electrode impedance will be very low – typically in the order of 10 ohms or less, which may be impracticable, or often impossible to achieve - even with multiple electrodes.

(iii) relies on a specific Open PEN detection device, which monitors the voltage between the installation earth connection and a reference true earth taken at a sampling electrode. Should a dangerous touch voltage occur between these two references, exceeding a specified time, the device disconnects the live conductors and the source earth connection – in a predetermined time sequence. An earth electrode is required to monitor the true voltage differential between the installation earth and true earth (this of course would not need to be sized to 'shunt' any fault current as would be the case with a TT Earth electrode).

(iv) this permits the use of an open-PEN detection device which provides protection by monitoring the utilisation voltage at the chargepoint and disconnecting all conductors (line, neutral and earth), should the utilisation voltage **at the charging point** go above or below 10% of the nominal voltage (207V -253V). This device can either to be built into the EVCE but could also be employed in series.

Note: When an installation is deemed single phase, it is important to use a single phase protective device satisfying 722.411.4.1(iv) and where deemed three phase to use a three phase device satisfying 722.411.4.1(iv). If the situation is ambiguous for any reason, (such as a lack of access), the advice is to speak to the open PEN device manufacturer for clarification on the particular case at hand. (For example- an industrial unit with a single-phase supply, being taken from a three-phase main supply).

(v) allows a new technology to be used that can provide protection to EVCPs that is no less safe than those permitted in BS 7671:2018 amendment 1.

Note: Open-PEN devices and onsite generation / EESS issues

Note: Installations with onsite generation and / or Electrical Energy Storage Systems (EESS) may inadvertently cause these devices to trip. In order for generation and EESS to be able to 'push' their energy onto the network / building supply, they export at a voltage above that detected by the supply. If the building is connected to a network with a high supply voltage (ESQCR permits 230 V +10% / -6%), this could result in export voltages above the 253 V permitted by these devices. This is likely to be exacerbated on very sunny days where a PV system is operating at maximum capacity.

Conversely, under voltage may also present itself. The ESQCR permits 230 V – 6% as the minimum supply voltage equating to 216 V. If the maximum rated voltage drop (5%) for an installation is applied (230 x 0.05) 11.5 V can be lost.

This would then lead to a voltage of 216 V – 11.5 V = 204.5V being detected at the EVCP or at the O-PEN monitoring device where it is installed at the end of the radial circuit. If this is the case, it may therefore be prudent to design the circuit provided for the EVCP with a lower volt-drop of 1-2% to prevent this, although this would entail using conductors with an increased cross-sectional area.

Some open-PEN detectors are designed to be located at the origin of the circuit thus eliminating this issue.

Protective Measure: Electrical Separation (722.413)

Electrical separation is an option for providing protection against open PENs for an EVCP. This would be through the use of a fixed isolation transformer. However, these can be expensive, heavy and may prevent certain types of EV from charging due to earth referencing required during their initial 'handshake' with the EVCP.

Note: TN-S
Unless it can be guaranteed that the supply to the building is TN-S all the way back to the sub-station, it should be assumed to be a TN-C-S PME system, even if they were originally constructed using separate neutral and earth (SNE) cables. However, for a private network where it is guaranteed to be TN-S, no special conditions apply and the EVCP can be connected as a straight-forward radial circuit.

TT

For buildings on an existing TT earthing system, or where the building is being converted to a TT earthing system or where the EVCP will solely be connected via TT earthing system.

In these situations, specific RCD / RCBOs must be used. Either types A, B or F.

If an additional upstream 30 mA RCD is provided in the consumer unit, additional protection will be provided for the cabling to the EVCP. If the EVCP is to be installed using surface mounted cabling or through the use of SWA or similar, an upstream RCD is not required.

If a type A RCD is used to protect an EVCP without RDC-DD this should not be installed downstream of a standard type AC RCD as this may impair its functionality. The installer should consult with the EVCP manufacturer to clarify the requirements.

Providing TT earthing for the EVCP

One option is for the EVCP to have its own TT earthing arrangement.

However, this may not always be the best solution as there are specific considerations to take into account such as:

1. **Separation distance from buried underground services**

   It may not always be possible to provide sufficient separation from buried metalwork connected to the supply PEN conductor. If an open-PEN fault condition was to occur, any voltage that appears on buried metal work connected to the PEN conductor may also appear on the vehicle or the EVCP connected via the earth electrode. It is therefore important to consider the distances between electrodes and buried metallic services.

   Table 3 shows the recommended minimum separation distances below ground between buried conductors and earth electrodes of a TT system from those connected to a PME or TN-S earthing system:

   More information can be found in annex H of the IET Code of Practice for Electric Vehicle Charging Equipment Installation.

2. **Exposed and extraneous-conductive-parts**

   It is also important to ensure that simultaneous contact between exposed or extraneous-conductive-parts connected to the TN-C-S supply and the electric vehicle is not possible. This includes any parts on neighbouring properties.

3. **Simultaneous Contact Assessment**

   Regulation 411.3.1.1 states that:

   Simultaneously accessible exposed-conductive-parts shall be connected to the same earthing system individually, in groups or *collectively*.

   Therefore, if an EVCP is installed on a TT earthing system, it is important to ensure that persons cannot simultaneously touch the EV, and another exposed extraneous part that is connected to a differing earthing system such as the building, or neighbouring buildings TN-C-S. It is essential that a simultaneous contact assessment is carried out.

4. **Hazards of hidden underground services**

   Without the use of specialist equipment, such as a cable avoidance tool, it is difficult to identify hidden unmapped underground services. These could include electric cables, gas pipes and water pipes. There is obviously a danger to the installer and the client if these are damaged through the installation of an earth electrode.

   The Health and Safety Executive (HSE) guidance HSG47 offers advice on avoiding dangers from underground services.

5. **Electrode Corrosion**

   Earth electrodes will corrode over time and eventually may need to be replaced. It is therefore important that testing of the electrode is noted as being required on future servicing and maintenance.

   Note: Multiple EVCPs can be earthed from a single earth electrode connection

Table 3: Recommended minimum separation distances below ground between buried conductors and earth electrodes of a TT system from those connected to a PME or TN-S earthing system

Purpose of TT system	Recommended minimum separation distance D	Worst-case voltage fraction transferred	Voltage transferred for an earth potential rise of 253 V rms on a PME earthing system
Whole installation conversion to TT	10 m	10.0%	25 V rms
TT provided for charging equipment only (other than on-street)	2.5 m	27.5 %	70 V rms
TT system for on-street charging equipment	2.0 m	30.0%	76 V rms

Converting building from TN-C-S to TT earthing system

One option is for the electrical installation for whole building to be converted to a TT earthing system. This would mitigate against the issue of exposed or extraneous conductive parts from the site in question, but consideration should still be made for issues of proximity of neighbouring properties PME systems and also for hidden underground services.

There is the possibility of increasing the earth loop impedance (Zs) and exceeding the maximum values required for existing circuit protection. A high Zs can be mitigated through the use of an RCD, but these must be designed to be factored in with any existing RCDs in the circuit, including any within the EVCP itself.

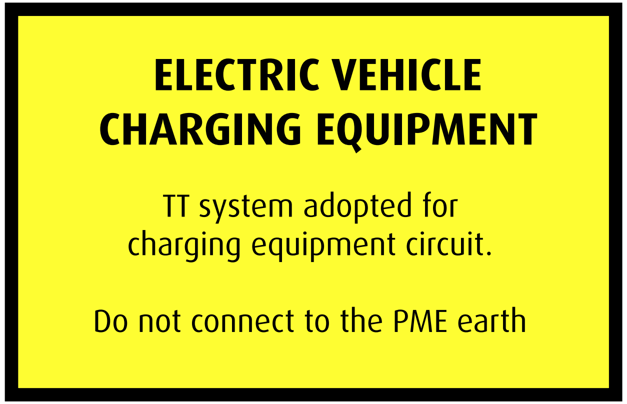
In either circumstance if the EVCP is installed via a TT earthing system or if the whole building is converted to TT from TN-C-S, a warning notice stating this must be provided. An example of which is shown in Figure 4.

Earth Electrode Resistance

If the use of an additional earth electrode is required, for example, in converting the building or the EVCP to TT, or to allow the use of PME, then it is important that this complies with regulation 544.1.1. The resistance of the electrode should be such that the maximum voltage between the main earthing terminal of the installation and Earth in the event of an open-circuit fault in the PEN conductor of the low voltage installation does not exceed 70 V rms.

Note: Information on calculating this earth resistance is provided in A722.3 of The Wiring Regulations BS 7671.

Figure 4: EVCE warning notice



Inspection and testing requirements

This section of the document is not intended to inform individuals or organisation how to undertake the relevant inspection and testing, this should be familiar to any practitioner. Reference should be made to material such as the IETs Guidance Note 3, however, the information below may be of use.

The inspection and testing requirements for an EVCP circuit are similar to the requirements for a standard radial circuit.

Inspection of the installation should be carried out as per BS 7671 and the details completed on an appropriate Electrical Installation Certificate such as those found in Appendix 6 of BS 7671 or on the ECA website.

Prior to any work being undertaken, the requirements of Regulation 132.16 of BE 7671 should have been met to ensure that the installation is suitable for the addition or alteration and the requirements of Regulation 644.1.2 stipulates that any defects that affect the safety of the addition or alteration should be corrected.

All relevant dead tests should be completed prior to energisation, when the live tests may be (where relevant) conducted.

The common tests required for an EVCE circuit are:

- Continuity
- Insulation resistance
- Polarity
- Adequacy of earth electrode (where relevant)
- Earth fault loop impedance
- Residual current device

Continuity of conductors

A continuity test should be carried out to ensure that all protective conductors are suitable and present. The results should be recorded on the schedule of test results in either the R1 or the R1+R2 column.

Insulation resistance

Insulation resistance testing is to be undertaken to ensure that the conductors are not damaged throughout their length.

The test is likely to be undertaken at a voltage of 500 V DC, as per Table 64 in BS 7671.

It is important to ensure that this test does not damage the EVCE which may need to be disconnected from the circuit prior to the test taking place.

The outcome of the test should be a minimum value of 1 MΩ, although this is likely to be far higher.

Polarity

The purpose of the polarity test is to ensure that the cables are terminated in the correct location and that any switching is, where relevant, in the phase conductor (or combined). In many cases this test will be proven by undertaking the aforementioned continuity tests. For poly-phase systems however this may need further consideration.

Earth electrode Testing

Where the designer has utilised an earth electrode, this should be measured to ensure it has a suitable resistance. This test, R_A, can be done in 2 methods, the most common is using an earth fault loop impedance tester, though a fall of potential method is also acceptable.

Where an earth electrode is used a maximum value of 200 Ω is recommended as anything above this could be unstable. However, depending on the type and rating of the RCD installed, values in excess of 1000 Ω may be acceptable.

Earth fault loop impedance

The earth fault loop impedance should be measured (or calculated) and compared against the relevant tables in BS 7671 for the selected overcurrent protective device.

RCD Testing

For most EVCE installations the RCD shall be verified for providing additional protection. In this case, an RCD meeting the requirements of Regulation 415.1.1 of BS 7671 is deemed as suitable if it disconnects within 40 ms when tested at a current equal to or higher than five times its rated residual operating current.

Additional tests may be useful, though they are not required.

Phase Sequence (3 phase)

It may be possible to visually check that the phases have been installed in the correct sequence throughout the installation.

Alternatively, an electronic phase rotation check can be conducted.

Functional Testing

Through the use of dedicated test equipment, it is possible to fully test the functionality of the EVCE by simulating an EV being connected. This would ensure that the charger functions as intended and conducts and responds to the relevant ‘handshake’ communication with a vehicle. These tests are not required in BS 7671 but may be useful.

V2G EV Chargers

Vehicle to Grid (V2G) services have been successfully trialled globally and it is anticipated that the number of these connections will increase, thereby aiding in grid flexibility. National Grid ESO anticipate 45% of consumers engaging in V2G services by 2050 in their leading the way scenario in their 2021 Future Energy Scenarios.

The number and size of the V2G chargers in your project will determine what type of application form is needed. Multiple and large installations can’t use Smart Connect, and must use the application forms on our website. More guidance on the dedicated website page: Vehicle to Grid | UK Power Networks.

Other useful links

ENA EVCP and Heatpump Connections Process Flowchart

ENA EVCP and Heatpump Connections Form

https://www.gov.uk/government/publications/register-energy-devices-in-homes-or-small-businesses-guidance-for-device-owners-and-installation-contractors/register-energy-devices-in-homes-or-small-businesses-guidance-for-device-owners-and-installation-contractors

Home: V2G Hub | V2G Around the world (v2g-hub.com)

EDS 08-5050 Electric Vehicle Connections (ukpowernetworks.co.uk)

EDS 08-2101 LV Customer Supplies up to 100A Single Phase (ukpowernetworks.co.uk)

EDS 08-2100 LV Customer Supplies (ukpowernetworks.co.uk)

EDS 08-1103 Multi-Occupied Building Supplies (ukpowernetworks.co.uk)

EDS 08-1101 Inset Networks (ukpowernetworks.co.uk)

Best Practice Guide 4 Electrical installation condition reporting (electrical safety first)

IET Wiring Regulations BS 7671

IET - Guidance Note 1: Selection & Erection, 8th Edition

IET code-of-practice-for-electric-vehicle-charging-equipment-installation-4th-edition

Health and Safety Executive (HSE) guidance HSG47

National Grid ESO Future Energy Scenario

ECA Members

ECA Members can download editable PDF checklists and risk assessments for a range of **EVCP installations**

You can find out more about membership benefits and joining ECA **here**