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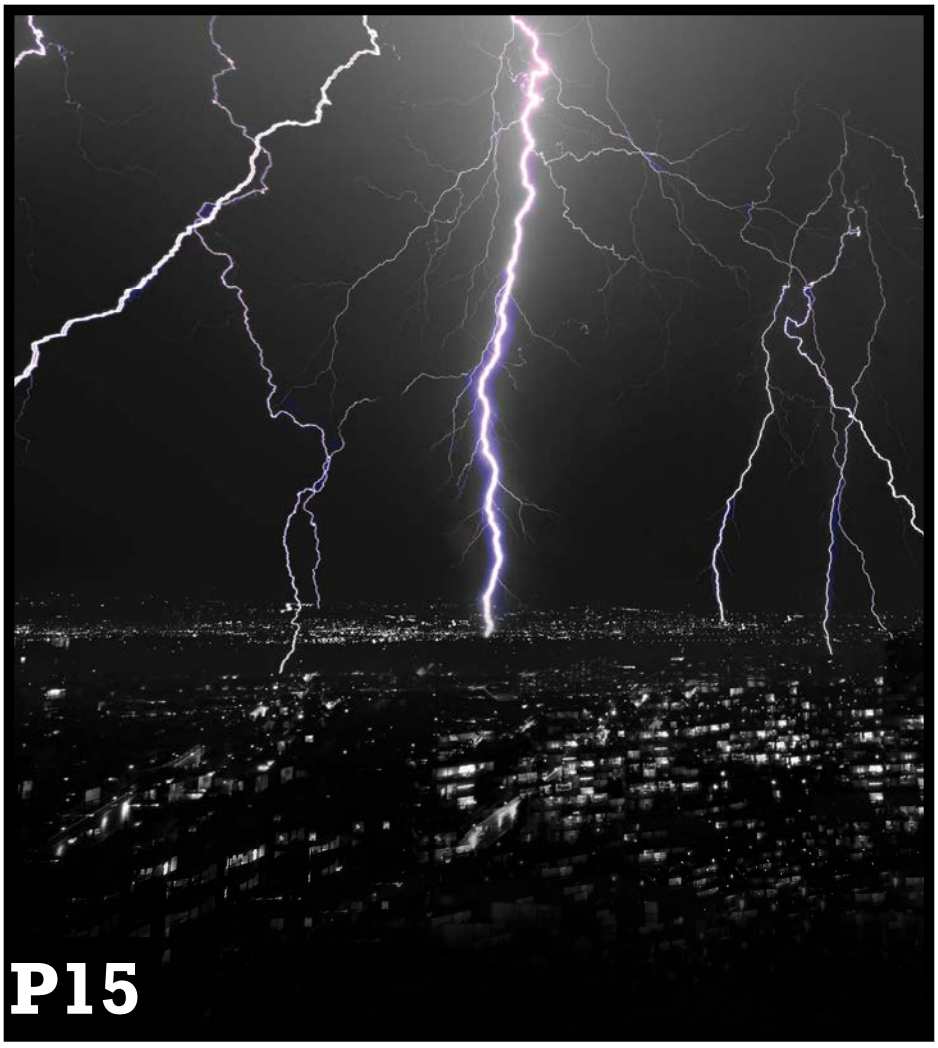

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YOUR**LETTERS**

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SOCKET PROTECTORS

It is good to see John Madden calling for a British Standard for socket covers (letter in issue 45 of *Wiring Matters*; see also www.shocked.org.uk). Regulation is also the subject of an e-petition started by Trevor Ord and supported by FatallyFlawed.

Mr Madden raises a number of issues deserving further examination. He refers to the evidence he gave to the Fatal Accident Inquiry into the tragic death of Liam Boyle, killed as a result of having access to a cable with exposed conductors. The Sheriff's determination in this case is online in the public domain, and is worth studying.

The idea that plug-in socket covers reliably prevent children from plugging in dangerous appliances is not based on research or fact, but on wishful thinking. A BS 1363 plug is secured in a socket solely by force exerted on the pins by the socket contacts. The only way that a cover can legitimately be made difficult to remove is to ensure that it is impossible to grip it and that there is no gap between cover and socket face. The shape of the cover must ensure that any finger pressure results in a force which pushes the cover into the socket, with removal only possible with a tool.

In practice there are no covers available meeting these criteria, and none that conform to BS 1363 plug dimensions. A common fault is to have pins shorter than the specified length; this tends to cause the 'pop out' effect which makes covers very easy to remove. One YouTube video depicts an 11-month old child removing a cover in two seconds.

Evidence showed that Liam (22 months) was adept at removing and inserting plugs. The important message is that dangerous items must be kept beyond the reach of children, promoting the use of socket covers to prevent plugging them in is an ineffective and a misguided distraction.

The only 'reasonable precautions' which form part of the determination were that "the cable and plug be kept in a place where Liam could not get at them…" and that "once that work had been completed, they be removed…", the Sheriff having rejected the socket-cover suggestion because there was no supporting evidence. Mr Madden's photograph of the cable shows that the plug was a conventional rewirable type. Had it been removed from the cable before the cable was disconnected from the appliance Liam would not have been killed. If the plug had been a non-rewirable type, then it could have been made safe by removing the fuse, using pliers to twist the power pins to prevent further insertion, and then cutting it cleanly from the cable (as shown in the picture) before disconnecting the cable. Removal of the plug before disconnecting the cable was the most important precaution which should have been suggested to the Inquiry, but the Sheriff's determination makes no reference to it, indicating that it was not raised.

David Peacock FIET
Co-founder, FatallyFlawed

Removing the fuse from a discarded non-rewirable plug could save a life

BsEST Practice

After reading Geraldine O'Farrell's article on heritage buildings in the November issue, I felt I just had to share my experience of a visit to St Peter's Basilica in the Vatican. We were some of the first visitors through security, nice and early before the crowds. As I walked in the door I could hear what sounded suspiciously like lump hammer upon bolster. I followed the sound, and, to my amazement, found an Italian electrician bashing away enthusiastically, chasing an inch-wide slot in one of the huge marbled pillars. It was to hide a speaker cable. The memory still brings a smile to my face – rather him than me!

Nigel Redding

PME Supplies

While obviously agreeing with the points raised and the information in Mark Coles' article in the November issue, I would raise a further important subject. The author describes the effects of open-circuit PEN/CEN conductors but fails to mention the effects of high resistances in these conductors – especially the failure or malfunction of higher-current equipment due to volts drop across the high resistance.

I have experienced several such situations in my career. At one property, for example, the microwave stopped when the electric shower was energised as the supply volts dropping to 116V! In every instance the cause lay with corroded or inadequate connection on the overhead system in close proximity to the property.

I refuse to use PME on overhead supplies and would urge my colleagues to take note of this phenomenon (particularly in rural situations).

John Braddy

LEDs

In his otherwise interesting article on LEDs (issue 45) Ben Papé says, on p24, "Any visitor to a local supermarket will see that 100W equivalent (1200lm output) domestic LED lamps retail at £20 to £30…"

I beg to differ. My local supermarkets have no LED GLS replacements. Homebase has a bigger selection of lamps, but all they offer is a 6W, with a lumen output of 337, much less than a 40W GLS. The price is £5.99.

Online I see that the highest light output LED GLS replacement currently available from the big manufacturers is 1055lm (14.5W). Available from some online suppliers, but at £43.49. They are longer by 11mm than the GLS lamp so may not suit all shades.

A 100W GLS has an initial light output of 1320lm, so an alternative offering 1200lm is not as good. In fact the EC Regulation (244-2009) which led to the ban on sales of incandescent lamps also has requirements regarding claims for equivalence of the alternatives. In order to claim equivalence with a 100W incandescent lamp an LED must produce 1521lm and a compact fluorescent lamp (CFL) 1398lm. For this reason a 20W CFL giving 1200lm which used to claim 100W equivalence now only claims 85W.

Ray Burgin

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IET launches new career-boosting initiative

Young professionals networking at the IEC Seattle standards workshop

THE IET IS hosting a free one-day workshop designed to show how individuals and companies can profit from helping to create and improve standards. Attendees will be given examples of how standards can increase competitive advantage, facilitate product development, benefit technical and professional interactions and aid development. The workshop will be held in London on 21 March.

The IET is committed to the principle that standards are indispensable – promoting improved quality of life and contributing to safety and human health. With world electricity consumption predicted to double between now and 2030, electricity production will also need to dramatically expand, and energy efficiency will become even more important. International standards can help increase electrical energy efficiency, helping to reduce the threat from climate change.

Unfortunately, demographic trends in the developed world suggest a decline in the number of people involved in electrotechnology and standardisation work. In the future, the percentage of the total population making up the workforce will be significantly lower. For example, the chief executive of Iberdrola, the Spanish energy group that owns ScottishPower, has said that 80 per cent of ScottishPower's engineers are due to retire over the next 15 years, and that this was typical across the UK power industry.

This growing problem has prompted the International Technical Committee (IEC) to establish the Young Professionals Programme designed to encourage the younger generation of experts and leaders to participate in standardisation and conformity assessment activities. A key feature of this programme is a series of annual three-day workshops. The IET is fully supportive of this IEC initiative. It has helped fund young professionals to attend workshops in Seattle, Melbourne and Oslo, and, working with BEC, BSI, BEAMA and GAMBICA, created a one-day standards workshop for young professionals in Birmingham last year.

The London workshop will provide an opportunity for all professionals to learn how standards can boost their careers and give their company a competitive advantage. One exciting feature will be the selection of two candidates to attend the next IEC workshop in New Delhi.

IET member Peter Ridge, who went to the IEC workshop in Seattle, described it as a "wonderful experience". He found the organisation "warm and welcoming and very excited about the new Young Professionals Programme".

Further information on the London workshop: www.theiet.org/ispw

New Qualified Supervisor requirements

The Electrotechnical Assessment Specification Management Committee (EAS) has agreed the implementation of the new Level 3 Qualified Supervisors technical competence requirements to take effect from 6 April 2013. There are a variety of routes to registration as a qualified supervisor, including on-site and off-site assessment and through gaining appropriate qualifications.

The new requirement will not apply retrospectively to existing qualified supervisors who already have a competency-based qualification. However, they do apply to proposed qualified supervisors applying after 5 April 2013. Persons who have been working as registered qualified supervisors within the two years preceding 6 April 2013 will be eligible to be proposed as a qualified supervisor for a new employer without needing to demonstrate the new level of technical competence.

For those choosing the qualification route to the new Level 3 qualification, a certificate in 'Installing, Testing and Ensuring Compliance of Electrical Installations in Dwellings' is available. This will be the minimum qualification level for qualified supervisors responsible for electrical work in domestic properties subject to Part P of the Building Regulations (England and Wales).

For compliance with Building Regulations in Scotland, Approved Certifiers of Construction for electrical installations must be eligible to be graded as Approved Electricians and be suitably qualified, e.g. SVQ Level 3 in electrical engineering or equivalent.

For work in commercial or industrial premises, the minimum qualification requirement for Qualified Supervisors will be the new Level 3 NVQ 'Diploma in Installing Electrotechnical Systems and Equipment (Building and Structures)'.

A call to authors

Wiring Matters welcomes contributions from anyone involved in electrical installation and safety. If you have something to say that could be of value to your fellow professionals, then why not turn it into an article? Along with article we'd welcome opinion pieces – our 'guest editorial' - of around 700 words. If you have any ideas you'd like to discuss, please contact the editor at wiringmatters.editor@theiet.org

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FAKE ELECTRICAL GOODS: THE BATTLE FOR REPUTATION

The rampant trade in counterfeit electrical products shows no sign of stopping but can industry slow the flow of fakes from East to West? By Rebecca Pool

IF YOU PRESUMED the trade in counterfeit goods was dominated by Rolex watches, Nike trainers and Louis Vuitton handbags, think again. The copying of electrical products, from circuit breakers to cables, is big business. It is estimated that some £30m worth of counterfeit equipment enters the UK market every year.

According to BEAMA (British Electrotechnical and Allied Manufacturers Association) at least 10 per cent of electrical goods traded worldwide are fake. This global market is currently valued at around €2.4bn, and 90 per cent of replica goods come from China.

"The problem is huge," says BEAMA Policy Committee chair Malcolm Mullins, from Honeywell MK Electric. "I've been on BEAMA raids to China, and on occasion we're finding 100,000 counterfeit products at any one time. For some of my competitors we've found a quarter of a million products ready to go."

For the counterfeiter, just about any electrical product is ripe for exploitation, with widely-copied electrical products including adapters, plugs, chargers, sockets, circuit-protection devices, residual current devices and miniature circuit-breakers, as well as moulded-case circuit-breakers. Keith Smith, deputy director, BEAMA Installation Sector, highlights the fact that these products are prolifically copied, as the many end markets are spread far and wide.

"Many of these are global or IEC standard products," he says. "Very attractive markets include BS1363 plug and socket applications, but there's also a massive market for former British Standard sockets in the Middle East, Africa and certain parts of the Far East."

Beyond the products

It is not just the products that are being counterfeited. Certification copying is rife, with counterfeiters more than willing to provide a potential buyer with documentation 'proving' the safety of a device.

"I can go to any trade fair in any country in the world, and ask for any brand of electrical product, and [a supplier] could ask me what sort of documentation I need," asserts Mullins. "It could be certification from [US safety organisations] Underwriters Laboratories or Aston Global, whatever. They'll counterfeit it and provide it with the products, which is pretty outrageous."

This is where the business of counterfeiting electrical goods clearly differs from counterfeiting watches and footwear. Counterfeiters aim to fool a buyer that his or her circuit breaker or socket-outlet is safe and manufactured

Poster promoting Counterfeit Kills – an initiative of Voltimum and BEAMA

Companies concerned over their reputation for quality goods face a constant battle to keep potentially dangerous counterfeits off the market

by a reputable company, when the simple truth is, it is not. A typical copy does not comply with British, European or US safety legislation and can cause electrocution or explosion and fire when installed and used.

In 2007, a seven-year-old boy was fatally electrocuted by a fake Nintendo Game Boy charger his family had bought in Thailand. Later examination of the charger showed that the gap between the primary and secondary circuits was only 1mm instead of the 4.6mm demanded by EU standards, meaning the touchable charging pins of the device could become live.

The tragic accident prompted a UK Trading Standards Institute investigation that led to a Europe-wide recall of dangerous chargers and adapters, but six years on sub-standard and counterfeit chargers are still on sale. According to UK-based Plugsafe, a voluntary group of electrical engineers, a number of major retailers are currently selling chargers that are illegal in the UK.

Dr Michael Grant, senior electrical engineer at South Africa-based CBI-Electric, highlights the fact that counterfeit goods may look the same, but they don't perform in the same way.

"The reproduction [of our circuit-breakers] is visually similar, but there is no quality reproduction whatsoever," he says. "The counterfeit versions... offer no form of safety at all, and pose a direct risk to the installation."

Indeed, when tested against IEC 60947 standards for low voltage switchgear and control-gear, the counterfeit devices fail dismally. "The South African government, through its Department of Trade and Industry conducted raids, seized counterfeit goods, and tested them in a laboratory. Even under normal load-conditions the counterfeit products have ignited and started to burn," adds Grant.

Analysis has revealed counterfeit circuit-breakers are typically manufactured with cheaper substitute materials. For example, steel is used instead of copper while plastic components do not contain the necessary flame retardants and degassing additives to prevent fires.

US-based electrical components manufacturer Eaton has experienced similar problems. "I've seen [copies] that are absolutely stupid," says Dr Ulrich Spindler, Head of Coordination of Associations at Eaton. "We saw a breaker that was more or less empty, guaranteeing no safety at all."

Likewise, Mullins describes miniature circuit-breakers manufactured without arc splitters and switches sold as circuit-breakers. "People rely on weight to check the authenticity of a product so counterfeiters put a lump of metal inside," he adds. "That's not going to do anything to enhance its performance."

Clearly safety is the top priority, but copying components also does very little for the profits and reputation of companies involved. According to Mullins, Honeywell can't make its own devices at counterfeit prices, while Grant asserts copied goods sell at less than his company's raw-material costs.

"We all rely on our brand names, but counterfeiting destroys this trust," adds Spindler.

Small-scale operations

Without a doubt, counterfeit activities are already widespread, so how does it happen? Grant from CBI-Electric says his company only recently became aware of counterfeit goods, but suspects that local opportunists take products to the East and then find a factory willing to reproduce them.

Wenzhou City, China, is one such likely destination for the budding counterfeiter. Spanning an area the size of Wales, this industrial estate is described by both Mullins and Smith as 'electric city' and comprises hundreds of operations ranging from multi-storey factories to 'back-alley' operations employing only a few staff.

"Some are legitimate outsourcing operations for *bona fide*, well-known brands, but a lot are counterfeit operations, many of which are unlicensed," explains Smith.

Surely Chinese authorities keep a check on such activities? Well, apparently, local authorities and law enforcement bodies, worried about revenue loss from unlicensed operations, are very cooperative with worried companies. However, actions from senior government are not always effective.

"Senior Chinese government officials have told us about changes in law," says Smith. "I'm sure they implement these [regulations] in Beijing but by the time you get to Wenzhou, these directives are either not heard or ignored."

Like Smith, Mullins asserts that local authorities in China act quickly. His team works with China's Technology and Science Bureau (TSB), set up to police product quality, standards and IPR protection. The bureau is able to seize suspect goods, impose fines and pass equipment on to China's Municipal Government Special Department for destruction.

"If you go to the TSB and say there is a factory down the road making counterfeit products... they'll be raiding it within an hour and a half," he says.

But as he adds, government politicians are motivated to create jobs, which can be at odds with closing counterfeit operations. "At the bottom they say, you've got a problem we'll sort >

Chinese authorities are quick off the mark to stamp out suspected fakers – but companies are still wary

it out but at the top, they won't necessarily care about counterfeiting."

Eaton's Spindler also harbours doubts over some actions taken by Chinese authorities. As he explains, his company's products are CCC marked with the China Compulsory Certification, as required for many electrical products domestically manufactured or imported into China. Certification involves product testing and a factory audit, carried out by Chinese authorities.

"By miracle, a short time later, we find copies of these products on the market, [manufactured] by Chinese companies," he says. "I don't know if they [the counterfeiters] pay for this or just have personal links, but it's obviously the kind of channel that is open to counterfeiting."

Beyond China

Although China appears to lead the way on counterfeit trade, similar activities take place around the world. The United Arab Emirates has been described as a major trafficking route for products produced in China with Iraq and Nigeria seen as hot-spots for counterfeit activities.

"Iraq is rebuilding its entire country so a massive end-market exists for counterfeit products," says Smith. "And Nigeria is just such an open and corrupt market, it really doesn't matter what you do, but we still gather intelligence that could lead us back to another Chinese factory."

Ironically, Smith also believes the trade of counterfeit electrical goods has gathered pace in recent years alongside the implementation of worldwide standards. Take IEC 60898: any circuit-breaker meeting, or claiming to meet, this global over-current protection standard for household and similar installations can now be sold anywhere.

But as Smith also points out, UK manufacturers may have also fuelled the fire by transferring production to low-cost manufacturing bases. "Well over 90 per cent of counterfeit products come out of China, and of course, this is the country we outsourced low-cost manufacturing to," he says.

Depressingly, as the worldwide network of counterfeit electrical products grows, so does the ingenuity of the counterfeiters. The latest evolution among China-based counterfeiters is to leave products unbranded until they reach the distributor.

The patents of many major equipment manufacturers expired some years ago, so as Smith explains, an identical product no longer infringes intellectual property if left unbranded. And so the counterfeit businesses will now ship unbranded products to the distributor while sending its labels, or printing equipment, via a different route.

"This means if we're taking actions by raiding factories, we've now literally got to be at the distributors to catch the product as a counterfeit," he explains.

Smith has also seen electrical goods with lookalike labelling intended to fool the contractor into thinking he or she is purchasing a well-known brand. As one example, he cites how Chinese authorities have permitted the name

BRITISH STANDARDS

THE CABLE PROBLEM

Set up in 2010, the Approved Cable Initiative (ACI) has discovered myriad counterfeit and defective electric and data cables, from armoured cables and house wiring to Arctic grade flex and fire-performance cables. But while the organisation has major concerns over counterfeiting, it believes a bigger issue in the cable supply chain is the manufacture of cable products that do not meet specified British Standards, don't carry independent third-party approval and are unmarked.

According to Peter Smeeth, ACI director, most problems encountered by ACI in defective electric cables relate to some manufacturers reducing copper content – sometimes by as much as 50 per cent – to counter rising copper costs.

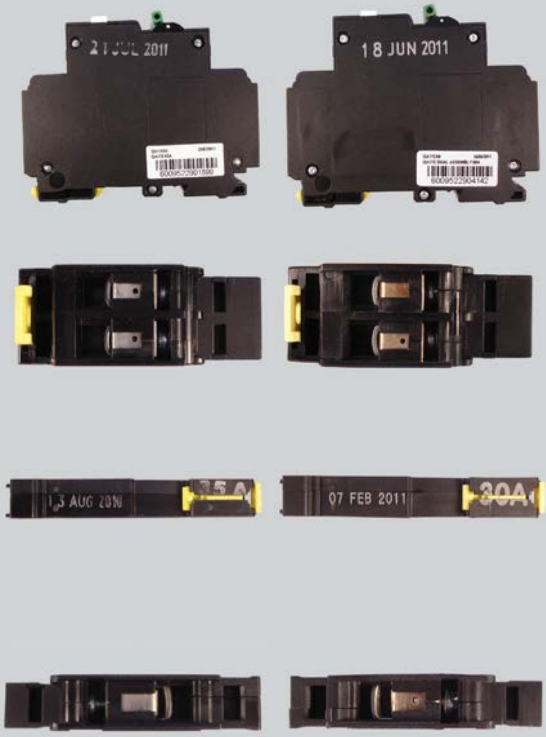
The organisation is currently lobbying government to make minor amendments to planning and building regulations, to eliminate the threat of unsafe cable in Britain. "We believe that Britain is the main focus for distributors of substandard electric cables as the nation has few regulations to stop the importer," says Smeeth. "Our lack of effective safety regulation on cable installations makes this a profitable market for those cable distributors."

He adds that many of the problems the ACI has dealt with involve cables manufactured in Turkey, China and India.

Middle Eastern countries place a high value on British standards, and fakes like these being crushed in Dubai are very damaging

VISUAL CHECK

CAN YOU SPOT THE FAKE?



The residual current device has been subject to 100 per cent quality inspection, with the date stamp applied by hand. The fake device has a machine-applied date stamp.

The residual current device has locating holes on both terminals. On the fake device only one terminal has a locating hole.

The authentic circuit-breaker has been subject to 100% quality inspection, with the date stamp applied by hand. The fake device has a machine-applied date stamp.

The authentic circuit-breaker doesn't have a hole in the terminal; the fake device does.

The fakes are all on the right-hand side.

IVIK to be registered, which resembles the branding of UK-based electrical wiring accessories business MK Electric.

"Look at this about a foot away from your face and you'll see that is comes across very neatly as MK," he says. "If you take an unmarked product and brand it, that product now has a totally different price."

And as he adds: "[Some counterfeiters] then go a step further and add 'Made in the UK'; Saudi Arabia and Qatar are very good export markets for British Standards products, and place a very high value on British products."

Fighting back

So what exactly can be done to stem such widespread, and often coordinated, counterfeiting? As part of its Anti-Counterfeiting Working Group, BEAMA is already taking strong actions having established operations in China, Tanzania, Nigeria, Ghana, Kuwait, Jordon, United Arab Emirates, North-East Africa and the UK – operating under the apt title 'Electric Bulldog'.

The organisation employs myriad investigators, worldwide, that know where the end-markets for counterfeit goods are and gather intelligence on illegal operations. They pass information to border agencies and law enforcement bodies, which typically invite them on warehouse raids to seize the infringing intellectual property, be it the products, packaging or tooling. These copied goods are publicly destroyed with notices issued to the owners of the counterfeit operations.

"In 12 years we've raided more than 500 factories, and seized and destroyed well over 15 million products," says Smith. "We have over 2,000 entries – be it a sighting or tip-off of counterfeiting activity – on our suspect-and-raided database, which we share with law authorities, Interpol and local trading standards."

Customer awareness is also crucial to preventing counterfeit product trading. Many companies are taking action to educate customers on counterfeit products, fraudulent certification marks as well as associated dangers and efforts underway to beat counterfeiters.

Eaton for one holds regular anti-counterfeiting 'webinars' that include, for example, information on its product packaging and labelling. The company has also been vigilant in embedding its intellectual property into its products. Typical techniques taken by any company may include moulding registered trade names or etching part numbers into a product. Codes or even dot-matrix barcodes can also be applied to products.

Meanwhile CBI-Electric recently issued a 'public announcement' poster with the headline "imitation isn't flattery, it's murder". Annotated photos in the poster educate consumers how to spot a counterfeit product and as Grant says: "It's been in the market for just over a month and we've had excellent feedback."

But as Mullins asserts, electrical contractors also have a key role to play in preventing counterfeit trade. "One big problem is that some contractors – around 20 per cent – will not accept that these products are unsafe," he says. "They look at the price, which for say miniature circuit-breakers is a fraction of the cost, and that's what they go for."

With contractors liable for the consequential losses caused by the failure of installed counterfeit products, Grant cautions his customers to buy from authorised distribution networks, and to contact the manufacturer to verify the authenticity of a distributor if unsure.

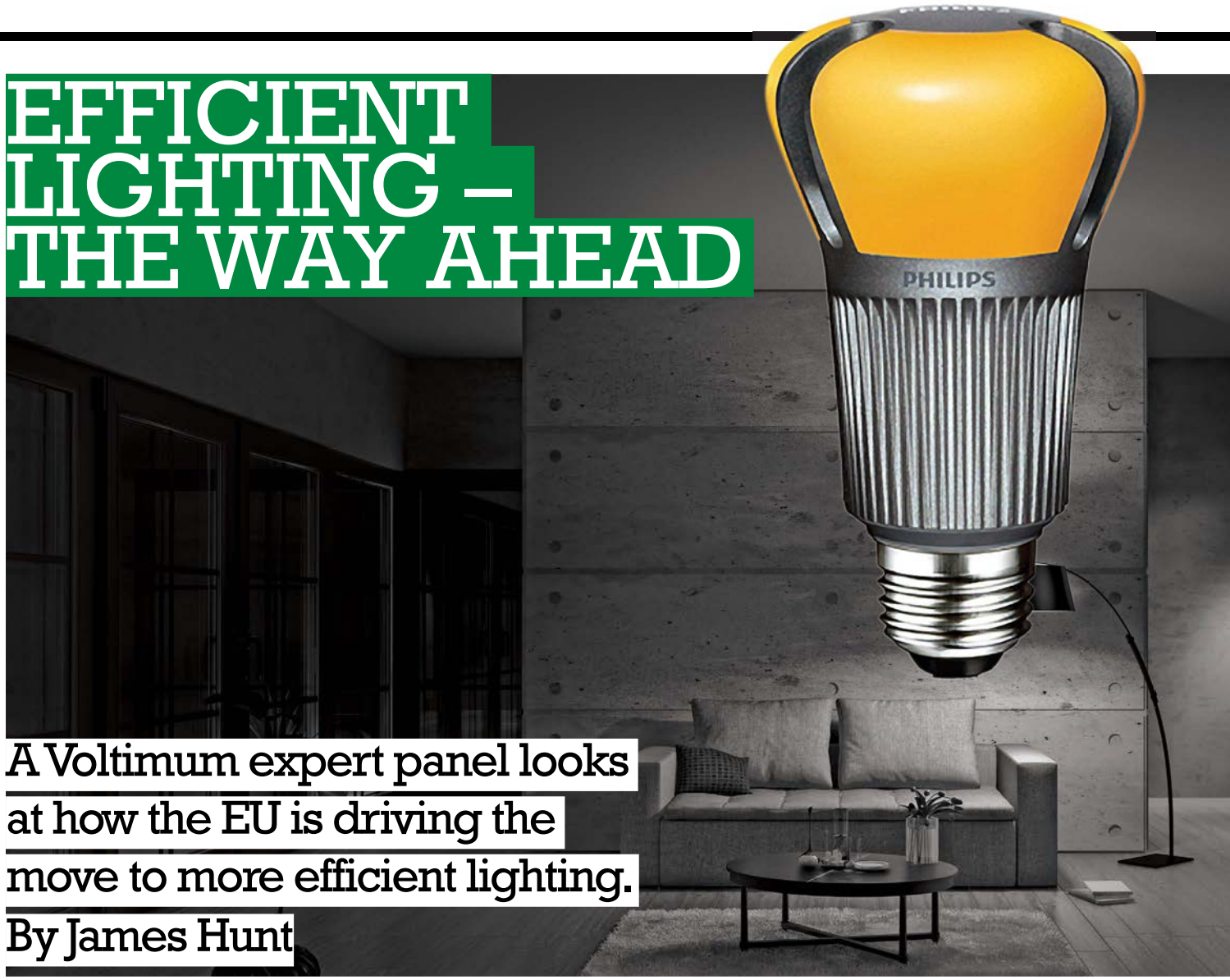
"Some prices are too good to be true; there's clearly guilty knowledge on behalf of the contractor when [he or she] undertakes the purchase," he adds.

And results are emerging. According to Mullins, while once he went to trade fairs and saw counterfeit brands displayed everywhere, now he doesn't see them at all. "Although if you pretend you want to buy [a counterfeit], some will still reach under a cupboard and pull something out," he says.

Indeed, as Smith highlights, thanks to surveillance at European borders, the European Community is 'fairly well' protected against counterfeit products in this particular field. But given the sheer scale of worldwide operations, it's doubtful that counterfeiting will ever be completely stopped.

"We are always coming up with new technical procedures to protect ourselves, but counterfeiting technology also improves," concludes Spindler. "This is a permanent chase, but we will never give up."

EFFICIENT LIGHTING – THE WAY AHEAD



A Voltimum expert panel looks at how the EU is driving the move to more efficient lighting. By James Hunt

ARGUABLY the most important outcome of the European Union's drive for CO_2 emission reductions and greater energy efficiency is the phasing out of inefficient lamps. This began in late 2009 under Eco-Design Regulation 244/2009 first stage (often called 'DIM 1') with the restriction on the sale of all 100W+ GLS, frosted incandescent and non–clear halogen lamps.

Clear halogen lamps Class D&E were to be phased out by September 2012. This process will continue year by year. For example, Class C lamps should be phased out by 2016. Next to be phased out under the second stage of the Eco-Design Regulation ('DIM 2'), are the least efficient directional halogen lamps, such as the MR16 type.

It has been calculated that when completed, the change to more energy efficient lamps should reduce domestic lighting energy consumption across the EU by 30 per cent, equivalent to cutting a massive 23 million tonnes of CO_2 emissions every year.

The Voltimum 'Expert Panel on Lighting' (see www.voltimum.co.uk/lighting for more) is made up of industry specialists, publishes the very latest UK lighting regulatory and technical information, and answers queries. This article, based on content provided by panel members for the January 2013 edition of *VoltiTECH,* Voltimum's e-newsletter, focuses mainly on DIM 2, which will restrict the sale of directional light sources, and continue the phasing out of inefficient lamps, starting with the worst performing in September 2013.

Lighting and CO_2 emission

Lighting offers one of the biggest opportunities to save energy, while reducing costs and emissions, as it has been calculated to account for up to 40 per cent of a building's total energy consumption. The EU has pledged to cut its energy consumption by 20 per cent, compared with projected levels, by 2020. Around 60 per cent of European lighting installations are still inefficient and 75 per cent of office and industrial installations are still fitted with conventional luminaires. The energy consumption of the least efficient lighting (the now-banned incandescent) is roughly five times greater for the same amount of light as the best – the compact fluorescent lamp and the latest LEDs. Getting rid of incandescent lamps is therefore making a significant contribution towards meeting CO_2 emission targets and reducing dependency on increasingly expensive fossil fuels.

Making lighting more energy efficient is a crucial

Offering a host of benefits, LED lamps have a bright future

component of the fight against increasingly severe climate change, and the aim of the staged phase-out is to force greater use of better alternatives, of which there are now several. Go to www.voltimum.co.uk/VoltiBulletin9_10_0 for more details on the phase-out programme, the timelines, the types of lamps affected and their more efficient replacements.

Eco-Design for lighting

In the UK there is a legal national requirement to reduce CO_2 emissions by 80 per cent (based upon 1990 levels) by 2050. A proposed interim target of a 60 per cent reduction by 2030 is designed to encourage the realisation of this ultimate goal. These national targets have led to studies under Defra's Market Transformation Programme (MTP), which supports UK government policy on sustainable products and covers all products that fall under the EuP Directive (Eco-Design Requirements for Energy-Using Products, 2005/32/EC). This directive is an integral part of the EU's climate protection programme, and sets minimum environmental performance standards across the EU for Energy Related Products (ErP), required to reduce their environmental impact, including lamps.

DIM 1, DIM 2 and TIM 1

DIM 1, DIM 2 and TIM 1 are unofficial but widely used acronyms for Eco-Design regulations applied to lighting.

DIM 1 – or the first stage of ErP Directive, Regulation EC 244/2009, defines requirements relating to the Eco-Design of non-directional household lamps. It covers the technologies typically used in domestic sector incandescent lamps (now mostly phased out), halogen lamps, compact fluorescent lamps (CFLs) and LED retrofits having integrated control gear. It basically does what it says on the tin, covering non-directional light sources – household lamps.

DIM 2 was published in December 2012, and is the follow-on to DIM 1. It covers directional light sources, including LEDs, and it seeks to phase out inefficient lamps, including conventional low-voltage halogen lamps, starting with the worst performing in September 2013. The proposals include both domestic and commercial luminaires, again setting minimum energy performance requirements, but they are more complex. A full review of the legislation's effects will take place in 2015.

TIM 1 – By contrast, Regulation 245/2009 (Tertiary Implementing Measures) covers non-domestic (professional) lamps, ballasts/control gear, fixtures and controls, and is product-related and application independent. The products include those used in offices, public buildings, schools, factories, warehouses, workshops, laboratories, shops, restaurants and streets. The target is to save 20 million tonnes of CO_2 a year.

Go to www.voltimum.co.uk/voltiTech_04_09 for more details on TIM 1.

Directional lamps phase-out under DIM 2

Regulation DIM 2 has now been published. The industry and individual manufacturers are working with the EU to understand the regulations more fully, and to identify the specific products affected. However, DIM 2 clearly sets minimum performance standards for directional reflector lamps (such as MR16s) including tungsten, tungsten halogen and compact fluorescent reflector types. In addition, tungsten reflector lamps, older, less efficient LEDs and halogen lighting converters will be restricted from sale in EU markets.

The minimum performance standards apply to all types of directional lamps, covering efficacy, colour ▶

Philips Lighting's LED expertise provides a changing palette of colour for Brazil's João Alves bridge

rendering and product lifetimes. Note that no lamp type is explicitly banned, but each will have to comply with the minimum performance standards or be phased out through market restriction. Therefore, manufacturers can continue to offer the more energy-efficient lamps (for example, more modern MR16 types that are compliant).

The Lighting Industry Association (LIA) has stated that the least efficient directional lamps will be phased out from September 2013 at the earliest. Following that, other low-efficiency lamp types will be phased-out by September 2014 and 2016.

Lux magazine, which is the official publication of the LIA, has provided answers to a range of frequently-asked questions about DIM 2. Go to www.voltimum.co.uk/article19130 to view these.

Alternative light sources

To replace phased-out lamps, homeowners, along with building facilities managers, will have the choice between compact fluorescent lamps (CFLs), which use up to 75 per cent less energy than conventional light bulbs, and also the latest very efficient halogen lamps, which use between 25 per cent and 50 per cent less energy depending upon the exact type.

They also now have an increasingly important choice in the form of LED lamps. These provide a wide range of benefits, including very long lives (leading to lower total cost of ownership), a year-on-year improvement in luminous efficacy that is now comparable with CFLs, and significant energy savings in many applications. However, LED lighting, which still has a relatively high initial cost, is only just starting to make inroads into homes, though the same is not true of public, retail, commercial and industrial buildings where LED lighting is being taken up in a big way.

The Green Deal

The UK government's Green Deal initiative, announced in January 2013, is designed to help householders and businesses increase the energy efficiency of properties across the UK and reduce their carbon emissions. The idea is that there are no up-front costs; energy-saving measures are funded via loans from the private companies, with the costs repaid over a 25-year period as an additional charge on energy bills.

The Green Deal is also intended to help the sustainable economy by enabling 'green' product introduction right through to installation for domestic, non-domestic and public buildings. Moreover, it is a fundamental part of the Energy Company Obligation (ECO), which now addresses energy efficiency funding in the domestic sector. Under the ECO, supplier subsidy and Green Deal finance work together. The Green Deal is expected to have a significant effect on lighting. Indeed, Philips Lighting says that Green Deal/ECO financing is a crucial element, and that it would be impossible to optimise the Green Deal for homes without including lighting.

John L Gorse, technical marketing manager at Philips, has provided a PowerPoint presentation that summarises the Green Deal in terms of lighting. This was shown initially on the first day of the LuxLive 2012 lighting exhibition last November. Go to www.voltimum.co.uk/article19135 to view it.

And finally...

The growing importance of LED lighting has already been mentioned. The technology has been spoken about for a decade or more, but only recently has it begun to have the kind of positive impact on general lighting that so many have long forecast. Although development is rapid, it has taken some time for LEDs to become truly economically viable. Now, though, the technology is beginning to deliver equivalent acceptable colour rendering, which matches that of the incandescent lamps it is intended to replace, as well as offering high energy efficiency and an extremely long working life, plus many other important benefits.

Key to the adoption of LED lighting is the fact it will lead to a reduction in lighting electricity consumption of between 40 and 80 per cent. However, unlike incandescent lamps, specific types of LED need to be selected if dimming controls are to be used (as well as being a comfort control, dimming can help save more energy). Go to www.voltimum.co.uk/article19170 for a useful summary of LED dimming controls from Legrand.

James Hunt in the managing editor of the UK arm of the Voltimum electrical web portal.

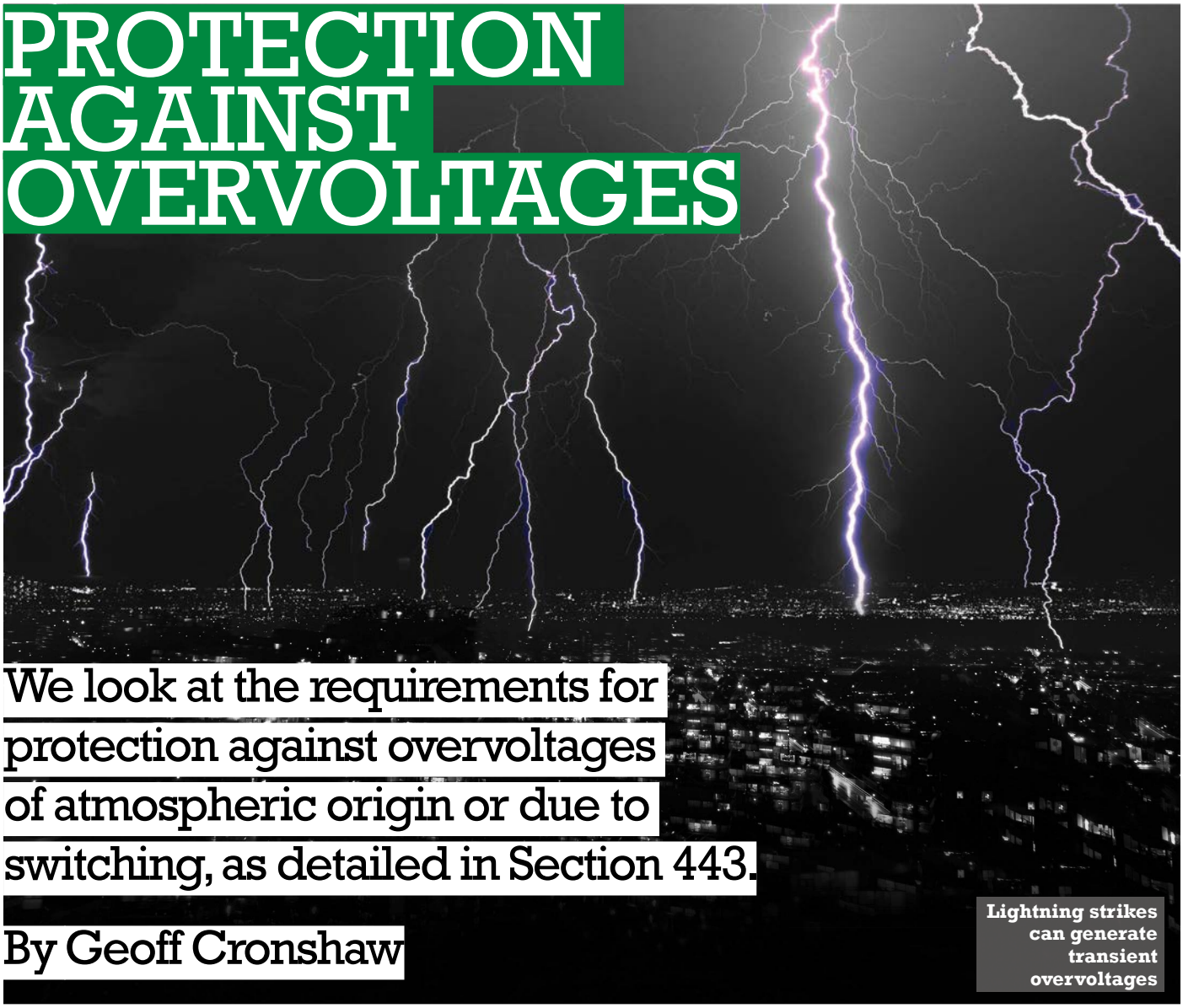
FACT BOX

VOLTIMUM

Voltimum is an electrical Web portal, which operates in a number of countries worldwide. This is a central source of information for electrical contractors and installers, panel builders, specifiers, consultants, manufacturers, trade associations and industry bodies (including the IET), and wholesale distributors. Voltimum is not a trading portal, but provides round-the-clock access to the latest industry news and events, training courses, technical information, and updates to legislation and regulations. Much rich content is provided by important industry partners, and then woven together by specialist journalists and editors. Search engine optimisation expertise ensures high visibility in Web searches, while online video news reports present information in an enjoyable way.

Voltimum's award-winning monthly e-newletter, *VoltiTECH*, started publication in June 2003, and has now run to nearly 120 editions.

PROTECTION AGAINST OVERVOLTAGES



Lightning strikes can generate transient overvoltages

We look at the requirements for protection against overvoltages of atmospheric origin or due to switching, as detailed in Section 443.

By Geoff Cronshaw

THE FIRST amendment of BS 7671:2008, which came into effect on 1 January 2012, introduced only minor changes to Section 443. This section deals with protection of electrical installations against transient overvoltages of atmospheric origin transmitted by the supply distribution system, and against switching overvoltages generated by the equipment within the installation. It does not cover overvoltages transmitted by data transmission systems.

Transient overvoltages

Both lightning strikes and electrical switching can inject what are called transient overvoltages into an installation. Transient voltages are usually only a few microseconds in duration. However, their peak value can reach 6kV.

Switching events

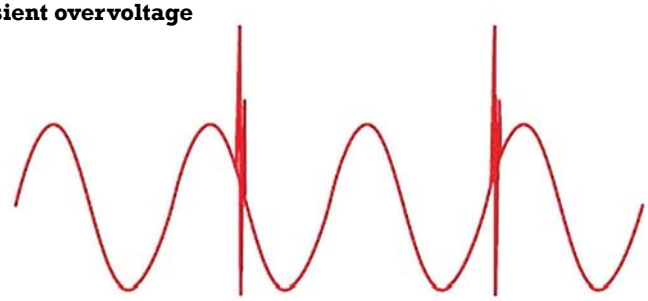
Generally, any switching operation, fault initiation or interruption in an electrical installation is followed by a transient phenomenon in which overvoltages can occur. The sudden change in the system can initiate damped oscillations with high frequencies (determined by the resonant frequencies of the network), until the system is stabilised to its new steady state.

The magnitude of the switching overvoltages depends on several parameters, such as the type of circuit, the kind of switching operation (closing, opening, restriking), the loads, and the protection device. In most cases, the maximum overvoltage is up to twice the amplitude of the system voltage, but higher values can occur, especially when switching inductive loads.

Atmospheric events

The current contained within a lightning strike varies considerably with the atmospheric conditions. However, it is understood that values of 200kA are possible. Associated with this sudden discharge of current is a magnetic field that surrounds the lightning perpendicular to the direction of travel. Lightning can impress a voltage on to a low-voltage power network in a number of different ways: resistively, inductively or capacitively. A lightning strike direct to ground, overhead lines or building protection lattice, will inject a huge amount of charge, which flows in the form of current away from the point of injection. As it passes along its routes, potential differences are created, and if the routes coincide with building structures or >

Transient overvoltage



cabling then these voltages are seen within the installation. In addition, the magnetic field associated with a lightning strike can induce a voltage in any metallic structure the magnetic flux cuts. Also, if a building is struck, it is the objective of the lightning rod and conductor tape to pass the current to ground to help protect the structure from physical damage.

However, the current flowing through the tape will generate its own magnetic field which can induce transients within the building's cabling system.

As detailed within BS EN 62305 'Protection against lightning', surges present a risk of dangerous sparking or flashover, leading to possible fire and electric shock hazards. Surges also present risk of disruption, degradation and damage to electrical and electronic equipment leading to costly system downtime.

Current requirements of Section 443

Regulation 443.2.1 makes it clear that, where an installation is supplied by a low-voltage system containing no overhead lines, no additional protection against overvoltage of atmospheric origin is necessary if the impulse withstand voltage of equipment is in accordance with Table 44.3.

Regulation 443.2.2 deals with the case where an installation is supplied by a low-voltage network which includes an overhead line and the condition of external influences AQ1 (fewer than 25 thunderstorm days per year) exists. No additional protection against overvoltages of atmospheric origin is required if the impulse withstand voltage of equipment is in accordance with Table 44.3 (see table below and on facing page).

Where protection against overvoltages is by the use of SPDs they should be selected and erected in accordance with Section 534 of BS 7671.

The term 'AQ' simply refers to the external influence by a possible lightning strike. Overvoltages of atmospheric origin are categorised within Appendix 5 of BS 7671 as:

- **AQ1 – Negligible (less than or equal to 25 thunderstorm days per year)**
- **AQ2 – Indirect exposure (more than 25 thunderstorm days per year)**
- **AQ3 – Direct exposure.**

IET Guidance Note 1 makes it clear that the condition of external influence which exists in the United Kingdom is AQ1, and this means that installations in the UK are not required to have surge protective devices when using the AQ criteria. However, a note below Regulation 443.2.2 states that, irrespective of the AQ value, protection against overvoltages may be necessary in applications where a higher reliability or higher risks (e.g. fire) are expected. See BS EN 62305.

Irrespective of whether the electrical designer chooses to specify surge protective devices, all electrical equipment must be capable of withstanding the impulse voltage at its point of installation as shown in the Table below from IET Guidance Note 1.

Regulation 443.2.4 states that as an alternative to the AQ criteria in Regulations 443.2.2 and 443.2.3, the use of surge protection may be based on a risk assessment method and gives the following consequential levels of protection to be considered as part of this risk assessment:

i. **Consequences related to human life, e.g. safety services, medical equipment in hospitals;**
ii. **Consequences related to public services, e.g. loss of public services, IT centres, museums;**
iii. **Consequences to commercial or industry activity, e.g. hotels, banks, industries, commercial markets, farms;**
iv. **Consequences to groups of individuals, e.g. large residential buildings, churches, offices, schools;**
v. **Consequences to individuals, e.g. small or medium residential buildings, small offices.**

Nominal voltage of the installation (V)	Required minimum impulse withstand voltage (kV) *			
	Category IV (equipment with very high impulse voltage)	Category III (equipment with high impulse voltage)	Category II (equipment with normal impulse voltage)	Category I † (equipment with reduced impulse voltage)
230/240 27 7/480	6	4	2.5	1.5
400/690	8	6	4	2.5
1000	12	8	6	4

* Applied between live conductors and PE.

† Category I equipment (equipment with reduced impulse voltage) has a required minimum impulse withstand voltage of 1.5 kV for a nominal voltage of 230 V, and should not be connected to the electricity supply without surge protection.

Future developments at international level

The Wiring Regulations (BS 7671) are based on international standards. Work is ongoing at the international level to significantly revise Clause 443. The new international proposals no longer include the AQ criteria for determining if protection against transient overvoltage is needed. The draft criteria for determining if protection is required depend on the type and function of the installation/ premises. Three cases are considered.

First, where the consequence caused by overvoltage affects care of human life, public services, cultural heritage, and commercial or industrial activity, then protection against transient overvoltage must be provided.

Second, where the consequence caused by overvoltage affects an installation with a structure where there is a risk of explosion, or structures where the damage may also involve surrounding structures or the environment (e.g. chemical or radioactive emissions), then IEC 62305 series must be applied.

Third, for all others cases, a risk assessment must be performed in order to determine if protection against transient overvoltage is needed, and if it is not performed, then the electrical installation shall be provided with protection against transient overvoltage. However, an exception not to provide protection is included in this third case if the total value of the installation and equipment therein, does not justify such protection.

Category	Example
I	Equipment intended to be connected to the fixed electrical installation where protection against transient overvoltage is external to the equipment, either in the fixed installation or between the fixed installation and the equipment. Examples of equipment are household appliances, portable tools and similar loads intended to be connected to circuits in which measures have been taken to limit transient overvoltages.
II	Equipment intended to be connected to the fixed electrical installation, e.g. household appliances, portable tools and similar loads, the protective means being either within or external to the equipment.
III	Equipment which is part of the fixed electrical installation and other equipment where a high degree of availability is expected, e.g. distribution boards, circuit-breakers, wiring systems, and equipment for industrial uses, stationary motors with permanent connection to the fixed installation.
IV	Equipment to be used at or in the proximity of the origin of the electrical installation upstream of the main distribution board, e.g. electricity meter, primary overcurrent device, ripple control unit.

Conclusion

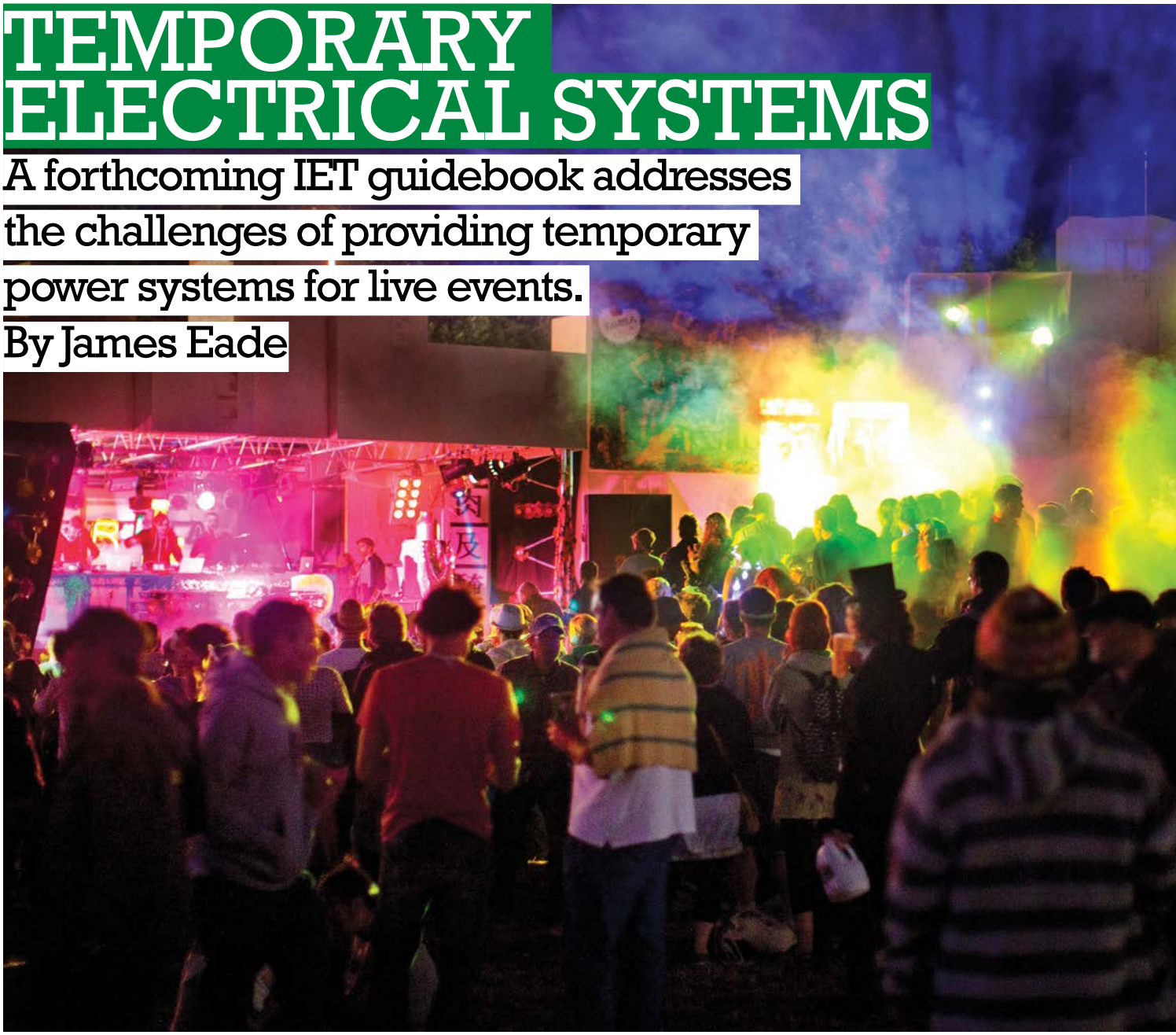
It is important to be aware that this article only gives an overview of the requirements of Clause 443 of the 17th Edition of the Wiring Regulations (BS 7671). For more information refer to Clause 443 of BS 7671:2008 incorporating Amendment 1.

It is also important to point out that this future development work is still at a very early stage of development in IEC and therefore may not become an international standard.

TEMPORARY ELECTRICAL SYSTEMS

A forthcoming IET guidebook addresses the challenges of providing temporary power systems for live events.

By James Eade



DAVE ROBERTS, PIC LIBRARY

TEMPORARY ELECTRICAL systems are more common than you might think. Over Christmas you probably admired a lighting display in your local town, visited an outdoor Christmas market or perhaps even had a go on one of the many temporary ice rinks that appeared in shopping malls around the country.

As we head into the summer, the annual round of agricultural shows, festivals and village fêtes will soon be upon us. Less seasonal examples of temporary power usage include theatre shows, corporate sales or marketing events, film, television, broadcasts and exhibitions.

The scale of temporary systems varies considerably. Many are small, running from generators under 10kVA; larger events may have multiple synchronised generators delivering capacities measured in MVA. The London Olympics saw the deployment of around 220MVA of temporary generation – equivalent to over 20 per cent of the UK's oil-fired generating capacity. Sky, one of the UK's largest broadcasters, deploys around 100 live outside broadcasts (OBs) for sporting events each month, along with around 50 news OBs every day. Not every OB needs a temporary supply, but the majority do.

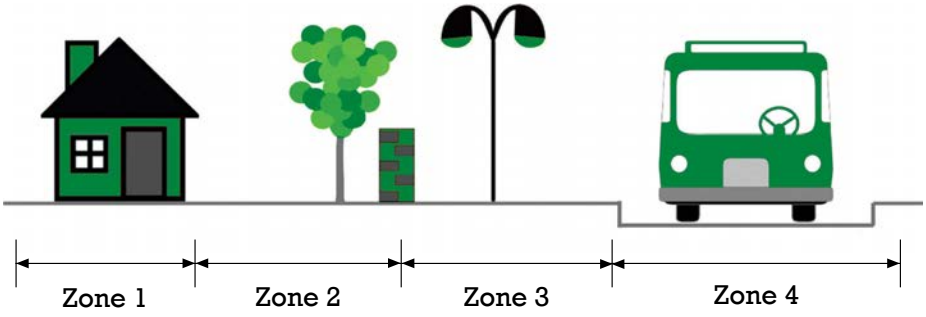
This is a very sizeable business. The entertainment industry is worth approximately £15bn to the UK economy per annum, of which £1bn comes directly from staging live music events. When you add in all the other agencies with a need for temporary supplies, including the armed services, construction, rail and power industries it will be clear just how big the temporary power business really is.

Hardware

The entertainment side of the industry has changed considerably since the 1960s and 1970s, when it was a

fledgling business. But, although the industry is now a much larger and more mature, the basic objectives remain the same: the rapid deployment of sufficient power to where it's needed. In response to this goal, the industry has developed customised, ruggedised distribution units that can be quickly plugged together using cable and connector assemblies. However, while this 'plug 'n' play' approach using stock equipment offers real gains from a logistical perspective, and also has some safety benefits, too many installers have lost sight of the need to design and verify systems to ensure

Fig 1: Example of electrical environments



that protection against the risks of electric shock and fire is maintained in the haste to get systems assembled and operational. For example, it's all too easy to fall into the trap of thinking that a 63A cable and connector assembly can safely deliver 63A to a connected load, with scant regard to its length or the characteristics of the supply to which it is connected.

The typical time pressures of an event give rise to unique challenges. A band on tour could well have two or three 400A three-phase distribution systems, which, along with all the mains distribution, lighting, sound, video and other equipment, has to be unloaded from trucks, rigged and ready for the show within 36-48 hours. After the final encore, everything will then be dismantled, packed and on the road to the next venue in an even shorter timescale.

With thousands of gig-goers arriving at the door to see an event, no one is interested in delay notices, extras or similar construction-industry-related issues. In response to this very demanding operating environment, the events industry has developed its own unique culture, along with the equipment and working practices that enable it to stage the same event reliably, time after time, in venues hundreds and sometimes thousands of miles apart.

BS 7909

While protection is one area that is prone to being overlooked when assembling temporary power systems, it's increasingly necessary to address the relatively new issues of power quality and EMC. In the past most loads were linear in nature, typified by tungsten lighting and amplifiers with linear supplies. Today however, nearly everything is driven by a switched-mode power supply if it isn't already connected to a dimmer or variable-speed motor drive, giving rise to problems with harmonics, power factor, voltage quality and high leakage currents.

The industry has also had to respond to environmental pressures. Recent research by the environmental group Green Festival Alliance shows that in 2011 UK festivals generated enough electricity to power 12,000 homes for a year, consuming 12 million litres of diesel and releasing 31,600t of CO_2 into the atmosphere in the process. Not surprisingly, there have been attempts to introduce green energy to events, ranging from solar power to biodiesel and hydrogen fuel cells. However, integrating renewable energy sources into temporary power distribution systems demands careful planning.

In response to these and other similar factors, BS 7909:2011 'Code of practice for temporary electrical systems for entertainment and related purposes' was extensively revised and rewritten in 2008, and further updated in 2011 to reflect the changes in Amendment 1 of BS 7671:2008. As a code of practice, BS 7909 aims to provide guidance on the practical considerations for designing, deploying and managing a temporary system. But it still requires the reader to actually design a safe system in accordance with the fundamental principles of BS 7671.

BS 7909 or BS 7671?

The question of which standard to apply, and when, often arises. BS 7909 was largely written with the entertainment industry, including broadcast, film, theatre, outdoor events and touring in mind, and the terminology often reflects that fact. However, BS 7909 also represents a set of recommendations for the safe use and deployment of temporary electrical systems of any size or scope that use distribution equipment designed for the purpose – e.g. cables with plugs and sockets fitted, purpose-built portable distribution equipment and so on. As such, the scope of BS 7909 is wide; it gives recommendations for the management, >

Skid-mounted distribution unit with 400A three-phase in and through connections and a selection of 125A, 63A, 32A single and three-phase socket-outlets

design, setting-up and operation of temporary electrical systems for both entertainment and related industries, which include any events or activities using temporary electrical systems.

A note in the scope refers to the fact that equipment used to form a temporary electrical system should be supplied as pre-assembled units that have been tested and are known to be safe and suitable for use. It doesn't prohibit the manufacture on site of simple units that might be necessary, but it does consider this should be the exception rather than the rule. That note answers the question of which standard to apply. If a system plugs together without recourse to using tools to make terminations, then it falls within the scope of BS 7909. However, if a system (whether temporary or not) needs building, with wiring accessories having to be fitted, cables terminated and so on, then BS 7671 alone applies. It should be remembered that BS 7909 does require systems to be designed in accordance with BS 7671, but it does make provision for simplified testing based on the specific recommendations for equipment being followed.

Further guidance on the symbiotic relationship between the two standards, and how to interpret the relevant regulations of BS 7671 and BS 7909 in order to achieve a safe temporary system, is given in the IET's new guidebook, 'Temporary Power Systems and Infrastructure for Entertainment' – see panel on p22.

BS 7671 Part 7 – special locations

Some of the special locations in BS 7671 are relevant to the temporary power industry as a whole. Section 717 covers the electrical installations within mobile and transportable units, such as Portakabins, outside broadcast trucks, catering buses and accommodation units. It should be noted that Section 717 is not concerned with temporary electrical systems that may be connected to such units (except for the supply). Section 711 is concerned with exhibitions shows and stands, the scope of which is aimed at the type of exhibition or show that may be held within a purpose-designed venue, such as the Ideal Home Show. Theatrical-type shows or events are excluded in the scope of Section 711 as they come under the scope of BS 7909.

Often the technical intent of a section will apply to a temporary system. For example, in the case of an outdoor ice rink consideration might be given to the requirements of Section 702, or for a festival with camping facilities Section 708 would be considered. The new IET guidebook gives guidance on those situations where the deployment of a temporary system may not necessarily need to (or be able to) follow all the requirements given in the appropriate Section of Part 7, but which should still follow the technical intent – invariably concerned with minimising the enhanced risk of electric shock.

KEY POINT

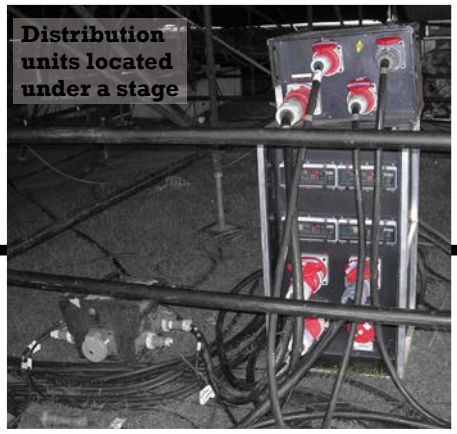
HOW LONG IS 'TEMPORARY'?

BS 7671 makes no distinction between an electrical installation that is permanently fixed to a building structure and one that is not. It defines an electrical installation as "an assembly of associated electrical equipment having coordinated characteristics to fulfil a specific purpose". It goes on to define a temporary electrical installation as an "electrical installation erected for a particular purpose and dismantled when no longer required for that purpose". The key point to note is that despite being temporary, in BS 7671 it is still referred to as an 'installation'. BS 7909 tries to make a distinction between permanent installations where equipment is permanently bolted to the building structure and temporary electrical distributions.

Throughout the course of the lifetime of the temporary system it should perform effectively and safely. A Christmas lighting display would have a defined period of existence whereas a theatre show may have the planned run extended if it proves successful at the box office. There is no time limit that a temporary system may stay in existence but BS 7909 requires that the designer takes into account all the factors likely to affect the system for its original planned duration, with a date stated on the Completion Certificate at which a further assessment should be made to ensure the continued adequacy of the system. So a designer of a system used for a TV drama that is due to run for six weeks may state a reassessment date of eight weeks to allow for minor overrun, but give an indication that a proper review should be taken of the system if it is proving to be a popular show and the run is being extended accordingly.

Design considerations

A quite different approach is required when designing a temporary system, compared to a fixed installation, and the IET guidebook describes the many areas that need considering, giving both worked and practical examples where necessary. For example, almost invariably temporary systems will be under the control of a skilled or instructed person, which may have implications for the design of circuit protection, or it might be outdoors exposed to the elements. In most cases selection of equipment is important as it needs to have the necessary resilience for repeated use as well as changing environmental factors. The use of armoured cables is rare because they are difficult to manhandle, not readily reuseable and do not have Class 5



Distribution units located under a stage

flexible conductors. As such, mechanical protection of less robust cables has to be provided by other means, such as cable traps or positioning, and distribution connectors must be robust and suitable for repeated use.

The electrical performance of a temporary distribution also needs careful planning. At an event the installation is often equivalent to 'clipped direct' (reference method C) and thermal insulation is uncommon. Instead, designers must allow for factors such as the warming of exposed cables by solar radiation. Also, many distribution units may be covered to keep off the rain and this may require MCBs to be de-rated if their ambient operating temperature exceeds 40°C.

Another design factor often overlooked is that the current-carrying capacities and voltage drop tables in BS 7671 often need to be corrected for Class 5 flexible conductors depending on the cable type. If multicore cables are used (which are common for lighting circuit distribution) further correction factors should be applied depending on the load of each circuit in the multicore as well as the number of circuits.

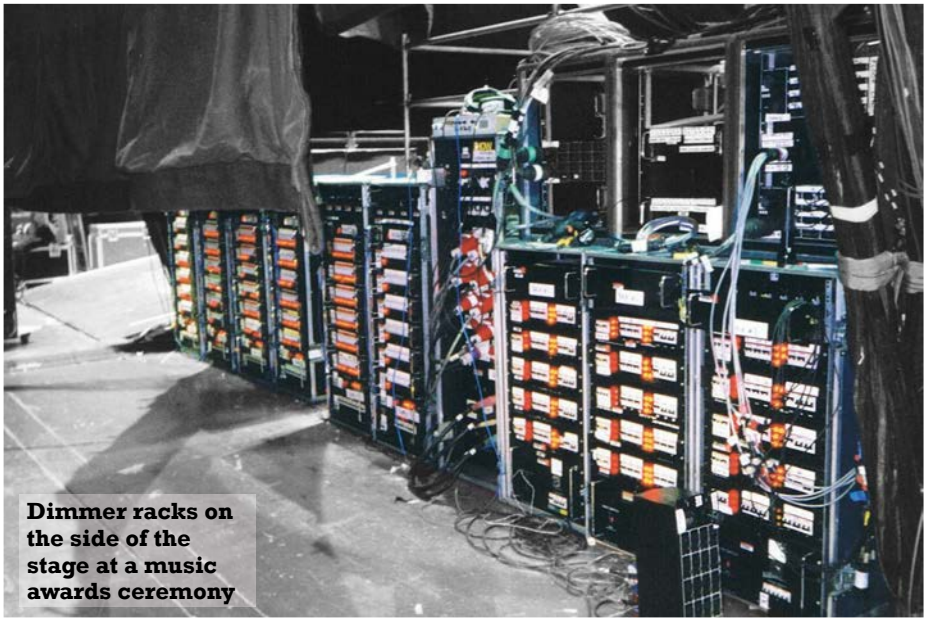
At larger events where significant quantities of power processing equipment such as switched-mode supplies, dimming or motor controls are used, consideration should also be given to power quality and residual currents as described earlier. Such equipment is a common source of harmonics, the triplens of which sum in the neutral of three-phase distributions, giving rise to high neutral currents – especially, and this is not uncommon, if the overall load is unbalanced.

The use of EMI filtering in such equipment means high residual currents can be expected, which has implications for the specification of RCDs for circuit protection and protection against electric shock. The new IET guidebook discusses how to correctly specify and use the different types of RCDs based on detection characteristics, operating currents, delay and load, as well as the common – and mostly erroneous – practice of bypassing them. And if that statement raised an eyebrow, then the book explains it all.

Bonding and the environment

Another design consideration that is often overlooked is the 'electrical environment' – a term defined in BS 7909 which is allied to, but not the same as, an equipotential zone. To understand the concept, consider a house with an electrical installation, as shown in Fig 1. The inside of the house with its electrical supply is one electrical environment, and if correctly wired is also likely to be an equipotential zone. The garden is a different electrical environment as it is at true Earth potential; not the potential of the supply earth at the main earth

James Eade, the author of 'Temporary Power Systems and Infrastructure for Entertainment', has worked in the events industry for over 20 years. He was formerly technical editor of the magazine *Lighting&Sound International* as well as chairman of the PLASA annual industry innovation awards panel. He currently provides industry training in temporary power systems as well as general design and management of event electrical services including those for event venues.



Dimmer racks on the side of the stage at a music awards ceremony

< terminal in the house (except for TT systems of course). The area around the street light in the road (which has its own supply distinct from that of the house) is another electrical environment. A vehicle in the street with an on-board generator encloses another electrical environment.

BS 7671 does not specifically consider the interconnection of fixed installations derived from different supplies (save for some commentary in Section 444). In events, however, such interconnections are common. Generators are often used to provide additional power for a stage system located within a building which itself has its own supply, or at large events (such as Glastonbury, for example) multiple temporary distributions, each with its own generating plant, may reside together. More often than not the earthing systems will end up being interconnected, whether by mutual connection through exposed conductive parts (such as via lighting equipment mounted on a truss) or earth-referenced signal cables.

In the event of a neutral failure on a TN-C-S building supply, for example, the earth electrode of a generator being used to supply power for an event inside the building may form the principal means of earthing through fortuitous connections between the temporary supply CPC and the building's CPC. Even if no failure is present, the earth loops that can be created by such interconnections will invariably give rise to signal degradation, resulting in humming audio systems, jittery lights or scrolling 'hum' bars on video pictures. Taking supplies from an installation in a building to provide power for outdoor events presents similar safety issues that need to be considered.

Example of a 'keyed single-pole connector' as defined in BS 7909

Testing

The guidance given in BS 7909 is firmly rooted in the principle that equipment delivered to site has been checked for electrical safety, and can be shown to be safe and serviceable for use. It requires all the pre-manufactured cable assemblies and distribution equipment be tested in accordance with the IET Code of Practice for In-Service Inspection and Testing.

The issue of testing temporary distributions is probably the most widely misunderstood aspect of the application of both BS 7909 and BS 7671. The new guidebook describes why testing is conducted and how to effectively and quickly test a temporary distribution. It also recommends testing intervals for portable equipment and items such as mobile and transportable units. In short, the book contains all you need to know to ensure a rigorous approach to testing within the timescale of a typical live event.

FACT FILE

ABOUT THE BOOK

The IET publication 'Temporary Power Systems and Infrastructure for Entertainment' deals with the correct application of the principles of BS 7671 and the application of BS 7909 to a temporary event. It is written in an accessible manner to assist readers with a range of skills and the wealth of information contained within its covers will be invaluable to students, technicians as well as practising electrical engineers. Its detailed chapters cover key topics including:

- The relevant legislation, standards and industry guidance that apply to temporary events, including those relevant to permanent venues that may host temporary events such as exhibition halls or theatres.
- Earthing arrangements including guidance on the identification and treatment of extraneous-conductive-parts, supplementary bonding and protection methods.
- Design principles and requirements including assessment, protective devices (especially the correct use of RCDs), load balancing, the effects of neutral loss, cable calculations, designing for power factor and harmonics, uninterruptible power supplies, emergency lighting and more.
- Equipment provision and testing, including the supply of mobile and transportable units and correct specification of cable and connectors. It covers the relevant test requirements for portable equipment, suggests time intervals for the testing of equipment and explains the requirements of BS 7909 in respect of equipment supply.
- The testing requirements of BS 7909 and how to achieve results in a timely manner on-site or when changing location. The potential hazards and problems associated with testing equipment such as dimmers, UPSs and RCDs as well as the additional requirements for special locations as defined in Part 7 of BS 7671 are considered.
- Guidance on generators, street furniture and other supplies including operational considerations, methods of Earthing including earth electrode calculations, generator/supply interconnection and generator housekeeping.
- Operational considerations including bypassing RCDs, safe working practices (including live working), protection of the temporary electrical distribution, emergency procedures and the relevant requirements of BS 7909.
- Requirements for venues including provision of appropriate supplies and the requirements of BS 7909 with regard to exchange of information between visiting events and venue management.

PROTECTION AGAINST FIRE

We look at the requirements of Chapter 42 of the 17th Edition of the Wiring Regulations. By Geoff Cronshaw

AMENDMENT number 1 of the 17th edition came into effect on 1 January 2012, and includes requirements for protection against thermal effects. The requirements are contained in Chapter 42 for the protection of persons, livestock and property against fire caused by electrical equipment, against burns and overheating and include precautions where particular risks of fire exist.

Protection against fire resulting from the electrical installation and the use of the electrical installation has been necessary since electricity was first introduced into buildings.

Protection against fire caused by electrical equipment

Regulation 421 requires measures to prevent electrical equipment from presenting a fire hazard to materials in close proximity to electrical equipment.

The regulation gives examples of causes of damage, injury or ignition, including:

- **thermostats, temperature limiters, seals of cable penetrations and wiring systems;**
- **overcurrent;**
- **insulation faults and/or arcs causing interference;**
- **harmonic currents;**
- **lightning strikes, see the IEC 62305 series.**

Special precautions are necessary for flammable dielectric liquids. Regulation 421.5 requires that where electrical equipment in a single location contains flammable liquid in significant quantity, adequate precautions shall be taken to prevent the spread of liquid, flame and the products of combustion.

IET Guidance Note 4 explains that the options available to the designer will depend on a number of things; for example, whether a single item or a number of items of equipment are involved, and whether the location is indoors or outdoors. The options include:

- **reducing the risk by partitioning the location with fire doors and sills;**
- **providing bunds or kerbs around items of equipment or, for larger items, a retention pit filled with pebbles or granite chips (the net capacity of the bund or retention pit when filled with pebbles or chips should exceed the oil capacity of the equipment by at least 10 per cent);**
- **providing a drainpit and flame arrestor;**
- **provision of automatic fire venting and/or automatic fire suppression or foam inlets and integration with the automatic fire detection and alarm system of the building, where appropriate;**
- **ramped floors;**
- **use of an outdoor location;**
- **blast walls between large items.**

Chapter 42 also contains requirements for fixed equipment. Regulation 421.4 requires that fixed equipment producing high concentrations of heat – for example, radiant heaters and high-intensity luminaires – must be at a sufficient distance from any fixed object or building element to ensure that, in normal conditions, the object or element is not subjected to a dangerous temperature.

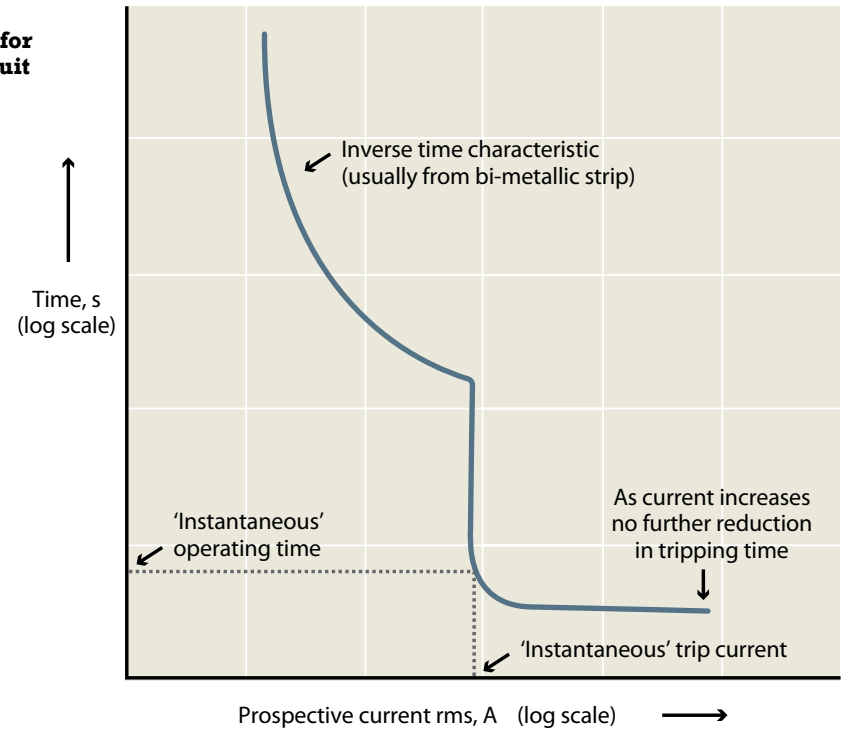
Regulation 421.3 requires that where arcs or sparks may be emitted, for example in circuit-breakers or semi-enclosed fuses, the equipment shall be either:

- **totally enclosed in arc-resistant material; or**
- **screened by arc-resistant material; or**
- **mounted so as to allow safe extinction of the emissions at a sufficient distance from material upon which the emissions could have harmful effects.**

Precautions where particular risks of fire exist

The requirements of this section fall under five headings: >

Time/current characteristic for miniature circuit breaker



■ **Selection and erection of installations in locations of national, commercial, industrial, or public significance**
Requirements for electrical installations in locations of national, commercial, industrial or public significance were introduced into BS 7671:2008, the 17th Edition, when it was published in 2008, and this has been retained in amendment 1 of the 17th Edition. These are areas such as museums, national monuments, airports, railway stations, laboratories, computer- and data-storage centres, and archiving facilities. Regulation 422.6 requires compliance with Regulation 422.1 and consideration of a number of measures such as installation of cables with improved fire-resistance.

■ **Requirements for fire-propagating structures**
Some buildings with certain shapes may facilitate the spread of fire, e.g. high-rise, or forced ventilation where a chimney effect may exist. Chapter 42 contains requirements to protect against these hazards.

■ **Locations with risks of fire due to the nature of processed or stored materials**
In condition BE2 (fire risk) Chapter 42 contains requirements for luminaires, enclosures, switchgear, cables, motors, heating appliances etc.

■ **Requirements for locations with combustible constructional materials**
Precautions should be taken so that electrical equipment does not pose an ignition hazard to walls, floors or ceilings to which it is in close proximity – by the adoption of appropriate design, installation methods and choice of electrical equipment. Distribution boards and accessory boxes for switches, socket-outlets, and the like, that are installed into or on the surface of a wall made from combustible materials should meet the requirements of the relevant product standard for temperature rise. Where this is not the case, the equipment or accessory should be enclosed by non-flammable material of suitable thickness, taking into account the nature of the material being employed. Refer to Regulations 422.4.1, 422.4.3, and 422.4.4 for further details.

■ **Emergency escape routes**
In conditions BD2 (multi-storey buildings such as offices), BD3 (buildings open to the public, such as shopping centres and places of public entertainment), BD4 (high-rise buildings open to the public, such as hotels), wherever possible wiring systems should not encroach on escape routes and should in any case be as short as possible.

Future developments at international level

The Wiring Regulations (BS 7671) are based on international standards. Work is ongoing at international level to amend IEC 60364-42 to incorporate requirements 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.

Arc faults

Arc faults can occur between line conductors and earth, or line conductors and neutral. Also, series-arc faults can occur, for example in a broken conductor or loose connection. These faults may result from insulation defects between live conductors, or live conductors and earth, leading to fault currents (parallel arcs), or broken or damaged conductors or poor terminal connections with increased resistance (serial arcs).

RCDs

It is recognised that RCDs can reduce the likelihood of fires associated with earth faults. For example, Section 705 of BS 7671 (Agricultural and horticultural premises) requires (Regulation 705.422.7) that, for the protection against fire, an RCD has a rated tripping current not exceeding 300mA.

An RCD is a protective device used to disconnect automatically 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 ($I_{\Delta n}$). 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.

Overcurrent protective devices – circuit breakers

Whilst RCDs can detect earth faults, because there is no leakage current to earth, they cannot reduce the risk of electrical fire due to series or parallel arcing between live conductors. Also, it is understood that the impedance of the series-arc fault reduces the load current, which will keep the current below the tripping threshold of the circuit-breaker. It is therefore worthwhile looking briefly at the operation of a typical commonly-used circuit breaker.

There are many types of circuit breaker available, the most common being the thermal magnetic circuit breaker. Miniature circuit breakers (MCBs) should comply with BS EN 60898 entitled 'Circuit-breakers for Overcurrent Protection for Household and Similar Installations'. The scope identifies that MCBs are designed for use by an uninstructed person. The maximum rated current permitted is 125A.

Combined RCD and circuit breakers are available

Thermal trip

A thermal bi-metallic trip is used to protect against overload currents. The bimetallic or thermal sensing element deflects mechanically as current passes through it. The higher the overcurrent, the greater the deflection.

At a predetermined point, the element will actuate a tripping mechanism, open the contacts and disconnect the circuit. This action is represented by the inverse time characteristic (curved section) of the circuit breaker (see graph on facing page). The Standard BS EN 60898 refers to 1.45 I_n (the rated current or current setting of the protective device) as the conventional tripping current which must open the circuit breaker contacts within the conventional time. This is defined as one or two hours.

Magnetic characteristics

The magnetic characteristics of BS EN 60898 circuit breakers are fixed. Devices with a common nominal current rating are available in three different types. A letter preceding the nominal current rating e.g. B20 for a 20A type B circuit breaker denotes the type of device. The letters B, C, or D relate to the magnetic trip setting or characteristic curve.

The sensing component of the circuit breaker is constructed using a coil or solenoid, which is designed to operate the tripping mechanism when the overcurrent reaches a set magnitude. This magnetic component is specifically designed to deal with fault currents. The letter B, C, or D represents a multiple of I_n. When the current rises to this multiple value, the magnetic trip operates instantaneously to open the contacts.

Conclusion

To summarise, it is recognised that RCDs can reduce the likelihood of fires associated with earth faults. However, whilst RCDs can detect earth faults they are not 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 therefore the circuit-breaker may not operate to disconnect the circuit.

For this reason work is ongoing at present at international level to amend IEC 60364-42 to incorporate requirements for the installation of AFDDs to mitigate the risk of fire in final circuits of a fixed installation due to the effect of arc fault currents.

Important

Please note this article only gives an overview of the requirements of section 42 of the 17th Edition of the Wiring Regulations (BS 7671). For more information refer to section 42 of BS 7671:2008 incorporating Amendment 1. Also, it is important to point out that this future development work is still at a very early stage of development in IEC and therefore may not become an international standard.

WiringBooks #46

The Institution prepares regulations for the safety of electrical installations for buildings, the IET Wiring Regulations (BS 7671), which has now become the standard for the UK and many other countries. It has also prepared the Code of Practice for Installation of Electrical and Electronic Equipment In Ships (BS 8450) and recommends, internationally, the requirements for Mobile and Fixed Offshore Installations. The Institution provides guidance on the application of BS 7671 through publications focused on the various activities from design of the installation through to final test and certification with further guidance for maintenance. This includes a series of eight Guidance Notes, two Codes of Practice and model forms for use in wiring installations.

REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

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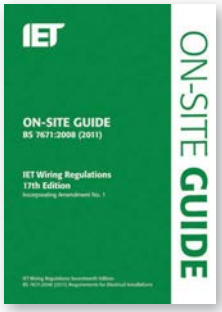

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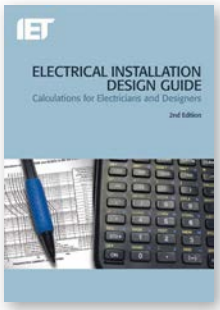

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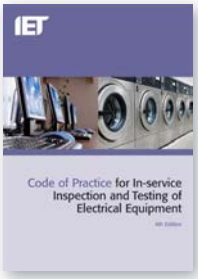

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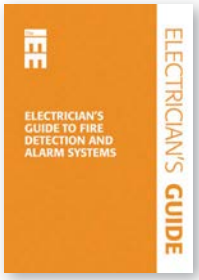

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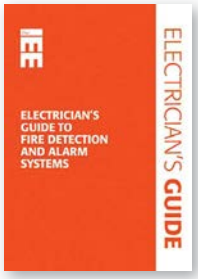

This is one of a number of publications prepared by the IET to provide guidance on electrical installations in buildings. This publication is concerned with fire detection and fire alarm systems and must be read in conjunction with the legislation, Approved Document B and the British Standards, in particular BS 5839-1 and 5839-6.

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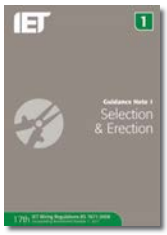

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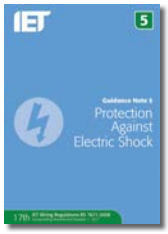

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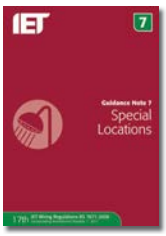

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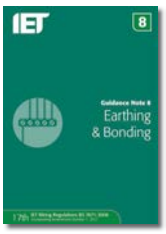

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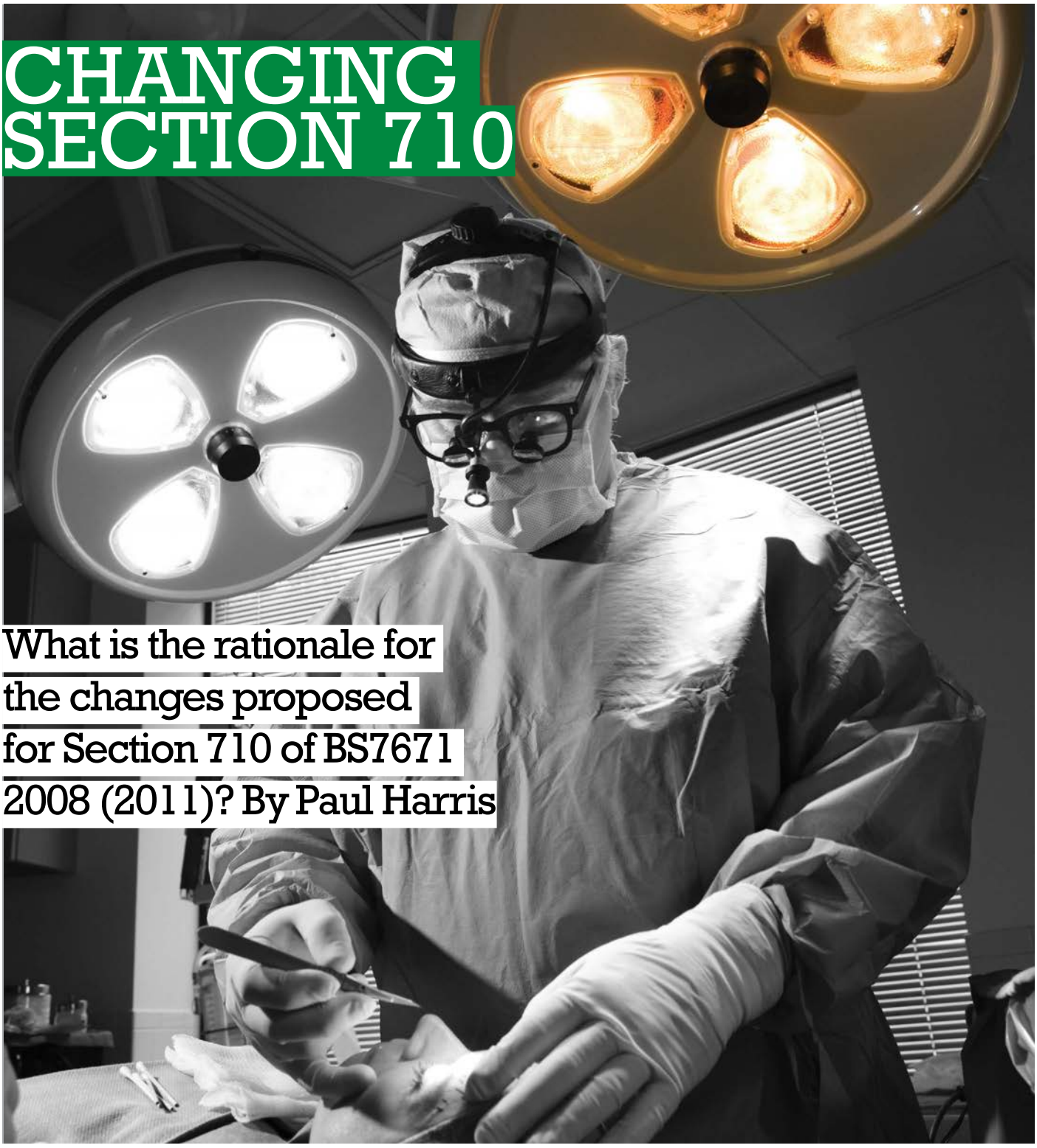
CHANGING SECTION 710



What is the rationale for the changes proposed for Section 710 of BS7671 2008 (2011)? By Paul Harris

FOLLOWING LAST October's announcement by the Medicines and Healthcare products Regulatory Agency (MHRA) regarding the withdrawal of MEIGaN Annex 1, and the noticeable lack of development of MEIGaN 2007, the tag MEIGaN compliance has started slowly to disappear.

This change is a reflection of the fact that, within NHS and general procurement processes, major contractors, consultants and clients are now working to Section 710. Similarly, the previously reported lack of appreciation of Section 710 (*Wiring Matters* #45, p12) appears to be disappearing as BS7671:2008 (2011) enters the design and installation phases of major projects.

As a special location, there is a heavy burden on all those responsible for maintaining Section 710 to ensure that the information provided is correct and safe, but without burdening designers, installers and the client with requirements that are over stringent or call for measures which add little or no value to an installation.

BS0 (the standard for writing British Standards) does not allow individuals or committees to interpret the standard on behalf of BSI. This makes comment or interpretation an individual matter, which is generally not acceptable on large construction projects.

Members of the working group that advise BSI on Section 710 Medical Locations, who are all practitioners in the different fields covered by Section 710, have individually, or through the institutions they represent, identified areas for clarification, and in some instances change. Permission to update the section was obtained from JPEL 64, the >

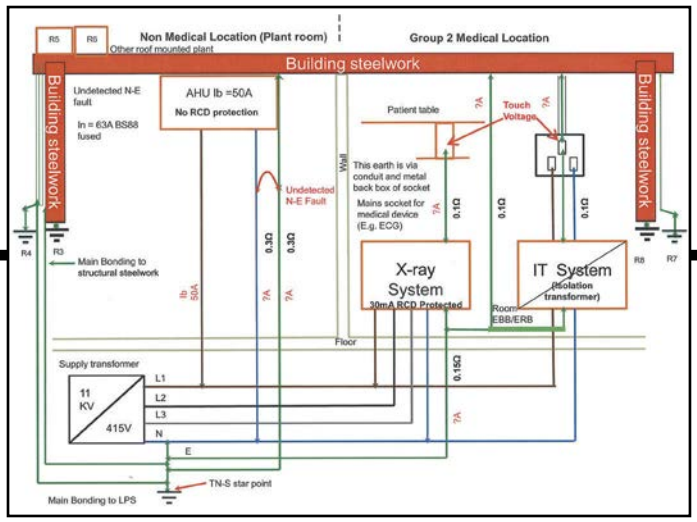


Fig 1: Group 2 location with a neutral-to-earth fault in an adjacent location

committee responsible for the production of BS7671 in its entirety.

At the end of January 2013 the working group agreed a redraft of Section 710 for submission to JPEL 64 for approval at the next meeting. The redraft includes a small number of important points; making the proposed Section 710 align more closely with the Harmonised Document HD 60364-7-710 2012.

Proposed changes

A number of the proposed changes are intended to improve clarity of the text:

- **Diagram Figure 710.3 has been modified from IET Guidance Note 7 and added to Section 710 to assist understanding of terminology;**
- **The wordings of references to HTM 06-01 have been amended to confirm the status of the HTM as a Department of Health Guidance Document;**
- **Regulation 710.411.6.3.1 has been reworded to clarify the alarms and notification for faults on Medical IT systems**
- **Regulation 710.415.2.2 has been reworded to clarify the values required for the protective conductor resistances, in order to meet the simultaneously accessible voltage requirements (710.411.3.2.5) and the maximum 0.7Ω and 0.2Ω values for Group 1 and Group 2 locations respectively. The values remain unchanged.**

However, there are four areas where changes/clarifications will affect the installation:

- **Haemodialysis room reclassification**
- **UPS battery autonomy**
- **Additional supplementary bonding connection points**
- **Monitoring of TN-S circuits.**

Haemodialysis room reclassification

In BS7671:200 (2011) table 710 item 19, haemodialysis room was categorised as a Group 2 location; it is proposed that this be recategorised to a Group 1 location

Review of actual procedures in haemodialysis rooms are generally considered to be less onerous than an operating theatre or ICU etc. This falls in line with the categorisation within the HD and removes the minimum requirement for Medical IT systems UPS etc, which could be considered too onerous for the type of

procedures carried out.

As with all design, if there is a specialist requirement in a particular haemodialysis room, the designer is at liberty to increase the provisions beyond those minimum requirements specified in Section 710.

UPS Battery Autonomy

Regulation 710.560.6.1.1 requires power to be restored in 0.5s by means of a safety source, which invariably requires the use of an uninterruptible power supply. The safety supply source must be capable of providing power for three hours. The existing regulation had a note stating this may be reduced to one hour if the requirements of Regulation 710.560.6.1.2 were met.

As a note in a regulation has no normative status, the note can be ignored by the reader, which could then give rise to significantly different battery autonomies. The original note has been changed to a normative piece of text, with the requirements applying to items (ii) and (iii), with a supporting note identifying the separate requirements for luminaires of theatre operating tables.

Designers are still able to choose a three-hour autonomy to serve the equipment in points (ii) and (iii) should their design require it.

Large battery rooms can severely impact spatial planning, particularly where they are above ground level, resulting in onerous design restrictions due to the need for structural reinforcement. Where a backup supply in accordance with Regulation 710.560.6.1.2 is available, then the reduction to one hour autonomy would be reasonable which in turn removes the requirement for oversized battery rooms and proportional structural support.

Additional supplementary bonding connection points

Considerable attention has been given to the requirements for additional protection by supplementary equipotential bonding in Regulation 710.415.2.1.

The aim has been to make the regulation as clear as possible and the requirements effective, without the onerous demand of a large number of additional bonding connection points.

The requirement for supplementary equipotential bonding connection points for each location has been changed as follows:

(vi) Group 1: a minimum of one per patient location

(vii) Group 2: a minimum of four, but not less than 25 per cent of the number of medical IT socket–outlets provided per patient location.

This change was prompted by discussions with clinicians, estates departments, contractors and design consultants, all of whom saw no benefit in a large number of supplementary equipotential bonding connection points, as anecdotal information showed very few of these additional connections were used. The proposal demonstrates a minimum

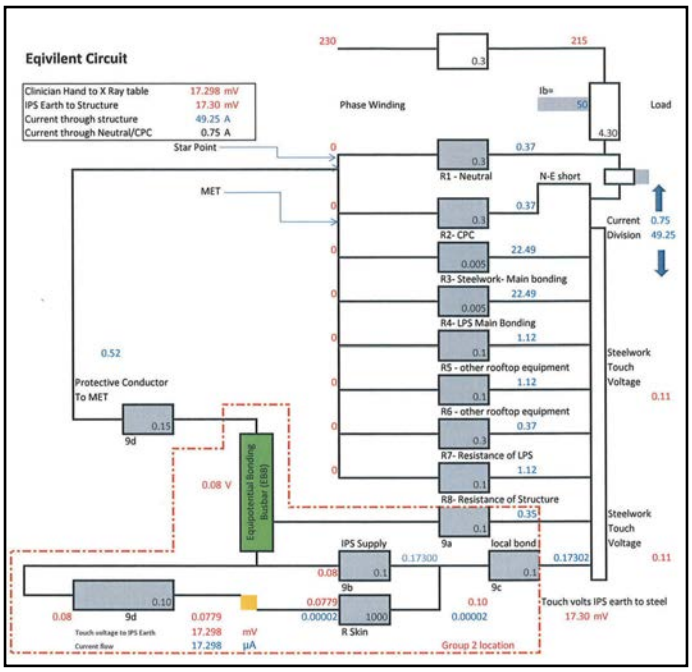


Fig: 2: Equivalent circuit (non-isolated earth pin IPS socket outlets)

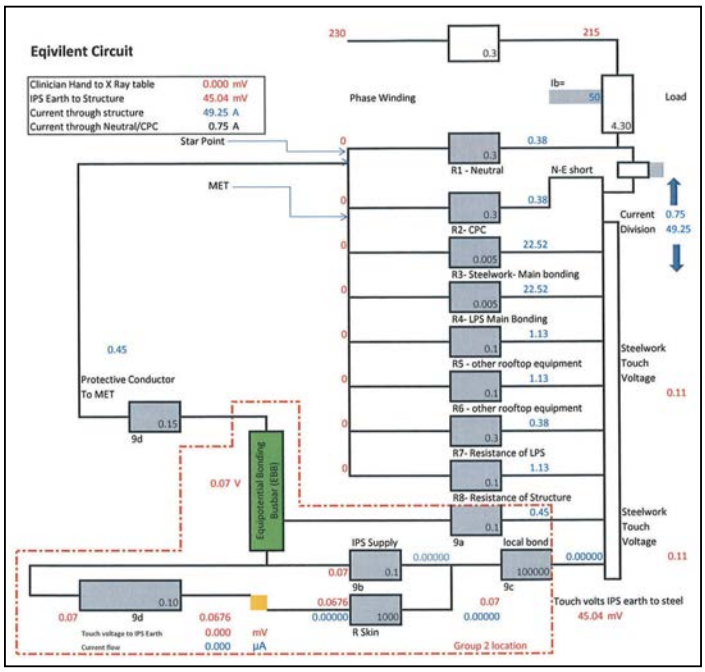


Fig: 3: Equivalent circuit (isolated earth pin IPS socket outlets)

< requirement, rather than a large finite number, as currently specified.

The working group believes a common-sense minimum number has been provided on grounds of clinical equipment space and financial prudence in times of financial austerity.

As an example of the effect of the change, a 21-bed ITU with 28 Medical IT sockets per bed over four IT circuits would previously have required 588 supplementary equipotential bonding connection points in that one unit. Applying the newly proposed arrangement, the minimum number of supplementary equipotential bonding connection points required would be 147, i.e. seven per patient location.

The rationalisation of minimum numbers of connection points would mean more room on the specialist articulated pendants or, with fixed bed-head trunking, increased bed-head space for other services.

Where a designer is aware that there is a specific need for these connection units, he or she is free to specify as many as are required by the project in group 1 or group 2 locations, over and above the minimum number prescribed in Section 710.

Monitoring of TN-S circuits

In its second paragraph, Regulation 710.411.4 had a requirement for all TN-S systems to be monitored. The requirement arose from concerns that undetected neutral-to-earth faults could increase risk levels in group 2 locations. The scenario shown in Fig 1 indicates the arrangement giving rise to these concerns.

A review of this scenario suggests that such concerns are over-cautious. The presence of low impedances in group 2 locations will ensure that most of the load current from the neutral-to-earth fault will flow through other conductors, rather than the relatively high impedance of the equipment supply cable.

This can be seen in the equivalent circuit diagram shown in Fig 2.

Although the majority of the load current takes a different route from the supply cable, assessment of the wider installation shows that with correct main protective bonding, and other parallel circuits, the current passes through the structure and is dissipated through protective conductors, bonding conductors, extraneous conductive parts and the building structure, reducing the general touch voltage to a low value.

In the group 2 location the risk is further reduced by the location of the equipotential bonding busbar (EBB) positioned in or close to the room in question, in conjunction with supplementary bonding arranged in a star topology which 'collects' leakage currents and passes these currents through large protective conductors to the main earth terminal (MET), where these currents are dissipated at the transformer.

The touch voltage across X-ray equipment can be further reduced by providing an isolated earth pin arrangement on all medical IT socket outlets, however, as can be seen in Fig 3. This reduces the touch voltage at the X-ray table but raises the touch voltage potential to the structure.

Reasoning

Although monitoring of all conductors can indicate where a neutral-to-earth fault exists, for the monitoring to be effective, the acceptable threshold of residual current needs to be determined by assessing installation and equipment leakage current. However, any changes to equipment or additional equipment may alter that threshold, and cause an alarm resulting in potential panic and a full-scale investigation.

The likelihood of a neutral-to-earth fault in new or modified installations is limited, as installers have a duty to ensure the installation is correct at the time of installation. Additions should be tested as modifications are carried out, and duty holders have a responsibility to carry out ongoing tests to existing installations to ensure the safety of the installations.

As the impact of a neutral-to-earth fault is not as onerous as was previously considered, coupled with the fact that the likelihood of such faults is low, the monitoring requirement has been deemed unnecessary. Designers remain free to specify monitoring where necessary, as an additional to the minimum requirements of Section 710.

Summary

The proposed change to the requirements of Section 710 have been derived from industry feedback and tested against the technical intent of Harmonised Document HD 60364-7-710 2012. It is believed that the changes reflect the industry's needs and requirements, and have, where necessary, been reworded to give clarity and reduce ambiguous and onerous interpretation by individuals or organisations.

This article is a summary of the main points, and is not intended to be a complete and comprehensive guide to the changes in Section 710 as the document may still have final JPEL 64 amendments or alterations prior to publication, the date of which has yet to be agreed by JPEL 64 the IET and British Standards Institute.

Paul Harris is an independent consultant for Harris Associates Ltd and one of a number of experts for medical locations serving JPEL 64.

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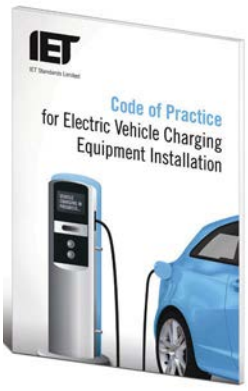

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Richard Lunt is team leader electrical at South Cheshire College

RICHARD LUNT
SOUTH CHESHIRE COLLEGE

Teaching in an further education college can offer electricians and engineers a richly rewarding job.

PICTURE A COLLEGE classroom somewhere in the north of England. It's 8.59am and before me 18 unfocused souls idly chat about subjects that range from imagined sexual conquests to Remembrance Day services that stole valuable hours from playing the latest incarnation of online war games. They're mostly teenagers – which helps explain the lack of focus – but there's also a smattering of 20- and 30-somethings, all with a common goal of becoming qualified electricians.

"Right," I bark loudly, in a tone borrowed from an episode of Dad's Army, "which earthing arrangement is this?" The temperamental projector, only recently installed by the IT department, flickers as it displays an image from an article in latest issue of *Wiring Matters*. "TNT," the former paratrooper shouts.

I roll my eyes towards the ceiling, groaning inwardly: somebody, anybody, please help. Why, I wonder, had I bothered rigging up a generator on the test rigs last week, hooked up a transformer and connected the secondary winding to an anchor bolt (acting as an earth electrode)? All this hastily installed by the technician moments before the lesson. And to what end had I then devoted so much effort to enthusiastically extolling the virtues, while highlighting the limitations, of the protective multiple earthing system?

My gaze levels out and I look round tracking the furtive exchanges that, hopefully, will culminate in the answer I crave, the answer I need. "TT," a student calls out. It's a guess, it's wrong and I feel a momentary stab of despair. But then it comes: "TNC-S." The right answer. My fix is delivered, and suddenly I'm enthusiastically launching myself into three hours of lecturing on earthing and bonding, and I'm loving it.

As my little vignette of FE life hopefully illustrates, teaching can be a tough, but very rewarding experience. In my working life I've filled skips, been a self-employed electrician, worked for the biggest telecoms companies on large projects in the UK and abroad, but nothing prepared me for energy-leeching teenagers with egos inversely proportional to their ability or experience, or the challenge of inspiring the same teenagers to stick with their studies for up to six hours a day. You put yourself on a pedestal and invite your audience to have a go at knocking you off. It can be daunting.

And then there's Ofsted. The Office for Standards in Education, Children's Services and Skills has a fearsome and iron grip on all colleges and sets the benchmarks for compulsory and further education. The very mention of a pending Ofsted inspection sends shivers of fear down even the most seasoned educator's spine. Of course, something as important as education needs regulation, but I firmly believe that teachers, lecturers, schools and colleges do not perform best when pasteurised and homogenised into uniformed monochromatic moulds. In particular, I'm convinced that if you ask an engineer or electrician to come off site and enter 'academia' then we should embrace their often logical, real-life and common-sense approach to teaching, and not try and standardise everything they're asked to do.

Which brings me to the biggest problem in my role as a departmental team leader: finding people to do the teaching. Drawing on my own experience, I believe teaching in FE offers good electricians and engineers the opportunity to find a new niche in life, carving out a rewarding career and becoming brilliant and engaging teachers. However, it's undoubtedly true that finding and retaining such industry-seasoned would-be educators is the biggest challenge facing further and higher education.

Could this be for you? Don't let the challenge of the occasional difficult teenager or even the fear of Ofsted put you off. Most of the time, within reasonable bounds, you'll enjoy a healthy degree of teaching autonomy. You're given a subject or area of expertise – for example inspection and testing – and are expected to deliver it in a way that engages your group while cognitively fattening them up for the feast of assessments scheduled later in the year.

And as for the students? Well, again, most of the time, you couldn't met a more likeable, bright and intelligent group of individuals.

Have a go, stick at it, steady yourself, and you will find that FE teaching is the most rewarding, enjoyable and enlightening of jobs.

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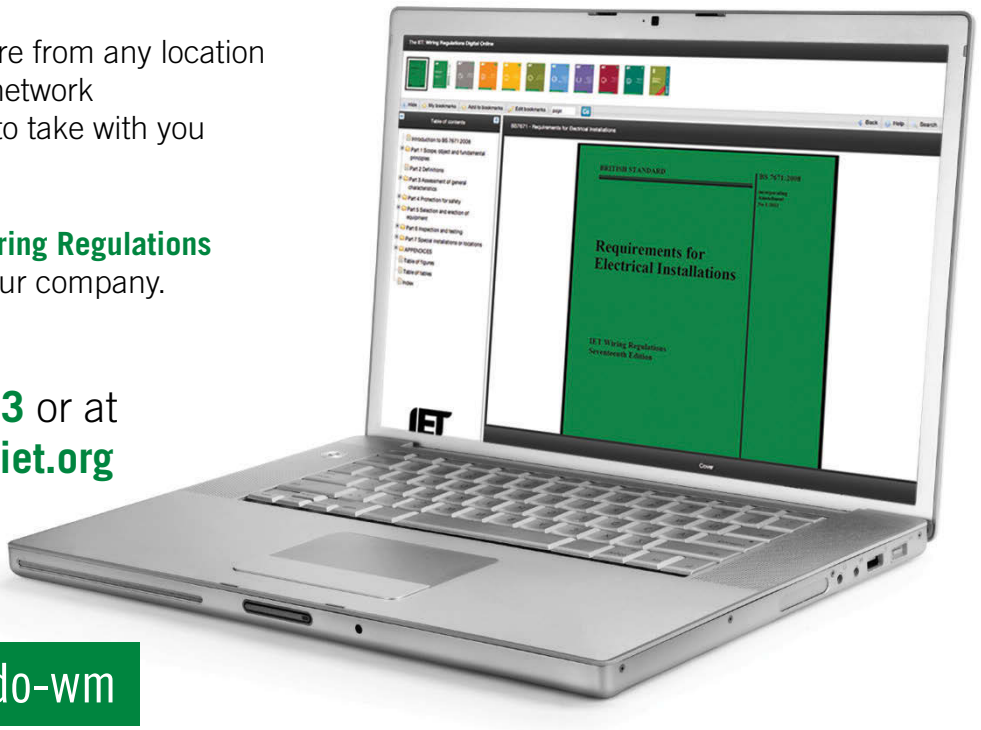

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