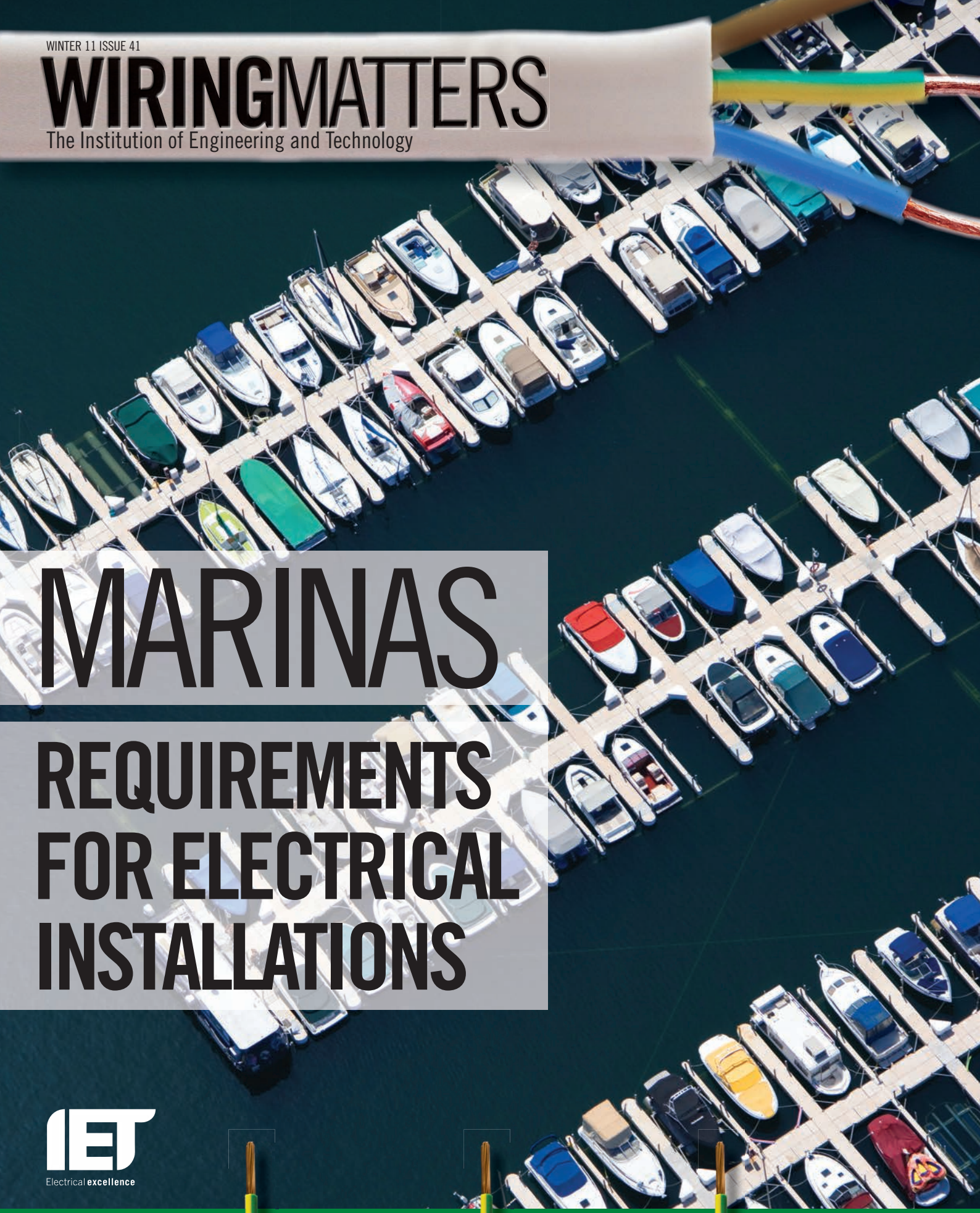
WINTER 11 ISSUE 41

WIRINGMATTERS

The Institution of Engineering and Technology



MARINAS

REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

IET
Electrical excellence

Socket outlets
Discussion of where RCDs for socket outlets can be omitted

Regulation numbers
BS 7671:2008 Adoption of the IEC numbering system

Swimming pools
An overview of Section 702 Swimming Pools and Other Basins

Electrical vehicles
What is the required charging infrastructure?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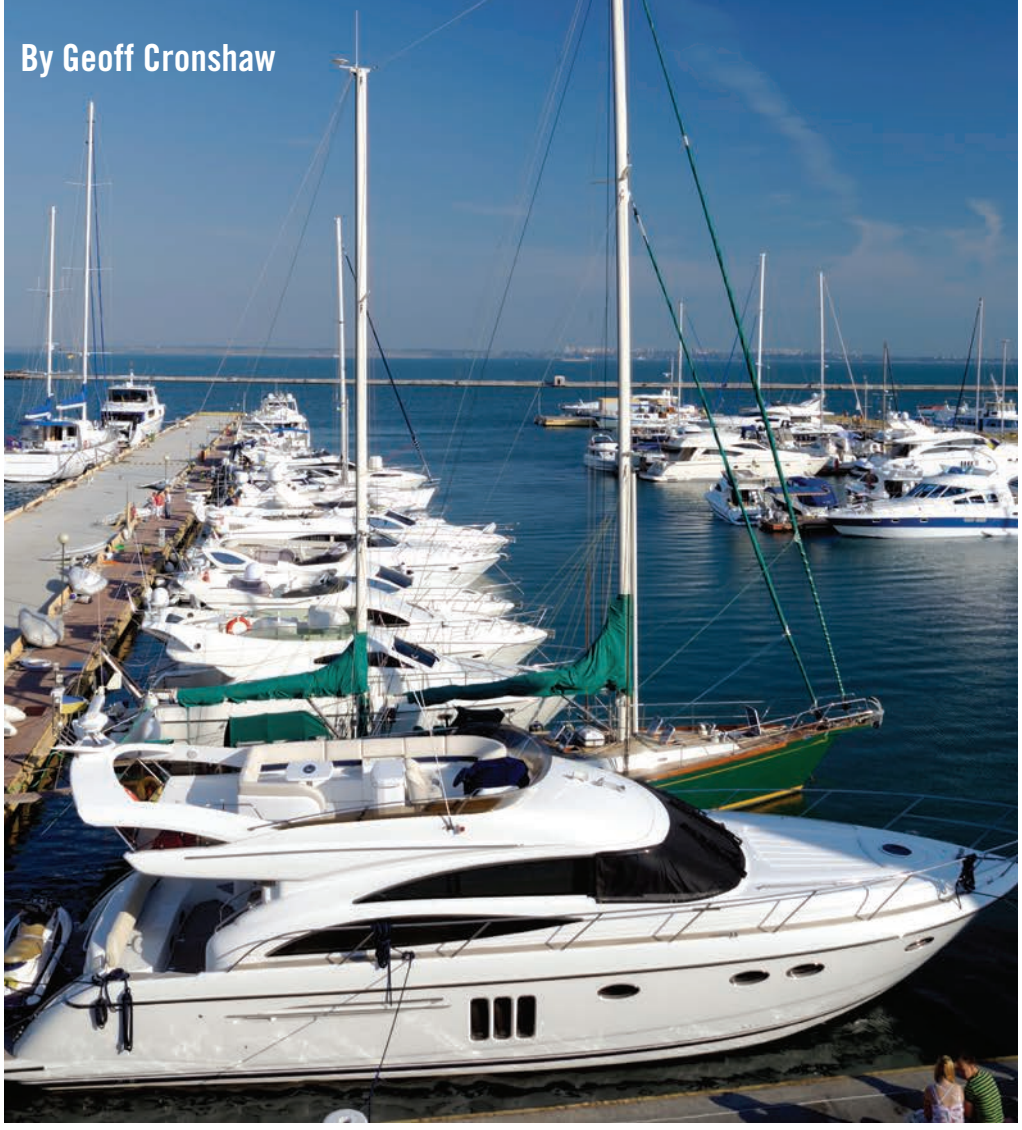
MARINAS AND SIMILAR LOCATIONS

We look at the requirements for electrical installations in marinas, together with the risks associated, including corrosion resulting from circulating galvanic currents and supplies to marinas, in particular the special concerns regarding Protective Multiple Earthing.

By Geoff Cronshaw



The 17th Edition of the Wiring Regulations (BS 7671:2008) introduced additional sections on special locations that were not included in the 16th Edition from 2008.

Among the special locations introduced were requirements for Marinas and similar locations contained in section 709 of BS 7671.

There are particular risks associated with electrical installations in marinas. Obviously, the environment of a marina or yachting harbour is harsh for electrical equipment.

The water, salt and movement of structures accelerate deterioration of the installation. The presence of salt water, dissimilar metals and a potential for leakage currents increases the rate of corrosion. There are also increased electric shock risks associated with a wet environment, by reduction in body resistance and contact with earth potential. The risks specifically associated with craft supplied from marinas include:

i. open circuit faults of the PEN conductor of PME supplies raising the potential to true earth of all metalwork (including that of the craft, if connected) to dangerous levels;
ii. inability to establish an equipotential zone external to the craft;
iii. possible loss of earthing due to long supply cable runs, connecting devices exposed to weather and flexible cord connections liable to mechanical damage.

Particular requirements to reduce the above risks include:

i. prohibition of a TN-C-S system for the supply to a boat (Regulation 709.411.4);
ii. additional protection by 30mA RCDs in both the craft and the marina installation (Regulation 709.531.2);
iii. outlets to be installed at not less than 1m above the highest water level. (Regulation 709.553.1.13 does give certain exceptions.)

There are also additional requirements to meet the conditions of external influences.

SUPPLIES

Regulation 709.313.1.2 states that the nominal supply voltage of the installation for the supply to small vessels, recreational crafts or houseboats shall be 230 V a.c. single-phase, or 400 V a.c. three-phase.

Where the supply system is protective multiple earthed ▶

◀ (PME), Regulation 9(4) of the Electricity Safety, Quality and Continuity Regulations 2002 prohibits the connection of the neutral to the metalwork of any caravan or boat. While the PME supply may be fed to permanent buildings in the marina, supplies to small vessels, recreational craft or houseboats must have a separate earth system.
A TT system having a separate connection with Earth, independent of the PME earthing system will meet this requirement.

What is Protective multiple earthing?

The Electricity Safety, Quality and Continuity Regulations 2002 (as amended) permit the distributor to combine neutral and protective functions in a single conductor provided that, in addition to the neutral to Earth connection at the supply transformer, there are one or more other connections with Earth. The supply neutral may then be used to connect circuit protective conductors of the customer's installation with Earth if the customer's installation meets the requirements of BS 7671.

This protective multiple earthing (PME) has been almost universally adopted by distributors in the UK as an effective and reliable method of providing their customers with an earth connection. Such a supply system is described in BS 7671 as TN-C-S.

Whilst a protective multiple earthing terminal provides an effective and reliable facility for the majority of installations, under certain supply system fault conditions (external to the installation) a potential can develop between the conductive parts connected to the PME earth terminal and the general mass of Earth. The potential difference between true Earth and the PME earth terminal is of importance when:

i. body contact resistance is low (little clothing, damp/ wet conditions), and/or
ii. there is relatively good contact with true Earth.

Contact with Earth is always possible outside a building and, if exposed-conductive parts and/or extraneous-conductive-parts connected to the PME earth terminal are accessible outside the building, people may be subjected to a voltage ▶

First characteristic numeral		Second characteristic numeral	
(a) Protection of persons against access to hazardous parts inside enclosures (b) Protection of equipment against ingress of solid foreign objects		Protection of equipment against ingress of water	
No.	**Degree of protection**	**No.**	**Degree of protection**
0	(a) Not protected (b) Not protected	0	Not protected
1	(a) Protection against access to hazardous parts with the back of the hand (b) Protection against foreign solid objects of 50 mm diameter and greater	1	Protection against vertically falling water drops
2	(a) Protection against access to hazardous parts with a finger (b) Protection against solid foreign objects of 12.5 mm diameter and greater	2	Protected against vertically falling water drops when enclosure tilted up to 15°. Vertically falling water drops shall have no harmful effect when the enclosure is tilted at any angle up to 15° from the vertical
3	(a) Protection against contact by tools, wires or such like more than 2.5 mm thick (b) Protection against solid foreign objects of 2.5 mm diameter and greater	3	Protected against water spraying at an angle up to 60° on either side of the vertical
4	(a) As 3 above but against contact with a wire or strips more than 1.0 mm thick (b) Protection against solid foreign objects of 1.0 mm diameter and greater	4	Protected against water splashing from any direction
5	(a) As 4 above (b) Dust-protected (dust may enter but not in amount sufficient to interfere with satisfactory operation or impair safety)	5	Protected against water jets from any direction
6	(a) As 4 above (b) Dust-tight (no ingress of dust)	6	Protected against powerful water jets from any direction
	No code	7	Protection against the effects of temporary immersion in water. Ingress of water in quantities causing harmful effects is not possible when enclosure is temporarily immersed in water under standardized conditions.
	No code	8	Protection against the effects of continuous immersion in water under conditions agreed with a manufacturer

Table 1: IP characteristic numerals

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Advertising Sales D Thomasson +44 (0)1438 767224 dthomasson@theiet.org | **Editor** G D Cronshaw +44 (0)1438 767384 gcronshaw@theiet.org | **Contributing Editors** M Coles, R Townsend, P Bicheno | **Sub editors** Jim Hannah, Leanne Farnell | **Design** John Rooney, Jon Bonny, Dan Shadrake | **Production controller** Nikki McEllin

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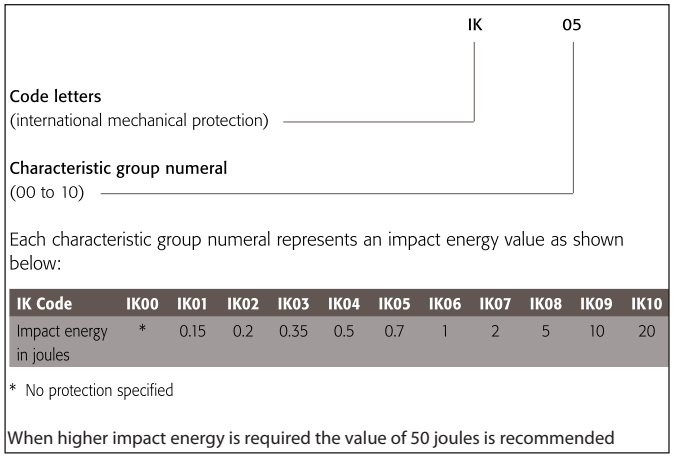

Each characteristic group numeral represents an impact energy value as shown below:

IK Code	IK00	IK01	IK02	IK03	IK04	IK05	IK06	IK07	IK08	IK09	IK10
Impact energy in joules	*	0.15	0.2	0.35	0.5	0.7	1	2	5	10	20

* No protection specified

When higher impact energy is required the value of 50 joules is recommended

Table 2: IK characteristics of BS EN 62 262:2002

◀ difference appearing between these parts and Earth. For this reason Regulation 9(4) of the Electricity Safety, Quality and Continuity Regulations 2002 (as amended). does not allow a combined neutral and protective conductor to be connected to any metalwork in a caravan or boat.

PROTECTION AGAINST ELECTRIC SHOCK

As you would expect the protective measures of obstacles, placing out of reach, non-conducting location and protection by earth-free local equipotential bonding are not permitted. These measures are contained in Sections 417 and 418 of BS 7671:2008 and are not for general application. The protective measures of section 417 provide basic protection only and are for application in installations controlled or supervised by skilled or instructed persons. The fault protective provisions of Section 418 are special and, again, subject to control and effective supervision by skilled or instructed persons.

OPERATIONAL CONDITIONS AND ENVIRONMENTAL FACTORS

Electrical equipment to be installed on or above jetties, wharves, piers or pontoons must be selected according to the external influences which may be present. In the marina environment, particularly at jetties, pontoons etc., consideration must also be given to the possible presence of corrosive or polluting substances. Equipment should be located to avoid any foreseeable impact, be provided with local or general mechanical protection and have a degree of protection for external mechanical impact IK08.

Presence of water (AD)

Any wiring system or equipment selected and installed must be suitable for its location and able to operate satisfactorily without deterioration during its working life. Suitable protection must be provided, both during construction and for the completed installation. Regarding presence of solid foreign bodies, a minimum degree of protection of IP3X is required. For presence of water the following applies:

- Presence of water splashes – IPX4
- Presence of water jets – IPX5
- Presence of waves of water – IPX6

The IP classification code, BS EN 60529:2004, describes a system for classifying the degrees of protection provided by the enclosures of electrical equipment. The degree of protection provided by an enclosure is indicated by two numerals. The first numeral indicates protection of persons against access to hazardous parts inside enclosures or protection of equipment against ingress of solid foreign objects. The second numeral indicates protection of equipment against ingress of water (see table 1 on p4). More information on the IP classification code is given in IET Guidance Note 1 – Selection and Erection.

Impact (AG)

The effect of environmental conditions and general characteristics around an installation should always be assessed to enable suitable electrical equipment to be specified. All electrical equipment selected must be suitable for its location, use and method of installation. Equipment should be located to avoid any foreseeable impact, be provided with local or general mechanical protection and have a degree of protection for external mechanical impact IK08.

The IK classification standard BS EN 62262 describes a system for classifying the degrees of protection provided by enclosures for electrical equipment against external mechanical impacts. The letters 'IK' are followed by two numerals which identify a specific impact energy. BS EN 62262:2002 specifies a system for classifying the degrees of protection provided by enclosures against mechanical impact (IK code)

The Standard describes only the general requirements and designations for the system. The application of the system to a specific enclosure type will be covered by the British Standard applicable to that equipment or enclosure. An enclosure is defined as a part providing protection of equipment against certain external influences and protection against contact. This may be considered to include conduit, trunking, etc. In general, the degree of protection will apply to a complete enclosure. If parts of an enclosure have different degrees of protection, they must be separately identified. The coding is separate from the IP rating and will be marked separately as shown in table 2 (above).

Devices for fault protection by automatic disconnection of supply RCDs

Regulation 709.531.2 requires that socket-outlets shall be protected individually by an RCD having the characteristics specified in Regulation 415.1.1. Devices selected shall disconnect all poles, including the neutral. ▶

Up to 63 A	Should comply with BS EN 60309-2
Above 63 A IP rating	Should comply with BS EN 60309-1 At least IP44. Alternatively this IP rating can be provided by an enclosure. (Note that if AD5 (waterjets) or AD6 (waves) is applicable, the IP rating should be at least IPX5 or IPX6 respectively)
Located as close as practicable to the berth to be supplied	
Installed in a distribution board or in a separate enclosure	
A maximum of four socket-outlets should be installed in any one enclosure	
One socket-outlet should supply one leisure craft or houseboat	
Placed at a height of not less than 1 m above the highest water level except for floating pontoons or walkways where this height may be reduced to 300 mm providing appropriate additional measures are taken to protect against the effects of splashing	

Table 3: requirements for socket outlets

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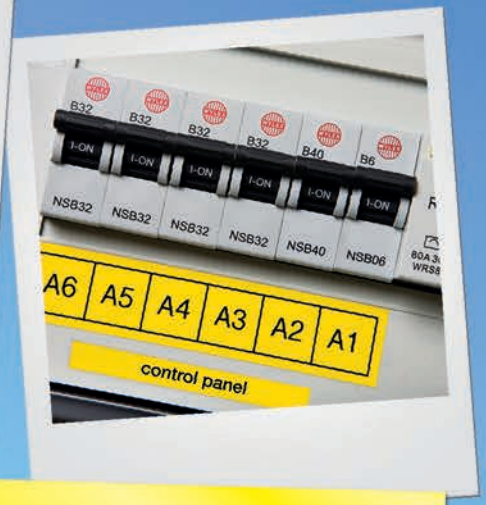

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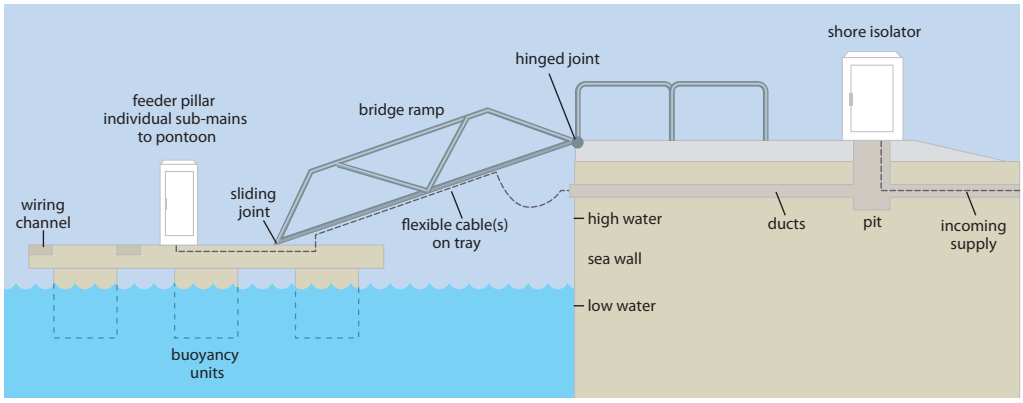


Typical wiring arrangement from shore to pontoon

◀ Final circuits intended for fixed connection for the supply to houseboats shall be protected individually by an RCD having the characteristics specified in Regulation 415.1.1. The device selected shall disconnect all poles, including the neutral.

An RCD is a protective device used to automatically disconnect the electrical supply when an imbalance is detected between live conductors. In the case of a single-phase circuit, the device monitors the difference in currents between the line and neutral conductors. If a line to earth fault develops, a portion of the line conductor current will not return through the neutral conductor. The device monitors this difference, operates and disconnects the circuit when the residual current reaches a preset limit, the residual operating current (IΔn).

An RCD on its own does not provide protection against overcurrents. Overcurrent protection is provided by a fuse or a circuit-breaker. However, combined RCD and circuit breakers are available and are designated RCBOs. Unwanted tripping of RCDs can occur when a protective conductor current or leakage current causes unnecessary operation of the RCD. An RCD must be so selected and the electrical circuits so subdivided that any protective conductor current that may be expected to occur during normal operation of the connected load(s) will be unlikely to cause unnecessary tripping of the device.

Regulation 709.533 has requirements for protection against overcurrent. Each socket-outlet shall be protected by an individual overcurrent protective device, in accordance with the requirements of Chapter 43.

A fixed connection for supply to a houseboat shall be protected individually by an overcurrent protective device, in accordance with the requirements of Chapter 43.

Isolation

BS 7671:2008 (2011) IET Wiring Regulations recognises four distinct types of isolation and switching operation:

i. isolation
ii. switching off for mechanical maintenance
iii. emergency switching
iv. functional switching.

Regulation 709.537.2.1.1 requires at least one means of isolation shall be installed in each distribution cabinet. This switching device shall disconnect all live conductors including the neutral conductor. One isolating switching device for a maximum of four socket-outlets shall be installed.

Types of wiring system

Cables must be selected and installed so that mechanical damage due to tidal and other movement of floating structures is prevented.

Regulation 709.521.1.4 recognises that the following wiring systems are suitable for distribution circuits of marinas:

i. Underground cables
ii. Overhead cables or overhead insulated conductors
iii. Cables with copper conductors and thermoplastic or elastomeric insulation and sheath installed within an appropriate cable management system taking into account external influences such as movement, impact, corrosion and ambient temperature
iv. Mineral-insulated cables with a PVC protective covering
v. Cables with armouring and serving of thermoplastic or elastomeric material
vi. Other cables and materials that are no less suitable than those listed above.

Regulation 709.521.1.5 does not permit the following wiring systems on or above a jetty, wharf, pier or pontoon:

i. Cables in free air suspended from or incorporating a support wire, e.g. as installation methods Nos. 35 and 36 in Table 4A2
ii. Non-sheathed cables in conduit, trunking etc., e.g. as installation methods Nos. 4 and 6 in Table 4A2
iii. Cables with aluminium conductors
iv. Mineral insulated cables.

Regulation 709.521.1.7 requires that underground distribution cables shall, unless provided with additional mechanical protection, be buried at a sufficient depth to avoid being damaged, e.g. by heavy vehicle movement.

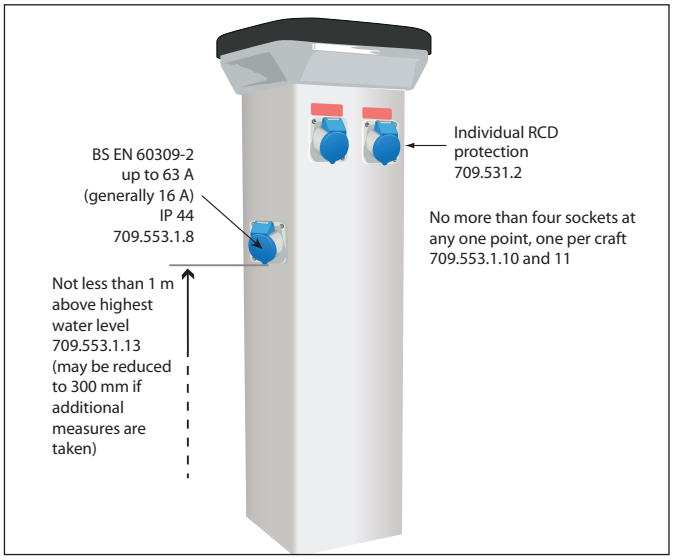
Regulation 709.521.1.8 requires all overhead conductors to be insulated.

Poles and other supports for overhead wiring shall be located or protected so that they are unlikely to be damaged by any foreseeable vehicle movement.

Overhead conductors shall be at a height above ground of not less than 6m in all areas subjected to vehicle movement and 3.5m in all other areas.

Distribution boards, feeder pillars and socket outlets

Socket outlets when mounted on floating installations or jetties should be fixed above the walkway and preferably not less than 1m above the highest water level. This height may be reduced to 300mm if appropriate additional measures are taken to protect against the effects of splashing (IPX4), but care should be



taken to avoid creating a low-level obstacle which may cause risk of tripping on the walkway. When mounted on fixed jetties they should be mounted not less than 1m above the highest water level.

Corrosion

As mentioned previously the immersion of metal components of a craft in water, particularly in salt water, provides the natural mechanism of galvanic corrosion.Where there are dissimilar metals on the electro-chemical series in proximity the detrimental effect of galvanic couples can be exacerbated and for this reason small vessels, recreational craft, houseboats, ships and many immersed metal structures are provided with sacrificial anodes (zinc for salt water) to which the more valuable/essential immersed metal parts such as propellers, shafts, hull fittings and fixings are electrically bonded and the sacrificial anode(s) preferentially deplete as a consequence of providing galvanic corrosion protection to such immersed parts.

Section 709 of BS 7671:2008 is based on European CENELEC Harmonisation Document HD 60364-7-709. Annex A of the document contains examples of methods of obtaining a supply in a marina. HD 60364-7-709 recognises that there is an additional risk of electrolytic corrosion resulting from circulating galvanic currents in the protective conductor from the shore supply to a vessel when connected to a shore supply.

There have also been reports of increased rate of depletion of the sacrificial anodes of recreational craft which are connected on a longer-term basis to shore supplies, which is believed by some observers to be associated with the connection of the recreational crafts protective earth terminal (to which immersed components and sacrificial anodes are bonded) to the shore supply earth in a marina or similar location.

HD 60364-7-709 recognises the use of an isolating transformer to prevent galvanic currents circulating between the hull of the vessel and the metallic parts on the shore side. The current standard for isolating transformers is BS EN 61558.

It is important to point out that all equipment must comply with the relevant standard.

Regulation group 511 of amendment 1 of BS 7671:2008 has requirements for compliance with standards. Extract below:

511 COMPLIANCE WITH STANDARDS

511.1 Every item of equipment shall comply with the relevant requirements of the applicable British Standard, or Harmonized Standard, appropriate to the intended use of the equipment. The edition of the Standard shall be the current edition, with those amendments pertaining at a date to be agreed by the parties to the contract concerned (see Appendix 1).

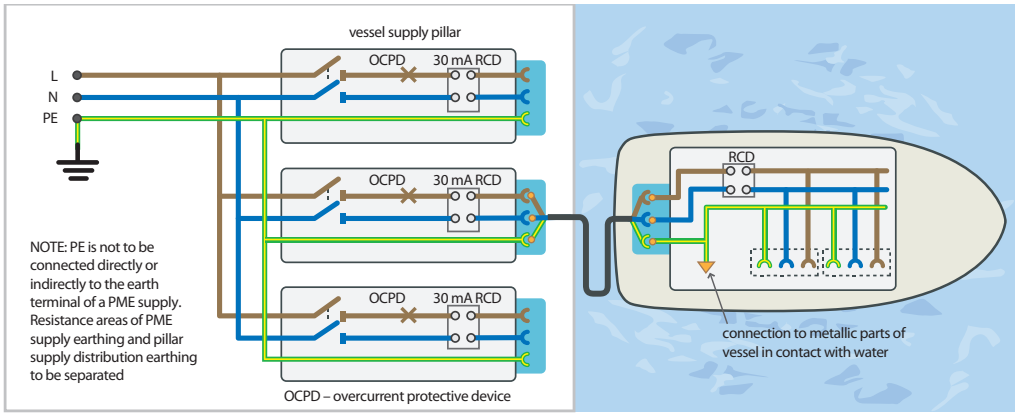
Alternatively, if equipment complying with a foreign national standard based on an IEC Standard is to be used, the designer or other person responsible for specifying the installation shall verify that any differences between that standard and the corresponding British Standard or Harmonized Standard will not result in a lesser degree of safety than that afforded by compliance with the British Standard.

511.2 Where equipment to be used is not covered by a British Standard or Harmonized Standard or is used outside the scope of its standard, the designer or other person responsible for specifying the installation shall confirm that the equipment provides the same degree of safety as that afforded by compliance with the Regulations.

Equipment installed on board a small vessel or recreational craft does not come under the control of the wiring regulations (BS 7671) and would be required to comply with the appropriate standard.

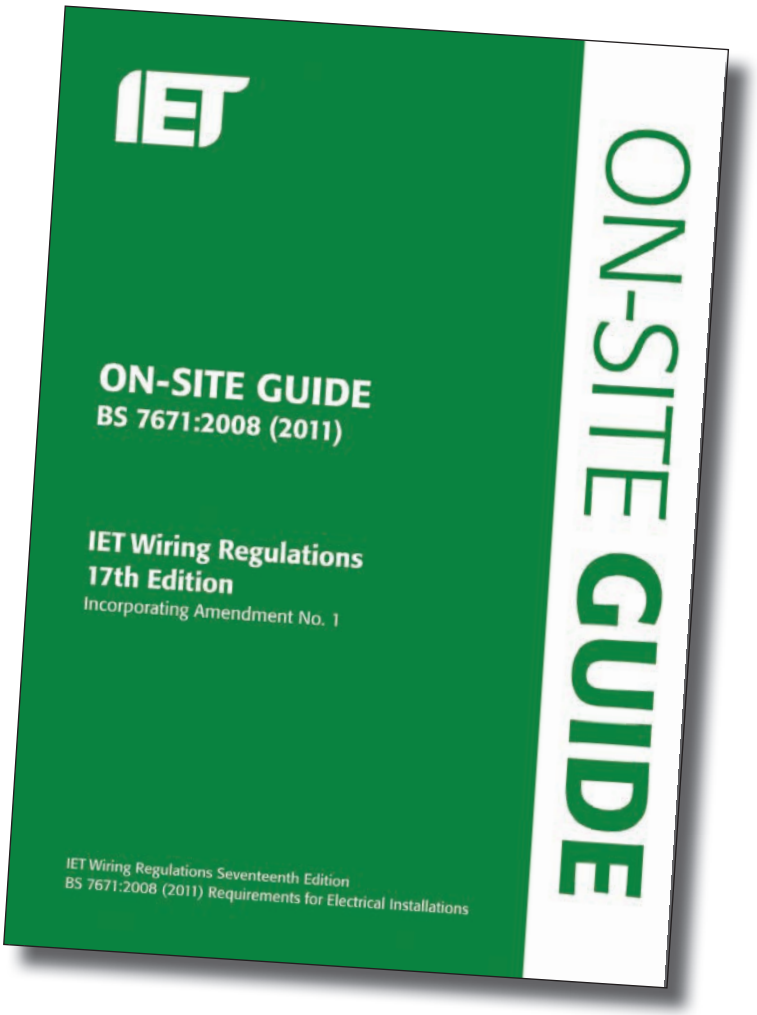
Conclusion

It is important to be aware that this article only gives an overview of electrical installations in marinas and similar locations. For more information refer to section 709 of BS 7671:2008 incorporating Amendment 1. ■



Connection to mains supply with single phase socket outlet

Where RCD protection for socket-outlets can be omitted



This article looks to discuss issues raised by the IET's updated On-Site Guide to BS 7671:2008(2011) relating to the intended omission of RCDs. The inclusion of such guidance in the On-Site Guide has prompted much debate within the electrical industry, which, it must be emphasised, is a very good thing. This article discusses RCD protection for socket-outlets only and does not consider the requirements for the protection of cables in walls.

By Mark Coles

Scope of the On-Site Guide
First, let's look at the scope of the On-Site Guide and what it is intended to be used for.

The Guide is for installers (for simplicity, the term installer has been used for electricians and electrical installers) and covers the following installations:

a. domestic and similar installations, including off-peak supplies, supplies to associated garages, outbuildings and the like

b. small industrial and commercial single- and three-phase installations.

This Guide is restricted to installations:

i. at a supply frequency of 50 hertz

ii. at a nominal voltage of 230 V a.c. single-phase or 230/400 V a.c. three-phase

iii. supplied through a distributor's cut-out having a fuse or fuses rated at 100 A or less

Guidance
The particular clause prompting discussion in the On-Site Guide is 3.6.2.2 and is reproduced here:

Installations under the control of skilled or instructed persons
BS 7671:2008(2011) permits RCDs, where usually provided for additional protection, can be omitted where the installation is under the control of a skilled or instructed person.

The decision as to which socket-outlets or circuits do not require additional protection by RCDs should be taken by the designer of the electrical installation and only after consultation with an appropriate person in the client's organisation. An appropriate person would be one who is able to ensure that the socket-outlets or circuits in question are, and will remain, under the supervision of skilled or instructed persons.

Wherever a designer so chooses to omit RCD protection, traceable confirmation must be obtained from the client to identify the reason for the omission and such confirmation shall be included within the documentation handed over to the client upon completion of the work.

Where no such confirmation can be obtained, RCD protection should not be omitted.

The guidance in clause 3.6.2.2 in the On-Site Guide looks to support installers working on smaller installations no greater than 100 A, which is in line with the scope of the Guide.

The requirements of BS 7671:2008(2011)
Additional protection is that which is extra to the fundamental requirements in BS 7671:2008(2011) for basic and fault protection. It is to be provided to protect users in the event of failure of the provision for basic protection and/or the provision for fault protection or carelessness by users.

Regulation 415.1 states that the use of RCDs with a rated residual operating current (IΔn) not exceeding 30 mA and an operating time not exceeding 40 ms at a residual current of 5 IΔn is recognised in a.c. systems as additional protection.

Regulation 411.3.3 sets out the requirements for additional protection by means of an RCD in accordance with Regulation 415.1:

i. socket-outlets with a rated current not exceeding 20 A that are for use by ordinary persons and are intended for general use, and

ii. mobile equipment with a current rating not exceeding 32 A for use outdoors.

An exception to (i) is permitted for:

a. socket-outlets for use under the supervision of skilled or instructed persons, or

b. a specific labelled or otherwise suitably identified socket-outlet provided for connection of a particular item of equipment.

Competency
Electrical installations must always be designed by competent persons. This competent person must be fully aware of the extent of the work or daily activity intended, for which, the electrical installation will be installed to support.

As a point of clarity, some installation work, such as minor additions and alterations, could be very small and, even though no pen has been put to paper, a design process will have been utilised, albeit a mental design process.

Scenario
Consider the following scenario: a small commercial installation has been designed and installed by an electrical contractor. Socket-outlets in an office have not been protected by an RCD with a rated residual operating current of 30mA, as required by Regulation 411.3.3(a) – the reason being that the operator of the electrical installation, usually the employer, has stated that the installation will be under the supervision of a skilled or instructed person. After some time, during which, the electrical installation has ▶

Defined term	Definition	Example of who the person could be
Skilled person	A person with technical knowledge or sufficient experience to enable him/her to avoid dangers which electricity may create.	Building maintenance electrician
Instructed person	A person adequately advised or supervised by skilled persons to enable him/her to avoid dangers which electricity may create.	Building manager (non-technical)
Two further important definitions are important and should also be noted:		
Competent person	A person who possesses sufficient technical knowledge, relevant practical skills and experience for the nature of the electrical work undertaken and is able at all times to prevent danger and, where appropriate, injury to him/herself and others.	Electrical designer
Ordinary person	A person who is neither a skilled person nor an instructed person.	Employee (non-technical) Member of public

Table 1 – Classification of person

◀ been operated perfectly safely, an employee receives a severe electric shock, requires hospital treatment and, subsequently, the HSE investigates the incident.

The investigation finds that the employee had brought in an electrical appliance from home and was attempting to plug the appliance into a socket-outlet but came into contact with the line conductor as the appliance's supply cable had been damaged.

The case goes to court and the electrical contractor is asked to supply the electrical installation certificate for the installation. The prosecution, representing the injured employee, asks why the socket-outlet was not protected by an RCD with a rated residual operating current of 30 mA, as required by Regulation 411.3.3.

The electrical contractor states that the client told him the installation would be under the supervision of a skilled or instructed person and that RCD protection, therefore, would not be required. The prosecution asks for evidence but, of course, there isn't any tangible evidence, the design was based on a discussion.

Taking this scenario, the On-Site Guide instructs such that:

"wherever a designer so chooses to omit RCD protection, traceable confirmation must be obtained from the client to identify the reason for the omission and such confirmation shall be included within the documentation handed over to the client upon completion of the work."

It further advises that:

"Where no such confirmation can be obtained, RCD protection should not be omitted."

Classification of person

It is pertinent to look at who these skilled or instructed persons are; see Table 1. The definitions are taken from Part 2, Definitions, of BS 7671:2008(2011) and an example is given of who the person could be.

It cannot be argued that an installation in a dwelling, e.g. house or flat, will be constantly under the control of a skilled or instructed person; an example being that visitors will bring their non-tested apparatus and plug them into socket-outlets. Therefore, all socket-outlets for general use in a dwelling are to be protected by RCDs rated at 30 mA. As highlighted earlier, Regulation 411.3.3(b) permits the omission of RCD protection for a specific labelled or otherwise suitably identified socket-outlet provided for connection of a particular item of equipment; an example of this is the provision of a non-RCD protected socket-outlet for the connection of a fridge-freezer. Such a labelled and non-RCD protected socket-outlet would not be intended for general use.

Larger installations

Where larger installations are designed and installed, i.e. those greater than 100 A and beyond the scope of the On-Site Guide, there may be many circuits which require a decision to be made over whether RCD protection should be provided or omitted during the designer's risk assessment process. In such situations, the client is likely to be looking to the designer for guidance and advice and to design a suitable installation fit for the work intended to be carried out in the building. Should the designer be assured that the installation will be under the control of a skilled or instructed person at all times and throughout the expected life of the installation then additional protection by RCDs, as permitted by Regulation 411.3.3(i), could be omitted. An example could be the installation of socket-outlets specifically for the use of IT equipment. In this situation, the designer could choose to omit RCD protection by reference to Regulation 411.3.3(a).

Should the designer chose to omit RCD protection, in accordance with Regulation 411.3.3(b), the sockets-outlets would need to be suitably labelled or otherwise identified. The designer, who will be a competent person, will of course be able to demonstrate the reasons for omitting RCD protection as determined during the designer's risk assessment if called to clarify.

The designer's decision process

In a commercial situation, for example, such as an office environment, where the employer states in company policy that employees must not bring in appliances, such as phone chargers and radios and that only the company's tested appliances can be used, then RCD protection for socket-outlets can be omitted.

Where socket-outlets are provided for use by cleaners, for example, RCD protection ▶

17th Edition amendment 1

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◄ can be omitted if precautions are taken, i.e. company policy states that all appliances are tested, regularly inspected and that the socket-outlets are not to be used for any other purpose.

Where there is no company policy describing the situations above and employees are free to use socket-outlets at will, RCDs, providing additional protection at 30 mA should be included within the design for the circuits in question as the use of the installation is not policed.

Departures from the Regulations

Consider the scenario posed earlier where socket-outlets are not protected by an RCD and are not under the supervision of skilled or instructed persons as required by Regulation 411.3.3. This may be an intended departure from the Regulations but does not meet the criteria for departures.

It is worthwhile discussing departures from the Regulations too. BS 7671 permits intended departures from the Regulations – the requirements are very specific but two conditions would be acceptable.

The first condition:

120.3 Any intended departure from these Parts (1 to 7 of the Regulations) requires special consideration by the designer of the installation and shall be noted on the Electrical Installation Certificate specified in Part 6. The resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations.

In Regulation 120.3, the key words are "The resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations".

Consider the scenario posed earlier where socket-outlets are not protected by an RCD and are not under the supervision of skilled or instructed persons as required by Regulation 411.3.3.

If it is decided that additional protection by use of an RCD rated at 30 mA is not to be provided then some other method, equal in terms of safety to protection against electric shock by additional protection, should be adopted to ensure that the resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations.

Regulation 410.3.3 gives four methods of protection against electric shock which are generally permitted:

i. Automatic disconnection of supply (Section 411)
ii. Double or reinforced insulation (Section 412)
iii. Electrical separation for the supply to one item of current-using equipment (Section 413)
iv. Extra-low voltage (SELV and PELV) (Section 414).

Beyond the implementation of automatic disconnection of supply with additional protection by use of an RCD rated at 30 mA, given in Regulation 410.3.3(i) and Regulation 411.3.3, it is very unlikely that any of the other three generally permitted measures with an enhancement will be suitable in the posed scenario.

The second condition:

133.5 New materials and inventions

Where the use of a new material or invention leads to departures from the Regulations, the resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations. Such use is to be noted on the Electrical Installation Certificate specified in Part 6.

Regulation 133.5 permits the use of a new methodology or item of equipment that may not have been manufactured to a British or other Standard, again, the requirement is that "the resulting degree of safety of the installation shall be not less than that obtained by compliance with the Regulations.".

Summary

For installations falling within the Scope of The IET's On-Site Guide, wherever a designer so chooses to omit RCD protection, traceable confirmation must be obtained from the client to identify the reason for the omission and such confirmation shall be included within the documentation handed over to the client upon completion of the work. Where no such confirmation can be obtained, RCD protection should not be omitted.

For installations beyond the Scope of The IET's On-Site Guide, the designer may decide to omit additional protection by RCDs, the decision being based on their knowledge of the client's requirements and how the installation will be used.

The designer will, as a matter of course, retain all design information, such as the risk assessment, calculations, etc. and clearly stating why particular decisions were made in the Design File and/or CDM File.

Finally, listing departures on the Electrical Installation Certificate will only meet the requirements of the Regulations if the resulting degree of safety of the installation is not less than that obtained by compliance with the Regulations. ■

Thanks

Giuliano Digilio (ECA) ; Connor Flynn (ECA); Ken Morton (HSE); Charles Tanswell (ScEME)

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BS 7671:2008(2011) incorporates UK only Regulation numbers

When BS 7671:2008, The 17th Edition of The IEE Wiring Regulations, was published, one notable change in the Standard was the adoption of the IEC numbering system.

By Mark Coles

Primarily, this was evident in the swapping of two Parts, i.e. Inspection and testing became Part 6 (was 7) and Special Installations or Locations became Part 7 (was 6). One other obvious change was the appearance of the Regulation numbers. Previously, The 16th Edition of the IEE Wiring Regulations used a hyphenated separator, then came The 17th Edition with a dot separator; BS 7671:2008(2011) takes things a little further with the implementation of the ".100" sequence for UK only Regulations, i.e. those Regulations which relate to a UK only practice or are not included in international documents.

The following example demonstrates:

- In BS 7671: 2001 (2004), 522-06-05 was a Regulation concerned with the protection of cables installed under floors or above ceilings and had the hyphenated separator,
- In BS 7671:2008, the IEC numbering system was implemented and Regulation 522.6.5 had the dot separator
- In BS 7671:2008(2011), the Regulation is now identified by 522.6.100 and adopts the".100" sequence for UK only Regulations.

BS 7671:2008 adopted the IEC numbering system making it easier to embody future changes and additions resulting from ongoing international standards work within IEC and CENELEC. This meant that, whatever happened in standardisation internationally, The UK could simply take on the IEC number of the new requirement and drop it in to BS 7671 at the required position.

One problem, however, was that the UK had "home grown" requirements which do not appear in the international documents. If a new UK Regulation was to be included, a gap could not simply be created by moving every Regulation down a position as this would interfere with the numbering system. So, to accommodate future IEC changes, a decision was made to have a ".100" signifier for UK only Regulations, i.e. "home grown" and not international or European requirements.

Other examples of ".100" signifier Regulations in BS 7671:2008(2011) are:

422.3.100 Flexible cables shall be of the following construction:

(i) heavy duty type having a voltage rating of not less than 450/750 V, or

(ii) suitably protected against mechanical damage.

422.4.101 Electrical equipment that does not comply with Regulation 422.4.100 shall be enclosed with a suitable thickness of non-flammable material. The effect of the material on the heat dissipation from electrical equipment shall be taken into account.

525.102 A greater voltage drop than stated in Appendix 4 section 6.4 may be accepted for a motor during starting periods and for other equipment with high inrush currents, provided that it is verified that the voltage variations are within the limits specified in the relevant product standard for the equipment or, in the absence of a product standard, in accordance with the manufacturer's recommendations.

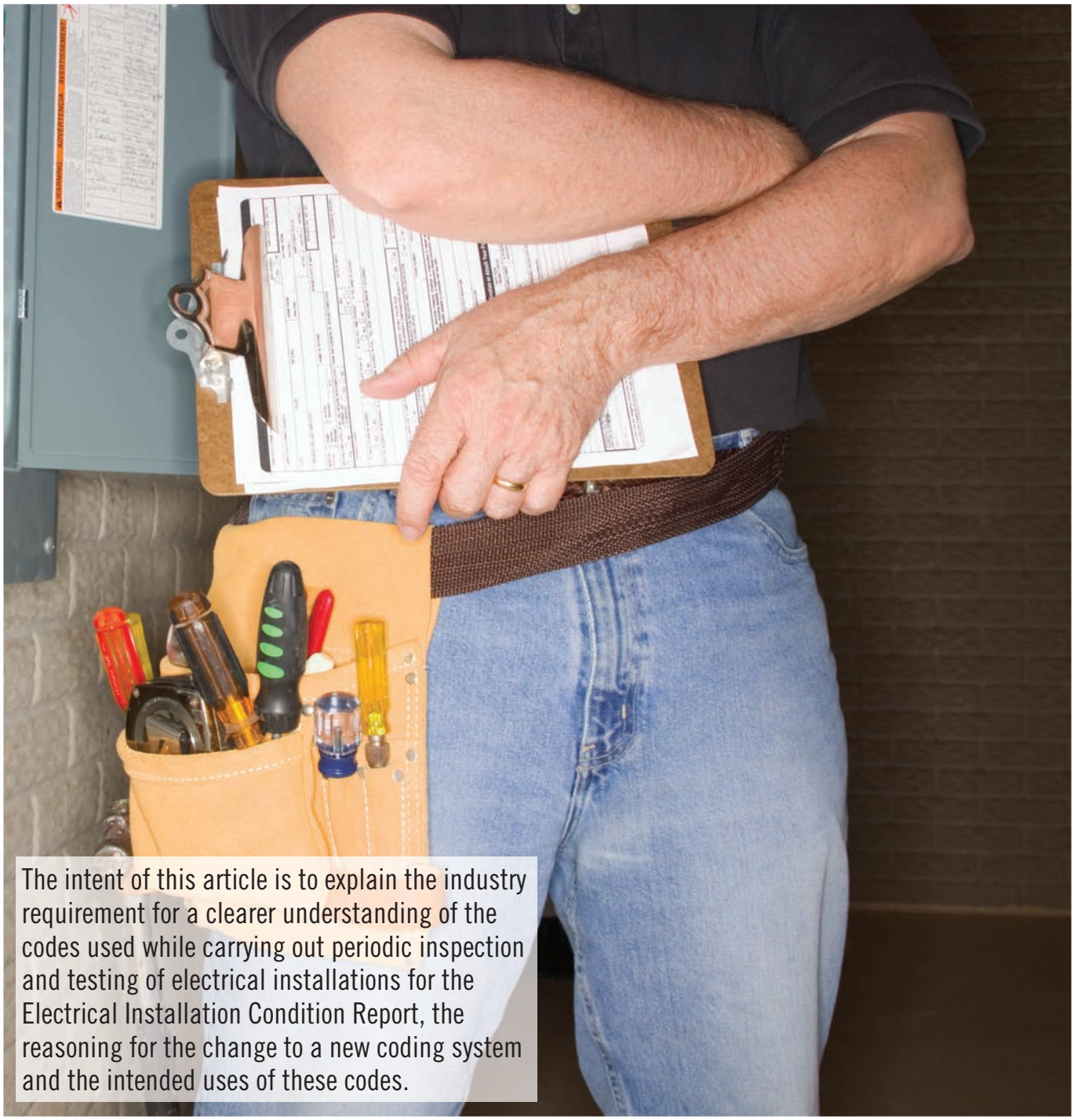
433.1.103 Accessories to BS 1363 may be supplied through a ring final circuit, with or without unfused spurs, protected by a 30 A or 32 A protective device complying with BS 88 series, BS 3036, BS EN 60898, BS EN 60947-2 or BS EN 61009-1 (RCBO). The circuit shall be wired with copper conductors having line and neutral conductors with a minimum cross-sectional area of 2.5mm^2 except for two-core mineral insulated cables complying with BS EN 60702-1, for which the minimum cross-sectional area is 1.5mm^2.

Such circuits are deemed to meet the requirements of Regulation 433.1.1 if the current-carrying capacity (Iz) of the cable is not less than 20 A and if, under the intended conditions of use, the load current in any part of the circuit is unlikely to exceed for long periods the current-carrying capacity (Iz) of the cable.

This system has been slowly implemented over the years. We are familiar with the terms "Reserved for future use" and "Deleted by BS 7671:2008". Rather than delete the requirement and move the Regulations up one position, it is important to retain the number and position as it allows us to cross-reference between the international and European documents. ■

Observation codes used for periodic inspection and testing of electrical installations within the scope of BS 7671:2008 (2011)

By Richard Townsend



The intent of this article is to explain the industry requirement for a clearer understanding of the codes used while carrying out periodic inspection and testing of electrical installations for the Electrical Installation Condition Report, the reasoning for the change to a new coding system and the intended uses of these codes.

THINKSTOCK

The introduction of a new coding system (see figure 1) for the Electrical Installation Condition Report has been warmly welcomed by all areas of the contracting industry. The previous observation codes (see figure 2) Code 1, Code 2, Code 3 and Code 4 had the capacity to be misunderstood, be confusing and ambiguous and open to abuse.It was for these reasons that the National Committee, JPEL/64, concluded that there was a good opportunity for change at the amendment 1 stage of BS 7671:2008.

Observation Code 1

The previous observation Code 1 was always intended to be used to give an overall unsatisfactory assessment result with the discovery of an immediate risk of injury during an inspection but it was ambiguous as to what could considered to be an immediate risk. Although the previous observation Code 1 and the new code C1 have the same outlook and intention, the meaning of a new code C1 has been clarified. ▶

.....	.....	.....
One of the following codes, as appropriate, has been allocated to each of the observations made above to indicate to the person (s) responsible for the installation the degree of urgency for remedial action.		
C1 ñ Danger present. Risk of injury. Immediate remedial action required		
C2 ñ Potentially dangerous - urgent remedial action required		
C3 ñ Improvement recommended		

Figure 1: The new codes for Electrical Installation Condition Reports as they appear in BS 7671:2008 2011).

.....

One of the following numbers, as appropriate, is to be allocated to each of the observations made above to indicate to the person(s) responsible for the installation the action recommended.

1 requires urgent attention 2 requires improvement 3 requires further investigation

4 does not comply with BS 7671:2008 amended to Ö Ö ..Ö .. This does not imply that the electrical installation inspected is unsafe.

Figure 2: The previous observation codes for Periodic Inspection Reports, now known as the Electrical Installation Condition Report, as they appear in BS 7671:2008.

◀ Whilst the previous observation code 1 stated:

"Requires urgent attention"

The new C1 now states:

"Danger present. Risk of injury. Immediate remedial action required"

This new definition of a situation, which would incur a code C1, will help inspectors ensure it is used to report that a risk of injury exists, which could incorporate, for example, accessible live conductors due to damage, poorly modified enclosures or removed maintenance panels. It should be noted that incorrect polarity would also attract a code C1 as it may allow conductive parts, not normally expected to be live, to become live.

The presence of a code C1 would warrant immediate action to be taken which would be to inform the duty holder or responsible person for the installation immediately, both verbally and in writing, of the risk of injury that exists. A detailed explanation of this risk

should be recorded on the report, together with details of any verbal and written warnings of dangerous situations that exist. If possible, immediately dangerous situations should be made safe or rectified before further work or inspections are carried out.

Observation Code 2

The previous observation Code 2 was designed to give the recipient of the report an indication of the possible improvements to an installation which would increase safety. However, this was open to confusion and misinterpretation within the industry.

The previous Code 2 could either be used to give an unsatisfactory overall report or a satisfactory report, hence, the huge opportunity for confusion and constant debates on where the severity of a Code 2 rendered the overall report unsatisfactory and when a Code 2 would not be considered severe enough and a satisfactory report would be issued.

This also spurred the popular argument that if enough low threat Code 2s, that would normally attract a satisfactory assessment, were present then an unsatisfactory report should be issued based on a 'tot up' basis. Totting up was ambiguous, as at what point was the tot up figure of C2s to be set at and why should an installation receive an unsatisfactory report based on tot up if the individual C2s would normally attract a satisfactory assessment?

The previous Code 2 states:

"Requires improvement"

The new code C2 states:

"Potentially dangerous-urgent remedial action required"

The phrase "potentially dangerous", in the new code is designed to point towards a risk of injury from contact with live parts after a sequence of events. A sequence of events could mean that an individual would need to move, open or gain access to live parts through a day to day task that would not be expected to give access to live parts, for example:

If an isolator in a locked cupboard had a damaged casing, leaving exposed live parts that could not be accessed without the use of access equipment, such as a specialist tool or key this would be considered a code C2. An individual would need to gain access to the cupboard before coming into contact with live parts and the potential for risk of injury is high.

The lack of an adequate earthing arrangement for an installation, the use of utility pipes as the means of earthing or an undersized earthing conductor (established by use of the adiabatic equation in Regulation 543,1,3) will also warrant a code C2 observation because a primary fault would be needed in order for these scenarios to become potentially dangerous.

It should be noted that with the new code C2, there is no leeway for unsatisfactory versus satisfactory, as a code C2 can now only be given an unsatisfactory overall result.

With this new classification system there is very little area for confusion as both codes C1 and C2 attract only unsatisfactory report findings.

Observation Code 3

The new code C3 states:

"Improvement recommended"

Whereas the previous observation Code 3 states:

"Requires further investigation"

The new code C3 removes the ambiguity of requiring further investigation, as the previous code 3 implies there are unknown variables or findings that are not compliant with the current version of BS 7671, these findings may require improvement but this can only be a recommendation. The new code C3 should imply to the client that the installation is not necessarily dangerous but it may not comply with the current version of the regulations or for example, may have damaged fittings that do not have exposed live parts.

A code C3, in itself, should not warrant an overall unsatisfactory report.

Observation Code 4 (removed from the observation codes)

The removal of observation code 4 was required as it stated:

"Does not comply with BS7671:2008. This does not mean that the electrical installation is unsafe" ▶

◀ This philosophy has been incorporated into the new code C3, in order to remove the need to note on a report findings, that although not compliant with the current regulations, are not unsafe and do not necessarily require upgrading. It was determined that if an instance such as this was included in a report, it gave the impression that something was unsafe or required upgrading, when this was not the intention.

A portion of the findings from the previous observation Code 4 may now be classified as a new code C3 and some of the previous observation Code 4s will not incur a code and may not even be referred to in the report. If an inspector feels that these types of non-classifiable findings should be put into a report, it should be made clear to the client that findings of this nature do not detract from the installation's safety and it should be made clear in the report that they are only observations.

For further information on the new coding system and examples of what constitutes a code C1, C2 or C3, the Electrical Safety Council's Best Practice Guide 4, which has been compiled with input from the industry and is available from their website as a free download. ■

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Electric Vehicle Charging Equipment

Much of the discussion regarding electric vehicles in the UK is centred on various customer incentive schemes to assist in purchasing the vehicles. However one important aspect of the electric vehicle market is the electric vehicle charging infrastructure that will be needed to support the various needs of the user. This article describes the charging modes applicable to electric vehicles, a summary of the electrical installation requirements, the guidance available to installers and a summary of various charging infrastructure schemes and equipment solutions.

By Paul Bicheno

What is the current charging equipment infrastructure?

There are a number of initiatives to install dedicated electric vehicle charging points throughout the UK. These include on street public charging points, off street public charging points such as car parks and places of work. Many of the public schemes are currently offering 'free' electricity to encourage the use of these charging points. There are also schemes where the consumer can become a member for a nominal fee and then use one of the schemes charging points for no extra cost.

A consumer also needs to consider how they are likely to charge their electric vehicle while at home, therefore what are the options available for charging of electric vehicles.

Electric vehicle charging options?

Table 1 (opposite) provides a summary of the recognised options that are available for charging of electric vehicles. They are referred to as 'charging modes 1, 2, 3 and 4'. A review of the table shows

Charging Mode	Electric Vehicle Charging Equipment
1 (Standard charge)	■ Connection by use of standard single-phase or three-phase socket-outlets (e.g. BS 1363, BS EN 60309) ■ Supply to electric vehicle not exceeding 16A per phase and not exceeding 250V a.c. single-phase or 480V a.c. three-phase ■ No control pilot function provided by the equipment
2 (Fast charge)	■ Connection by use of standard single-phase or three-phase socket-outlets (e.g. BS 1363, BS EN 60309) ■ Supply to electric vehicle not exceeding 32A per phase and not exceeding 250V a.c. single-phase or 480V a.c. three-phase ■ Control pilot function provided by an in-cable control box (not via the standard socket-outlet) ■ RCD protection provided between the plug and electric vehicle or as part of the in-cable control box
3 (Fast charge)	■ Connection by use of dedicated single-phase or three-phase socket-outlets, or via a tethered cable ■ Supply to electric vehicle not exceeding 32A per phase and not exceeding 250V a.c. single-phase or 480V a.c. three-phase ■ Control pilot function provided by the equipment via the dedicated socket-outlet or tethered cable ■ RCD protection provided as part of the equipment or supply circuit
4 (Rapid charge)	■ Connection by use of a tethered cable ■ Supply to the electric vehicle from the dedicated charging equipment is d.c. (typically 500V 125A) ■ Control pilot function provided by the equipment

Table 1 – Summary of charging equipment arrangements

that mode 1 provides an option to use standard socket-outlets with the lowest power rating and functionality and as such would take the longest time to charge an electric vehicle. This is also referred to as a 'standard' charge arrangement and would typically take 6-8 hours to fully recharge a vehicle. Figure 1 (p26) shows an example arrangement. Mode 2 has an increased power rating and would provide a 'fast' charge, typically up to 4 hours, via standard socket-outlets that would need to be rated appropriately. This mode includes an in-cable control box that has a control pilot function to interface with the vehicle connection to verify a protective conductor connection before charging can commence. This mode also includes the provision of a Residual Current Device (RCD) for electric shock protection which is typically included within the in-cable control box. Figure 2 (p27) shows an example of this arrangement. Mode 3 also provides a fast charge via equipment dedicated to charging of ▶

1-4 Typical a.c. charging equipment 1

2

◄ electric vehicles. There would be two options available for connection. The first is via a socket-outlet dedicated to electric vehicle charging that is part of the charging equipment thus needing a connecting lead to connect to the vehicle inlet. The second is a tethered cable permanently connected to the charging equipment that would then be connected direct to the vehicle inlet. A control pilot function and RCD protection is also provided as part of the equipment. Figure 3 shows an example of this arrangement. Mode 4 is the fastest mode for charging as a high d.c. voltage and current is supplied direct to the vehicle from the charging equipment and is referred to as 'rapid' charging. This mode also includes a control pilot function. Figure 4 shows an example of this arrangement.

What are the electrical installation requirements?

Currently there are no specific requirements in BS 7671 other than the general requirements of Parts 1 to 6 for the charging of electric vehicles. However within the standardisation process there have been developments at both the IEC and CENELEC levels. There is currently a new Section 722 for the supplies to electric vehicles for charging being developed within the 60364 series of standards for electrical installations. The CENELEC document is FprHD 60363-7-722:2011 which means this it at the final draft voting stage. Therefore it is likely that this section will become a published HD in the near future. The impact of this is that this will eventually need to be published in BS 7671 as part of the development process. The new section covers a number of specific requirements such as:

- prohibiting the use of a PEN conductor in a final circuit of a TN-system supplying an electric vehicle connection point
- no diversity to be applied to a final circuit supplying a connection point
- a dedicated circuit is to be provided for the connection of electric vehicles
- Every connection point to be provided with individual

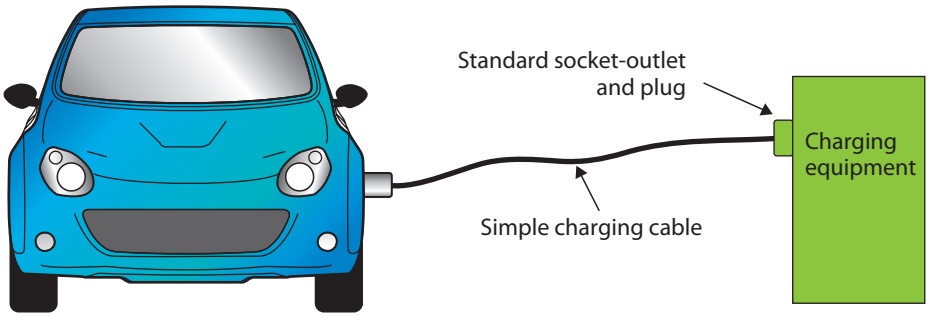
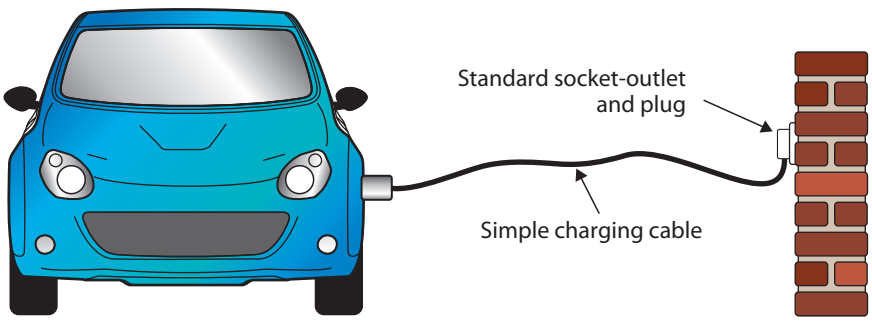
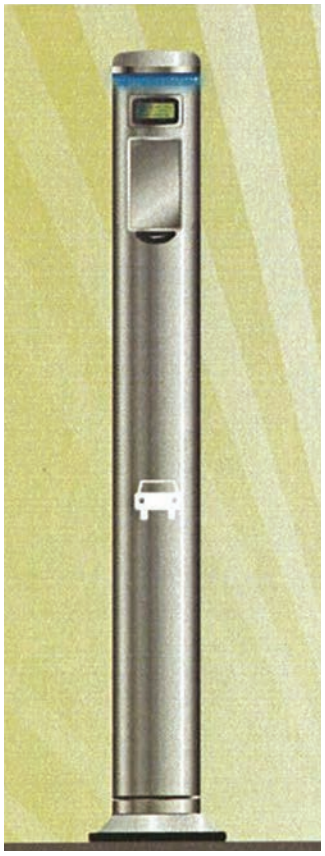


Figure 1 – example of mode 1 charging





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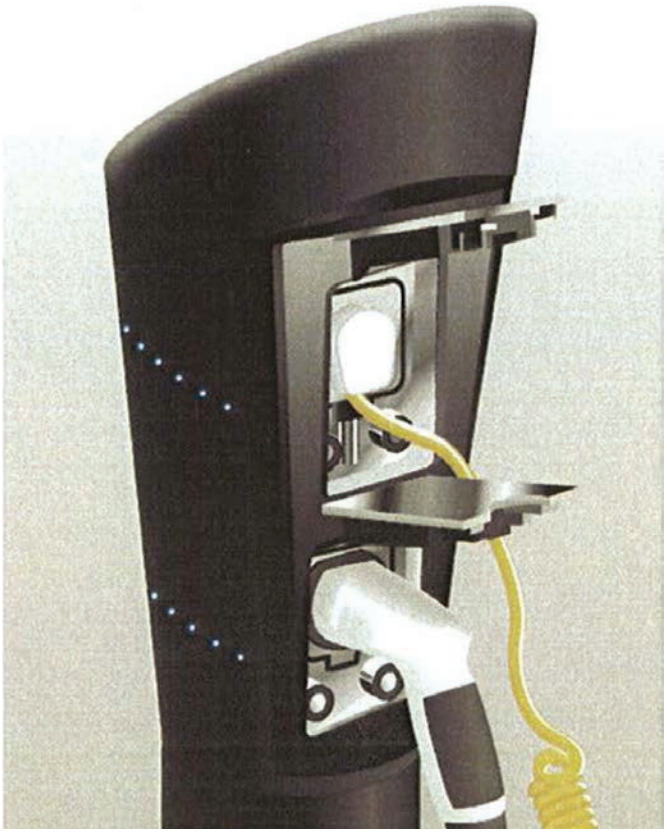

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RCD protection not exceeding 30mA and individual overcurrent protection

What guidance is available to installers?

The IET has worked with various stakeholders such as Government departments, electrical contractor organisations, electric vehicle manufacturers, electric vehicle charging equipment manufacturers and supply distribution organisations to develop a code of practice for the installation of electric vehicle charging equipment.

This includes guidance on what needs to be checked prior to installation, general installation requirements for the equipment, more detailed electrical installation requirements covering domestic, on-street and commercial and industrial installations as well as additional information on the charging modes and types of equipment. The development process raised an important issue regarding the solutions to be applied for the scenario of a broken neutral in the PEN conductor where protective multiple earthing (PME) supplies are installed in certain scenarios such as a domestic environment. Guidance on this is included within the code of practice. Anyone installing electric vehicle charging equipment should be aware of this guidance. A copy can be can be ordered from the following site (www.theiet.org/publishing/standards/ev-charging-cop.cfm) ▶

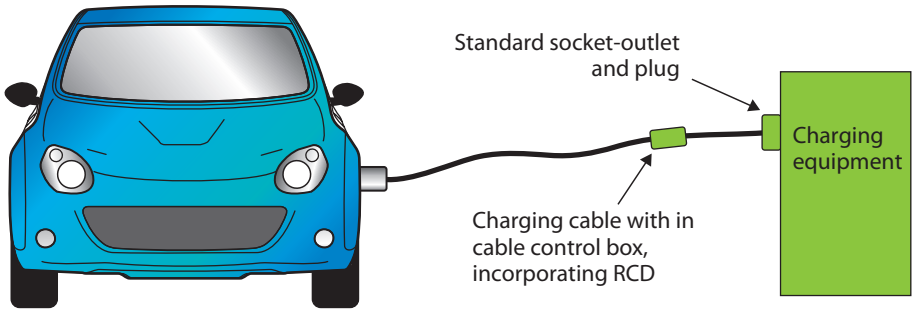
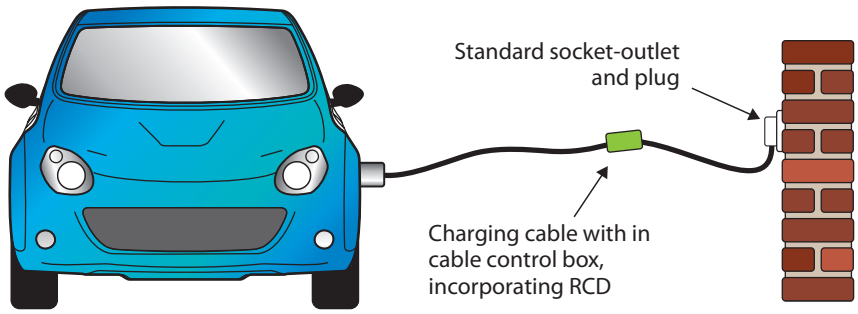


Figure 2 – example of mode 2 charging



◀ The following information gives an additional insight into some of the initiatives for the types of infrastructure being developed and the solutions for electric vehicle charging equipment

Sample list of electric vehicle charging point domestic and public infrastructure solutions

British Gas
offers a domestic dedicated electric vehicle charger solution (www.britishgas.co.uk/electricvehicles)

Charge Your Car
(www.chargeyourcar.org.uk) this scheme has been launched in the North East of England. This is a membership scheme that enables owners and drivers of electric vehicles to access any of the Charge your Car charging points at no additional cost.

EDF Energy
Offers the EcoRecharge domestic dedicated electric vehicle charging solution (www.edfenergy.com/products-services/for-your-home/electric-vehicles/)

Electromotive
has developed the Elektrobay (www.elektromotive.com/html/elektrobay.php) electric vehicle charging infrastructure in a number of London boroughs and other parts of the UK (www.elektromotive.com/html/index.php)

POLAR
(www.polarnetwork.com/home) is a membership scheme providing domestic, public and workplace infrastructure solutions.

Source London
(www.sourcelondon.net/) this is a scheme in London with publicly accessible charge points located on the street, supermarkets, London Underground car parks and car parks all over London. This is a membership scheme to enable the use of the Source London charge points to charge the vehicle at no additional cost.

Sample list of suppliers of dedicated electric vehicle charging equipment and services

Chargemaster
(www.chargemasterplc.com/)

Elektromotiv
(www.elektromotive.com)

POD Point
(www.pod-point.com/)

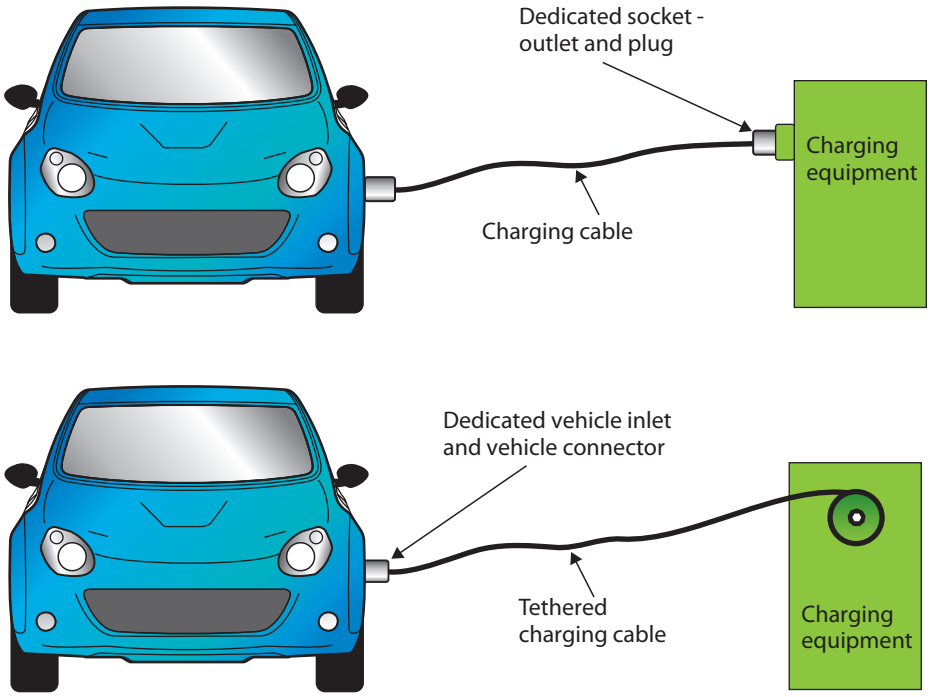


Figure 3 – example of mode 3 charging

Typical d.c. charging equipment

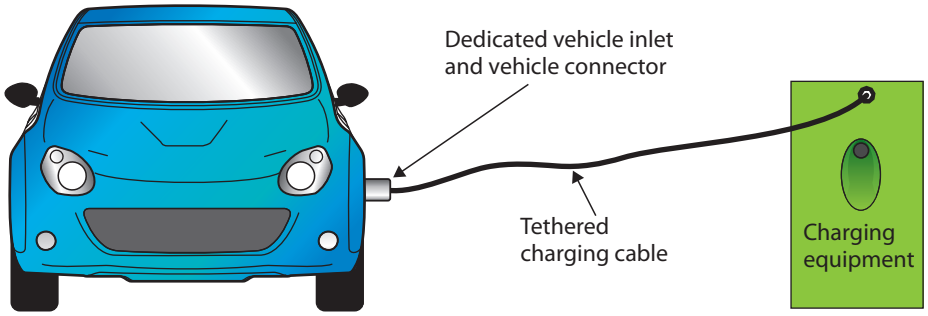
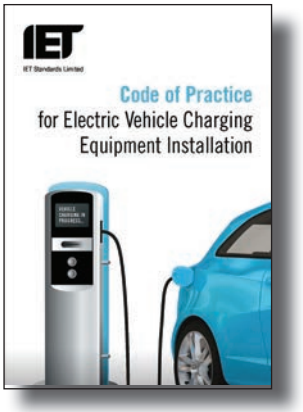


Figure 4 – example of mode 4 charging



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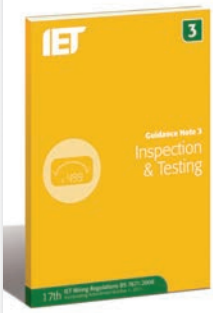

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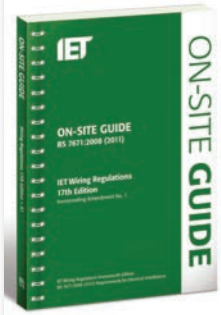

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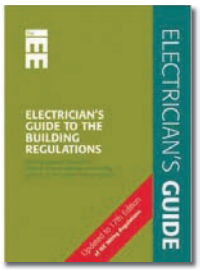

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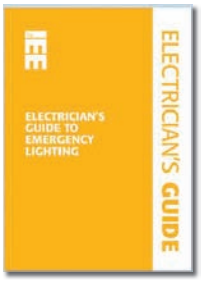

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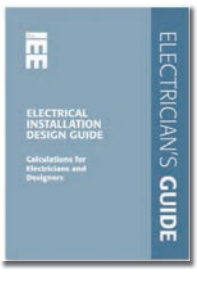

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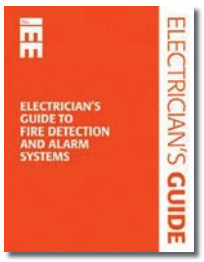

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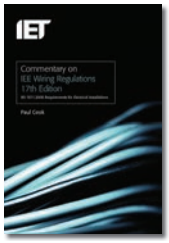

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P. Cook

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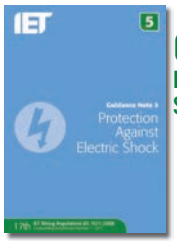

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Cables of SELV or PELV circuits in walls

With the publication of BS 7671:2008(2011), a slight revision of Regulations 522.6.100, 522.6.101 and 522.6.101 has taken place with the inclusion of a reference to SELV or PELV circuits.

By Mark Coles

Note that these three Regulations have been renumbered, previously being 522.6.5, 522.6.6 and 522.6.8 in BS 7671:2008.

Examples of SELV or PELV circuits are:

- SELV lighting circuits
- A/V installations – TV and hifi distribution
- CCTV
- home and building electronic systems linked using twisted pair (TP) to control lighting and temperature

Regulation 522.6.101 is reproduced here; the revision is shown in bold (Regulations 522.6.100 and 522.6.103 have a similar inclusion):

522.6.101 A cable concealed in a wall or partition at a depth of less than 50 mm from a surface of the wall or partition shall:

i. incorporate an earthed metallic covering which complies with the requirements of these Regulations for a protective conductor of the circuit concerned, the cable complying with BS 5467, BS 6724, BS 7846, BS EN 60702-1 or BS 8436, or

ii. be enclosed in earthed conduit complying with BS EN 61386-21 and satisfying the requirements of these Regulations for a protective conductor, or

iii. be enclosed in earthed trunking or ducting complying with BS EN 50085-2-1 and satisfying the requirements of these Regulations for a protective conductor, or

iv. be mechanically protected against damage sufficient to prevent penetration of the cable by nails, screws and the like, or

v. be installed in a zone within 150 mm from the top of the wall or partition or within 150 mm of an angle formed by two adjoining walls or partitions. Where the cable is connected to a point, accessory or switchgear on any surface of the wall or partition, the cable may be installed in a zone either horizontally or vertically, to the point, accessory or switchgear. Where the location of the accessory, point or switchgear can be determined from the reverse side, a zone formed on one side of a wall of 100 mm thickness or less or partition of 100 mm thickness or less extends to the reverse side, or

vi. form part of a SELV or PELV circuit meeting the requirements of Regulation 414.4.

The requirement for RCD protection

It is particularly important to understand the requirements of Regulation 522.6.102 where the installation is not intended to be under the supervision of skilled or instructed persons. In such circumstances, where a cable is concealed in a wall or partition at a depth of less than 50mm from a surface, RCD(s) with a rated residual operating current not exceeding 30 mA would need to be provided for those cables without earthed metallic coverings or not installed within earthed metallic containment and where the circuit is not SELV or PELV.

Therefore, SELV or PELV circuits do not require RCD protection. It is, nevertheless, a fundamental requirement to sufficiently protect all circuits at all times; Regulation 522.6.1 describes:

522.6.1 Wiring systems shall be selected and erected so as to minimise the damage arising from mechanical stress, e.g. by impact, abrasion, penetration, tension or compression during installation, use or maintenance. ■

Thanks
Paul Harris – IHEEM
Bob Cairney – SELECT
Connor Flynn – ECA
Tim Benstead – Electrical Safety Council
Charles Tanswell - ScEME
Paul Sayer - BEAMA

Swimming pools – an overview

By Peter Lang

Although the First Amendment to BS 7671:2008 has just been published and is due to come into effect from 1st January 2012, it is only since the publication of The 16th Edition of The IEE Wiring Regulations in 1991 that there has been a dedicated section to swimming pools, Section 702 Swimming Pools and Other Basins.

Section 702 appears to be quite compact in its makeup but the Regulations are to be viewed as a whole and individual sections should not be viewed in isolation.

Remember that Part 7 of BS 7671 *Special Installations or Locations – Particular Requirements* supplements or modifies the requirements of Parts 1 – 6 of the Regulations.

Pool construction

Pool construction in the domestic market (domestic meaning those pools of private residences) will vary due to the requirements and budget of the pool owner. It will range from a reinforced concrete construction to a non-concrete structure/framework which has little, if any, structural strength and which supports a tailored vinyl lining (liner pools).

Additionally, fibreglass modular and above ground pools are installed. In the commercial market, the main form of construction is reinforced concrete but there are some non-concrete structures with more substantial linings.

The pool shell is generally a monolithic structure not reliant on any other construction.

Specialist systems

The swimming pool is an amalgam of many specialist systems, which are:

- the pool construction
- the water circulation system
- the filtration system
- the heating system
- the water treatment system

Additionally there may be:

- an environmental control system
- a hydro-therapy system

At the heart of all the pool is the filtration system, which can consist of many pumps. The pumps move the pool water through all the specialist systems listed above and without it operating correctly all other systems will fail. Theses pumps are driven by electric motors of varying sizes depending on the volume of water of the pool and the nature of the pool use.

SPATA

SPATA – the Swimming Pool and Allied Trades Association – is a member of BSPF, the British Swimming Pool Federation and of EUSA, the European Union of Swimming Pool and Spa Associations and is celebrating its 50th anniversary this year

It is intended that a future *Wiring Matters* article will outline some of the considerations for electrical installations and the requirements of BS 7671:2008(2011) for swimming pools. ■

About the author

Peter Lang has been Technical Adviser to SPATA since 2002, prior to which he was an installer of all types of pools for nearly 25 years. He is a Fellow of ISPE and spent 11 years chairing the Technical Committee for the European Union of Swimming Pool and Spa Associations (EUSA).

A typical swimming pool plant room

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