WiringMatters

Your insight into BS 7671 www.theiet.org/wm

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BS 7671: the 18th Edition report

With the 18th Edition to the Wiring Regulations not too far off (it's due to publish 1st July 2018), Nicole Whitton looks at what is being discussed at committee level now and what changes are likely to be included in what will be BS 7671:2018.

As Leon Markwell discussed in his March 2016 blog post, four panels inform JPEL/64, the decision-making committee of BS 7671:

- Panel A – covers verification and inspection and testing (Part 6 and Appendix 6 of BS 7671) plus any work relating to Parts 1, 2 and 3 of BS 7671.
- Panel B – covers cable sizing and installation and related matters (some of Parts 4 and 5, Appendices 3 and 4 and some Part 7 items of BS 7671).
- Panel C – covers earthing installations and related matters (some of Parts 4 and 5 and some Part 7 items of BS 7671).
- Panel D – covers the remainder of Parts 4 and 5, some Part 7 items and some Appendices of BS 7671).

There are two standard setters that we work with: the IEC (International Electro-technical Committee) and CENELEC (European Committee for Electrotechnical Standardization). Mark Coles explains the working relationships with these standard setters in more detail in his October 2015 blog, and also provides instructions on how to gain access to the various topics being discussed for inclusion in the 18th Edition.

Significant changes

Protection against overvoltages

Geoff Cronshaw discussed the work being undertaken on this change in the Spring 2013 issue of Wiring Matters. I summarise the likely changes here.

Clause 443 is likely to be significantly revised based on the recently published IEC and CENELEC standard. However, the exact requirements will have to be agreed by the UK national committee. Assuming BS 7671 follows the IEC and CENELEC standard the AQ criteria (conditions of external influence for lightning) for determining if protection against transient overvoltage is needed would no longer be included in BS 7671. Instead, protection against transient overvoltage would have to be provided where the consequence caused by overvoltage affects:

- human life, e.g. safety services, medical care facilities;
- public services and cultural heritage, e.g. loss of public services, IT centres, museums; and
- commercial or industrial activity, e.g. hotels, banks, industries, commercial markets, farms.

For all other cases, a risk assessment would have to be performed in order to determine if protection against transient overvoltage is required. If the risk assessment is not performed, the electrical installation would have to be provided with protection against transient overvoltage.

However, an exception not to provide protection is included for single dwelling units where the total economic value of the electrical installation to be protected is less than 5 times the economic value of the SPD located at the origin of the installation.

Protection against switching overvoltages should still be considered.

Protection against fire

Protection against fire resulting from the electrical installation and the use of the electrical installation has been necessary ever since electricity was first introduced into buildings. Chapter 42 contains the requirements for the protection of persons, livestock and property against fire caused by electrical equipment, against burns and overheating and for including precautions where particular risks of fire exist.

It is recognised that RCDs can reduce the likelihood of fires associated with earth faults. However, whilst RCDs can detect earth faults they aren't able to reduce the risk of electrical fire due to series or parallel arcing between live conductors because there is no leakage current to earth. Also, it is understood that the impedance of a series arc fault reduces the load current, which will keep the current below the tripping threshold of the circuit-breaker and the circuit-breaker may therefore not operate to disconnect the circuit.

For this reason details will be included in BS 7671:2018 for the installation of arc fault detection devices (AFDDs) to mitigate the risk of fire in final circuits of a fixed installation due to the effect of arc fault currents.

Changes to Section 753

The scope of Section 753 has been extended to apply to embedded electric heating systems for surface heating. They also apply to electric heating systems for de-icing or frost prevention or similar applications, and cover both indoor and outdoor systems. These include heating systems for walls, ceilings, floors, roofs, drainpipes, gutters, pipes, stairs, roadways and non-hardened compacted areas (for example, football fields, lawns). Heating systems for industrial and commercial applications complying with IEC 60519 and IEC 62395 are not covered. The IEC standard covers issues such as surface temperatures and refers the reader to the appropriate IEC guide.

Documentation is also covered. The designer will be required to provide appropriate information about approved substances in the surroundings of the heating units. For wall heating systems (which are more vulnerable than floors and ceilings from penetration) the standard contains additional requirements to protect against the effects of overheating caused by a short-circuit between live conductors due to penetration of an embedded heating unit. In the case of heating units that are delivered from the manufacturer without an earthed conductive shield, a suitable conductive covering, for example, a mesh metallic grid, with a mesh size of not more than 3 mm for wall installations, shall be provided on site and connected to the protective conductor of the electrical installation. In addition, the IEC standard requires that electric heating systems shall be selected and erected so as to avoid any harmful influence between the heating system and any electrical or non-electrical installations envisaged.

New section – energy efficiency

The worldwide need to reduce the consumption of energy means that we have to consider how electrical installations can provide the required level of service and safety for the lowest electrical consumption. The draft proposals enable a client to specify the level of energy efficiency measures applied to an electrical installation. Installations can also be awarded points for energy efficiency performance levels, for example, transformer efficiency. These

points can be added together with points for efficiency measures to give an electrical installation an efficiency class, ranging from EIEC0 to EIEC4, depending on the number of points awarded.

The new section will cover several energy efficient areas, such as electric vehicles, lighting, metering, cable losses, transformer losses, power-factor correction, and harmonics.

We will be featuring a more detailed article about energy efficiency in a forthcoming issue of Wiring Matters, and will continue to provide as many updates to our readers about the work being undertaken on the 18th Edition to the Wiring Regulations. Please ensure that you have subscribed to Wiring Matters to ensure that you receive notification of new issues of the magazine.

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A guide to lighting design for electricians and installers

Simon Robinson, Chair of the Society of Light and Lighting's (SLL) Technical and Publications Committee, provides some guidance about how to approach lighting design.

The visual element of lighting is perhaps the most noticeable part of an electrical installation, and yet can be one of the most subjective, with the same lighting design generating very different responses from people. Perhaps lighting design, especially where visual impact is important, is closer to architecture and interior design than it is to electrical installation work.

For this reason, some find it a difficult area to work in, however, there are a few basics that, when followed, should result in a lighting design that meets the customers' needs and produces that smile from them that we all want to see!

Where to start

What is a good lighting design? Unfortunately, there is no black-and-white answer to this question. There are too many variables that can affect the outcome, including public opinion, so anyone embarking on lighting design should first ensure that they understand their client's needs and aspirations.

Consider the function of the space: lighting levels

The tasks to be carried out in a space should be considered. Some spaces have areas where complex tasks are performed and need high light levels, whereas other areas that are not so critical can have much lower light levels. Different types of light are required for different tasks and even to create different moods. The SLL produces excellent guidance on recommended lighting levels for a variety of tasks, building types and uses, including outdoor lighting, so their website is a good starting point.

Generally, lighting can be described as either being direct or diffuse. A mixture of direct and diffuse light allows us to determine things such as surface texture or facial features. Choosing pale matt finishes for walls and ceilings will assist in creating a diffuse element, although a purely diffuse lighting solution can make a space look bland and featureless, whereas a purely direct solution can result in sharp contrast and deep shadows. A diffuse solution may be the best option for a space where tablet computers are being used extensively as there would be no direct light to reflect on the screen. It wouldn't really be suitable in a space such as a museum though where lighting is used to guide people and highlight exhibits.

Consider the surroundings: light absorbance

Once a lighting level has been determined, the route to achieving that level, and how uniform it needs to be, can begin. The lighting of a space is affected by the colours and reflectance of the walls and even the furniture, so these factors need to be taken into account. Dark matt finished walls and ceilings will absorb much of the light energy and result in a gloomy looking space unless the amount of light is increased to compensate. This, of course, increases the amount of energy being used, so it is better to have paler coloured walls and ceilings where possible. Floor coverings can also absorb light and the texture is as important as the colour. For example, a beech-effect laminate floor will reflect much more light than a carpet of a similar colour as the carpet's texture absorbs light.

In many cases, a lighting solution should include a mixture of both direct and diffuse elements so that a general diffuse illumination is achieved with areas highlighted by direct lighting. This will allow a user of the space to carry out a specific task or to be able to determine facial features or recognise textures.

Perhaps the domestic market has been an area where, historically, the need to mix diffuse and direct lighting with a sympathetic colour and texture choice has been misunderstood. Spotlights are often used in kitchens, which provide a direct element for tasks carried out within their beam range but do little to provide a general diffuse element. This can lead to frustrated users of the space, for example if they want to read a cookbook in an area not covered by a spotlight.

Consider the ambiance: light colour

The colour of the light can also have a significant effect. Visible light provided by electric lighting is generally in a range that covers white light with a yellow appearance (described as 'warm') to white light with a blue appearance (described as 'cool'). Cool colours are thought to promote alertness in people whereas warm colours are thought to help people relax. Warm colours in a domestic space and cool colours in an office environment should therefore be used, unless there is a specific reason to do otherwise. Wall, ceiling and floor finishes and colours can also affect the overall colour of a space. For example, a room with blue walls and a blue carpet will still appear to have a cool lighting effect even if warm light sources are used, so matching room finishes to the required lighting effect is important.

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Renewed confidence: solar PV and other renewable energy installations

Do you have clients who are making decisions about installing renewable energy systems? With the UK government no longer offering feed-in tariffs (FiTs) for domestic installations, it might be a tough investment decision to make.

Barny Evans is associate director for waste and renewables at WSP | Parsons Brinckerhoff. He writes for Wiring Matters about what the lack of government subsidies means for the future of renewable energy.

Recently I gave a presentation at Ecobuild on the future of renewable energy in a post-subsidy world. Looking at solar (photovoltaics), wind, biomass and heat pumps in particular, I discussed how different models for investment might work. In the 'good old days' (the last five years!) solar and wind project investments were most profitable by being as big as possible, up to incentive boundaries, to benefit from economies of scale. In most cases this meant building ever bigger solar or wind farms with no specific end user/customer for the power, except the local network. The two primary sources of income would be from the FiT or the government's Renewables Obligation Certificate (ROC) payments, with the other being the power purchase agreement of supplying to the grid. The price paid for electricity under a power purchase agreement supplied to the network is about 5 p per kWh.

In a world *without* subsidies the only source of income is the price paid for the electricity supply. In most cases that simply isn't going to be enough, at least in the near term.
So we have to make renewable electricity viable without subsidies. We can do this in two main ways: first, we can reduce the price of renewable power, which is already happening. Second, and more importantly in the short term, we can increase the price paid for the electricity generated.

The easiest way to increase the price is to supply the electricity directly to an end user such as a factory or office. An end user will be typically paying a retail price of 11-14 p per kWh for electricity and it is therefore possible to sell power to them for much more than the current 5 p rate and still save money. Everyone's a winner!

There is a catch. You can only sell an end user as much power as they need. This means that solar and wind systems are likely to be smaller and more bespoke to customer demand and will therefore require careful analysis. When we are looking at this for clients we take the half-hourly metered data to understand what their minimum daytime demand is. This dictates how big a solar or wind installation should be alongside other metrics.

The good news is that there are likely to be a lot more solar and wind projects in the future, but they are more likely to be a lot smaller and more complex. This in itself is probably good news for electrical installers as the work will be more valuable and more bespoke. For solar it is likely to drive more rooftop installations, supplying the occupier in the building. Rooftop installations are more complex than ground-mount systems due to the access, safety, connections (electrical and physical) and the roof layout itself.

To add to the complexity and opportunity, energy storage is now becoming available, commonly in the form or lead acid or Li-ion batteries. This is really exciting for the power sector as a whole, and in renewables it offers a range of opportunities for solar and wind projects that are serving sites. For example, it may mean that you can increase the size of a solar/wind system and simply store excess energy when you don't need it and then use it when you do. Further, due to the additional charges that apply for electricity at peak periods of demand there are extra savings that can be made.

Whilst I have focused on renewables here, this is a microcosm of what is happening in the wider electrical system. The sector is becoming much more fragmented as more of us become producers as well as consumers of electricity and begin to manage our energy use

more actively. This represents a massive opportunity and challenge for the electrical sector as a whole, but particularly at the building/site scale.

Further references:

If you're designing or installing solar PV, you might find the IET's *Code of Practice for Grid Connected Solar Photovoltaic Systems* useful.

Work is underway to develop a Code of Practice for energy storage. Please see the IET Standards webpage to be involved in consultations in this area: http://www.theiet.org/resources/standards/. A Technical Briefing on the subject is due to be published shortly.

Calling all electricians and installers who have fitted smart home solutions!

We're interested to hear from anyone who is fitting, or has fitted, renewable energy solutions for domestic dwellings or small business. We would also be interested to hear whether you've fitted any 'smart home' technology, which comprises anything from light dimmers to smart meters to energy control systems. Please contact Wiring Matters with some information about the project and your experience: wiringmatters@theiet.org

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Electrical installations in caravan/camping parks, caravans and motor caravans

As the warmer weather approaches and with summer around the corner, thoughts turn to holidays. Chief Engineer Geoff Cronshaw reminds us of the requirements of BS 7671:2008+A3:2015.

Introduction

The particular requirements of Section 708 apply to the electrical installations in caravan/camping parks and similar locations that provide connection points for supplying leisure accommodation vehicles (including caravans) and tents.

The particular requirements of Section 721 apply to the electrical installations of caravans and motor caravans at nominal voltages not exceeding 230/440 V a.c. or 48 V d.c.

Note: there are some exclusions.

The risks specifically associated with installations in caravan/camping parks, caravans and motor caravans arise from:

- open circuit faults of the PEN conductor of PME (TN-C-S) supplies raising the potential to true Earth of all metalwork to dangerous levels.
- incorrect polarity at the pitch supply point.
- possible loss of earthing due to long supply cable runs, connecting devices exposed to weather and flexible cable connections liable to mechanical damage.
- vibration while the vehicle is moving, causing faults within the caravan installation.

Particular requirements to reduce the above risks include:

- prohibition of the connection of exposed- and extraneous-conductive-parts of a caravan or motor caravan to a PME (TN- C-S) terminal. Where the supply to the site is PME (TN-C-S), the earthing arrangement at the pitch supply point shall form part of a TT system.
- additional protection by 30 mA RCDs in both the vehicle and the pitch supply point.
- double-pole isolating switch and circuit-breakers protecting the final circuit in the tent, caravan or motor caravan.
- internal wiring of the tent, caravan or motor caravan by flexible or stranded cables of cross-sectional area 1.5 mm^2 or greater; additional cable supports; segregation of low voltage and extra-low voltage circuits.

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Caravan/camping parks

Protection against electric shock: general requirements

As you would expect, the protective measures of obstacles, placing out of reach, using a non-conducting location and ensuring protection by earth-free local equipotential bonding are not permitted. These measures are contained in Sections 417 and 418 of BS 7671:2008+A3:2015 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 the control and effective supervision by skilled or instructed persons.

Protective multiple earthing

Regulation 708.411.4 of the Electricity Safety, Quality and Continuity Regulations 2002 (ESQCR) prohibits the connection of a protective multiple earthing (PME) facility to any metalwork in a leisure accommodation vehicle (including a caravan).

This does not preclude the use of a PME earthing facility as the means of earthing for other purposes, such as to the installations of permanent buildings.

What is protective multiple earthing?

The ESQCR permits 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 7671:2008+A3:2015.

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 7671:2008+A3:2015 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:

- body contact resistance is low (little clothing, damp/ wet conditions); and/or
- 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 difference arising between those parts and Earth. For this reason Regulation 9(4) of ESQCR **does not allow a combined neutral and protective conductor to be connected to any metalwork in a caravan.**

External influences

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. A minimum degree of protection of IP3X is required if solid foreign bodies are present. If water is present, a minimum degree of protection of IPX4 is required.

Caravan pitch socket-outlets

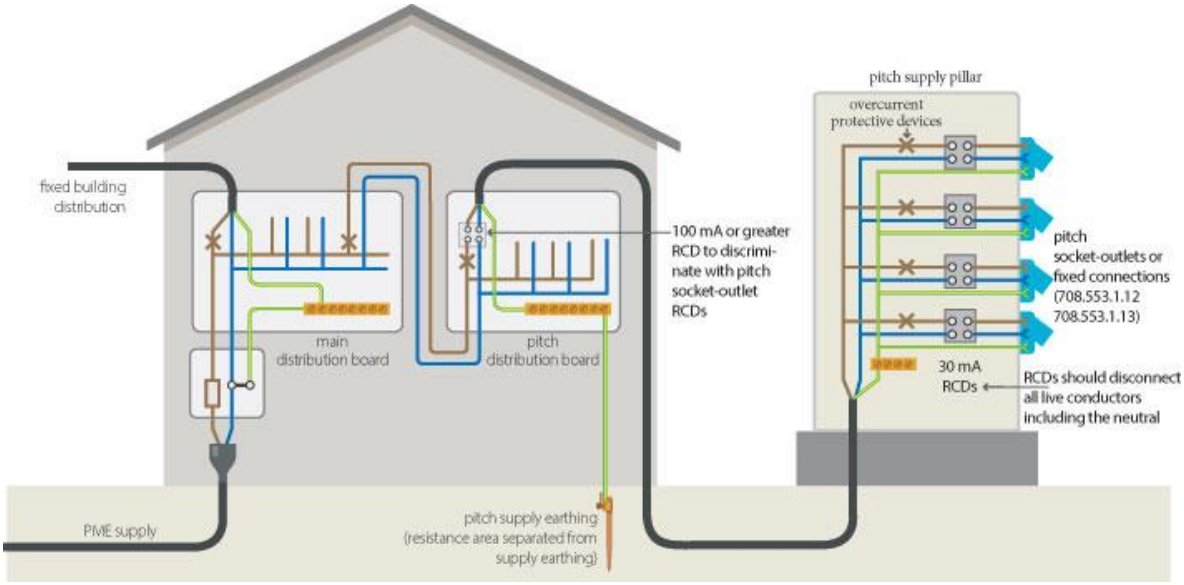
Caravan pitch socket-outlets are required to comply with BS EN 60309-2 and must have a degree of protection of at least IP44. The current rating is to be not less than 16 A but may be greater if required. At least one socket-outlet should be provided for each caravan pitch. Where socket-outlets are grouped in pitch supply equipment, there should be one socket-outlet for each pitch limited to a group of four. To be compatible with the caravan connecting cable, socket-outlets should be two-pole with the earthing contact having key position 6 h.

Each socket-outlet must be protected individually by an overcurrent device, which may be a fuse but is more usually a circuit-breaker, and individually by an RCD having the characteristics specified in Regulation 415.1.1 for additional protection. The RCD must disconnect all live conductors including the neutral.

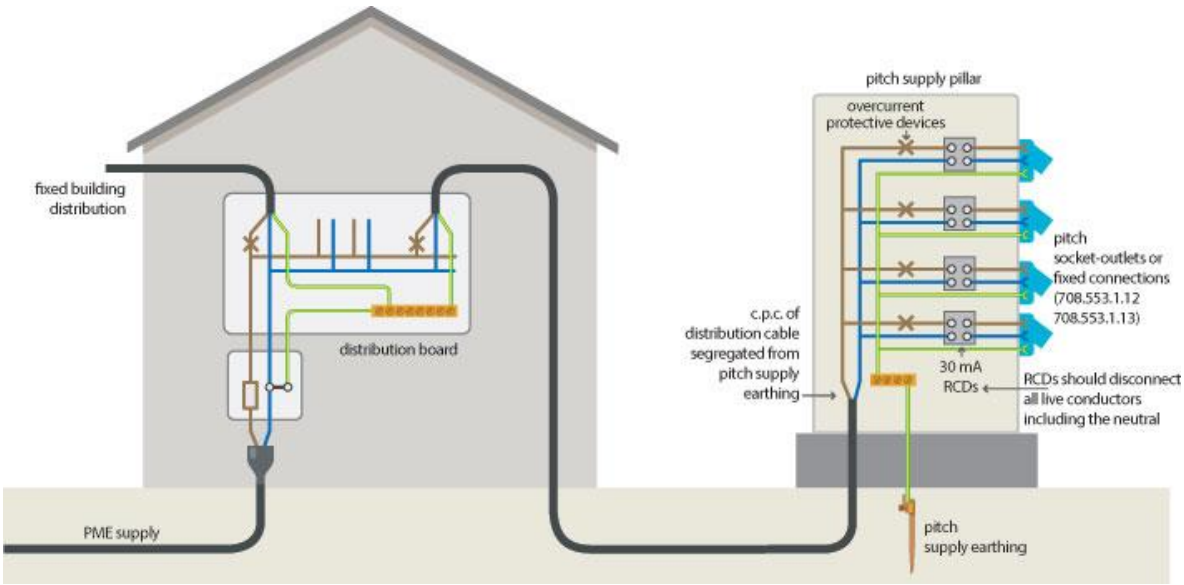
As mentioned previously the ESQCR prohibit the connection of a PME earthing facility to any metalwork in a leisure accommodation vehicle (caravan). If the caravan supply is derived from a permanent building that is supplied by a PME system then the caravan supply will have to be part of a TT system having a separate connection to Earth independent from the PME earthing.

The separation of the earthing can be effected at the main distribution board. See the below Figure 7.1 of IET Guidance Note 7 for detailed information. This enables the exposed-conductive-parts connected to each system to be more readily identified and inspected

periodically. An earth electrode for the TT system should be provided nearby and located so that the resistance areas of the PME supply earthing and earth electrode do not overlap.



Alternatively, the separation of the earthing can be made at the caravan pitch supply points. In this instance, earth electrodes will be required at these points. See the below Figure 7.2 of IET Guidance Note 7 for detailed information.



Caravans and motor caravans

Protective equipotential bonding

Regulation 721.411.3.1.2 requires structural metallic parts that are accessible from within the caravan to be connected through main protective bonding conductors to the main earthing terminal within the caravan.

Provision of RCDs

Regulation 721.411.1 requires that where protection by automatic disconnection of supply is used (Section 411), an RCD complying with BS EN 61008-1 or BS EN 61009-1 interrupting all live conductors is required to be provided having the characteristics specified in Regulation 415.1.1 (30 mA) for additional protection. The wiring system must include a circuit protective conductor connected to:

- the protective contact of the inlet;
- the exposed-conductive-parts of the electrical equipment; and
- the protective contacts of the socket-outlets.

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 and operates and disconnects the circuit when the residual current reaches a pre-set limit, the residual operating current ($I_{\Delta n}$).

Switchgear and controlgear

The installation to the caravan should have a main disconnector, which will disconnect all the live conductors. This should be placed in a suitable position for ready operation within the caravan to isolate the supply. When a caravan only has one final circuit then the isolation can be afforded by the overcurrent protective device as long as it fulfils the requirements for isolation.

An indelible notice in the appropriate language(s) must be permanently fixed near the main isolation point inside the caravan to provide the user with instructions on connecting and disconnecting the supply (refer to Figure 721 of BS 7671).

The inlet to the caravan must be an appliance inlet complying with BS EN 60309-1. This should be installed not more than 1.8 m above ground level, in a readily accessible position, have a minimum degree of protection of IP44, and should not protrude significantly beyond the body of the caravan.

The connecting flexible cable

The means of connecting the caravan to the pitch socket-outlet should be provided with the caravan. This must have a plug at one end complying with BS EN 60309-2 and a flexible cable with a continuous length of 25 m (±2 m). The connecting flexible cable must be in one length, without signs of damage, not contain joints or other means to increase its length, and have a connector, if needed, that is compatible with the appropriate appliance inlet. The cable should be to the harmonized code H05RN-F (BS EN 50525-2-21) or equivalent, include a

protective conductor, have cores coloured as required by Table 51 of BS 7671:2008+A3:2015 and have a cross-sectional area as shown in Table 7.1 of BS 7671:2008+A3:2015.

Periodic inspection and testing

The purpose of periodic inspection and testing is to provide an engineering view on whether or not the installation is in a satisfactory condition where it can continue to be used safely. Periodic inspection and testing is necessary because all electrical installations deteriorate due to a number of factors such as damage, wear, tear, corrosion, excessive electrical loading, ageing and environmental influences. IET Guidance Note 3 gives the recommended initial frequencies of inspection of electrical installations for caravans and caravan parks.

Conclusion

It is important to be aware that this article only gives a brief overview of electrical installations in caravan/camping parks, caravans and motor caravans. For more information refer to Sections 708 and 721 of BS 7671:2008+A3:2015.

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Electrical installations at live outdoor venues

In the second article of a series looking at electrotechnical job roles in the entertainment industry, Wiring Matters talks to ABTT member Shaun Pearce about designing and installing electrical installations for live outdoor venues.

Live music and related events contribute significant sums to the UK economy, with live music alone contributing more than £1 billion annually – the entertainment industry as a whole is reputedly worth £44 billion per year. A part of that is the burgeoning festival scene, with many small boutique festivals popping up around the country, vying for attention amongst the stalwarts such as Glastonbury or the Reading Festival. With the summer season about to get into swing, Shaun Pearce of Pearce Hire discusses their activities as an event power contractor.

Could you give the reader a brief overview of your company, and how you ended up doing what you do now?

We provide a range of technical services to the events industry, such as audio, stage lighting and rigging. The mainstay of the business though is power distribution including generators and site lighting. Like many companies in this industry Pearce Hire came together by chance. I built my own Public Address system and operated a mobile DJ service from the age of 14. I did an electrical apprenticeship at Redring Electric (a company that will be familiar to many readers!) and having completed that the scene was set – an interest in sound and lighting coupled with a job as an electrician. I left Redring and started work as an electrical contractor, continuing my entertainment interest by working with local bands and on nightclub installations. Having expanded into PA and lighting hire I found a niche market (well, it was then!) providing power services for gigs and events. Back in those days there was not much in terms of bespoke power distribution, generators were unreliable and I was one of very few qualified electricians working in the industry. I worked for many industry companies and then a spell at Glastonbury led to more work in Nigeria, Kenya and Uganda. All this time I was continually expanding my stock of equipment; we built all of our own power distribution equipment, which is a practice that continues to this day. We now have our own generators, miles of cable, hundreds of distribution units, lots of site lighting and a 15 thousand square foot warehouse in Peterborough. The company now has 17 employees and annual turnover of over £2 million.

Blickling Hall Proms concert - three generators in synchronised set up

What is the typical year like for you? Much of your work is festival and event based, what keeps you going over the winter months?

In the winter months there is the maintenance to be done – every distribution unit is taken apart and fully tested. Of course over winter there are still related events and we provide power services for Christmas markets, Christmas trails, fireworks events and architectural illuminations. We also do corporate events as well as providing electrical testing and maintenance services for venues such as the Cambridge Corn Exchange, schools and colleges etc. We also have sound and lighting departments, which are very busy during the winter months.

Bury St Edmunds Christmas Fayre

A lot of work is usually short notice, how do you go about actually designing systems? Or is it achieved 'on the fly' and verified as you go?

We have to design to a degree to ensure that we take the correct equipment to site, but things tend to alter considerably once on site. Some jobs are on the fly, usually due to last minute confirmations, however, we always ensure all circuits are tested and verified before use.

Some jobs are unusual and in riskier locations. An example that comes to mind are the Forestry Commission Concerts – what is involved in such a project? Where do you start?

Apart from the remoteness there's not much difference between these and a standard greenfield site. The riskier locations we have worked in would include ship naming ceremonies on docksides, an opera in a disused chemical factory and a party on a roundabout at Heathrow airport (Richard Branson's idea – don't ask!). Some events are riskier by virtue of where they are – the lack of health and safety culture in places such as Qatar and Africa is something that springs to mind …

As with any project, planning is key but getting the correct information from the client and production management team from the outset is the most vital element.

Usually the distribution is made up of stock units used in a variety of environments. Do you design and/or build your own? What are the requirements for such equipment?

We design all of our distribution, all our rubber boxes are manufactured by SES electrics but we do all the internal wiring and fit our own circuit protection so as to maintain the same standard. All our distribution designs are structured so as to be completely modular and versatile.

Pearce Hire warehouse - generators and fuel tanks ready for hire!

Given the increase in LED lighting and electronic power supplies in equipment are you having to put in any additional measures to cater for power quality problems?

We have not had any power supply issues as yet (probably due to planning), however, we are aware of the underlying problems and when necessary we have increased the neutral cross sectional area and the rating of the generators to reduce the chances of a problem occurring.

As an industry we're not shy of consuming large quantities of reliable power for short durations. Energy efficiency is hard to achieve using more traditional non-renewable sources so how to you try to reduce your carbon footprint?

We achieve this in many ways. We only use EUIIIa emissions compliant generators (they meet the stringent European emission standards for CO_2 & Greenhouse gas emissions. Find out more at https://www.dieselnet.com/standards/eu/nonroad.php) and we keep the running hours to a minimum. We continually strive to reduce load and have invested heavily in LED technology in terms of both site and stage lighting. Where possible we also use on-demand generator systems. For example, instead of running a single 300 kVA generator, we use three 100 kVA sets with only one running for 24 hours while the others switch on as the load increases. This significantly reduces fuel consumption and consequently our carbon footprint.

Pop in the Park Cambridge - triple synchronised generator set up

What we have found is that the best way of reducing the carbon footprint of an event is for the event organisers to engage with us at an early stage. Entering into a long term contract not only has commercial benefits but enormous green benefits; working alongside a client for several seasons enables us to gauge how they work and where we can make significant reductions in the power supplies. For instance, after the first year we may find that all the stage generators can be reduced from 300 kVA to 200 kVA, or we might find a centrally located generator position supplying several bars, stages and concessions is better than smaller distributed generator sets. A common cause of oversizing generation capacity is the perceived demand based on hardware, not actual loads. As an example, lighting companies will often ask for a 400 A three-phase supply, because that is what the connectors on their

Cambridge University sponsors dinner and presentation – distribution set up

main distribution are rated at. Often the loads are actually much less, but usually we are asked for that size of supply so we ensure we have the capacity to provide it.

Longer term relationships also allow for us to invest in the latest power saving technology. If we have a client that looks for the cheapest supplier every year without any loyalty, in order for the job to be won they will end up with older technology, which is not the most efficient and costs more to run. A commitment to a 3-5 year contract allows us to look into ways to reduce costs for them and make the whole process more efficient, such as by investing in LED lighting. This is an environmental win-win situation for both the client and us as we are both working in tandem to reduce an event's carbon footprint.

General electrical qualifications are typically geared towards mainstream electrical contracting industries. How do you approach the need for competent staff? Is there a skills gap? Are you worried about future skills or lack thereof?

This is a constant issue and we struggle to get good electrical apprentices from our local college as they only study a domestic wiring course – this knowledge level is okay for us to a degree, but our problem is that we cannot give them the relevant experience in a domestic environment. So we are constantly on the lookout for competent electrical staff; we have our own staff plus a plethora of regular freelancers, but we are always on the lookout for more.

Like most of the industry, we find our crews by word-of-mouth and usually this is the best way of attracting good people. We are finding that there is definitely a skills gap – it seems endemic across all technical trades in this country, not just in our industry. I think the UK has ignored technical training for too long and now we are seeing the consequences. So I am concerned there's not enough to go round and it may well end up with the best staff going to the companies who can command the highest rates – in our industry that's often those working in the corporate events sector.

Field Day Festival, Victoria Park, London - equipment bone yard (stores!)

Aside from electrical knowledge, what other skills/training do your crews have?

All our project managers are trained in first aid as they may be working remotely (in a forest for instance!) and this knowledge could save someone's life. Other training includes forklifts of many varieties, working at height and International Powered Access Federation (IPAF), electrical testing and certification, asbestos awareness, manual handling, generator operation/service, portable appliance testing, trailer towing, the new CDM regulations – the list goes on!

What standards and/or other guidance documents do you use for your work?

Obviously BS 7671 and BS 7909 are the main electrical ones, but also the purple guide (which was updated from the HSE publication HSG195) and relevant guidance for compliance with Lifting Operations and Lifting Equipment Regulations (LOLER). I also sit on the Powerful Thinking group as the Production Services Association representative and this looks to try and reduce energy usage at events across the sector.

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Interview with Colin Reed

Colin Reed I.Eng. MIEE has been a long-standing member of JPEL/64 and is the outgoing Chairman of Panel B Thermal effects, one of the four panels that feeds into the wider JPEL/64 committee, responsible for BS 7671. Colin retired from chairing Panel B in March, so we took the opportunity to catch up with him and celebrate his career.

Tim Benstead, new Chairman of Panel B (left) and Colin Reed, retiring Chairman of Panel B (right)

Colin, you've spent much of your working life in the electrical cable industry. What do you find most interesting about this area?

The ever-changing nature of the electrical industry and the developments of new technology, such that you are always learning new things.

You must have seen a lot of change in the cables and installation techniques and requirements over the years. What has been the most interesting change?

I joined the cable industry the year it changed from imperial cable sizes to metric. This was a major change at the time for those even older than me. In more recent years it must be the change of core colours of cables from RED, YELLOW, BLUE, BLACK to BROWN, BLACK, GREY, BLUE which involved coordinating a large number of originations such that the change went ahead on time and safely.

What has been the most challenging moment of your career?

In the early days I was responsible in my company for producing all the detailed cable designs for Sizewell B nuclear power station. It was at the time when desktop computers first

became available in helping or maybe complicating ones work. Taking into account when I first started work I had log tables and a slide rule, it was a steep learning curve.

You've been through several editions of BS 7671, from the 14th Edition through to the most recent Amendment 3 to the 17th Edition. Was there any one Edition that particularly stands out in your mind?

Two really.

The first was when we amended the regulations to use the international current rating and installation in IEC 60364 instead of using purely UK stated ones. This change may not even been noticed by the average user of the regulations as work had been going on in the background for quite a few years at IEC level to align these ratings and methods in order to give a smooth change over.

The second was Amendment No 1 to the 17th edition as this was the first that I was chairman of panel B, and at that stage you realise both the extent of the work involved and how you have to manage the committee so that everyone contributes to the final document taking into account their area of expertise.

JPEL/64 Committee outside Savoy Place

You would initially have been a member of the IEE's Wiring Regulations Committee before it changed to IET. What other significant changes have you seen in the electrical industry?

The rise of new technology and industries such as wind and solar power creating new opportunities and unfortunately the decline in others such as, steel, coal and building oil rigs for the North Sea.

How do you think wiring and cabling will change over the next couple of decades?

Like many industries it must change with time, new technology and additional regulations. The industry is becoming greener in the products it produces and will continue to do so. It will also change by taking into account security of supply, d.c. power in the home and I am sure there are many more changes that have not been thought of yet.

What advice would you have to young professionals interested in a career in the standard-setting industry?

Always ask questions and do not be afraid to do so. I have found that all experts are delighted that someone is interested and are more than willing to share their knowledge, I know that I am.

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Insulation inserts in metallic gas service pipes to consumers' premises

Recently, a technical question was raised about the use of insulating inserts/insulation joints in metallic gas service pipes to consumers' premises in order to electrically insulate one section of pipe from another.

Chief engineer Geoff Cronshaw takes a brief look at the current requirements and the reasons why the gas industry installs insulating inserts/insulation joints (IJs) in metallic gas service pipes. The type of insulation joint used is outside the scope of this article. It is important that gas installations comply with all relevant legislation including the Gas Safety (installation and use) Regulations 1998.

What is protective multiple earthing (PME)?

Firstly, it is worthwhile explaining what PME is, as it is mentioned throughout this article.

The Electricity Safety, Quality and Continuity Regulations, as amended in 2002 (ESQCR) 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.

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 difference 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:

(a) body contact resistance is low (little clothing, damp/wet conditions); and/or
(b) 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 potential difference appearing between these parts and Earth. (Earth is defined as: the conductive mass of earth, whose electric potential at any point is conventionally taken as zero.)

Purpose of an insulating section/insulation joint

In the case of a PME service, for example, in the event of a line-to-earth fault occurring within the installation, the fault current will travel through the circuit protective conductor to the main earthing terminal of the installation. From there, the installation's earthing conductor will carry the fault current to the PME earthing terminal; the fault current will then travel through the combined PEN conductor and finally back to the distribution transformer. This flow of current will be sufficient (if the installation complies with BS 7671:2008+A3:2015) to operate the protective device within the required time.

The use of an insulating section/insulation joint in a metallic gas service pipe is intended to prevent the fault current finding a route along that pipe.

In the case of a PME service, if the neutral conductor (PEN) in the service cable becomes severed then the neutral return current could flow through the metallic gas pipe. Such a flow of neutral return current can cause heating of the gas pipework and could lead to danger.

In addition, the use of an IJ in a metallic gas service pipe is used to provide an electrical break in the metallic pipework where cathodic protection is used to control the corrosion in gas pipelines.

The requirements

ENA Engineering Recommendation G12 published by the Energy Networks Association

ENA Engineering Recommendation G12 Issue 4 Amendment 1 December 2015 *Requirements for the Application of Protective Multiple Earthing to Low Voltage Networks* contains clause 5.2.1 which states:

> Provision of earth terminal requires that where a metallic gas service is provided to a consumer's premises with a PME earth terminal, an insulated insert should be fitted in the gas service.

Historical note from ENA:

> Prior to these standards (in particular IGEM GL/5), IJs were occasionally installed downstream of the ECV. This was to comply with PME requirements, and so these IJs are still required.

IGEM/G/5 Edition 2 document published by the Institution of Gas Engineers and Managers

IGEM/G/5 Edition 2 document (clause 11.2) contains requirements for insulating fittings. Clause 11.2.1 states:

> … insulating fittings shall be installed in all metal pipe, whether gas carrying or containing a PE liner, capable of providing electrical continuity between earth and the above ground pipework.

Clause 11.2.2 states:

> Insulation fittings shall be installed in accessible location as close to the pipes entry into the building or, in the case of external pipework, as close as possible to the pipes exit to the ground and upstream of any ECV. The uninsulated section of the exposed pipe shall be as short as possible.

BS 7671:2008+A3:2015 published by BSI and IET

Regulation 544.1.2 states the main protective bonding connection to any gas, water or other service shall be made as near as practicable to the point of entry of that service into the premises. Where there is an insulating section or insert at that point, or there is a meter, the connection shall be made to the consumer's hard metal pipework and before any branch pipework. Where practicable the connection shall be made within 600 mm of the meter outlet union or at the point of entry to the building if the meter is external.

Conclusion

To summarise, the two main reasons for insulating inserts/insulation joints in metallic pipework are to prevent corrosion and to prevent pipes being used as a path for fault current. Also, the main protective bonding requirements in BS 7671:2008+A3:2015 are understood to be written on the expectation that insulating inserts /insulation joints are installed in metallic service pipework.

It is important to be aware that this article only gives a brief overview of the issue of insulation inserts.

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Electrical Safety Management: video and book giveaway

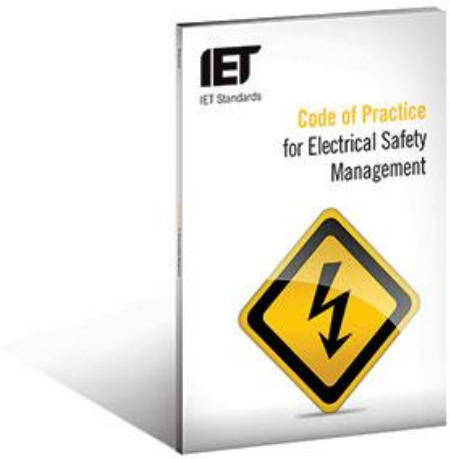
In the Autumn 2015 issue of Wiring Matters we published an article on electrical safety management (ESM). The need to understand ESM is motivated by the very significant penalties and consequences that might arise if you *don't* understand ESM.

My colleagues in Standards have put together an excellent video about ESM. The video is a great tool for presenting to Human Resource departments or to owners of small businesses, who may not realise the risks of not following good practice.

For more information, the *Code of Practice for Electrical Safety Management* is available to purchase for £130.00 (member price £84.50).

Book giveaway

Have you worked with clients who have terrible electrical safety management? Have you witnessed any horror stories? We'd love to hear from you. We're happy for you to keep all client-related information anonymous. Please submit your stories to wiringmatters@theiet.org. One name will be randomly drawn from a hat and will receive a free copy of the *Code of Practice for Electrical Safety Management*.



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Video resources for LV and ELV d.c. power distribution

After the success of the Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings*, we ran a series of events on the subject of LV and ELV d.c. power distribution. Videos from these events are available on an IET.tv subscription only, however, Wiring Matters has collaborated with IET.tv to make one video from each event free to view.*

The need for LV and ELV d.c. power distribution is growing to support, for example:

- solar PV installations and energy storage;
- energy efficient installations (particularly given that a new section on energy efficiency will be included in the 18th Edition of the Wiring Regulations);
- the rise in popularity of d.c. power distribution networks in buildings, such as for lighting installations;
- technological breakthroughs that make it easier to transmit d.c. over long distances; and
- to allow for the ever growing consumption of more and more products and equipment that require d.c. to operate.

Blane Judd discusses the growing significance of low and extra low voltage d.c. power distribution in buildings in the Summer 2015 issue of Wiring Matters.

Videos

The videos now available are:

The case for DC: a vision of the future, filmed at the Low Voltage Direct Current 2015 event.

Case Study: Sola Bristol (an LCNF Project). Revealing the Challenges of Integrating DC Energy Storage Systems in the Home, filmed at the KTN and IET Forum: Direct-Current Energy Systems – Landscape and Opportunities event.

Keynote: Importance of HVDC for future energy supply, filmed at ACDC 2015.

Further work

The IET is undertaking a lot of work in this area. Please keep an eye on the Built Environment Sector team page.

ACDC 2017 will take place in Manchester – visit the event page for more details.

The *Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings* is available to purchase for £65.00 or £42.25 member price.