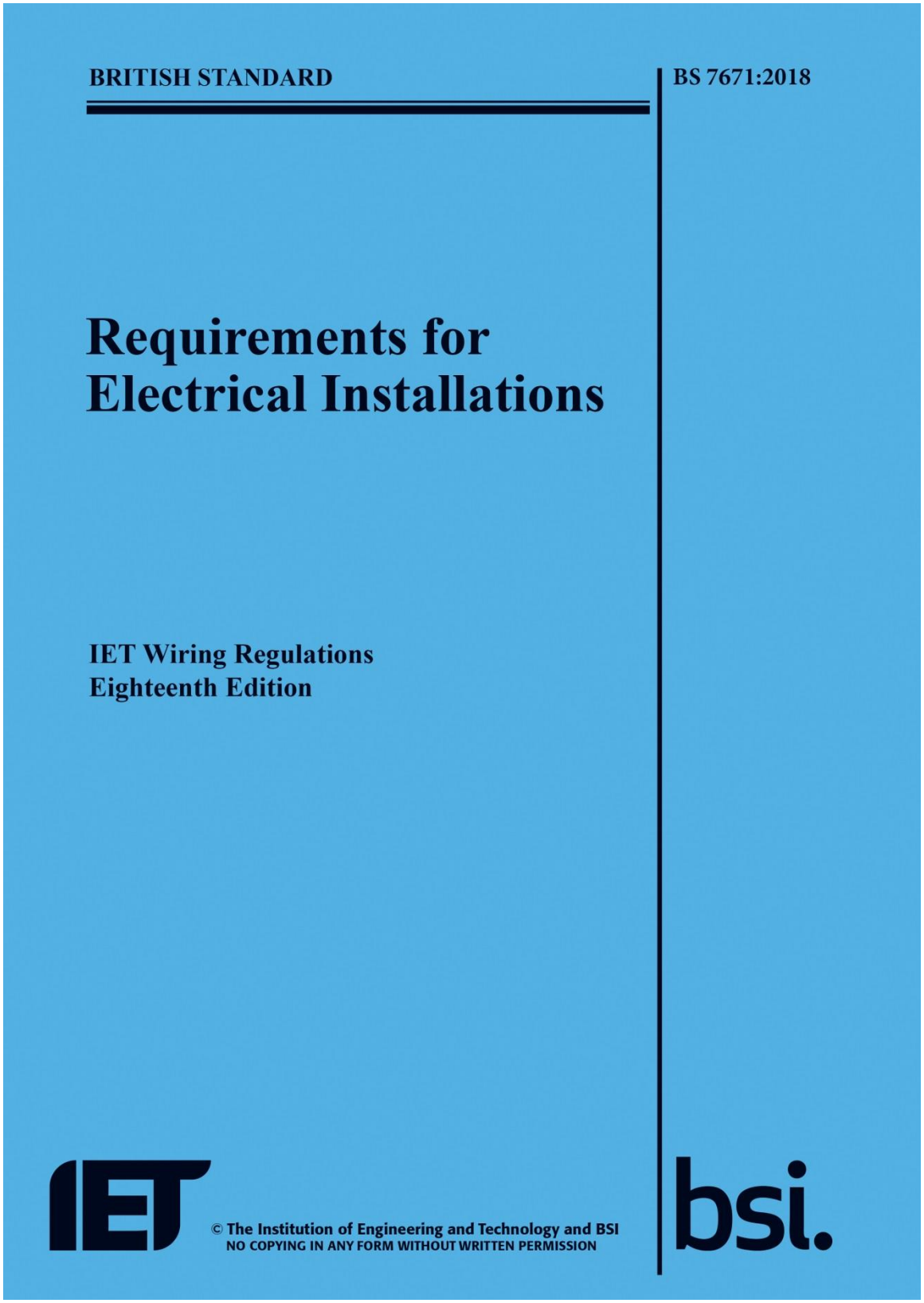



# WIRING MATTERS JULY 2018

# The 18th Edition (BS 7671:2018) is launched

BS 7671:2018 was issued on the 2nd July 2018 and is intended to come into effect on 1st January 2019. Installations designed after 31st December 2018 are to comply with BS 7671:2018.

In this article Geoff Cronshaw answers some of the typical questions that are raised and look at the impact that some of the changes introduced by the 18th Edition will have on the industry. We focus on electric vehicle charging, surge protection, and arc fault detection.

## Introduction

The IET often gets asked why is there a new edition or amendment to the IET Wiring Regulations (BS 7671). The IET Wiring Regulations (BS 7671) are based on European Standards which in turn are usually based on International Standards. As the UK is a Member of CENELEC (the European Standards organisation) the UK have to implement the technical intent of published CENELEC Harmonisation documents. The CENELEC Harmonisation documents are regularly updated to keep pace with new emerging technology such as electric vehicle charging, surge protection and arc fault detection.

## Section 722

Section 722 (electric vehicle charging installations) provides requirements for the supplies to electric vehicles. There are a number of significant changes in Section 722 of the 18th Edition.

*Protection against electric shock*

Regulation 722.411.4.1 concerning the use of a PME supply has changed. The exception for a dwelling if none of (i), (ii), or (iii) is reasonably practicable has been deleted. This now means that PME cannot be used unless you meet (i), or (ii), or (iii) of 722.411.4.1.

Regulation 722.411.4.1(i) refers to a situation where a connecting point is supplied from a three phase installation used to supply loads other than charging points and where the load is sufficiently well balanced.

Regulation 722.411.4.1(ii) requires a very low resistance earth electrode to mitigate the effects of an open circuit PEN conductor fault on the supply.

Regulation 722.411.4.1(iii) refers to protection by a voltage operated device. An important change is that the regulation now makes the point that this device could be included within the charging equipment. It is worth noting that this device will also require an earth electrode.

*External influences*

In addition to IPX4 (protection against presence of water), Section 722 now requires IP4X as well to protect against presence of solid foreign bodies (AE3), and protection against impact (AG2).

Any wiring system or equipment selected and installed must be suitable for its location and able to operate satisfactorily without deterioration during its working life. Suitable protection must be provided, both during construction and for the completed installation.

*RCD protection*

Regulation 722.531.2.101 has been redrafted concerning RCD protection. The regulation now contains further requirements for both type A and type B RCDs to take account of DC fault current.

*Socket-outlets and connectors*

It is now required that where a BS 1363-2 socket outlet is used for EV charging it must be marked 'EV' on its rear, except where there is no possibility of confusion. A label shall be provided on the front face or adjacent to the socket-outlet or its enclosure stating: "suitable for electric vehicle charging".

Socket outlets must be fit for purpose. They must be suitable for the load, and for the external influences such as protection against mechanical damage and ingress of water.

**Changes to the requirements concerning surge protection**

Clause 443 of the 18th Edition (BS 7671:2018) deals with protection of electrical installations against transient overvoltages (surge protection) of atmospheric origin transmitted by the supply distribution system, and against switching overvoltages generated by the equipment within the installation. Clause 443 contains significant changes.

The AQ criteria (conditions of external influence for lightning) for determining if protection against transient overvoltage is needed is no longer included in BS 7671. Protection against transient overvoltage now has to be provided where the consequence caused by overvoltage affects:

a) serious injury to, or loss of, human life;
b) interruption of public services and/or damage to cultural heritage;
c) interruption of commercial or industrial activity; and
d) interruption affects a large number of collocated individuals.

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

However, an exception not to provide protection is included for single dwelling units where the total value of the installation and equipment therein, does not justify such protection.

There are different types of SPDs. Type 1 are generally installed at the origin of the installation and type 2 are generally installed at distribution boards within the installation. It is important that SPDs are selected and installed in accordance with the manufacturer's instructions.

## The introduction of arc fault detection

*Protection against fire*

Protection against fire resulting from the electrical installation and the use of the electrical installation has been necessary ever since electricity was first introduced into buildings. Chapter 42 of the 18th Edition contains the requirements for the protection of persons, livestock and property against fire caused by electrical equipment, against burns and overheating and for including precautions where particular risks of fire exist.

The 18th Edition now recommends 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. The 18th Edition gives examples of where such devices can be used as follows:

a) premises with sleeping accommodation;
b) locations with a risk of fire due to the nature of processed or stored materials, i.e. BE2 locations (e.g. barns, woodworking shops, stores of combustible materials);
c) locations with combustible constructional materials, i.e. CA2 locations (e.g. wooden buildings);
d) fire propagating structures, i.e. CB2 locations; and
e) locations with endangering of irreplaceable goods.

Arcs can be caused by Insulation defects in cables, damage to cables by impact and penetration of nails and screws, loose terminal connections etc. Switching arcs caused by fluorescent lighting, for example, should not cause the AFDD to operate.

An AFDD is designed to operate (trip) when a dangerous arc is detected by analysing the signature of an arc. AFDDs can be installed in distribution boards and consumer units to protect final circuits. AFDDs should be installed in accordance with the manufacturer's instructions. When installing components of a different manufacturer to the existing equipment in a distribution board or consumer unit it is important to seek advice from the manufacturer that the new equipment is suitable and compatible.

### Important

Section 710 (medical locations) contains particular requirements.

Regulation 710.421.1.201 states: "In medical locations of Group 1 and 2 Arc Fault Detection Devices (AFDDs) are not required to be installed. In medical locations of Group 0 Arc Fault Detection Devices (AFDDs) shall be used subject to a risk assessment."

## Conclusion

Important: this article only gives a brief overview of some of the changes within the 18th Edition (BS 7671:2018). For more information refer to BS 7671:2018, which you can purchase here.

## Impact of the changes in the 18th Edition IET Wiring Regulations on the Lightning Protection and Surge Protection Industry

The 18th and latest Edition of BS 7671 (The IET Wiring Regulations) published on the 2nd July 2018. In this article, Sean Passant, ATLAS Council Member and Technical Manager at DEHN (UK) Ltd assesses the impact of this new edition on the lightning protection and surge protection industry.

Structural lightning protection has been with us since the late 19th century in one form or another, but it was only really formalised into a coherent standard with the release of BS 6651 in 1985. The adoption of the IEC standard in 2006 gave the UK the current BS EN 62305 which also contained the first real attempt to include comprehensive co-ordinated surge protection. The awareness of surge protection, its uses and benefits have been something of a 'slow burn' in the UK and even 12 years on from the release of BS EN 62305 surge protection can often be seen as something of a 'dark art'.

One of the key changes in the 18th Edition will be the requirement for surge protection devices (SPDs). This is a real seed change in the industry in the UK with the emphasis moving from a point of view of 'are they really required?'" to the new view which is very much 'prove you don't need them!'.

The 17th Edition contained a fairly lengthy and somewhat complicated risk assessment process including "AQ criteria" and "ceraunic levels" to establish whether SPDs were required or not. This is no longer included in the 18th Edition. Instead in Section 443 we have some very definitive criteria, which, if appropriate and applicable to your project, completely removes the requirement to carry out a risk assessment.

This section now states:

“Protection against transient over voltages **shall** be provided where the consequence caused by overvoltage effects:

(a) results in serious injury to, or loss of, human life, or

(b) results in interruption of public services and/or damage to cultural heritage,

(c) results in interruption of commercial or industrial activity, or

(d) affects a large number of collocated individuals”.

That covers an awful lot of structures in the UK without having to resort to a risk assessment. It is also heavily on the side of installing SPDs in the majority of cases. In addition to this, any structure fed via an overhead supply line shall also require an SPD.

Structures not covered by these stringent categories still require a risk assessment to be carried out. Here, the process has been simplified but there is still a fair amount of data that needs to be collected prior to undertaking the assessment. The new amendment offers a route around this process by stating that if the risk assessment is not carried out then SPDs shall be fitted in all cases. It’s not envisaged that this risk assessment will be completed by the lightning protection specialist; this is likely to be carried out along with other calculations relating to the LV distribution system.

This may not mean a great deal of change for many of the existing ATLAS accredited designers who were already well aware of the requirements for SPDs and the process of determining their use. However, a major change to Section 534 is a raft of measures that spell out the actual deployment of surge protection measures and here the real economic impact is felt. This roll out of SPDs is achieved by following the lightning protection zone concept (LPZ) – a concept directly taken from the current lightning protection standards BS EN 62305: 2012.

Regulation 534.4.1.1 requires SPDs to be installed at the origin of the installation and then further SPDs deeper within the low voltage (LV) distribution or data system to protect from surges generated from induced voltages or frequency oscillations within. Simply put; an SPD is required whenever a cable enters or leaves the internal zone (zone 1) from the external zone (zones 0a or 0b). There is also a requirement for additional SPDs to be installed each time a cable or service crosses an internal zonal boundary. These internal zones are to be determined via consultation with the end client and their associated specialist advisors/contractor.

Which type of SPD is installed at the origin, depends on whether there is a structural lightning protection system (LPS) installed or not. Type 1 SPDs should be installed if there is a fitted LPS and type 2 if there is no fitted LPS. Then the exact position of the service line/cable must be looked at, if there is a fitted LPS. A type 1 device is definitely required if any cable or service line is routed from the outside the zone of protection afforded by the

structural LPS (external zone 0a) this would also include any plant or services which have been 'bonded' into the structural lightning protection system. If the external load is within LPZ0b (an area protected by a structural LPS with air rods or catenary wire system for example) then no direct strike is possible so a type 2 device is acceptable.

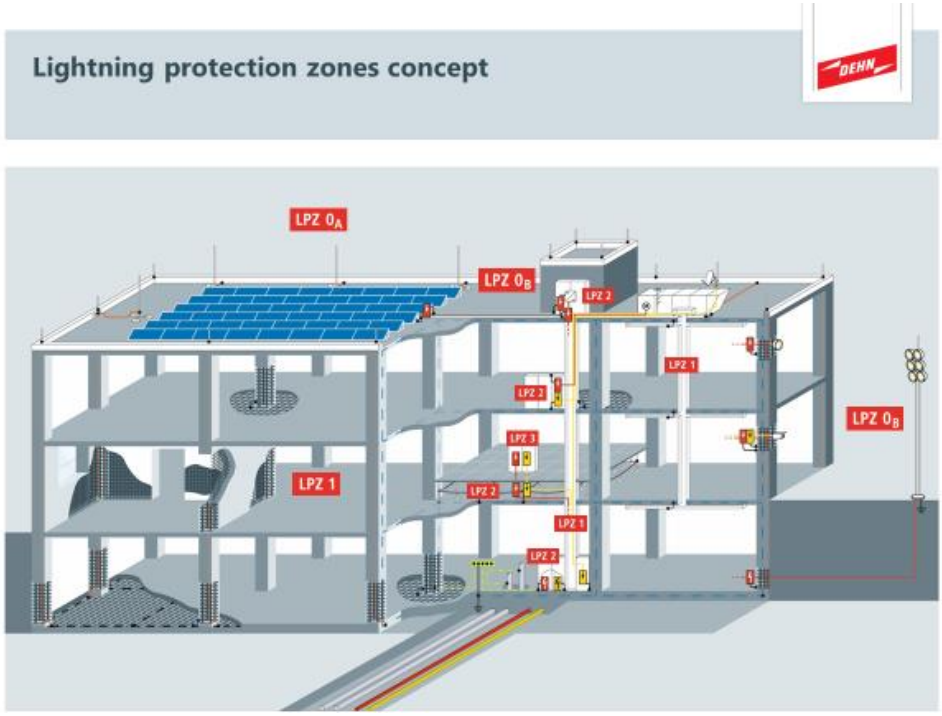



**Figure 1**: Lightning protection zones concept

Just how well the zonal concept will work in practice remains to be seen; this concept has existed within the lightning protection standards for 12 years but remains widely misunderstood outside of that specialist, niche industry. The requirement for zoning a structure really does need some in-depth input and thought on behalf of the end client and their specialist contractor, exactly which services and equipment will be critical for the function of their structure and their ongoing business continuity will have to be determined at as early a stage as possible. This conversation will be one that some lightning protection installers have not had previously, it will now become unavoidable.

All the above must be addressed at the design stage, the initial risk assessment, the location of the LPZ zones and the level of LPS required (if any) must be known from the onset so the SPDs can be factored in for the panel builder to allow space in the control or power panels.

The LPZ zones are fundamentally derived from any structural lightning protection requirements and these are driven by the risk assessment process within BS EN 62305. This information will now be required at a very early stage in the planning and design phase.

Additional care will need to be taken with any structures which are covered by The Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) or The Control of Major Accident Hazards Regulations 2015 (COMAH). Lightning and LV overvoltage faults

are dangerous sources of ignition in hazardous areas that need to be controlled to prevent explosion, the SPD requirement on such projects will therefore become even more important and the zonal concept even more stringent, as an industry we are going to have to become better informed.

These new regulations will mean that there will have to be a far closer commercial, technical and engineering relationship between the end client, the M&E designer/contractor, the panel manufacturer and the lightning protection specialist. Previously this relationship has been quite limited. It is impossible to imagine that all the requirements of Sections 443 and 534 could be fully understood and met without these parties enjoying a closer and more mutually beneficial relationship going forward. It is a relationship that may have to be driven by the lightning protection specialist.

Clearly there are huge opportunities ahead for the whole industry as the volume of SPDs required will increase dramatically. In addition to this, the consultation required with lightning protection contractors will now include projects where there is no structural LPS, typically projects the industry had no prior input or knowledge of. However, potential commercial benefits need to be countered by ensuring that the end client receives the correct technical solution but this is certainly a large growth area.

Training and continuing personal development (CPD) will be essential to ensure that the knowledge base is extended right through the project delivery chain from estimator, to contract manager and site supervisor if the full remit of BS 7671 and BS EN 62305 are to be realised and a project safely and correctly signed off as compliant. Training courses are already being planned which will be delivered through ATLAS (Association of Technical Lightning & Access Specialists).

**The IET Academy 18th Edition Certificate in the Requirements for Electrical Installations BS 7671:2018. Working with City & Guilds**

After much anticipation by the electrical industry, the 18th Edition of the IET Wiring Regulations, BS 7671: 2018 published on 2nd July. Over a century has passed since the 1st Edition of the 'Wiring Rules' was published and, although fundamental principles are relatively similar, it is the electrical industry that has changed astronomically in this time. The range of materials and equipment used in the electrical industry, as well as installation methods, are much wider reaching than ever before

**Why is it important to keep up to date with the current requirements?**

Let's look at it from another point of view. You are likely viewing this article on your smart phone or laptop. What model is it? If current, how long will it be until a newer better model is available? Probably not more than six months. This isn't just happening with smart phones and laptops; the whole planet is advancing quicker than ever before. There are many emerging technologies being introduced into the electrical industry that require skilled persons, competent in such work, to install them whether it be the installation of a solar PV system, electric vehicle charging point, SPDs or AFDDs. To develop the minimum installation standards for current and emerging technologies experts and specialists are continuously working to produce requirements to be met during the installation of the wiring system so that they are safe to be used.

Undoubtedly, newer and better technology will supersede what is currently being installed. However, it is essential that minimum safety standards are produced and updated so that wiring systems and equipment can be installed by skilled persons that are competent and understand the requirements for electrical installations.

**Training options and keeping up to date**

The IET Wiring Regulations (BS 7671) is amended or updated every 3-5 years, based on the current price of the book that works out to be between 4-8 pence per day or between £14 and £29 per year. A TV licence costs around five times as much. So in terms of value for money BS 7671 is a winner, if you don't believe me have a look at the price of some other British Standards!

An electrician, in the UK, will be expected to carry out work in accordance with the current version of BS 7671. There are various qualifications available that an electrician can gain to demonstrate to potential employers and scheme providers, when being interviewed or assessed, that they are aware of the current requirements. Training for these qualifications can be gained through colleges and training providers and now there is the IET Academy.

Working in the electrical industry today can be demanding and the thought of taking time off work to sit in a classroom is, for many, not worth thinking about. The IET Academy online training for BS 7671:2018 C&G 2382:18 examination saves taking time away from the job and provides interactive resources to help you to absorb information. The resources are available on your computer, tablet and even your smart phone which means that there is no need to take valuable time off work. The package also provides three full practice exams to work through, so that you can build up confidence, knowledge and understanding before sitting the exam. After completing the IET Academy 18th edition course, the examination can be taken at a local exam centre as usual. The course material provides information and guidance on how to book the exam.

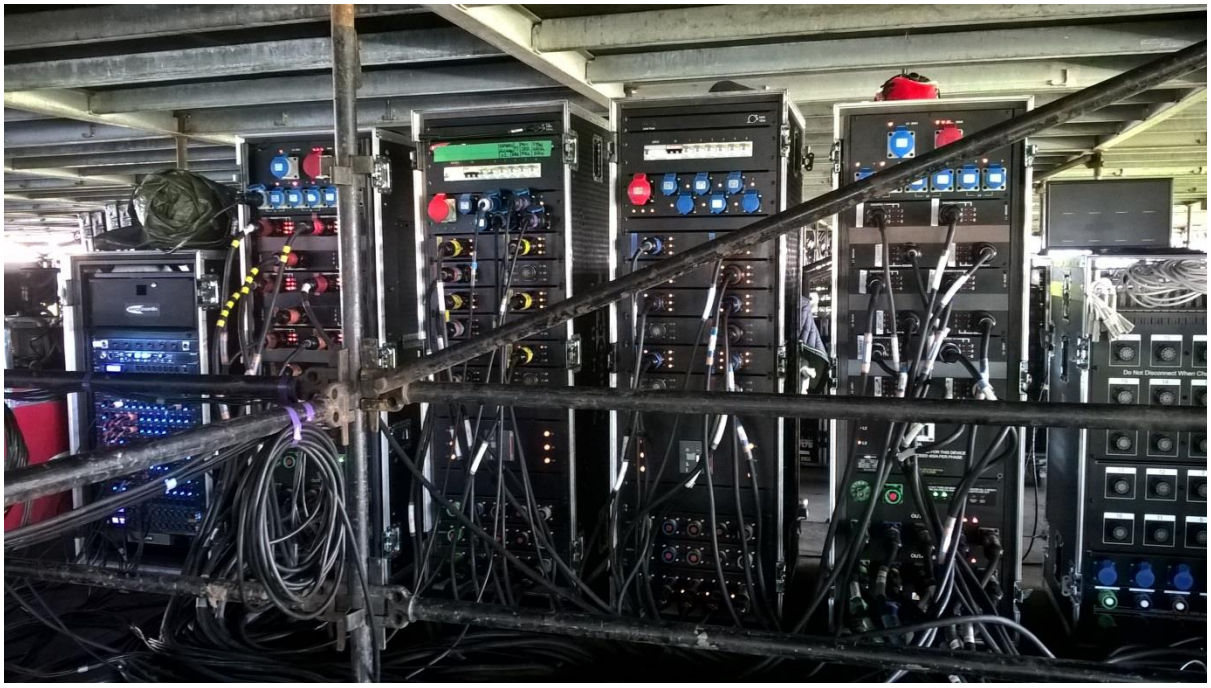
**BS 7671 18th Edition available from Monday 2nd July**

The 18th Edition of the IET Wiring Regulations published on the 2nd July and will come into full effect as of January 2019. BS 7671 is one of the few British Standards that has a transitional period. This means that from publication there will be roughly six months that either the current edition or the new edition can be used. This does not mean that installations can be installed using two different standards, for example, if a new installation is started using BS 7671 2008 +A3:2015 then the entire installation must be to that standard. The same is true if you are using the 18th Edition.

**2019**

As of January 2019 all electrical installations within the scope of BS 7671 should comply with the 18th Edition. If you are a member of a scheme operator you will most likely be required to produce a certificate to show that you have passed the 18th Edition examination. For those of you who have been in the industry for a while there is the option of an update course and if you are new to or returning to the electrical industry there is a full course available.

For more details on the courses available please visit https://academy.theiet.org/training-courses and don't forget the new electrical website packed full of useful information and links https://electrical.theiet.org/



**Implementing the 18th Edition in concerts, theatre and events. Easy as…? James Eade highlights some of the changes making the headlines in that sector.**

Event electrical systems have one big advantage over others, namely that much of the distribution has been pre-made so it all plugs together. Concert in a field for 20,000 people? No problem, the electrical supplies, distribution and final circuits will be installed in a couple of days, tested and handed over. If it were made from scratch, it'd take many electrical wholesalers that long just to source all the hardware.

This is all good, but when the spectre of change to electrical standards loom, it can be a worrying time. When a temporary system is put together, it's classed as a new installation, so should comply with the current version of BS 7671. In other words, from January 2019 every event will need to be compliant; having pre-built equipment that you can easily re-use is fine, until it needs changing. That is the Achilles heel of most systems; there is no physical room to add extra protection devices if it's required, so changes can involve major – and expensive – re-engineering to stock equipment. It's also possible that some distribution units could be rendered obsolete overnight. Ordinary electrical installations don't have this issue so much; the distribution boards are specified based around the protection required given the requirements at the time.

So what changes are likely to affect the industry? We asked some of the ABTT companies for comment on the 18th Edition, and how it might affect their businesses.

Chapter 41 which covers protection for electric shock sees quite a few changes. Currently Table 41.1 requires circuits under 32 A to have a disconnection time of 0.4 seconds, whereas this is being increased to 63 A going forwards. This is not a problem if you use miniature circuit breakers for protection, as the operating time is the same between 0.1 and 5 seconds. However, as Mark White, EU Sales Manager for the international stage lighting manufacturer ETC notes

"Many theatres still have legacy equipment with re-wireable fuses in them; they won't pass muster anymore. It could have financial implications for some."

Regulation 411.3.3 requires the use of 30 mA RCDs to provide additional protection against the risk of electric shock. It has been revised and now applies to socket-outlets with a rated current not exceeding 32 A indoors. In events, both single and three-phase 32 A circuits are often used for distribution, powering other units with appropriate RCD protection on final circuits.

Richard Bunn, Senior Consultant for Venues with Consultancy Arup, elaborated on this:

"We have been routinely specifying 30 mA RCD protection on circuits up to 63A. This is based on the view that these sockets are often very accessible and used by people with limited electrical knowledge, so the RCD reduces the risk of injury due to electric shock. Above this power level, there is a reasonable expectation that connection and associated equipment will be by a knowledgeable technician. From this viewpoint the amendments are in-line with our current thinking."

There is of course the problem of ensuring appropriate selectivity (formerly referred to as 'discrimination') between devices, and ensuring that unwanted operation of RCDs does not occur given the normal leakage currents from equipment. Bunn continued

"The rise of LED based luminaires with smaller loads and deliberate leakage currents associated with EMC filtering is presenting a significant challenge for distribution strategies. The limiting factor on the number of luminaires that may be connected to a circuit has once again become avoidance of unwanted tripping of the RCD rather than total load on the circuit. This will impact the design of new connection panels for temporary equipment."

For the first time in a while, a new type of protective device makes a debut in this Edition - the Arc Fault Disconnection Device (AFDD). These devices can identify arcing in a circuit and will provide protection for insidious faults like cable damage or equipment failure where there may not be enough current flowing to operate other protection such as circuit breakers, but enough to start a fire.

Currently they are recommended in final circuits where there's a heightened risk of fire or the effects thereof i.e. sleeping accommodation, locations storing flammable substances or installations at risk of fire such as old wooden buildings for example. This is where they could come in particularly useful; many old theatres are full of old timbers in stages and roof structures for example. They usually contain lots of old wiring and equipment too – as such retrofitting AFDDs could provide significant benefits. Mark White did highlight the skilled nature of crews on events though

"We have had a sort-of manual arc fault detection in at least lighting circuits in theatres for many years. We all are taught that electrical termination screws come loose with time, and when that happens technicians spot the flickering in tungsten lights due to the loose terminals. However, what about the circuits you can't see? Also not all stage lighting is incandescent, so electronic power supplies can mask the effects".

Richard Bunn noted that

“The AFDD is an interesting development. If we risk assess our environment to be at heightened risk (temporary cables with connectors running across a wooden grid?), this could add significant expense. Embracing this will also be dependent on manufacturers designing the protection into dimmer and distribution product so that it is available on the market. It will be interesting to see whether this becomes a more standard requirement over time, noting that RCDs were originally introduced as a similar innovation in a very limited way, but the scope of their application has been extended in each revision of the Wiring Regulations.”

Another change that has caused a lot of excitement especially on social media is the need to protect cables against premature collapse in the event of a fire. The last Amendment (3) to BS 7671 has required cable in escape routes to be suitably protected, such as can be achieved by using metal cable supports. There has been a lot of debate about what constitutes an ‘escape route’ as it may not always be obvious – for example in a theatre the aisle of an auditorium could be classed as such, as could the ramp off the back of a stage at a festival. Regulation 521.10.202 has been updated and now requires *cables to be adequately supported against their premature collapse in the event of a fire*. This now applies throughout the installation and not just in escape routes. As Mark White observed though,

“Technical Standards for Places of Entertainment has had a requirement for many years that all cabling shall be enclosed in metal containment so as to contain it in the event of a fire and to provide mechanical protection.”

Surge Protection Devices (SPDs) are not a new introduction to BS 7671, but the relevant Section in BS 7671 has been substantially revised. SPDs made more of an impact in Amendment 3 of the 17$^{th}$ Edition, but included the requirement for a risk assessment based on the AQ criteria. That requirement has now changed and protection against transient overvoltages *has to be provided* where the consequence caused by overvoltage (Regulation 443.4):

(a) Results in serious injury to, or loss of, human life, or

(b) Results in interruption of public services/or damage to and cultural heritage, or

(c) Results in interruption of commercial or industrial activity, or

(d) Affects a large number of co-located individuals.

Few events would not fulfil at least one or more of the above. A large number of co-located individuals or ‘Commercial or industrial activities’? Well, pretty much everything the industry does fits into one or both categories.

Jim Brown, General Manager of rental company Pearce Hire neatly rounds up the industry barometer:

“As with all new regulations and standards there’s understandably a fear from businesses that they will be hit with extra demands and additional costs. The final changes, in the main, appear fairly reasonable. Some questions of interpretation remain-particularly with regards to Surge Protection Devices in temporary systems.”