IET Standards

Guide to Highway Electrical Street Furniture

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Electrical Street Furniture

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The Institution of Engineering and Technology,
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Six Hills Way, Stevenage,
SG1 2AY, United Kingdom.

Copies of this publication may be obtained from:

The Institution of Engineering and Technology
PO Box 96, Stevenage, SG1 2SD, UK
Tel: +44 (0)1438 767328
Email: sales@theiet.org
www.electrical.theiet.org/books

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Acknowledgements

Allan Howard	WSP
Gareth Pritchard	HEA (to November 2017)
Dave Franks	Westminster City Council
Mark Moscrop	WSP

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HEA
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LoLEG

Introduction

New technologies and systems that provide a greater range of services to the public are now available to local authorities and other property asset owners and are easily enabled through their asset base. Such equipment includes, but is not limited to:

(a) public lighting, illuminated signage, bollards and infrastructure;
(b) architectural lighting (uplighters, under bench, art works etc.);
(c) electric vehicle charge points;
(d) market trader pillars (including event pillar requirements);
(e) event supplies;
(f) bus shelters; and
(g) 'smart city' and communication technologies and other 'on-street' electrical equipment (for example, electric bike chargers).

Note: For smart city technologies see 'highway electrical supplies'.

Such facilities can bring a number of community and public service benefits, for example:

(a) enhanced economic growth;
(b) investment in a local area;
(c) improved environmental considerations;
(d) provision of one or more services; and
(e) improved information sharing.

Safety first

However, this equipment needs careful consideration and understanding to ensure that it is not only provided efficiently and safely but that it fits into the existing 'streetscape' – not just from an aesthetic perspective but also to ensure that it can be constructed, maintained and operated. It is important, when considering such services, that the local authority/asset owner acts reasonably and sensibly to assess the opportunities that these new technologies bring.

This Guide will help the local authority/asset owner in this assessment by setting out the electrical requirements and obligations for traditional electrical street furniture as well as the requirements and risks that come with introducing new technologies and services.

Much of this equipment requires an electrical supply. This Guide addresses the electrical safety considerations and requirements relating to all electrical street furniture that may be expected to be found within the public realm.

Aim of this Guide

The aim of this Guide is to raise awareness of the electrical safety requirements for such features. It essentially 'walks' readers through the process, requirements and risks that need to be considered, including:

(a) how the client can assess the competency of the designers, installers and other duty-holders involved, ensuring that they meet their legal obligations under the Construction, Design and Management (CDM) Regulations.
(b) the approach to be followed over the full lifecycle of the equipment, from the point of identifying the need for new services through to evaluating the capacity of the existing network to ensure that it can accommodate the required electrical loading to design, as well as the installation, operation and maintenance of the equipment.
(c) assessing the structural loading, for example, of lighting columns, as other items of equipment are attached to them. The specific requirements of relevant different forms of electrical supply and earthing to such equipment are also discussed.
(d) the requirements for those wishing to use third-party supply points.

This Guide does not replace the need for technical knowledge and competence and does not look to duplicate what already exists within standards and published guidance. Where applicable, reference is made to such documentation.

SECTION 1

Legal

1.1 Powers and duties

The provision of electrical supplies has many community benefits, including facilitating the use of electric vehicles, enabling events and improving economic growth through local markets/street traders.

When reviewing the provision, maintenance and operation of such electrical installations within the highway for third-party use a local authority/asset owner must take into account the following:

(a) the obligation to act reasonably – failure to do so could lead to a review in the Courts.
(b) the requirement under Section 17 of the Crime and Disorder Act 1998 to have regard to the need to do all it reasonably can to prevent crime and disorder.
(c) the fact that where a local authority/asset owner provides the supply point, it is then the responsibility of the user to ensure that any equipment they connect to the service point is fit for purpose. The service provider must clearly communicate the suitable conditions of use to the user so that the user can connect equipment that is fit and suitable for purpose.

1.2 Managing risk

The objective of managing health and safety at work is to identify and remove or reduce hazards so that the possibility of injury is reduced. This principle is covered under the Management of Health and Safety at Work Regulations (MHSWR).

It is not the intent of this section to detail all requirements with respect to the management of risk as anyone undertaking design, installation, and maintenance and decommissioning has to meet the required competencies required under the CDM Regulations. However, there are a number of key elements that are worthy of mention:

(a) the Health and Safety at Work Act (HASAWA) Section 2 sets out the duties of employers to employees, requiring employers to ensure, as far as is reasonably practicable, the health, safety and welfare of their employees at work.
(b) similarly, Section 3 of HASAWA requires employers to conduct their undertaking in such a way that the health and safety of persons other than employees, including the general public, are not at risk.
(c) MHSWR takes this further and places an absolute requirement on the employer to carry out suitable and sufficient risk assessments.

The main stages in undertaking any risk assessment are:

(a) identify the hazards, i.e. anything with the potential to cause harm;
(b) identify who may be harmed;
(c) assess the risks and extent of the risks;

(d) identify any existing controls that are applicable;
(e) identify the required standard;
(f) identify what preventative and protective measures/actions need to be carried out, by whom and when in order to reach the standard required – this may require the production of method statements detailing the steps that make up the mitigation process;
(g) ensure that equipment is appropriately CE labelled and that the supporting technical documentation is provided;
(h) record the process;
(i) review and revise as necessary; and
(j) approval and sign off.

1.3 Construction Design and Management (CDM) Regulations

The CDM Regulations 2015 (CDM 2015) set out what those involved in construction work need to do to protect themselves and others.

The fundamental requirements of CDM 2015 are that:

(a) all duty-holders – designers, principal designers, contractors, principal contractors and workers – must not accept an appointment to undertake a role unless they have the skills, knowledge, capacity and experience and, if they are an organisation, the organisational capability, necessary to fulfil the role in a manner that secures the health and safety of any person affected by the project.
(b) any duty-holder appointing a designer, principal designer, contractor or principal contractor must take reasonable steps to satisfy themselves that the proposed appointee fulfils the above conditions.
(c) clients must make suitable arrangements for managing a project including the allocation of sufficient time and other resources. These arrangements must be maintained and reviewed throughout the project.
(d) all duty-holders must cooperate with any other person working on or in relation to a project or an adjoining construction site to the extent necessary to enable that person to fulfil their duty or function.

This applies to any party involved within the design, be it at the concept stage or feasibility stage through to detailed design, specification and construction stages.

It is necessary that staff involved in working with highway equipment, including contractors undertaking installation and/maintenance work, are deemed competent. Such competency will be met through registration in one of two ways:

(a) for staff who carry out site surveys and who need to access electrical equipment: the organisation and the staff must register with the Highway Electrical Registration Scheme (HERS) with an Electrotechnical Certification Card (ECS), which is affiliated to the Construction Skills Scheme (CSCS) – www.thehea.org.uk/HERS.
(b) for staff who do not require access to electrical equipment but are working on or near such equipment, it is preferable that they are registered under the HERS/ECS Scheme. The organisation's risk assessment may also show that CSCS alone is acceptable – www.cscs.uk.com/.

1.4 Health and safety

The Health and Safety at Work etc. Act Section 3. (1) states:

"It is the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be affected thereby are not thereby exposed to risk to their health or safety."

The Health and Safety at Work etc. Act Section 3. (1) and the Electricity at Work Regulations 1989 are legally binding and can be used as a vehicle for criminal prosecution should an accident arise due to a breach of a regulation. Such a prosecution would require the defendant to prove their innocence for it to be overturned.

All of the Electricity at Work Regulations 1989 must be adhered to and the following regulations are particularly relevant:

(a) **Regulation 3** places duties on employers, employees and the self-employed to comply with the regulations related to matters that are under their control and employees to co-operate with their employer.
(b) **Regulation 4** requires that all electrical systems should, so far as reasonably practicable, be of safe construction and maintained in that state. All work being carried out on or near systems must be carried out in such a manner as to avoid danger. Any protective equipment provided must be suitable and properly maintained and used.
(c) **Regulations 5 to 11**, in effect, place a duty to ensure that electrical equipment is suitable for where and how it is to be used, and is adequately protected.
(d) **Regulation 5** states that no electrical equipment should be connected to a system if there is a chance that its strength and capability may be exceeded in such a way as to cause danger.
(e) **Regulation 6** requires all electrical equipment that may be exposed to the following elements must be constructed or protected so that danger does not arise:
  - **i** mechanical damage;
  - **ii** the effects of weather, natural hazards (animals, trees and plants etc.);
  - **iii** the effects of wet, dirty, dusty or corrosive conditions; and
  - **iv** flammable or explosive substances.

(f) **Regulation 7** states that any conductor in a system (i.e. anything that conducts electricity) should either be insulated or protected in some other way from giving rise to danger.
(g) **Regulation 8** requires suitable methods of earthing.
(h) **Regulation 9** requires earthing conductors not to have their electrical continuity broken by anything that could give rise to danger.
(i) **Regulation 10** requires that all joints and connections must be suitable for safe use.
(j) **Regulation 11** requires that systems must be protected from excess current.

Any person who has a duty under Regulations 4(4), 5 and 8-11 can, in any criminal proceedings, use the defence that they had taken all reasonable steps and exercised all due diligence that is reasonably practicable to avoid the offence (but would need to prove this claim).

Note: Guidance above taken from Public and Commercial Services Union – Electricity at Work Regulations 1989 – legal guidelines.

1.4.1 Health and Safety design considerations

Aspects of the design must comply with relevant British and European standards, including:

(a) test procedures, which should comply with the requirements of the Health and Safety at Work etc. Act (Section 3.1) and the Electricity at Work Regulations 1989.
(b) the fixed installation segment of the systems and the earthing arrangements, which should comply with BS 7671 (the Wiring Regulations; for the purposes of this Guide, we assume the most recent version of BS 7671).

The end user must be notified of the need for them to comply with the Health and Safety at Work etc. Act (Section 3.1) and Electricity at Work Regulations 1989. The 'End User Agreement' includes information to allow for a check that these requirements are being adhered to and that the relevant communication is being recorded.

1.5 Designers

Designers are in a unique position to reduce the risks that arise during construction work and have a key role to play in CDM. Designs develop from initial concepts through to a detailed specification, often involving different teams and people at various stages. At each stage, designers from all disciplines can make a significant contribution by identifying and eliminating hazards and by reducing risks – and have a legal duty to do so.

1.5.1 Who are the designers?

Designers are those who have a trade or a business that involves them in:

(a) preparing designs for construction work including variations – such as preparing drawings, designs, details, specifications, bills of quantities and the specifications of articles and substances, as well as all the related analysis, calculations and preparatory work; or
(b) arranging for their employees or other people under their control to prepare designs relating to a structure or part of a structure.

This means that 'designers' include:

(a) design practices contributing to, or having overall responsibility for, any part of the design;
(b) anyone who specifies, modifies or alters a design, or who specifies a particular method of work or material – this can include clients;
(c) those procuring materials where the choice has been left open;
(d) contractors or others carrying out design work;
(e) temporary works design; and
(f) heritage organisations who specify how work is to be done in detail.

It is recognised that designers will have their own processes and procedures for undertaking the identification, review and elimination or mitigation of risks as part of their design practice.

1.5.2 Responsibilities

Designers' responsibilities extend beyond the construction phase of a project. They also need to consider the health and safety of those who will maintain, repair, clean and eventually demolish a structure. Failure to address these issues adequately at the design stage may make it difficult to devise a safe system of work. It could also lead to additional costs being incurred later because, for example, either scaffolding or access equipment is required.

Designers have to weigh many factors as they prepare their designs. These have to be balanced alongside other considerations, including cost (capital and revenue), fitness for purpose, aesthetics, buildability, maintainability, sustainability and environmental impact.

Designers must:

(a) reduce foreseeable risk to health and safety, based on the information available when the design is prepared or modified – the greater the risk, the greater the consideration that must be given to eliminating or reducing it. Designers must not produce designs that cannot be constructed and maintained safely.

(b) in accordance with the MHSWR, carry out suitable and sufficient risk assessments. CDM, particularly Regulations 11 and 13, set out the duties of the designer with respect to construction work, which applies even if the work is not notifiable under the scope of the CDM Regulations.

(c) where risks remain, provide the relevant information needed to ensure that other parties, including other designers and contractors, are aware of them and can take account of them. These risks must be recorded within the maintenance file.

1.5.3 Construction and maintenance

The designer must ensure through their design and risk analysis that the installation can be installed and maintained safety. This includes ensuring that all equipment must be easily maintainable through the use of standard access systems/plant with minimum disruption to motorists, pedestrians and access to premises and, unless a departure from standards has been agreed, not require any specialist requirement or equipment.

1.6 Installation and maintenance

Organisations selected to carry out the installation and/or maintenance of highway electrical equipment must be capable of carrying out the works safely and to the standard required using competent personnel.

The benchmark widely adopted throughout the UK for work on the public highway involving highway electrical equipment is the National Highway Sector Scheme 8 (NHSS 8) and the Highway Electrical Registration Scheme (HERS). For more details see: http://www.thehea.org.uk/HERS/.

SECTION 2

Highway electrical supplies

2.1 Introduction

This section will clarify the provision of electrical connections and earthing requirements for electrical street furniture, including lighting columns with a supply source from the Distribution Network Operators (DNO). It also considers the need for surge protection and how this may be assessed and provided to protect the increasing range of electronic equipment within the highway.

2.2 Service requirements

Those designing an electrical installation must determine, at an early stage, the earthing system requirements for the equipment being considered. Usually the system will be either TN-S, TN-C-S (PME) or TT (see Section 2.3) for a low voltage supply given in accordance with the Electricity Safety, Quality and Continuity Regulations (ESQCR).

The DNO/IDNO will be able to provide assistance in determining the type of supply that can be provided and hence the earthing requirements can be established.

2.3 Connection types

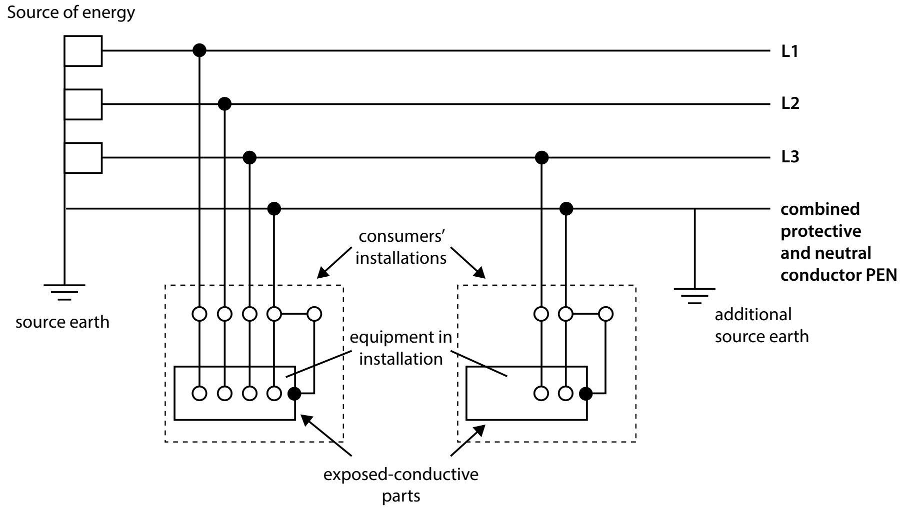
BS 7671 lists five types of earthing system: TN-S, TN-C-S, TT, TN-C, and IT.

T	Earth (from the French word Terre)
N	Neutral
S	Separate
C	Combined
I	Isolated (the source of an IT system is either connected to earth through a deliberately introduced earthing impedance or is isolated from Earth. All exposed-conductive-parts of an installation are connected to an earth electrode.)

Within the public realm the two main supply types are commonly TN-C-S (PME) or TT.

2.3.1 TN-C-S (PME) system

▼ **Figure 2.1** Typical TN-C-S system



In a TN-C-S (PME) system, neutral and protective functions are combined in a single conductor in a part of the system.

The usual form of a TN-C-S system is as shown in Figure 2.1, where the supply is TN-C with a combined neutral earth conductor and then the wiring arrangement for the installation becomes TN-S.

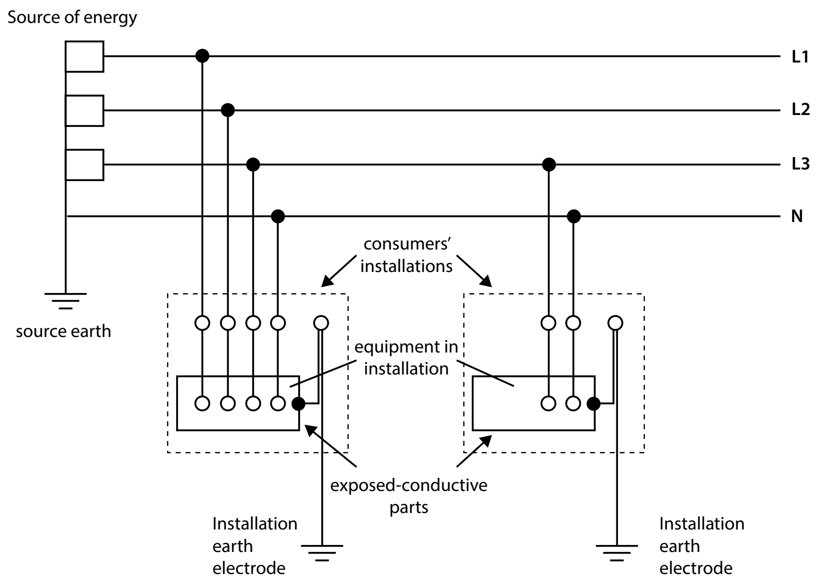
This type of distribution is also known as protective multiple earthing (PME) and the PEN conductor is referred to as the combined neutral and earth (CNE) conductor.

The supply system PEN conductor is earthed at several points and an earth electrode may be necessary at or near a consumer's installation.

All exposed-conductive-parts of an installation are connected to earth via the PEN conductor.

2.3.2 TT system

▼ **Figure 2.2** TT system



In a TT system, all exposed conductive parts of an installation are connected to an earth electrode, which is electrically independent of the source earth, as shown in Figure 2.2.

2.4 Characteristics of supply

BS 7671 requires the designer or installer of an electrical installation to determine the 'characteristics of supply' from whatever source. These characteristics include:

(a) the normal voltage;
(b) the nature of the current and frequency;
(c) the prospective short circuit current at the origin of the installation;
(d) the earth fault impedance of that part of the system external to the installation (Z_e);
(e) the maximum demand of the likely installed load; and
(f) the type and rating of the overcurrent protective device acting at the origin of the installation.

Some of the above characteristics will be dependent on where the supply of electricity is taken from with respect to the existing distribution network.

The characteristics advised are likely to apply to the majority of DNOs within the United Kingdom and are drawn from electricity supply industry recommendations. The designer is advised to contact and consult with the DNO applicable to the proposed installation to determine their characteristics of supply. They will also be able to advise if there are any special requirements for the provision of supply, which will affect the work proposed.

2.4.1 Voltage, current and frequency

Low voltage supplies are taken as 230 V single-phase, 400 V three-phase with an alternating current of 50 Hz in both cases.

2.4.2 Prospective short circuit current (PSCC)

The PSCC at the origin of an installation is based upon the supply system impedance (the sum of the service cable, the distributor, the supply transformer and the reflected impedance of the high voltage network). The installation must be designed to withstand a value of PSCC that:

(a) is based upon the maximum fault level that can be expected on the main; and
(b) makes allowance for the reduction in fault level due to the service cable between the main and the origin of supply.

This approach recognises the requirements of BS 7671 and also allows for the possibility of changes to the supply network during the life of the installation. It is therefore likely that the PSCC values used will exceed that measured.

▼ **Table 2.1** Example maximum design values of PSCC from one DNO

Supply	PSCC
230 V single-phase	16 kA
230/400 V three-phase	25 kA

The designer must consult with the relevant DNO to establish the PSCC values applicable to the proposed installation location.

The DNO has a statutory duty to provide safe and efficient service connections and apparatus to the client's highway equipment. To ensure this they provide a fuse at the intake point, which has a short circuit rating appropriate to the DNO's system at that point and capable of carrying the expected maximum load current for the installation.

In general, the DNO service will terminate in a fusible cut-out incorporating fuse links to BS 88-2 *Low-voltage fuses. Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application). Examples of standardized systems of fuses A to I.*

2.5 Highway electrical installations connected to a DNO service

2.5.1 Type of connection

Energy Networks Association (ENA; see www.energynetworks.org) *Engineering Recommendation G12* advises that the DNO is permitted to consider offering a PME connection provided the requirements of BS 7671 are met and the maximum load and consumer earth electrode resistance bonded to the main earth terminal are less than 2 kW and less than 200 Ω respectively.

The type of equipment for which a PME supply is suitable depends upon its class of protection against electric shock (see BS EN 61140 *Protection against electric shock. Common aspects for installation and equipment*). There are a range of classes, but in accordance with *Engineering Recommendation G12* and for the purpose of this Guide, lighting columns and sign posts are considered as Class 1. These are items of equipment that must have their external metalwork connected to an electrical earth.

Engineering Recommendation G12 advises that the majority of electrical equipment within the public realm (other than lighting columns and sign posts) will not be considered as Class 1. It goes on to state that a PME terminal should not be offered and a TT system with a residual current device (RCD) should be installed. This is also a requirement of BS 7671.

BS 7671 states that a PME/TN-C-S connection is not permitted as a supply source for some installations – in the sense that reliance only on the TN-C-S/PME earth as an earth conductor is not permitted.

Essentially – with the exception of lighting columns and illuminated signs, such as beacons and the like – all electrical equipment within the public realm should have a TT connection.

2.5.2 Single column, signals etc.

A PME supply point can be provided for individual street lighting columns, signals etc. and for pillars/supply points that may include a lighting authority's private cable network that supplies columns.

In providing a service to an individual item of street lighting equipment, the DNO will use a street lighting cut-out incorporating an earthing connection to the neutral. It is not necessary to provide an earth electrode for a single column supply provided the main has a suitable connection beyond the service position.

2.5.3 Lighting authority/asset owner private cable distribution system

A lighting authority/asset owner may design and install their own cable networks but these usually consist of a separate neutral and earth (TN-S), which is connected to a PME point of supply.

An earth electrode should be installed and connected to the earth terminal at the point of supply. It is good practice to install and connect an earth electrode at the last or penultimate lighting column on the circuit where there are three or more columns on that circuit.

2.5.4 Design

When considering the design of an installation to connect to a DNO network the principles of sound health and safety management must be taken into account to ensure that the system can be constructed, maintained and operated safely and effectively. For example, in the past it was considered suitable for items such as bollards and beacons located on traffic islands to have a direct DNO service. This is now considered poor practice based upon the risks involved in having a non-isolatable supply on an island.

2.5.5 Temporary supply points

The ESQCR prohibit the connection of a PME earthing facility to any metal work (or conductive material) within a temporary connected structure.

A temporary electrical system is defined in BS 7909 *Code of practice for temporary electrical systems for entertainment and related purposes* as:

"all switch gear, generators, distribution units, dimmers and similar equipment, cabling, connectors, protection, and measuring devices and current using equipment including mobile and transportable units that are required for an event."

Such installations should therefore be supplied using a TT system by the DNO/IDNO. This will require adequate earthing arrangements to be considered and designed.

2.6 Earthing systems/requirements

As a result of a supply usually being a TT system for many of the additional items of equipment being installed on the highway, the designer is required to consider a suitable earthing system. This system needs to be in the form of an earth electrode consisting of one or more earth mats buried in the ground lower than 600 mm from the surface or earth rods. The requirement is that the resistance of this earthing system should be no higher than 200 Ω, although in practice a substantially lower value of 20 Ω is usually used where practicable, with a typical maximum earth resistance value of 100 Ω (as a resistance of more than 200 Ω may not be stable). A dual earth electrode system may be adopted, which will offer a backup should one of the earth paths be accidentally damaged or broken by future works in the area. It is worth noting that individual situations may allow this requirement to be reduced to a single earth electrode following a site-specific risk assessment.

The earth system must be included in the periodic testing regime and it is therefore recommended that two earth pits be installed, at pre-determined locations, to allow for the testing of the earth installation whilst still maintaining a suitable and sufficient earth path. Due to variances in ground conditions the resistance of an earth electrode cannot be deemed to stay constant. Consequently, any electrode that has a resistance at or above 200 Ω cannot be deemed to be a stable earth, so all associated electrical circuitry would need to be protected, close to source, by a residual current device (RCD) with a protection value not exceeding 30 mA. This device may need to be of a time-delayed or type-S device to allow differentiation from other RCD devices if these are installed further along the network.

▼ **Figure 2.3** Earth mat installations

Note: Earth mats in Figure 2.3 are installed shallow due to buried services.

2.6.1 Use of column or pillar foundations

BS 7430 *Code of practice for protective earthing of electrical installations* states:

"Metallic street light columns or the metal carcasses of feeder pillars or control units, etc., may be used as protective earth electrodes, providing appropriate calculations and subsequent measurements show that such use is suitable."

The DNO should be consulted in advance to seek their agreement to such an approach as the usual default DNO position is to require an earth electrode or earth mat.

Using a column root as the earth would need to be verified under the worst conditions (dry soil) through both calculation and measurement. Account would need to be taken of any protective coating on the column root used to prevent corrosion, which may well act as a good insulator and have the effect of the column providing no effective earth path. The designer may need to understand the potential degradation and cathodic effects that may also impact on the column/pillar integrity.

2.6.2 Looped networks

It should also be noted that BS 7430 states:

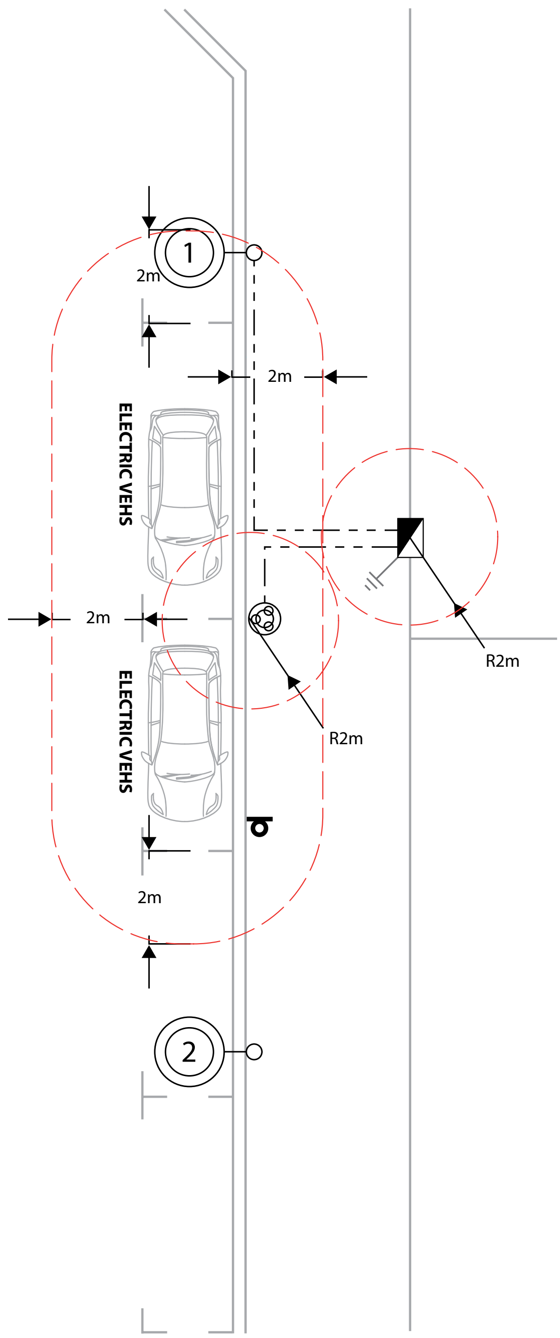
"In the case of circuits feeding more than one item of street furniture, for example, using a looped cable network with separate line, neutral and protective conductors, an earth electrode should be installed both at the point of supply and at the last or penultimate unit and this electrode should be such as to make the resistance to earth at any point less than 20 Ω before the connection of any circuit protective or bonding conductors to the earth terminal."

In this case the additional electrical equipment such as an electric vehicle charge point and the street light itself may both be classed as 'street furniture'.

2.6.3 Adjacent electrical connections/equipment

Careful consideration needs to be made of the electrical requirement for any equipment within the public realm where they may be located within 2 m of any other electrical street equipment (such as columns) or indeed attached to the column itself.

Figure 2.4 TT connection inclusion zone



For example, as can be seen from Figure 2.4, column 1 lies within a 2 m zone around the charge area and therefore requires its supply to be converted to a TT supply, whereas column 2 is outside the zone so may not require a change (subject to the policy of the relevant DNO/IDNO).

The supplies to the equipment need to be on the same phase and from the same distribution point.

BS 7671 requires any TT-connected equipment that is located within 2 m of any other such equipment or that may be made part of the same electrical system as the charge point should also be connected to a TT supply. It is usually the case that all lighting columns are on unmetered PME supplies and as such if there is a proposal to install, say, a charge point within 2 m of the column or a column already sits within 2 m of the advised area in which a vehicle will be charged, then its supply should be changed to a TT supply.

Note: This requirement means that an RCD must be attached to the street lighting circuit. This may result in nuisance tripping, which may in turn result in increased reactive maintenance costs.

2.7 Highway electrical supplies, types and characteristics

2.7.1 Equipment protection/selection of client protective devices

The designer must select protective devices for the installation in accordance with the performance requirements of BS 7671. These are usually a fuse link or a miniature circuit breaker (MCB).

2.7.2 Earth loop impedance (ELI)

The earth fault loop includes the impedances of all circuit components between the supply distribution transformer and the point of fault and then back to the distribution transformer. Typical theoretical maximum impedances for the part of the loop that covers the DNO service are given in Table 2.2.

▼ **Table 2.2** Typical DNO ELI values

Service type/rating	Maximum ELI (Ω)
PME up to 100 A 230 V single phase	0.35
PME up to 200 A 4,000 V three phase	0.35
TN-S up to 100 A 230 V single phase	0.8
TN-S up to 200 A 4,000 V three phase	0.8

These values do not correspond to the PSCC declared; they are designed to cater for the possibility of changes to the supply network during the life of the installation. In practice for existing electrical supplies, the earth loop impedance may be higher.

2.7.3 Isolation and switching at the origin of supply

BS 7671 requires that a linked switch or circuit breaker must be provided as near as practicable to the origin of supply to afford a means of interrupting the supply on load and acting as a means of isolation.

For all single-phase supplies the 'main' switch must interrupt both the 'live' conductors, which BS 7671 defines as being the phase and neutral conductors (i.e. a double-pole switch).

For three-phase supplies all live conductors (i.e. phase and neutral conductors) must be broken.

2.7.4 Surge protection considerations

With the advent of LED luminaires and associated central management system control technologies the value of the technology located within the highway has increased, as has its susceptibility to transient overvoltages. These considerations will only increase as authorities look to the development of 'smart city' technologies using the public lighting asset and this may present a weakness in the system. We therefore have to understand what causes overvoltages and how the asset can be protected against them.

Transient overvoltages have four main causes:

(a) lightning – this may not be a direct hit but could be through impact on overhead supply lines or a rise in ground potential;
(b) industrial and switching surges through the main power network;
(c) electromagnetic discharges; and
(d) nuclear electromagnetic pulses.

Overvoltages differ in amplitude, duration and frequency. The impact of lightning depends upon the distance from the flash and the properties of the event and installation. Industrial and switching transients of many kV with rise times of microseconds can causes disturbances to anything connected to that source.

To limit the effect of transients to an acceptable level the most effective solution is the installation of surge protection devices.

2.7.4.1 Surge protection device requirements

Many of the surge protection devices built into LED drivers are not suitable because they may not provide the level of protection required, there is no indicator to show when it has failed and, upon failure, the whole driver may then fail and require replacement. It is therefore better to consider a separate surge protector, which may be located within the luminaire or at the base of the column, the latter being easier to monitor for performance, risk of failure, etc.

LED luminaires and other highway/public-realm electronic equipment should therefore be supplied fitted with a stand-alone single-phase compact surge protection device operating within the parameters set out in Table 2.3.

▼ **Table 2.3** Surge protection device operating parameters

Compliance to	BS EN 61643-11/IEC 61643-11
Protection class	Class 2
Nominal operating voltage (L-N)	230 V (50 Hz)
Max load current	16 A
L-N voltage protection (withstand) U_p	U_p 1.5 kV (maximum)
Short circuit capability (mains) Isccr	6 kA (Isccr)

Note: L-N voltage protection can be considered as a door or car park height restriction, the kV value being the limiting height that is permitted to pass. Anything over 1.5 kV is therefore blocked. This is a case where bigger is not better as having a value of, for example, 10 kV will enable all voltage spikes up to 10 kV to pass and hence may cause damage to the equipment being protected.

The surge protection device should include a status indicator so that the condition of the device can be easily assessed on visual inspection. The in-service failure of the surge protection device should also be indicated as a consequence of the isolation of the supply to the LED driver/LED array, resulting in the luminaire being turned off. It is possible to have surge protectors that fail and still permit the circuit to remain operational but then the load may be subjected to further surges without surge protection, and potentially fail.

It is preferable that the installation of the surge protection device is not detrimental to the luminaire's warranty performance parameters and in any event should not fundamentally interfere with the operation of the luminaire's operation other than in the event of protecting it through the operation of the device as above.

2.7.5 In-rush currents

When undertaking electrical designs for discharge lamps and control-gear based technologies it is important to understand and manage in-rush currents. However, it is also important to understand and manage in-rush currents when using LED technologies.

'In-rush current' refers to the input current of a short duration that flows into the LED driver or control circuit during initial start-up. This is essentially to charge up the capacitors on the input side. This is normally of a very short duration during which time the amplitude is much greater than the operating or steady-state current.

If there are a number of LED luminaires each with its own driver on one circuit the maximum peak in-rush current and its duration may be additive. However, this does depend on the impedance of each driver and the line impedance. LED lighting systems that use direct drive solutions have no in-rush currents.

2.7.6 LED luminaire circuit protection

The LED luminaire protective device has to be able to withstand the in-rush current of the luminaire(s) without tripping. The in-rush current of LED luminaires is determined by the driver(s) and is not proportional to the luminaire wattage or running current. LED luminaire in-rush currents can be as high as 400 times the running current for a very short time, generally less than 500 μs.

This in-rush duration is significantly less than the 10 ms lower limit for conventional MCB tripping. However, some MCBs have a second tripping functionality for in-rush durations less than 10 ms, having an increasing tolerance to high in-rush currents related to the logarithmic inverse of the duration. Appropriate circuit protection design is the responsibility of the relevant competent designer.

2.7.7 Circuit protection

The DNO that provides a service to an individual item of street lighting equipment, such as a lighting column, will use a street lighting cut-out incorporating a BS 88 fuse link and earthing connection to the neutral.

For other equipment a general recommendation is to use a type-C circuit breaker or BS 88 fuse with the highest current rating that is allowed by the circuit cable size. The MCB that is used needs to have sufficient clearing time for the in-rush current to clear without creating nuisance tripping when the equipment is powered up. This will give protection from a short circuit and prevent overheating of wiring and connections.

MCBs operate by tripping open at the point at which an overload or short circuit condition is detected. The tripping point relates to the magnitude of electrical energy being passed and this in turn depends on both the in-rush current peak value and its time duration.

Accordingly, an MCB could be tripped either by a high peak of short duration or a lower peak of longer duration. In either case, the objective is to ensure that the MCB trips before allowing the passing of excessive electrical energy, yet does not trip and cause lighting blackouts when it does not need to.

2.7.8 In-rush limiters

Where a number of LED luminaires are on a single circuit it is advisiable to consider the use of an in-rush current limiter. This is an electronic unit that effectively limits in-rush currents to a precise level and with a high level of repetitive accuracy. A lower current also potentially allows for a smaller cable cross-section and fewer circuit breakers.

The in-rush current limiter is connected between the outgoing switch/contactor and the load. At the moment of switching on, the in-rush current is limited for a defined time, regardless of what the actual in-rush current is.

2.8 Inspection and testing

Upon completion of an installation, it must be inspected and tested in accordance with BS 7671 – i.e. 'initial verification' – and results recorded and provided to the local authority/asset owner for inclusion within their highway asset inventory.

In addition to the initial verification, it is usual that inspection and testing is carried out at suitable frequencies throughout the life of the installation ' i.e. 'condition reporting'. Typically for most public lighting equipment including lighting columns and signs, this would take place at intervals not exceeding every six years – subject to review of the previous inspection and test results to determine the rate of degradation, if any, of the electrical equipment.

Planning and design for additional highway electrical equipment

Good planning and the management of user expectations are critical when considering the provision of any of the services previously mentioned in the Introduction:

(a) public lighting, illuminated signage, bollards and infrastructure;
(b) architectural lighting (uplighters, under bench, art works etc.);
(c) electric vehicle (EV) charge points;
(d) market trader pillars;
(e) event supplies;
(f) bus shelters; and
(g) smart city technologies and other 'on street' electrical equipment (for example, electric bike chargers).

Such management and planning is not only essential in terms of the appearance of these installations within the streetscape but also for their construction and layout, which in turn determines to an extent how users will access and use them. Whilst some of these may be standalone features, others, such as electric vehicle charge points and market trader pillars, will have connections made to them using trailing cables or perhaps incorporated within the shell of a trader stall. Consideration of the wider environment will improve decision making and help to identify opportunities for decluttering and/or combining equipment, which can also assist in meeting the requirements of the Equality Act and the Manual for Streets.

With the exception of public lighting it is likely that all of these services will require some form of planning consent. It is also likely that these items will be third-party equipment on the highway and there may be a disconnect between local authorities and third party equipment management. Local authorities may assume that the third-party owners are managing the assets, however, it is possible that this assumption is flawed and that local authorities will potentially be challenged as the overarching authority and guardian of public safety.

For small items of third-party equipment it would be advisable for local authorities to have some type of license agreement in place.

3.1 The proposed service provision

This will depend upon the type of service provision being considered and each will require due consideration of the proposed location. There may also be government support for wider initiatives that are in the public interest, such as carbon reduction, increased health awareness or inclusion etc. and what may be a political wish to provide a service in one area or street needs to be carefully considered to ensure that it can be reasonably achieved.

These political drivers may also include the provision of localised charge points to suit residents who wish to own an electrical vehicle and who are required to park on the street through to larger charging areas, or to encourage the growth of local markets by providing electrical supplies where these do not currently exist.

A number of considerations need to be thought through at early planning stage. The majority of these considerations can be managed at an early planning/design stage through suitable consultation with stakeholders, such as the proposed user groups, trader associations, planners, local residents as well as the utility companies whose services will be required.

3.1.1 The physical installation requirements

Is the equipment suitable for the street/area or is its application going to present other concerns, such as an increase in street clutter or reduced accessibility for disabled users? What are the actual installation requirements in terms of foundations?

3.1.2 Electrical capacity

The electrical requirements of the proposed equipment must be known and considered at the early stage. In some instances the electrical loading for a single standard AC charge point of 3.7 kW or a DC charge point of 20 kW may seem low, however, when considered thoroughly and where a number of such installations are proposed within a given area, the total electrical load can be considerable. Many local authorities/asset owners should consider that the installation of DC 'rapid charger' stations and the electrical load requirements can range from 20 kV through to 50 kV or for bus and ultra-rapid chargers from 150 kW to 350 kW (this is potentially equivalent to a small office block).

In many cases, DNOs advise that their cables are already at maximum capacity and are therefore unsuitable for any additional loading. In these instances a complete DNO supply network upgrade, which may include the addition of a substation, may be required. Alternatively, the local authority/asset owner may have to consider installing a private cable network, assuming there is sufficient load capacity available locally. This is discussed further in Section 4.2.

3.1.3 The scope of the service provision on offer

If considering market stall supplies, what is offered to the stall holder needs to be realistic – for example, a basic provision of lighting and a power socket-outlet is reasonable but the details and electrical load still need to be set out. Offering food outlet supplies is generally likely to be impractical because these will usually require a dedicated substation/high power supply point, which may be a significant expense or not practicable within the street. Additionally, this may not be a reasonable offer if the markets are competing with local food outlets that pay full business rates.

It may also not be feasible to offer, for example, fast charge points for electric vehicles in some areas due to the limitations of the existing service network.

3.1.4 User access and use of the service

The following questions need to be considered and addressed at the design stage:

How will the user access the service? Will the user need to use a trailing lead and if so how may this be routed to prevent it from becoming a trip hazard?

3.2 DNO consultation

The ENA have developed an electric vehicle charging infrastructure installation notification procedure. The ENA also provide information that is relevant to any customer who is installing electric vehicle charging equipment as well as for persons undertaking such work.

The procedure includes an 'adequacy of supply' assessment that is required before any electric vehicle charge point is installed, so the procedure is best considered at the planning stage. As part of the notification procedure a load survey of the area will need to be provided, and the new maximum demand after diversity will need to be assessed, including the proposed electric vehicle charging equipment. Details to be provided/considered include:

(a) full installation address;
(b) the 21-digit meter point administrator number (MPAN) or, in Northern Ireland, the 11-digit meter point reference number (MPRN) for the meter to which the electric vehicle charging equipment is to be connected;
(c) details of the new installation, including the maximum demand from all electric vehicle charging equipment connected to the identified meter and any previously connected charging equipment;
(d) earthing arrangements;
(e) designer/installer connect details; and
(f) charge point owner.

3.3 Specific installations

The requirements for the following are considered in more detail within their respective sections in this Guide:

(a) electric vehicle charge points;
(b) market trader pillars and event supplies;
(c) safety and enforcement cameras;
(d) environmental monitoring equipment;
(e) smart car parking solutions; and
(f) shared traffic signals and lighting.

SECTION 4

Lighting equipment

4.1 Introduction

The purpose of this section is to clarify the electrical system requirements for fixed electrical equipment associated with a highway traffic function, including lighting columns, illuminated traffic signs, illuminated bollards, warning signs, belisha beacons, shared traffic signals and associated supply pillars.

For the purposes of this Guide what is set out for lighting columns will generally be applicable for all of the fixed electrical equipment associated with a highway traffic function.

Lighting columns equipment may be supplied, either:

(a) directly from the DNO's/IDNO's PME distribution network; or
(b) from a private distribution installation (including a street lighting authority) supplied from the DNO's/IDNO's PME distribution network.

4.2 Background

DNOs/IDNOs have different requirements for the characteristics of supply and earthing requirements relating to electrical street furniture. These are detailed in their 'characteristic of supply' and 'guidance notes for installations to protective multiple earthed systems' documents.

Section 2 of this Guide discusses some of the detail of these supply arrangements and requirements.

4.2.1 Single items of electrical street furniture

Current guidance permits the provision of a PME earth terminal, without conditions on earthing requirements, to all items of electrical street furniture provided that the customer's wiring conforms to the requirements of BS 7671. Guidance also permits the provision of a PME earth terminal within the lighting columns and the use of this earth terminal in accordance with the exemptions contained within the Supply Regulations and the ESQCR.

An earthing terminal should be made available in each column. The internal wiring of the column should consist of separate phase, neutral and circuit protective conductors. Street lighting columns should be bonded in accordance with the ESQCR.

The exposed metalwork of a street lighting column that is or may reasonably be expected to come into electrical contact with the general mass of earth must be connected to the earthing terminal by a conductor that has a minimum copper equivalent cross-sectional area equal to the supply neutral conductor at that point but not less than 6 mm^2, subject to any particular additional requirements imposed by the DNO/IDNO.

The DNO/IDNO will generally provide a PME earthing facility to the following:

(a) lighting columns and signs; and
(b) equipment (for example, a feeder pillar) where an earthing electrode (earth mat or rod) is installed providing an earth electrode resistance of 20 Ω or less. The designer must make an informed decision as to the best earthing electrode system to use depending upon site conditions and services.

The earth electrode limit ensures that even in the unlikely case of a loss of neutral earth connection to the supply, the contact potential on the pillar would rise to a maximum of 100 V. 100 V is far less likely to injure a member of the public than 230 V.

On all other equipment the DNO/IDNO will usually provide a 'TT' supply and the customer must provide their own separate earthing point. The requirements for this are discussed in this Guide under 'Highway electrical supplies' (Section 2).

Note: Any electrical equipment located within an island, such as illuminated bollards and signs, should preferably not have a direct DNO service. They should be supplied using a private cable network, which may be fed from a lighting column, sign or pillar located near to the island, alongside the highway.

4.3 Private cable networks

Where organisations run their own private cable networks from items of electrical street furniture then additional earthing requirements must be adhered to:

(a) all installations must comply with the ESQCR and BS 7671 as applicable.
(b) where an electrical circuit feeds three or more items of electrical street furniture then an earth rod or mat must be installed at the supply point and at the last or penultimate item on that circuit:
   i where a feeder column supplies an island with bollards and signs then it is usually impracticable to install earth rods on the island; and
   ii where a 3-phase system is used then an earth rod or mat should be installed at the last or penultimate unit on each phase.

4.3.1 Use of RCDs

When designers wish to provide additional protection or are unable to make use of a PME earthing terminal provided by the DNO they are advised to install RCDs to provide protection against earth faults. These units should be installed in accordance with the current edition of BS 7671.

The aim of this is to ensure that any installation is safe and compliant with the ESQCR. The protective earthing approach is designed to protect the public in the unlikely event of a loss of neutral earth connection to the supply.

4.3.2 Protecting a valuable asset

Lighting columns are increasingly being fitted with LED luminaires and central management systems and such electronic/solid-state equipment is vulnerable to electrical surges and supply variations. It is therefore recommended that the designer give due consideration to the electrical protective arrangements, which should include surge protection as discussed in Section 2 of this Guide.

This will become ever more important as we see the growth of smart city technologies, which will use the public lighting network as the backbone of the service, with the associated equipment being fitted to the luminaires/columns or fed from them.

4.4 Supply/feeder pillars

When considering the design and specification of the pillar the designer should bear in mind that whilst the final installation must comply with BS 7671 the assembly of products cannot. It is therefore incorrect to specify the manufacture of a pillar against this standard. All items of equipment need to comply with their own appropriate British or harmonized standard and where this does not exist then reference should be made to suitable international (IEC) standards.

Pillars therefore need to be considered and designed under the requirements of BS EN 61439 *Low voltage switchgear and control gear assemblies*. This standard lays down the definitions and states the service conditions, construction and verification requirements for low voltage switchgear and control gear assemblies. It does not apply to the individual components used within the assembly. The standard also lays down the schedule of testing for such assemblies.

Lighting columns may themselves be used as supply points for other columns, signage, bollards and the like.

4.5 Passively safe equipment

The Department for Transport's 'A safer Way' consultation process looked at how road deaths and serious accidents could be reduced. Part of this considered errant vehicles leaving the carriageway and colliding with a lighting column or illuminated sign. To reduce the potential severity of injury to the vehicle occupants BS EN 12767 *Passive safety of support structures for road equipment, requirements and test methods* was introduced. This is supported by the Institution of Lighting Professionals Technical Report TR30 *Guidance on the implementation of passively safe lighting columns and sign posts*.

Passively safe structures are defined by three energy absorbing categories:

(a) high energy absorbing: provides a gradual retardation to the vehicle and the support remains standing;
(b) low energy absorbing: support yields in front and under the vehicle and may sheer off; and
(c) non-energy absorbing: support sheers off at the base and will normally fall back over the roof of the vehicle.

Where passively safe supports contain power supplies for any purpose the electrical safety of the installation must be maintained at all times, and under all conditions, including in the case of vehicle impact. The designer must undertake a risk assessment on the design solution to ensure the electrical safety for the specific project. The designer must also consider the most suitable means of isolating the supply to the support. There are two approaches that can be applied:

(a) snatch or pull-out plugs located within the base of the support: these should be vandal resistant, reliable in use, weather, water and dust resistant (IP67), comply with BS EN 60309-1 *Plugs, socket-outlets and couplers for industrial purposes. General requirements* and BS EN 60309-2 *Plugs, socket-outlets and couplers* *for industrial purposes. Dimensional interchangeability requirements for pin and contact-tube accessories* and be provided with a practical method for inspection; and

(b) a 0.4 second disconnection installation: this may use impact or tilt sensors located within the base of the column that, upon impact, activate a disconnection circuit.

Such systems must in no way act as a tether. Direct DNO services are not suitable for passive supports and cannot be used.

4.6 Unmetered supplies

4.6.1 General requirements

It is worth noting the requirements for an unmetered supplies connection. The Electricity (Unmetered Supply) Regulations 2001 (Statutory Instrument 2001 No. 3263) specify that an unmetered supply may be given if the load is of a predictable nature and either the load is less than 500 W or it is not practical for the supply of electricity to be given through an appropriate meter either technically, financially or for legal reasons (i.e. due to technical difficulties associated with providing a meter, significantly higher metering costs or health and safety or other legislation). The 'tests' for financial, technical and legal viability are therefore not required for loads below 500 W.

The word 'or' has the effect that a predictable load significantly higher than 500 W could be provided with an unmetered supply if the anticipated metering costs, technical difficulties or the operation of law would mean that it was not appropriate for the supply of electricity to be given through an appropriate meter.

4.6.2 Predictability

The key factor in determining whether an unmetered supply is appropriate is therefore the predictability of consumption, and wattage is a secondary condition. However, predictability is dependent on accurate inventories being maintained.

The National Measurement and Regulation Office (NMRO) considers that in the context of these regulations, 'predictable' must be assumed to mean a load that can be consistently understood throughout its usage period, such that billing can be correctly estimated or accurately calculated based on pre-defined operational profiles or based on event records. The NMRO considers that to maintain settlement accuracy there should be a maximum permitted variation of +/– 3.5 %, which means that the calculated usage should be equivalent in accuracy to that of a metered supply.

In determining if a load meets this criterion the NMRO encourages a pragmatic approach to equipment that will, for the majority of time, require a constant load but may have small variations in load from time to time that are insignificant in terms of overall kWh consumption taken on an annual basis.

The definition of 'predictable' is intended to help stakeholders to determine if other items of street furniture are suitable for connection to unmetered supplies. When the load is less predictable, it may be necessary for the supply to be metered. However, the NMRO also encourages parties to adopt a pragmatic approach for small loads (for example, vehicle-activated signs where a speed warning sign 'flashes') where the cost of metering would significantly outweigh the value of the electricity consumed. In this situation it may be possible for the parties to agree a number of 'burn hours' based on the estimated number of 'flashes' over a time period to provide a reasonably accurate estimate (if necessary, erring on the high side) of consumption. This is particularly the case for customers who have a good record of maintaining an accurate inventory.

4.6.3 Load considerations

The 'less-than-500 W' requirement refers to the load rating of the equipment although it is the quantity of electricity consumed that needs to be predictable. This is the product of the load (in kW) and the hours of operation. Strict application of this rule could result in situations where equipment with a predictable load that is seldom used, but at times consumes over 500 W, is metered. Conversely, lower loads operating continuously would consume more energy over time but could be unmetered.

The Electricity (Unmetered Supply) Regulations do not define where the 500 W 'limit' is to be measured – i.e. at the load point or at the supply point. The NMRO have applied the following definitions:

(a) supply point: the point of connection to the authorised distributor's network.
(b) load point: the point at which the load of the equipment consumes electrical energy.

For the purposes of these Regulations, the NMRO adopts the interpretation that the 500 W is measured at the load point and is assumed to mean the maximum operating load of the equipment in question (i.e. the actual power consumption of the load when operating in service and taking into account any losses attributable to power factor characteristics, etc.).

A common example of this would occur where a number of lamps may be situated on a single column so that the total wattage exceeds 500 W but the individual lamps are below this limit, or where a number of lighting units of predictable load are fed from a single point of supply that, when aggregated, exceeds the 500 W limit.

It is generally not practical to meter individual lamp columns and the inclusion of the word 'or' in the Electricity (Unmetered Supply) Regulations has the effect that these applications may be considered for an unmetered supply provided they meet the definition of 'predictable'. Likewise the aggregated load from a series of columns fed from a single supply point may also be considered for an unmetered supply provided they also meet the definition of 'predictable'.

Further guidance is available from the NMRO – *Guidance on Unmetered Supply Regulations*.

SECTION 5

Electric vehicle charging stations

5.1 Benefits of electric vehicles

Electric vehicles cover hybrid vehicles, plug-in hybrid vehicles and pure electric vehicles. Electric vehicles are powered by a battery supplying electricity to the motor, offering a 'clean' and energy-efficient alternative to vehicles with an internal combustion engine. Pure electric vehicles produce no tailpipe emissions and no emissions at all when charged with green electricity from renewable sources, making them an environmentally friendly vehicle.

Despite the limited range of many of the electric vehicles on the market, they are becoming increasingly popular but require a suitable charging infrastructure. Technological improvements are allowing for the range of vehicles to expand and electric vehicles are now becoming a more viable option. By promoting the switching from internal combustion vehicles to electric vehicles both the public and private sectors can help to improve air quality and reduce greenhouse gases.

In order to promote the use of such vehicles it is important to develop an appropriate electric vehicle infrastructure. The following factors need to be taken into account:

(a) early engagement with the DNO to undertake an assessment of the current electrical capacity in the street/area to accommodate charge points;
(b) choice of charging system – trickle, fast or inductive charging;
(c) durability – including the anticipated demand and levels of use so that a long-term sustainable solution can be put into place;
(d) suitability of points for disabled users;
(e) compatibility with the majority of electric vehicles used; and
(f) infrastructure design, taking a minimalist approach looking to a 'clutter-free' street environment and managing the impact and risks of the installation and ease of ongoing maintenance.

5.2 Design guidance

Those considering and designing such installations should make reference to appropriate guidance including the following:

IET:	*Code of Practice for Electric Vehicle Charging Equipment Installation*
EV Association Scotland:	*Electric vehicle charging infrastructure, A deign guide*
Office for Low Emission Vehicles:	*Electric vehicle home charge scheme*
	Making the connection, The plug in vehicle infrastructure strategy
Transport for London:	*Guidance for implementation of electric vehicle charging infrastructure*

5.3 Standalone charge points

There are a range of electric vehicle charging units available that may provide slow or fast/rapid charge as well as the ability to charge one or two vehicles at a time. Although some chargers may have the facility to charge more than two vehicles, these tend to be located at 'destinations' in car parks rather than within the public highway. In some cases the link lead is tethered at the station and each lead provides a range of socket-outlets depending on the make and model of the vehicle to be charged.

▼ **Figure 5.1** Sample of a range of charge point stations available (courtesy of Siemens)

5.3.1 Charger positioning

The location of a charge point within the highway needs careful consideration, taking into account the size and style of the charge point and whether its application is going to present other concerns, such as an increase in street clutter or reduced accessibility along the street from the perspective of disabled users, together with actual installation requirements in terms of foundations and how the link cables will be used.

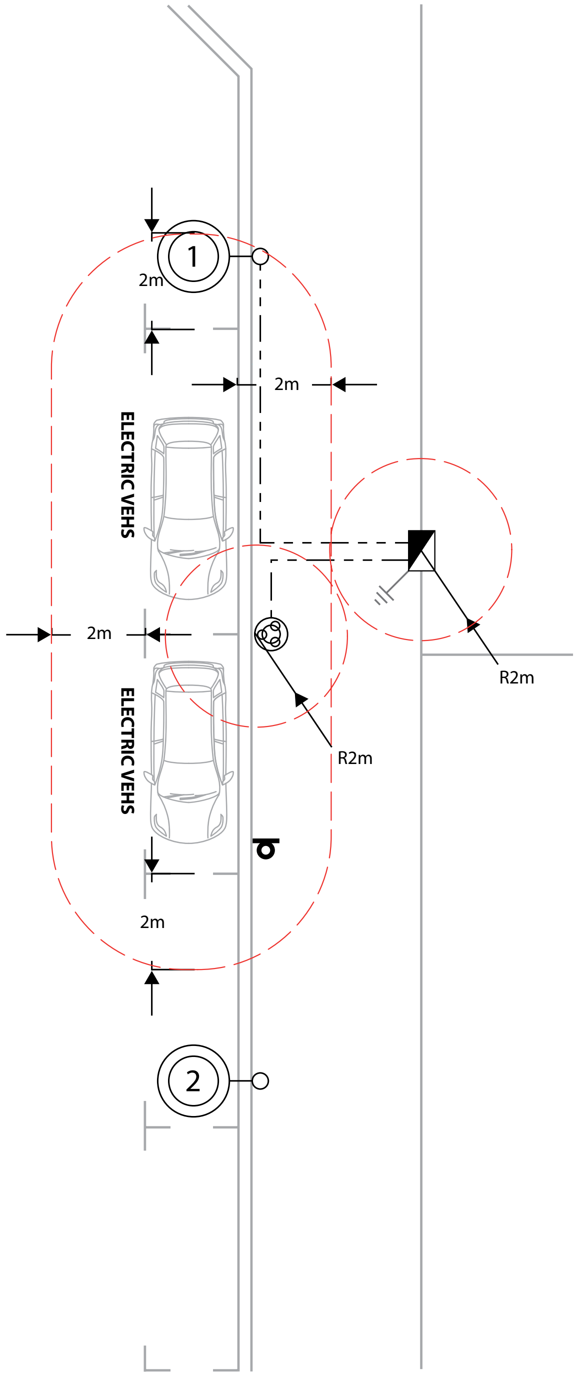
These considerations are also not helped by the diversity in location of the charge socket on the vehicles, which vary by make and model. However, multi-socket charge points can be considered, which will cover the majority of electric vehicles in the UK (but not all). The location and choice of the charge point therefore needs due consideration as to how many vehicles may be parked and their potential orientation. This will allow the consumer, using a normal link cable length of 5-8 m, to be able to connect reasonably easily. This will avoid the potential for the link cable being a barrier or hazard to other highway users, when in use.

Figure 5.2 Individual charge points and twin charge point with impact protection

Consideration should also be given to access by disabled users as well as access for servicing and maintenance. It may also be a consideration that some form of physical impact protection is provided for the charge point.

As discussed in Section 2 of this Guide and in Figure 5.3, consideration must be given to the vicinity of other electrical street furniture as anything within a 2 m radius of the charge point/vehicle being charged is likely to require its electrical service connection to be modified.

Figure 5.3 TT connection inclusion zone



5.3.2 Electrical arrangements/considerations

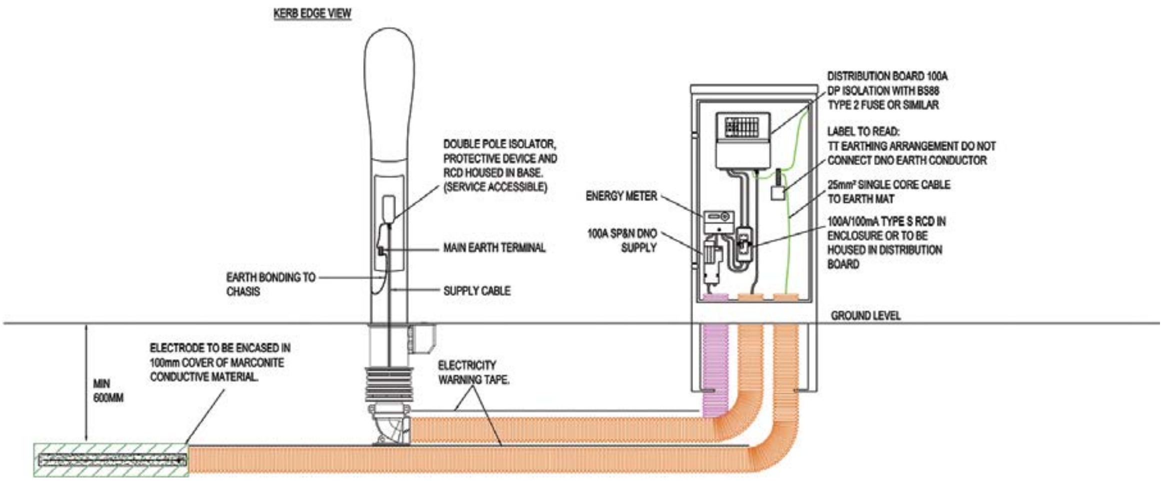
In general, a charge point or network of charge points will be supplied via a private cable network from a main distribution point/pillar located in a suitable position within the highway boundary. In some instances this pillar also incorporates a signpost supporting a sign plate advising of the charge point service, such as that shown below.

Figure 5.4 Charge point information sign

When considering the design and specification of the pillar the designer should bear in mind that although the final installation must comply with BS 7671 the assembly of products cannot (see Figure 5.5).

The pillar will contain the DNO/IDNO service cut-out, normally a 100 A service head, an approved meter, a 100 A/100 mA RCD (usually a type S due to other RCDs downstream in the network) and a distribution board fitted with type C MCBs or BS 88 type 2 fuses.

▼ **Figure 5.5** Electrical vehicle charge point – general layout



5.4 Charge points incorporated into existing street furniture

As the take up of electric vehicles increases there is a greater demand for charge points to be installed, especially where such vehicles are parked overnight in residential areas. Where the vehicle has to be parked on the highway it is not practical or safe for the owner to run a link cable from their house to the vehicle. In these instances residents are making requests for on-street charging stations to be provided. Where the street lighting column or other item of electrical street furniture is located towards the front of any footway/kerb it makes sense to consider how a change point may be located within it.

▼ **Figure 5.6** Charge point integrated onto the column door (courtesy of Ubitricity)

To facilitate this, the electrical supply to the column needs to be considered. The general approach for standalone charge points is for a TT supply to be supplied with the customer (local authority/asset owner) providing their own earthing system (see Section 3.6).

Where the lighting columns are on a PME supply then the ENA *Engineering Recommendation G12 Note* permits a DNO to consider offering a PME connection provided the requirements of BS 7671 are met and the maximum load and consumer earth electrode resistance bonded to the main earth terminal are less than 2 kW and less than 200 Ω respectively (see Section 3.5.1).

The load requirement can be addressed by providing a trickle charging facility only, but the earth resistance limitation does require careful consideration.

The energy consumed in these instances is measured through a meter incorporated into the link-lead charging cable itself and the vehicle will only charge when both ends of the correct link cable are connected.

▼ **Figure 5.7** Link cable incorporating a meter (courtesy of Ubitricity)

5.5 Earthing systems/requirements

As discussed in the highway electrical supplies section a result of a supply being a TT system is that the designer will be required to consider the necessary earthing system. This system would need to be in the form of an earth electrode consisting of a sequence of earth mats buried in the ground, 600 mm from the surface or earth rods (see Section 4.3).

5.5.1 Use of column or pillar root as an earth

As discussed in Section 3.6, BS 7430 states:

"Metallic street light columns or the metal carcasses of feeder pillars or control units, etc., may be used as protective earth electrodes, providing appropriate calculations and subsequent measurements show that such use is suitable."

Contact should be made with the DNO/IDNO in advance to seek their agreement to such an approach and it is understood that the normal default DNO position is to require an earth electrode or earth mat.

Using a column root as the earth would need to be verified under the worst conditions (dry soil) through both calculation and measurement.

Charge leads are normally between 5-8 m in length to reduce the potential trip hazard and must be equipped with couplers. The cross-sectional area of the charge lead conductors must be suitable for the highest current rated equipment expected.

It is noted that some charge leads are supplied with a standard domestic three-pin plug for connection to the charge point. This may be satisfactory, as on these charge points the actual socket is covered by a protective flap, which also closes and locks when the charge lead is plugged into it and can only be opened by the same key fob that initially accessed it. However, this could also, potentially, allow a normal household extension lead to be used to extend the length of the charge lead (to perhaps suit how a person has parked their vehicle). This could result in the connection between the charge lead and the extension lead being in an environment that is unsuitable for the intended use of the plug and socket (for example, damp or standing water) as they are not weather resistant.

▼ **Figure 5.8** Typical electric vehicle charge point connections

5.6 Visual awareness

The charge lead is a potential trip hazard to those using a public area and as such consideration must be given to ensure that it is as visible as possible by both day and night.

Note: Different artificial light sources can affect the colour appearance of the item when being viewed in dark conditions.

5.6.1 Using the charging lead

Before being connected to the supply, the equipment, including extension leads, should be checked. This information should be provided to the end user:

(a) for compatibility with the charge point;
(b) for any cracks, splits, abrasions or temporary joints or extensions in the cable;
(c) for security of cable cord grips at entries to equipment, plugs and sockets and that the outer sheathing of the cable is terminated within the apparatus; and
(d) to ensure that the plugs and sockets are in good condition.

During use, users must be notified of the terms of use, including that:

(a) flexible cables are not kinked;
(b) the weight of equipment or tightness of the cable (being over stretched between charge point and vehicle) will not result in the plug out of the socket getting pulled out;
(c) cables are not dragged over rough surfaces;
(d) the equipment is not overloaded;
(e) all equipment is safe and secure at all times; and
(f) cables are not positioned where they can form a trip hazard.

After use ensure that:

(a) the equipment is switched off and the plug withdrawn and cover clicked into place;
(b) the equipment is stored correctly and in a dry place;
(c) the supply points are left safe;
(d) if any faults are found with the charge cable that they are reported, repaired or replaced by a competent person and the equipment tested before reuse; and
(e) if any faults are found with the supply points, that they are immediately reported through to the relevant local authority/asset owner or asset owner.

5.7 Testing/commissioning

Upon completion of the installation the equipment must be tested and all results recorded and provided to the local authority/asset owner for inclusion within their highway asset inventory.

This information must include, but not be limited to:

(a) site location;
(b) charge specification/type;
(c) supply details;
(d) BS 7671 test results;
(e) date of commission; and
(f) charge commissioning certification.

The charge unit must be fully operational and this may include specific simulated charging tests as well as commissioning and client hand-over checklists.

Consideration must also be given to the link lead. Health and safety requirements (outlined in HASAWA, MHSWR, BS 7671, etc.) indicate that approved equipment for use on vehicle charging systems should be subject to inspection before each use as well as regular formal inspection and testing of the link lead to ensure it is safe and fit for use. Periodically (recommended at least every six months), all charge leads should be checked and tested. Where faults are identified, these should be rectified by a competent person or the lead replaced. Tests are carried out:

(a) to ensure that the requirements before connection are in order;
(b) to confirm the working order of maintenance functions as recommended by the manufacturer; and
(c) as part of routine electrical inspection and testing, including portable appliance tests where applicable.

Durable tags must be affixed on the charge lead within 150 mm of the plug. New equipment need not be tested but should be tagged with the date of entry into service.

5.8 Risk

This section only covers the electrical aspects of vehicle charging within the public domain, i.e. the charge point, the cable between the charge point and the vehicle (charge lead) and any relevant considerations regarding the vehicle itself.

Typical risks to safety through the use of the charge cable include:

(a) trip hazard: the type and location of the electrical supply point and the location of the electric vehicle charge point equipment, together with the way the link cable is likely to be used and run, must be considered at the design stage to try to identify how any trip hazards can be eliminated or minimized and to avoid the link cable forming a barrier if it is suspended between the charger and the vehicle.

(b) electrocution (direct or indirect contact with live parts) may be caused by:
- **i** damaged cabling/exposed conductors;
- **ii** ingress of moisture to live parts causing leakage currents;
- **iii** defective electrical equipment; and
- **iv** damaged supply bollards.

(c) burns (from direct or indirect contact with 'live' parts or overheating equipment) may be caused by:
- **i** contact with exposed live parts; and
- **ii** contact with hot electrical equipment/installations.

(d) fire (resulting from short circuit, high impedance fault or loose connections) may be caused by:
- **i** short circuit fault;
- **ii** high impedance fault; and
- **iii** loose electrical connections.

5.9 Energy

It is not the purpose of this Guide to advise on energy payments as charge points will usually be connected to a metered pay supply. In the case of column-mounted charge points, where the metered payment facility is not built into the charging lead cable itself, Elexon and the Unmetered Supplies Group (UMSUG) have produced proposals on how these charge points may be considered when connected to an unmetered payment supply. Such a supply uses the central management system to report on consumption to a meter administrator, who will then construct data flow for use in settlement.

SECTION 6

Market trader electrical supply pillars and event pillars

6.1 Introduction

This section looks at the provision of an electrical supply network supporting an individual market trader electrical supply pillar (MTESP) or a system of MTESPs. These are usually installed to allow the supply to, and responsible usage of electricity by, individual street market traders who use licensed temporary stall structures. The variation of use and environmental conditions carry a significant level of risk for a local authority/asset owner, its officers and the equipment operators (market traders).

Similarly, such pillars can provide supply electricity for one-off or regular events so, while the terminology in this section is aimed at market pillars, the approach will be exactly the same when considering such pillars for event use.

6.2 Scope

The provision of electrical supplies as a service to markets may bring added benefit to the people of an area/authority as a whole, leading to greater economic development of the markets themselves, and may also have a positive effect on the surrounding business. This can result in a growth in prosperity and can be beneficial to the authority as a whole.

These electrical supply assets would generally be the responsibility of the local authority or may be the property of the market trader association. However, these do not normally form a part of the authority's core service requirements and operational maintenance cost recovery through a 'service level agreement' should be considered. In this way, the local authority/asset owner can maintain control of their service and the associated maintenance, management and energy revenue costs within the constraints of minimum mandatory maintenance requirements.

Those responsible for the supply should look to ensure that any proposed system will be safe for use by traders and will not compromise public or workforce safety.

6.3 Safe supply of electricity to MTESPs

The Highway Authority or any other asset owner has a duty to understand the condition, maintenance and management requirements of assets on the highway. As part of this obligation they need to consider the provision of MTESPs and supply points. This will include requirements for installation, inspection, testing, maintenance, legal obligations, management and responsibilities/risk assessments related to connections to the market stalls. A sample risk assessment is provided within Appendix A.

This section considers the main aspects of the safe supply of electricity to market stall holders. The following points will be addressed:

(a) considerations when planning market trader supplies;
(b) market trader supply points; and
(c) market trader agreements/market rules and regulations.

There are no specific standards available for the supply of electricity to external market stalls, but locations having some similarities are covered by Part 7 of BS 7671 – these locations being:

(a) electrical installations in caravan/camping parks and similar locations;
(b) exhibitions, shows and stands;
(c) electric vehicle charging installations; and
(d) temporary electrical installations for structures, amusement devices, and booths at fairgrounds, amusement parks and circuses.

There is also guidance for comparable installations within BS 7909 (see Section 2) and BS 7375 *Distribution of electricity on construction and building sites*, although the latter relies upon a reduced safety voltage network, which is not suitable for market traders.

6.3.1 Overall considerations when planning the supply points for a market

Consultation should be held with market managers and market stall holders to determine their requirements and to involve them with each project. Their requirements should be balanced against what realistic service provisions can be provided.

The layout of each market will require careful consideration so that supply points can be suitably located and cable routes to all stalls can be managed. A rule of thumb of stalls being 3 m wide with a 1 m gap between them tends to fit in with most requirements and current market layouts. However, in some cases the size of the stalls may be different and this approach will therefore need evaluation.

All market trader sites need to be assessed to ensure that emergency vehicles can gain access at all times.

It would be considered sensible for each trader to pay for the energy used as well as being encouraged to be energy efficient when managing their electrical load. However, the practicalities and legalities of this must be considered; payment considerations are discussed later in this section.

An operational policy or market trader guidance for the use of each supply point, such as that explored in Section 6.11.7, requires consideration in terms of:

(a) how cables are run from the pillar to the stall, addressing health and safety issues/concerns such as trip hazards, protecting the cables from damage etc.;
(b) electrical testing and certification of electrical cables and apparatus supplied; and
(c) how energy use may be charged.

The electrical load to each stall should be carefully managed and in general be rated at 16 A unless, in exceptional cases, for example, where food preparation/cooking is permitted, by advance request at the design stage of the new installation. In such instances, a 32 A single phase supply could be considered. It should be noted that a domestic installation would be designed around 3.2 kW average use (when diversity is taken into account), so 3.7 kW should be more than sufficient for a market stall.

6.4 Design philosophy for electrical installations

6.4.1 Supply

Due to the nature of the equipment being supplied, the ESQCR prohibit the connection of a PME earthing facility to any metal work (or conductive material) within a temporary connected structure. BS 7909 defines a temporary electrical system as:

"... all switch gear , generators, distribution units, dimmers and similar equipment, cabling, connectors, protection, and measuring devices and current using equipment including mobile and transportable units that are required for an event" – therefore such installations would be supplied by the DNO/IDNO with a TT system."

See Section 3.3 for more information.

6.4.2 Types of pillar

The type of market supply pillar will really depend upon each particular application and should take into account the number of market trader stalls to be supplied from a single point as well as the intended use of the area, both whilst the market is in place and when it is not.

There is a wide range of options that the designer can consider and these include but are not limited to those shown in Figure 6.1.

▼ **Figure 6.1** Different types of pillar (courtesy of DW Windsor Ltd)

▼ **(a)** Heritage fixed pillar

▼ **(b)** Modern style single & double door pillar

▼ **(c)** In-ground retractable pillar

In the case of the above ground pillars these may either be fixed in their location or located in demountable sockets so they can be removed when not required. The pillars that are located below ground when not in use require an appropriate IP rating (IP68) and due consideration for drainage as well as taking into account existing utility and other underground services or features such as vaults and cellars.

▼ **Figure 6.2** Demountable pillars

In general it is likely that a market stall will be given access to a 230 V 16 A supply, protected by a 30 mA RCD.

When selecting pillars, the chance that they may be misused must be considered, and therefore a robust misuse-resistant pillar should be chosen. Issues to consider may include how much access to the equipment is provided. It may be that the local authority/asset owner wishes to limit access to the socket-outlet only and not to the circuit protective devices.

It is possible that the supply pillar will be located in a position where a direct DNO/IDNO service cannot be supplied and in these instances the pillar or network of pillars will be supplied via a private cable network from a main distribution point/pillar located in a suitable position within the highway boundary.

▼ **Figure 6.3** Main market supply pillar (courtesy of Charles Endirect)

When considering the design and specification of the pillar the designer should bear in mind that whilst the final installation must comply with BS 7671 the assembly of products cannot. It is therefore incorrect to specify the manufacture of a pillar against this standard (see Section 4.4).

6.5 Earthing

As a result of the supply being from a TT system, the market operator may be required to supply and maintain its own earthing system. This system would need to be in the form of an earth electrode, perhaps consisting of a sequence of earth mats buried in the ground below 600 mm from the surface or rods (see Section 4.3).

Figure 6.4 Typical earth mat installation

6.6 Link leads

It is recognised that the 'link' between the MTESP and the market stall has risks associated with it. These include:

(a) the use and integrity of the required earth bonding lead;
(b) the condition of the power lead between the MTESP and the market stall; and
(c) trips and falls due to inappropriate running of cables between MTESPs and market stalls.

Unless the local authority/asset owner considers otherwise, the market operator will own these link cables and a License Condition should include a requirement on the 'authorised user' (defined within the License Condition agreement) to ensure that:

(a) these connection leads are of a robust design that meet the minimum design specification;
(b) are inspected before use by the user; and
(c) electrically tested at least every six months and visually inspected by a competent person on a weekly basis to start with. The frequency of this competent visual inspection could potentially be reduced if, over time, no significant damage or degradation of the cabling is detected.

These checks should be logged following the procedures laid out in the Health and Safety Executive document HSG 107 *Maintaining portable and transportable electrical equipment*.

A key aspect to consider is how the supply from the pillar to the stall can be provided and the details of the 'extension/link' lead. It is recommended that a 'camping hook-up' type cable with a 3 or 4 gang 13 A socket head be considered. This socket head may be switched or un-switched at the stall end but must not contain an additional RCD unit. It would be preferable that the link lead is orange Artic flex cable of 4 mm^2 3 core construction and no more than 5 m long (unless otherwise agreed with the local authority/asset owner).

To counter potential trip and fall hazards it is recommended that a cable protection ramp should be used where the cable between the MTESP and the curb/back of stall is on the ground.

▼ **Figure 6.5** Cable protection ramps

The condition and suitability of the equipment attached to the network by the market traders is an area that is more difficult to manage. It is recommended that a limit to what equipment can be connected is agreed with the individual traders and an arrangement is made between the market operator and the trader to test any portable equipment on a regular basis and to make it clear to the traders that only inspected and tested equipment, suitably certificated, may be used. Again, this would need to be policed by a responsible person appointed by the market operator.

6.7 The market trader/market operator relationship

Any authorised user should be made aware of the associated risks to safety and of their responsibilities under the relevant acts/regulations.

Quoting the regulations with which a trader must comply is clearly a responsible action for the market operator/local authority/asset owner to take. This will go some way to ensuring safety and will correctly place responsibility for some safety aspects with the trader. Further practical guidance and rules as indicated in Section 6.11.7 can help to reduce risks. A license condition for the authorised user to present a valid inspection and test certificate for equipment registered for use on their stall can be linked to the process of allowing them access/issuing their access card.

6.8 Risks

The potential risks to safety include electric shock, burns, fire, trips and falls and lesions.

6.8.1 Electric shock

Electric shock from contact with 'live' conductive parts could be the result of:

(a) a market stall frame becoming live;
(b) damaged cabling/exposed conductors (owned/installed by the trader or local authority);
(c) damaged lamp holder exposing live parts (owned by the trader);
(d) broken lamp exposing live conductors/electrodes (owned by the trader);
(e) ingress of moisture to live parts causing leakage currents (local authority owned sockets);
(f) defective electrical equipment (owned by the trader);
(g) damaged MTESPs; and
(h) connection of non-inspection and tested equipment, suitably certificated, which could introduce a risk of fault on the supply network.

The following is an extract from the HSE website 'PAT – Portable appliance testing FAQs':

"**Note:** Portable appliance testing (PAT) is the term used to describe the examination of electrical appliances and equipment to ensure they are safe to use. Most electrical safety defects can be found by visual examination but some types of defect can only be found by testing. However, it is essential to understand that visual examination is an essential part of the process because some types of electrical safety defect can't be detected by testing alone."

A License Condition should include a requirement on the authorised user to ensure that their electrical equipment is inspected, tested and certified. While this is a requirement on the authorised user it could be that this is a service that can be offered by the market operator/local authority.

Figure 6.6 Market stall with multiple extension leads and incorrectly terminated cables

6.8.2 Burns

Burns (from direct or indirect contact with live parts or overheating equipment) may be caused by:

(a) contact with exposed live parts (owned/installed by trader or market operator); or
(b) contact with hot electrical equipment/installations (owned by trader or market operator).

6.8.3 Fire

Fire may be caused by:

(a) a short circuit fault (equipment owned/installed by the trader or market operator);
(b) a high impedance fault (equipment owned/installed by the trader or market operator);
(c) a loose electrical connection (equipment owned/installed by the trader or market operator); and
(d) extension leads not unwound.

Figure 6.7 Potential over-loading of supply (note the electric heater in bottom right corner)

Figure 6.8 Overloaded market stall, potentially excessive lighting, food preparation and cooking facilities

6.8.4 Trips and falls

Trips and falls may be caused by inappropriate routing of the cable between the MTESP and stall installations. A license condition will need to include a requirement on the authorised user to ensure that they employ a suitable cable management solution that allows for user and public safety to be maintained.

Figure 6.9 Vandalized pillar

Figure 6.10 Long extension lead that presents a trip hazard and a coiled extension lead presents a potential fire hazard

6.8.5 Lesions

Lesions may occur from glass fragments from an exploding lamp or sharp edges from a broken lamp envelope (whether caused by explosion or not). Explosions may occur when a lamp fails and the lamp envelope may also be shattered through mechanical impact.

6.8.6 Managing the risk

It must be noted that under The Health and Safety at Work etc. Act Section 3. (1):

"It is the duty of every employer to conduct his undertaking in such a way as to ensure, so far as is reasonably practicable, that persons not in his employment who may be effected thereby are not thereby exposed to risk to their health or safety."

In order to protect the market operator from any legal action it is necessary to implement suitably certificated and recorded inspection and testing.

6.9 Maintenance

The maintenance of equipment includes an inspection and testing regime that will trigger any defective or damaged equipment to be identified and removed from service until such time as it is returned to a safe operating condition. Ideally this should occur before such equipment leads to an accident.

Each piece of portable equipment should be subjected to a six-monthly portable appliance testing regime (PAT). The arranging of, and payment for, the PAT test will be the responsibility of the market trader. A condition of licencing to trade on a pitch with access to an electrical supply is that all portable electrical equipment used on the stall must be entered onto a list of equipment, held by the market trader. This list must form part of a current and valid PAT certificate. All PAT-tested equipment must be clearly and indelibly labelled with the date on which the current PAT test expires.

Notwithstanding the above, a PAT test does not guarantee a piece of equipment is in a safe condition at any time after the test was carried out, so it is vital to understand that visual examination is an essential part of safe operation. It should therefore be a requirement that the market trader carries out a daily visual inspection of each portable appliance before connecting it to the electricity supply. The person using the equipment should ensure that the equipment is in sound condition by checking for the following before it is put into use (the below points can be formalized into a checklist for the end user):

(a) damage (apart from light scuffing) to the supply cable, including frays and cuts.
(b) damage to the plug or connector, for example, the case is cracked, the pins are bent, wires are exposed, screws are missing etc.
(c) any joints in the cable or taped-up damage.
(d) the outer sheath of the cable not effectively secured where it enters the plug or the equipment. Evidence would be if the coloured insulation of the internal cable cores is showing.
(e) the equipment has been subjected to unsuitable conditions, for example, it is wet or excessively contaminated with paint, oil or grease.
(f) damage or cracking to the external casing of the equipment.
(g) loose or missing parts or screws.
(h) evidence of overheating (burn marks or discolouration around electrical components).

These checks also apply to all leads, plugs and socket-outlets. Any defect must result in the equipment being withdrawn from use until it is repaired or replaced by a competent person and certified as safe for use.

Any equipment found in use on a market stall that is clearly defective or has not been PAT tested could lead to the market trader losing the right to use electrical equipment on their stall.

The market trader should also ensure that the cable between the MTESP and the stall is installed in such a way that it is protected from external damage and does not constitute a trip hazard. Where a cable may be considered a trip hazard a suitable containment device must be used (see Figure 6.11).

▼ **Figure 6.11** Cable containment

6.10 Market stall equipment

When selecting the equipment to use on the market stall the market trader needs to ensure that, when any combination of the equipment is connected to the supply, it does not exceed 16 A. As most portable electrical equipment is sized by kilowatt (kW), Table 6.1 gives approximate amperages for the various sizes of equipment available to allow calculation. It should also be noted that whilst the supply may be 16 A each individual piece of equipment cannot exceed 13 A as it must be fitted with a domestic-style plug that cannot exceed this (therefore units bigger than 2.9 kW will not be suitable for the supply and units above 2.7 kW are not recommended). It is also required that all equipment selected carries a CE mark and, where practical, is double insulated. 'Double insulated' is denoted by the symbol of a square within a square (see Figure 6.12). Plugs and socket-outlets must comply with BS EN 60309.

▼ **Figure 6.12** Double insulation logo

0.06 kW = 60 W = 0.26 A	1.2 kW = 1200 W = 5.22 A	2.4 kW = 2400 W = 10.43 A
0.1 kW = 100 W = 0.43 A	1.3 kW = 1300 W = 5.65 A	2.5 kW = 2500 W = 10.87 A
0.2 kW = 200 W = 0.87 A	1.4 kW = 1400 W = 6.09 A	2.6 kW = 2600 W = 11.30 A
0.3 kW = 300 W = 1.30 A	1.5 kW = 1500 W = 6.52 A	2.7 kW = 2700 W = 11.74 A
0.4 kW = 400 W = 1.74 A	1.6 kW = 1600 W = 6.96 A	2.8 kW = 2800 W = 12.17 A
0.5 kW = 500 W = 2.17 A	1.7 kW = 1700 W = 7.39 A	2.9 kW = 2900 W = 12.61 A
0.6 kW = 600 W = 2.61 A	1.8 kW = 1800 W = 7.83 A	3 kW = 3000 W = 13.04 A
0.7 kW = 700 W = 3.04 A	1.9 kW = 1900 W = 8.26 A	3.1 kW = 3100 W = 13.48 A
0.8 kW = 800 W = 3.48 A	2 kW = 2000 W = 8.70 A	3.2 kW = 3200 W = 13.91 A
0.9 kW = 900 W = 3.91 A	2.1 kW = 2100 W = 9.13 A	3.3 kW = 3300 W = 14.35 A
1 kW = 1000 W = 4.35 A	2.2 kW = 2200 W = 9.57 A	3.4 kW = 3400 W = 14.78 A
1.1 kW = 1100 W = 4.78 A	2.3 kW = 2300 W = 10.00 A	3.5 kW = 3500 W = 15.22 A

Some examples of catering equipment and related power usage are listed below. These units are the smallest of their range available and this illustrates the care that must be taken in selecting the equipment.

These units are being used for example purposes only and the market trader must check the power consumption of any equipment they intend to use and not use the figures below.

▼ **Figure 6.13** Load indications for typical market staff electrical equipment

Large display warmer	1.8 kW (7.82 A)
Panini toaster	1.5 kw (6.52 A)
Expresso machine (small)	1.7 kW (7.39 A)
Water Boiler	2.6 kW (11.3 A)
Domestic kettle	2.2 kW (9.57 A)

Lights should be counted as the wattage shown on the box divided by 1,000 to give kilowatts. It is recommended that the market trader uses low energy lamps (preferably LED) to supply lighting. Care should be taken to ensure that any lamps are protected against accidental contact/impact as a safety precaution.

6.11 Inspection and testing regime

6.11.1 General requirements

To satisfy any defence against prosecution in the event of an accident involving electrical equipment, it is necessary that a structured method of recording all inspections and tests are documented in a register, signed, dated and retained and that all inspections and tests follow the guidance laid out in the Health and Safety Executive document HSG 107 *Maintaining portable and transportable electrical equipment*.

Due to the nature of MTESPs and their associated supply and networks and the fact that these installations are in the public realm, it is a requirement that the owners ensure that, as far as is reasonably practical, the complete installations are kept in a safe and well-maintained condition.

The requirement for inspection and testing should be allowed for in the design of any type of installation that has a number of components, and has to be considered to maintain the installations in a safe working condition and demonstrate compliance to the Health and Safety at Work etc. Act Section 3. (1) and the Electricity at Work Regulations 1989.

6.11.2 Construction phase requirements

On completion of the construction phase of an installation a full electrical inspection and test must be carried out to confirm that the installation complies with BS 7671 in its entirety but especially to Part 7, Section 708 – *Electrical installations in caravan/ camping parks and similar locations* as applicable.

A full inspection and test certificate for each installation must be handed to the local authority/asset owner before these installations are accepted for use by market traders. This test certification needs to be saved as part of the content of the installation health and safety file and included within the local authority/asset owner asset management data base.

6.11.3 Ongoing inspection and testing

The MTESP and user-side installations must then be inspected again and retested as above, every six months, in accordance with BS 7671 to ensure that there is no significant deterioration of the electrical safety of the installation. A new certificate must be issued and saved as part of the content of the installation health and safety file.

6.11.4 Installation connection requirements

These installations should be supplied by the DNO using a TT supply system, which relies on the installation operator supplying their own earthing system as an earth is not supplied by the DNO. As discussed in Section 2.6 the earthing system consists of a system of earth mats or rods. The correct functionality of these mats or rods is a key safety issue and as such an earth resistance test of each installation would form part of the compliance testing listed above.

It is mandatory that the earth resistance testing is carried out at each installation every six months, even when the duration between compliance tests is extended beyond the recommended six months.

These test results must be recorded and saved as part of the content of the installation health and safety file.

6.11.5 Routine inspection and testing recommendations

Over and above these testing regimes it is recommended that a competent person carries out a weekly visual inspection and function test on every MTESP that is in service. It is recommended that the local authority/asset owner appoint market managers who are trained to a level of competence to allow them to carry out this task.

This inspection will cover the condition and operation of the MTESP, so will cover such things as the security, condition and operability of any covers, controls, switches, doors and latches or locks as well as the physical condition of the bollard and its security in the ground socket. The competent person must also actuate the test trip button of the residual-current circuit breaker with overcurrent protection (RCBO) and ensure that the RCBO resets.

The competent person will also hold the responsibility of ensuring that each market trader is using only PAT-tested electrical equipment on the stall and to assess that the equipment in use will not overload the electrical supply to the stall. These weekly checks need to be recorded. As part of this inspection routine and at any time during a market patrol the competent person should also ensure that the equipment used by the market trader complies with the requirements of this report, i.e. that the equipment is free from any of the defects listed (see Section 6.10). Anything that is found to be unsafe must immediately be disconnected from the electrical supply until satisfactorily remedied.

6.11.6 Logistics of testing and recording test results

By carrying out the above inspection and testing and to ensure that all inspection and testing is recorded it is expected that the market electrical installations will be maintained in a safe and operable condition.

Tags must be affixed on the electrical cord within 150 mm of the plug. New equipment must be tested and tagged before entry into service.

Each authorised user or, where applicable, market manager, must maintain a register identifying the details of all electrical equipment and extension leads with dates of inspection and the results. Each item must be marked as tested, approved and a retest date.

An appropriate safety barrier must be in place between any heating facility equipment and customers, as shown in Figure 6.14.

▼ **Figure 6.14** Market trader stall with barrier

It is also expected that the whole fixed electrical system from incoming supply to the points of connection of the MTESPs is periodically inspected and tested in accordance with BS 7671. The periodic inspection and testing should be carried out at no less than 12-monthly intervals, due to the intended use of the system.

6.11.7 The (market trader) 'authorised user' agreement

The authorised user should be subject to a formal agreement that specifies that stall electrical systems are inspected, tested and certified by a competent person, are safe in all respects and that:

(a) stall systems are neatly installed with no cables crossing or rolls of cables, and that the socket unit is secured above ground level and is not exposed to rain, spills and suchlike;
(b) stall holders will comply in all respects with health and safety legislation;
(c) all electrical equipment used on the stalls are CE marked;
(d) multi-way adaptors are not used without the express permission of the market operator;
(e) any electrical equipment or system is rated for the particular voltage/current to which it is connected;
(f) stall electrical equipment is not located beyond the confines of the stall; and
(g) any market trader guidance published by the local authority is adhered to.

The electrical equipment used on market stalls can be considered as portable electrical equipment (see also the Health and Safety Executive HSG 107 *Maintaining portable and transportable electrical equipment)*.

Before being connected to the supply, the equipment, including extension leads, should be checked:

(a) for compatibility with the supply voltage and current;
(b) for any cracks, splits, abrasions or temporary joints or extensions in the cable;
(c) for security of cable cord grips at entries to equipment, plugs and socket-outlets and that the outer sheathing of the cable is terminated within the apparatus; and
(d) to ensure that the plugs and sockets are in good condition.

During use to ensure that:

(a) flexible cables are not kinked and extension leads are fully unwound to avoid over-heating;
(b) the weight of equipment is not supported on the flexible lead or used to pull the plug out of the socket-outlet and equipment does not drop;
(c) flexible cables are not dragged over rough surfaces;
(d) the equipment is not overloaded;
(e) the flexible cable is kept well clear of rotating and hot equipment;
(f) equipment used on, at, or for the site is safe and secure at all times;
(g) cables are not positioned where they can form a trip hazard; and
(h) metalclad equipment is stood, wherever possible, on non-conductive materials such as wood or plastic or on a rubber mat.

After use to ensure that:

(a) the equipment is switched off and the plug withdrawn;
(b) the equipment is stored correctly and in a dry place;
(c) the supply points are left safe and de-energised (switched off);
(d) any faults found with the portable equipment are reported, repaired or replaced by a competent person and equipment is inspected and tested before re-use; and
(e) any faults found with the supply points are immediately reported through to the market operator.

6.11.8 Operation of market trader electrical supply bollard

Prior to using a market trader supply bollard/point the user shall:

(a) carry out visual equipment checks as listed in Section 6.11.7;
(b) plug the link lead into the MTESP and run the lead out to the market stall, using any cable containment devices supplied; and
(c) ensure that the RCD for the chosen socket is in the 'up' or on position.

The market trader must report any faults with the MTESP equipment to the market manager at the earliest opportunity. The market manager will initiate a maintenance call and should carry out repair and restore service as soon as possible.

Under no circumstances must the market trader attempt to repair or alter any part of the MTESP or the electrical infrastructure supplying it.

6.11.9 Energy payments

A local authority/asset owner has a duty to monitor, manage and maintain their electrical assets while reducing the related energy use and may therefore want the option to recover energy used by market traders.

Perhaps the simplest way of achieving this is through an 'authorised user control solution' such as a key and/or electronic card switch, which ensures that only authorised users can access and use the MTESPs. In this case an authorised user would be a licensed trader and they will need to understand that the use of these assets comes with constraints and conditions on the authorised user that are designed to ensure the safety of the user, the public and the workforce.

Payment could be facilitated through the issuing of credit 'pre-loaded' swipe cards that could then be used by the traders to activate and measure electricity supply at the MTESP associated with the use of their stalls. By recovering electrical energy costs it is hoped that this will encourage responsible use of the equipment and electricity. The use of a swipe card system as an enabling 'key' will provide the required level of control over access to energy from an MTESP ensuring that the owner meets their health and safety obligations.

An alternative option to resale pre-loaded energy units would be to charge the traders a fixed annual fee for electricity as a service, which would be included in their stall fee, and use the swipe card as a key to allow use of electrical power. Another option would be to issue the cards free of charge to licensed market traders, but to also use them as a trader licence ID/token. This could then be used with, or replace, any existing 'issued' licence paperwork but still retain the required control of restricting access to the MTESPs to 'authorised users' – i.e. official licensed traders.

SECTION 7

Other equipment

Many of the sections of this Guide covered the main items of electrical street furniture currently being installed within the highway. There are, of course, many other items of equipment installed within the highway/public realm and as discussed in detail within Section 3.5.1 ENA *Engineering Recommendation G12* advises that the majority of electrical equipment within the public realm (other than lighting columns and sign posts) will not be considered Class 1. Based upon this it states that a PME terminal should not be offered and a TT system with an RCD should be installed. Essentially, the requirements for these types of equipment are the same as those already discussed.

7.1 Safety and enforcement cameras

Safety and enforcement cameras will not have a direct DNO service. They should be fed from a dedicated supply from a feeder pillar that is suitably located. In general these should have a TT supply.

▼ **Figure 7.1** Safety camera with sub-pillar

Where cameras or other equipment (for example, environmental monitoring equipment) are mounted on lighting columns themselves, the following must be considered:

(a) the structural integrity and suitability of the column structure;
(b) how the equipment will be connected, including circuit protection and labelling;
(c) how the equipment will be maintained – including electrical inspection and testing; and
(d) how emergency situations (such as a road traffic incident causing damage to the column) will be dealt with.

7.2 Bus shelters

Bus shelters may contain only a lighting system but more frequently they also accommodate live travel information screens as well as illuminated advertisements.

Figure 7.2 Adjacent supply pillar (L) and integral electrical housing (R)

The design of bus shelters varies and many tend not to favour the installation of a direct DNO/IDNO service due to limited space (mainly height) of the electrical compartment (see Figure 7.3 (L)), which prevents the DNO service cut-out being installed correctly and limits room for a distribution panel. They should therefore be fed from a dedicated supply from a feeder pillar that is suitably located (usually with a TT supply). As can be seen from Figure 7.2 (L), this can be unsightly and increase street clutter. Other bus shelter designs look to provide appropriate electrical compartments (Figure 7.3 (R)) within their structure, which presents a less cluttered and cleaner impression of the bus stop area as shown in Figure 7.2 (R).

Figure 7.3 Inadequate electrical compartment (L) and adequate electrical compartment (R)

A key requirement is to ensure adequate bonding between the metal structure of the bus shelter and the supply earthing system. Good practice dictates that the bus shelter structure should be bonded to a suitable earth mat or rod.

7.3 Smart city technologies

The consideration of smart city is discussed in Section 8. It is a wide-ranging topic encompassing many new and emerging technologies that will bring many benefits to the authorities, businesses, residents of, and visitors to, a city/town or area.

7.4 Shared traffic signals and lighting

Many authorities are considering de-cluttering the street scene and one such approach can be the combining of equipment, such as traffic signal aspects, onto lighting columns, provided that the locational requirements needed so that each achieves their respective tasks can be achieved.

Within the UK most new traffic signal equipment is 48 V extra low voltage (ELV) from the signal controller to the signal poles. 230 V low voltage (LV) controllers are still available but these are only for very limited applications and ELV is certainly the normal for all new signal installations.

Where it is agreed that a combined column can be used, the following is required:

(a) the signal controller must have its own feeder pillar with a DNO service and must not be used to supply any other equipment.
(b) combined columns must not have a direct DNO service – instead, they must be fed from a dedicated supply from a feeder pillar that is suitably located and is more than 2 m away from the signal feeder pillar. More than one combined column can be fed from a feeder pillar.
(c) in cases where lighting and signal-related cables for lighting combined columns share the same duct, they must be easily identifiable and easily isolated at each pillar.
(d) all cables must be identified by suitable labelling at both ends of the cable and any draw pit it passes through.
(e) all electrical work must comply with the current edition of BS 7671; in particular, LV and ELV circuits should be separated within the column – the wiring for the signals installation will be in accordance with the design and specification for the junction and will be installed by the approved signals contractor as instructed by the signals engineer.
(f) the wiring for the lighting will be in accordance with the design and specification for the lighting design and will be installed by the approved lighting contractor as instructed by the lighting engineer.

SECTION 8

Considerations for the future

The designer of any system should consider the question: 'what must I take into account when planning and/or designing existing equipment to make it ready for possible future additional applications?'

8.1 Earthing requirements

It may be worth identifying recommendations for the future such as ensuring that a good customer earth is achieved when installing new equipment. Whilst the usual connections may still be PME, there may be a reason to convert to TT supply in the future with the new technologies, such as electric vehicle systems and infrastructure monitoring equipment, that are starting to emerge and good earth paths will be required. Of course, this is arguably good practice anyway.

8.2 Smart cities technologies

'Smart city technologies' covers a wide range of possible applications and we therefore need to consider the areas that we may wish to develop as a business at a later stage. These areas may change as an understanding of the term becomes better defined over time, the technologies develop and clients get their own understanding of what they need. However, from actions already carried out, benefits can include income generation for the authority, increased efficiencies from targeted services and a more personal service for both residents and visitors.

As part of early adoption of smart city strategies, many authorities are considering how a city-wide system can be deployed. Due consideration is being given to the use of the street lighting furniture forming the backbone of the infrastructure through its ability to provide location, height, power and communications – i.e. lighting columns that not only act as sources of illumination but also as information hubs to help monitor and control services delivered by the municipality. Such services include, but are not limited to:

(a) parking – the monitoring of available parking and advising users of its existence.
(b) air quality – the monitoring of air quality with the potential to divert traffic onto other routes or, where practicable, reducing traffic idling times and, conversely, speeds, which will in turn reduce pollution in specific areas.
(c) drainage – monitoring of gullies, identifying when they need to be emptied rather than doing it on a fixed programme. This could also minimise disruption on the street and reduce flooding due to a blocked gully.
(d) waste collection – monitoring of authority-owned and commercial refuse bins.
(e) adaptive lighting – changing the lighting levels to suit the task to be lit, for example, changing light levels to suit pedestrian activity or traffic volumes.

One of the barriers to this is the current 'silo' mentality that exists in some local authorities, as departments do not tend to communicate well between themselves and look to share revenue incomes. For example, a team managing parking for a local area may use the lighting infrastructure for their system but may not share any of the revenue generated from their parking services to the lighting department, who have to look after the additional equipment on their columns.

In addition to revenue income, increased efficiencies through targeted service delivery and reduced traffic disruption, other benefits/considerations could include:

(a) public safety and security – equipment that senses rushes of people in an area that's usually deserted at night could trigger an alert to the police; alternatively, within security zones, enabling full automatic checks of street apparatus to ensure that suspect devices/suspicious packages are not left within them.
(b) retail analysis via footfall recording – does a specific event or festival have an impact on footfall and hence the local economy?
(c) street usage analysis – monitoring of traffic and users to establish how streets are used, including intelligent transport systems (ITSs), ranging from traffic monitoring to emerging co-operative-ITS (C-ITS) initiatives.
(d) water monitoring – use of smart water systems that help conserve water by detecting leaks.
(e) digital kiosks/information points for citizen engagement.
(f) smart mobility – ensuring that users such as residents, workers and visitor/tourists have particular services delivered, depending on their needs.

Currently many questions exist as to what can actually be achieved through the application of sensors on lighting columns in addition to questions as to the most appropriate networking technology to use: wired; wireless; mesh networks; GSM; Wi-Fi; Bluetooth etc., while still ensuring the privacy of the data and security of the system.

Certain smart city technologies mounted on columns may have associated safety requirements/safety zone limits. The designer must ensure that the client is fully aware of the manufacturer's guidance, who in turn must advise their contractors and operatives who may need to attend to such equipment.

8.3 Column design considerations

The development of smart city technologies and the consideration for such technologies to be located upon lighting columns merits consideration now, with the main requirements being:

(a) for the column to structurally support the additional loading of these technologies in terms of weight and windage: the current consideration to meet this requirement is for the column design to include both a factor of safety for the intended or existing luminaire and an additional consideration of a 0.6 m^2 sign plate located at the top of the column.
(b) the provision of a direct current electrical supply at the top of the column/at the luminaires: at least one LED driver supplier now produces a driver with a separate dedicated DC output for such a purpose.

Consideration should also be given to any equipment that may need to be located within the base compartment of the column and if the size and access details are adequate.

Appendix A

Market trader sample risk assessment

Brief Description of Activity:	Date of Assessment:	Assessors:	At Risk:
Market trader electricity supply to individual trade stalls	ONGOING	MWDM	A – WCC staff and contractors B – Market traders C – Members of the public D – Equipment and property

Other Supporting documentation (please list):

Hazard/risk	Groups at risk	Severity	Probability	Risk level before controls	Controls to be applied	Risk Level with Controls
General danger of electric shock.	A B C	Cr	O	H	**1.** 30 mA RCD/RCBO protective devices to be installed in the circuits directly before the last sockets to protect life. **2.** Any person permitted by the authority to use the electrical system is made aware of the associated risks to safety. **3.** Maintenance regimes will be implemented that ensure frequent monitoring/testing and record keeping is maintained throughout the life of the asset.	L
General danger of burns due to contact with exposed live parts.	A B C	Cr	R	M	**4.** 30 mA RCD/RCBO protective devices to be installed in the circuits directly before the last sockets to protect life. **5.** All portable equipment to be CE marked and/or double insulated. **6.** Recorded process – occasional monitoring.	L
General danger of burns due to contact with hot electrical equipment.	A B C	S	O	M	**7.** Stallholders must ensure that all equipment used on, at, or for their site is safe and secure at all times. **8.** Recorded process – occasional monitoring. **9.** Only PAT certificated equipment to be used (license condition) other than lighting, may be used.	L

Hazard/risk	Groups at risk	Severity	Probability	Risk level before controls	Controls to be applied	Risk Level with Controls
Use of equipment/ power supply by unauthorised persons.	C D	Cr	O	H	**10.** Use of swipe card issued to licensed traders (authorised user) to activate power supply.	L
Damage to cable between market trader electrical supply bollard and the stall resulting in electric shock.	A B C	Cr	O	H	**11.** The local authority will specify a minimum standard for this requirement and also provide a solution within the service level agreement (SLA). Along with various options that will ensure that they are electrically tested (minimum) every 6 months and visually inspected by a competent person on at the agreed interval. The licensed market trader (authorised user) will be issued with operational guidance that will instruct that, before being connected to the supply, the cable between market trader electrical supply bollard (MTESP) and the stall must be checked for any cracks, splits, abrasions or temporary joints or extensions in the cable, for security of cable cord grips at entries to equipment, plugs and sockets and that the outer sheathing of the cable is terminated within the apparatus and to ensure the plugs and sockets are in good condition.	L
					12. 30 mA RCD/RCBO protective devices to be installed in the circuits directly before the last sockets to protect life. **13.** Maintenance regimes will be implemented that ensure frequent monitoring/testing and record keeping is maintained throughout the life of the asset.	
Market trader attaching faulty equipment at the stall resulting in electric shock if current leakage to stall structure occurs.	A B C	Cr	R	M	**14.** 30 mA RCD/RCBO protective devices to be installed in the circuits directly before the last sockets to protect life. **15.** Maintenance regimes will be implemented that ensure frequent monitoring/testing and record keeping is maintained throughout the life of the asset. Only PAT certificated equipment to be used (license condition), other than lighting.	L

Hazard/risk	Groups at risk	Severity	Probability	Risk level before controls	Controls to be applied	Risk Level with Controls
Trips and falls due to inappropriate running of cable between MTESP and stall	A B C D	M	P	L	**16.** To counter potential trip and fall hazards it is a requirement that the cable between the MTESP and the curb/back of stall a cable protection ramp should be used. **17.** Monitoring, education and enforcement (license condition) will be implemented through the SLA.	T
'Removable' MTESPs and/or associated equipment could be damaged in transit or storage.	A B C D	Cr	R	M	**18.** Mitigated by an authorised/responsible authority appointed service provider having responsibility for the deployment and those persons carrying out visual and basic functional testing, on deployment of a unit to a location. These checks should be logged following the procedures laid out in HSG 107 (Health and Safety Executive, *Maintaining portable and transportable electrical equipment*). **19.** Recorded process – SLA managed and contract monitored process.	T
The condition and suitability of the equipment attached to the network by the market traders.	A B C	Cr	R	M	**20.** A limit to what equipment can be connected is agreed with the individual traders (authorised user). **21.** Only CE marked and/or double insulated equipment to be used on market stalls. **22.** Only PAT tested equipment, other than lighting, may be used. **23.** Traders may no longer retail used electrical goods. **24.** Monitoring, education and enforcement (license condition) will be implemented through the SLA.	L

Hazard/risk	Groups at risk	Severity	Probability	Risk level before controls	Controls to be applied	Risk Level with Controls
100 A single/ multi-phase TT supply needs user supplied earth mat	A B C	Cr	R	M	**25.** The requirement is that the resistance of this earthing system should be no higher than 200 Ω although a substantially lower earth value would be preferential if it is practical to achieve (compliant to BS 7671). **26.** 100 mA RCD timed delayed protective devices to be installed at the beginning of the installation immediately after the meter. **27.** Maintenance regimes will be implemented that ensure frequent monitoring/testing and record keeping is maintained throughout the life of the asset.	T
Damage to earth electrode or CPC between feeder pillar and earth electrode.	A B C D	Cr	R	M	**28.** A dual earth electrode system is adopted which will offer a backup, should one of the earth paths be accidently damaged or broken by future works in the area. **Note:** Individual situation may reduce this requirement to a single earth electrode following a site specific risk assessment **29.** The earth system is to be included in the periodic testing regime. **30.** 100 mA RCD timed delayed protective devices to be installed at the beginning of the installation immediately after the meter. **31.** Maintenance regimes will be implemented that ensure frequent monitoring/testing and record keeping is maintained throughout the life of the asset.	T

Hazard/risk	Groups at risk	Severity	Probability	Risk level before controls	Controls to be applied	Risk Level with Controls
Danger of electric shock due to leakage caused by ingress of liquid.	A B C	Cr	O	H	**32.** All primary (local authority owned) equipment to have an IP rating suitable to prevent water ingress in its designed location. **33.** 30 mA RCD/RCBO protective devices to be installed in the circuits directly before the last sockets to protect life. **34.** Maintenance regimes will be implemented that ensure frequent monitoring/testing and record keeping is maintained throughout the life of the asset.	L

	FREQUENT	PROBABLE	OCCASIONAL	REMOTE	IMPROBABLE
CATASTROPHIC	N	N	N	H	M
CRITICAL	N	N	H	M	L
SERIOUS	H	H	M	L	T
MINOR	M	M	L	T	T
NEGLIGIBLE	M	L	T	T	T

T	–	**T**olerable Risk	–	No additional controls required
L	–	**L**ow risk	–	Recorded process – occasional monitoring
M	–	**M**edium Risk	–	Frequent monitoring/testing and record keeping
H	–	**H**igh Risk		Constant management of location
N	–	**No** tolerable Risk		Cessation of activity. Activity is not to proceed.

SEVERITY	CONSEQUENCE
CATASTROPHIC (C)	Multiple fatalities or a single death of a member of the public; severe widespread environmental damage.
CRITICAL (Cr)	Single fatality and/or multiple severe injury or illness to members of the public; environmental impact.
SERIOUS (S)	Single severe injury or multiple minor injuries to members of the public, destruction of property.
MINOR (M)	Minor injury, damage to property.

PROBABILITY	DESCRIPTION
FREQUENT (F)	Expected, will occur several times.
PROBABLE (P)	Occurs repeatedly/an event to be foreseen.
OCCASIONAL (O)	Could occur some time.
REMOTE (R)	Unlikely though conceivable.

IET Standards

Guide to Highway Electrical Street Furniture

www.theiet.org/standards

IET Standards
Michael Faraday House
Six Hills Way
Stevenage
Herts
SG1 2AY