

WINTER 10 ISSUE 37

# WIRINGMATTERS

The Institution of Engineering and Technology

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**Installation Cables**  
The prevalence of  
substandard cables  
in the UK

**Standards**  
An insight into the  
development of  
BS 7671

**Smart Meters**  
Roll-out of new  
installations to  
commence in 2012

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# Smart electricity meters

A roll-out programme to introduce smart electricity meters into consumers' homes starts in 2012

By Geoff Cronshaw

The department of energy and climate change is planning to start a roll out programme to introduce smart electricity meters into consumers' homes in 2012. The programme is expected to run through until 2020 with the aim of helping customers to reduce their energy bills.

The smart meter will give customers information on energy consumed via a visual display and be capable of sending metering information to the energy supplier regarding the electricity consumed by the customer without the need of a meter reader.

This should put an end to estimated bills. It will also give customers information on any energy sold back to the energy supplier where the customer has a microgenerator installed such as a wind turbine or solar panels. (PV)

## What is a smart meter?

A smart meter is an electricity energy meter that incorporates a communications unit. The meter will measure the energy consumed and also measure any energy exported to the electricity network (where the consumer has micogeneration, such as a wind turbine or solar photovoltaic panels). The big difference is that the smart meter does not require a meter reader to visit the premises.

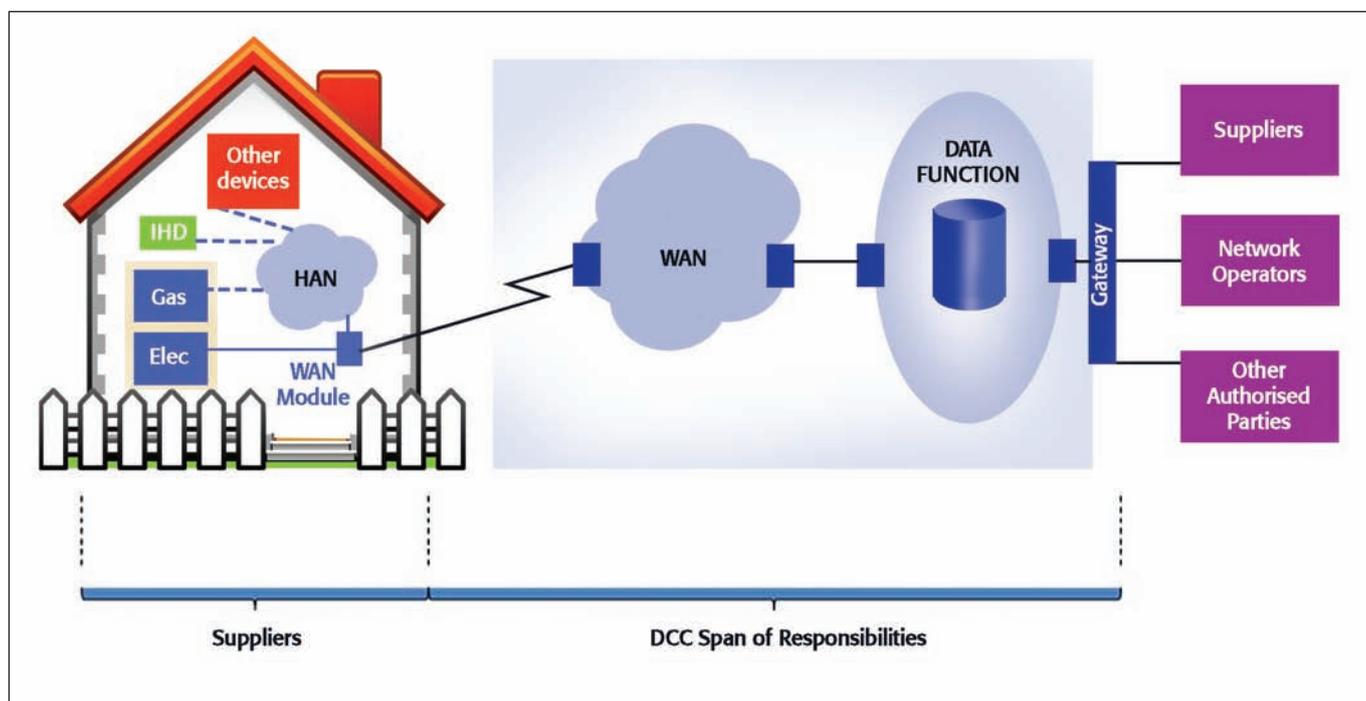
It is understood that smart meters will use wireless technology to communicate between the meter and the communications hub within the premises. To transmit the meter reading data to the energy supplier a number of communication options such as radio, power line transmission (PLT), or mobile phone technology could be used. It is expected in most cases, however, that mobile phone technology will be the



Consumer display-unit



Smart-meter installation



Typical configuration from Energy Networks Association

option used. A smart meter system may also be capable of controlling the consumers load in the future by sending signals to consumers appliances to switch off at peak times etc. It is also expected that the smart meter will be capable of providing flexible tariffs.

#### Who will install the smart meters?

Energy suppliers are responsible for the installation of the smart meters but this work may be carried out by their meter operators. The Smart metering roll out programme is probably the largest project ever undertaken within the electricity industry. It is estimated some 47 million meters (gas and electricity) will have to be changed and some 28 million homes will have to be visited.

The Energy Networks Association (ENA) has created a Smart Metering Operations Group to deal with the coordination of distribution

issues related to the installation of smart meters. The Energy Networks Association (ENA) represents the interests of its member companies who operate the national and regional networks for energy to transport gas and electricity into UK homes and businesses. The smart-metering roll-out programme is expected to commence in 2012 and it is hoped that a minimum of 60 per cent of installations will be complete by 2017 according to the ENA.

In order to achieve this the ENA anticipates that there will be a need for more training. The ENA is carrying out a coordination role and is planning an agreed process of installation with meter operators, as well as agreed meter installer checklists and processes, together with documented risk assessments for various installation types, defect reporting and rectification process, and an agreed process for inspection of distribution-owned equipment.

The Energy Networks Association has anticipated a wide range of operational issues in order that these can be catered for by the organisations responsible for the smart-meter installation. The operational issues include: asbestos meter boards; identification of service position faults; damaged distribution owned equipment; polarity issues; damaged meter boxes; fused neutral cut outs and other metal clad cut outs; lateral and rising mains issues; replacement of meter tails; earth connections; and signs of overheating, etc. There may also be issues relating to data communication and possible issues with the consumer's electrical installation itself.

#### What effect will the IEE Wiring Regulations (BS 7671:2008) have on the installation of smart electricity meters?

Systems for the distribution of electricity to the public (such as metering equipment) are outside the scope of the IEE Wiring Regulations

(BS 7671:2008). The distribution of electricity to the public is controlled by the Electricity Safety, Quality and Continuity Regulations 2002 (as amended) published by the Department of Business, Innovation and Skills (BIS). Therefore the issue of smart metering is not within the scope of the wiring regulations.

However, it is important to point out that meter tails from the electricity meter to the consumer unit are part of the consumer's installation and the IEE 'On Site Guide' gives guidance on this area.

Further information can be gathered from:  
 Department of Energy and Climate Change  
 Business Innovation and Skills  
 Energy Retail Association  
 Energy Networks Association



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# Wiring Regulations Digital

## in practice



The Wiring Regulations and some supporting publications are now available in e-book format. There are two packages, designed for domestic and industrial installers, and there is a **free trial** of the industrial package for a limited period.

By Ian Reeve

These products are available on the VitalSource Bookshelf, a smart, interactive and fully searchable e-book format with a powerful set of tools included.

A collection of IET books on your PC sounds like a good idea, but what is it like in practice? Feedback from users shows that the range of great features makes it suitable for many different applications.

### Contractors

For contractors, familiarity and ease of use are the key. Five features turn out to be particularly useful.

■ **Cross-referencing.** This is perhaps its most powerful feature. Obviously, one might expect that clicking on a contents page item, an index entry or an obvious cross-reference in the text would take the reader to that location and, of course, it does exactly that. However the Guidance Notes in particular, also carry cross-references in their text and the margins. These too, when

The screenshot shows the VitalSource Bookshelf interface. On the left, a 'Collections' sidebar lists various books, with 'IET Wiring Regs Digital' selected. The main window displays the 'On-Site Guide' for 'Requirements for Electrical Installations, IEE W'. The 'Contents' pane on the right shows a drill-down menu where '2.1 General layout of equipment' is selected. The main content area shows the text for section 2.1 and a diagram of a TN-C-S system meter position arrangement. The diagram includes a 100A main earthing terminal, a consumer's tails, a main switch, and various conductors (circuit protective, metal water pipe, water service pipe, gas service pipe). A note at the bottom states: 'Note: An isolator is often not installed by the distributor.'

Selecting the On-Site Guide opens the book

Using the extended contents 2.1 is selected

clicked, jump to the linked page.

■ **Finding a particular regulation quickly.** For this, the drill-down facility within the extended Contents list enables Regulations to be easily and quickly found – as shown to the right.

■ **Familiarity.** Wiring Regulations Digital displays the

The screenshot shows the 'Contents' page for 'Requirements for Electrical Installations'. The table of contents is as follows:

|   |    |
|---|----|
| Requirements for Electrical Installations |    |
| CONTENTS                                  | 3  |
| Introduction to BS 7671:2008              | 4  |
| Notes on the plan of the 17th...          | 10 |
| PART 1 SCOPE, OBJECT AND...               | 11 |
| CHAPTER 11 SCOPE                          | 12 |
| 110.1 GENERAL                             | 12 |
| 110.2 EXCLUSIONS FR...                    | 13 |
| 111 Not used                              | 13 |
| 112 Not used                              | 13 |
| 113 EQUIPMENT                             | 13 |
| 114 RELATIONSHIP W...                     | 13 |

The '113 EQUIPMENT' section is highlighted in blue. To the right, a snippet of the text for section 113 is visible, starting with 'EQUIPMENT' and 'The Regulat equipment in the installati assemblies of electrical equ'.

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books as exact copies of the familiar printed pages.

This approach to producing the digital versions was against the perceived wisdom. This suggested that, since printed pages are a different size to computer screens, the text in the books should be broken down to screen-sized chunks, and a strong font used to aid viewing. Testing proved that looking at actual pages reassured contractors that the text was correct. This was particularly evident when a complex Regulation was presented as a screen chunk. In that case, the accuracy of the text was sometimes questioned, whereas the same Regulation presented as in the printed page was not questioned. To present text in this way, a standard software package, VitalSource Bookshelf was used. This package is designed to present printed pages on screens, and so provide a very clear and readable interface for users.

■ You always know that you are using the latest information from the IET – because your bookshelf can be automatically updated via the Internet. So if the IET issues a correction to any of the books, you can be assured of receiving it. Obviously, any new editions would need to be purchased – although the IET is offering a **free update** to the new digital books after the 17th Edition Amendment No 1 is published, if you buy them now.

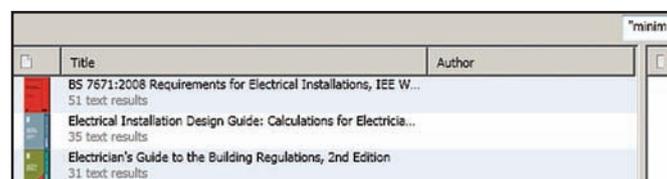
■ Once you have installed the VitalSource Bookshelf software, you can download e-books to your computer (or two computers) and access the content whenever you need it without going online.

One extra piece of good news for NICEIC contractors is that the Inspecting Engineers will accept Wiring Regs Digital as an alternative to the books, provided that they are readily available to all relevant persons at all times, whether site- or office-based.

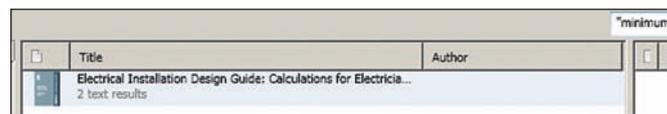
### Consultants

For consultants, it is the powerful search and text copying facilities of Wiring Regs Digital that are of particular importance.

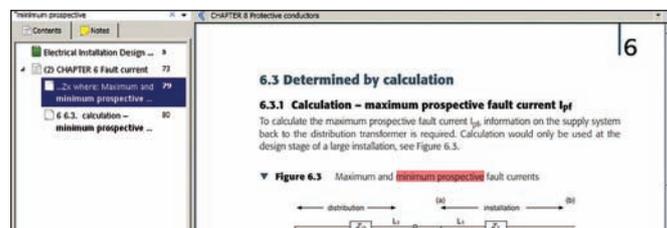
■ Wiring Regs Digital comes complete with an Internet-style search engine, which will search all of the books in a second. If, for example, you are interested in “minimum prospective fault current”. You don’t even have to type all that in, just typing “minimum” will immediately find:



That’s 51 matches in the Regs, 35 in the Design Guide etc, however as you keep typing when you get to “minimum prospective” only the two matches in the Design guide are listed.



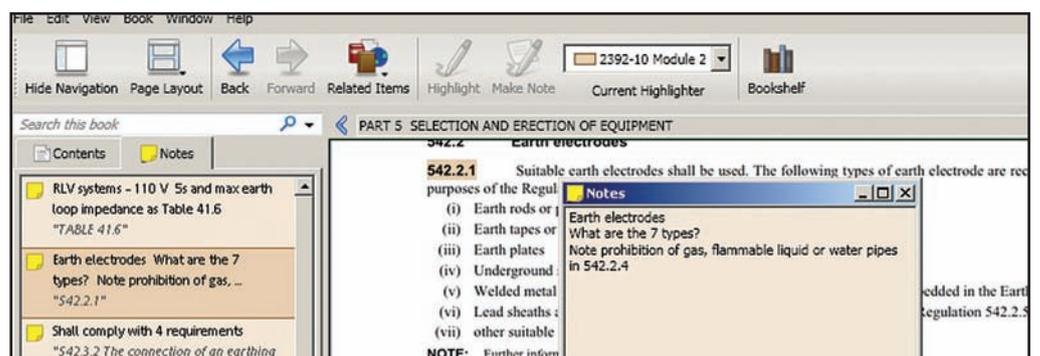
Clicking on that opens up the Design Guide as:



The really observant will have noticed that I actually typed a “quotes symbol” before the words minimum prospective – that forces a “match exact phrase” type of search.

■ For consultants, pages can be printed out and text can be copied and pasted (and edited via a word processor) into reports.

■ Notes can be added and even shared between colleagues – see below.



■ You can download e-books to your computer (actually two) and access the content whenever you need it without going online.

■ It is possible to build a library: by purchasing other titles from the VitalSource store as required, or linking your own pdfs and Word documents into your own folders within Bookshelf.

### Lecturers and students

For lecturers and students, the main requirement is to get to a particular location in a book as quickly as possible and then, perhaps, to produce a report or search for further information.

■ The search and copy facilities, described earlier, enable the production of research notes, summaries and reports, which can be linked into your own folders within Bookshelf.

■ Links from PowerPoint (or Word) can be made for use in the teaching environment.

■ The underlying software from VitalSource Bookshelf has been designed with students in mind. It allows notes to be added and shared and grouped. Any groupings can be created, with ‘Exam’, ‘Important’ and ‘Need Clarification’ as defaults. This shows a student’s own notes for Module 2 of the 2392-10 course.

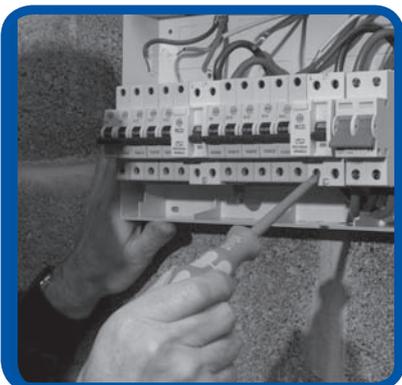


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# The Prevalence of Sub-standard Installation Cables in the UK

The quality of installed cables has come under a good deal of scrutiny from the Approved Cable Initiative. The results of the ACI's tests are alarming. Here we look at what was found, and what can be done to rectify a serious problem.



## By Richard Townsend

Over the last couple of years it has come to light that the quality of installed cables has come under scrutiny for a number of reasons. A key player in the compilation of this information has been the Approved Cable Initiative (ACI).

The ACI has openly been campaigning to bring to the attention of the electrical industry to the increase in occurrences of dangerously sub-standard cables used within electrical installations. The organisation has logged several cases on its website at [www.aci.org.uk](http://www.aci.org.uk).

It was found in the logged cases that the diameter of conductors used – both live and cpc – was significantly below the minimum requirements of the British Standards. This has a profound effect on the thermal efficiency and current-carrying



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capability of the conductors affected; the increased thermal loading of the insulators – owing to the increased resistance and therefore higher operating temperature – can exceed the design parameters of the cables, which affects the circuit design, resulting in a potential source of combustion.

Independent testing by the ACI has also found the standard of the copper in cable conductors used in some of the logged cases to be of a lower grade. This adversely affects resistivity per metre, resulting in the resistance on a given length of cable being increased. This can increase the Zs value of

final circuits which, as a result, could increase to such a level that initial design calculations would be exceeded and would possibly not meet the required disconnection times.

Low copper content and reduced conductor diameters have also been found in stranded cables, in so much as the number of strands in some cables has been reduced, having similar effects to those already described.

In addition to the practice of under-sizing the conductors, steel and aluminium conductors have been found

to be copper coated, which can cause similarly catastrophic effects.

ACI independent tests have also found – as well as the reduction of the copper content and diameter in conductors – that the materials used for insulation and the process to cure these materials are substandard to the point at which they could present either a high combustion risk, a high shock risk, or both, depending on the installation method. The effect on the insulation can be seen from the image below. Needless to say, the effect would be very serious of the insulation falling off and coming into contact

with an unsuspecting engineer tracing a fault – or indeed in the instance of cables being clipped direct whose conductors come into contact with unsuspecting individuals when the insulation degrades.

Other problems with the improper curing of insulators has seen the green band in green and yellow “earth” cable becoming detached and spiralling away from the main cable – a far from ideal circumstance that leaves a safety conductor incorrectly marked.

One common failing of armoured cables is the greatly



Damaged insulation could have a very serious impact on the unsuspecting engineer. Image courtesy of the ACI

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- Devices for Protection Against Overvoltage (Surge Protection) – new Section 534
- Medical Locations – new Section 710
- Operating or Maintenance Gangways – new Section 729
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reduced or poorly constructed armour strands, so the protection afforded or expected protection will be seriously compromised. Coupled with all of the other failings mentioned, the stalwart 'do all' armoured cable trusted by many suddenly becomes a multiple life threat.

### The Logistics

It would be reasonable to expect that such misdemeanours would be isolated and limited, with respect to the volume of produced material in the market place. However, the amount of substandard cable currently in use within our industry is very substantial. The cable from one manufacturer alone represented 14 million metres of affected cable of varying types but predominantly armoured and flat twin types (some HO5vv-F type cables also affected along with fire rated and 'arctic' type cables). Given these types of cable, the potential risk to domestic customers could be significant.

### What to look for

The ACI will undertake to test for free any samples of cables given to them and will give guidance to installers on the steps that they will need to take if the results are unfavourable. The organisation also produces several flyers to help with what to look for when encountering suspect cables. The ACI currently has industry support and backing from major certification and trade bodies, including ECA, ESC, NAPIT, NICEIC and BASEC.

Identifying sub-standard cables is not easy, as all 'counterfeit' products are relatively convincing. Some will

have fake approval markings, some will be cleverly worded to intimate that they are built to a British or European standard, when they are not. Some will be legitimately marked as approved – which they could be – however the actual quality is below that required standard.

It was for this reason, and similar practises, that the Turkish manufacturer Atlas Kablo was removed from the BASEC register and its HAR license (European equivalent of BASEC), removed. The HSE is currently evaluating the findings from the cable tests before considering its position and possible further action.

Given the varying degrees of poor-quality manufactured cable and counterfeit products, it is a hard task to eradicate the problem from the industry and we all need to take a role in removing the threat from ourselves and our clients.

When designing either a distribution or final circuit the designer will have a theoretical circuit resistance and in turn design Zs; if installers then test and report vigilantly, during and after, as described by BS 7671, then a great many faulty cables (increased resistance due to reduced diameter conductors, low copper grade or coated steel conductors), can be identified before they are finally energised and put into service, potentially risking the lives of clients and maintenance engineers alike.

Government statistics have shown that 27 per cent of electrical fires are accountable to poor quality cables and wires and of



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- Eradicate manufacturers and distributors of non-approved, unsafe or counterfeit cable products.
- Stop importers deliberately under-specifying cable for their own profit.
- Lobby Government to make the sale and use of compliant, approved cable obligatory in the UK.
- Proactively investigate non-approved, unsafe or counterfeit cable products in the supply chain.

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|   |                                     |
|---|-------------------------------------|
| <b>Cable is UNMARKED</b>  | <input type="checkbox"/>            |
| <b>Cable is marked with MANUFACTURER'S NAME <sup>1</sup> for traceability</b>                         | <input checked="" type="checkbox"/> |
| <b>Cable has NO MANUFACTURER'S NAME marked <sup>1</sup></b>   | <input type="checkbox"/>            |
| <b>Cable has CORRECT BRITISH OR EUROPEAN <sup>2</sup> STANDARD NUMBER</b>                             | <input checked="" type="checkbox"/> |
| <b>Cable has NO BRITISH OR EUROPEAN STANDARD <sup>2</sup> NUMBER</b>                                  | <input type="checkbox"/>            |
| <b>Cable has THIRD PARTY APPROVAL (e.g. BASEC, HAR) <sup>4</sup> for independent assurance</b>        | <input checked="" type="checkbox"/> |
| <b>Cable has NO THIRD PARTY APPROVAL <sup>4</sup></b>   | <input type="checkbox"/>            |
| <b>Cable marking has CORRECT NUMBER OF CORES <sup>6</sup> &amp; CROSS SECTIONAL AREA</b>              | <input checked="" type="checkbox"/> |
| <b>Cable marking has INCORRECT NUMBER OF CORES &amp; CROSS SECTIONAL AREA <sup>6</sup></b>            | <input type="checkbox"/>            |
| <b>Cable has CORRECT VOLTAGE RATING marked <sup>5</sup></b>   | <input checked="" type="checkbox"/> |
| <b>Cable has INCORRECT VOLTAGE RATING marked <sup>5</sup></b>   | <input type="checkbox"/>            |
| <b>Cable is CORRECTLY PACKAGED WITH MANUFACTURER'S TRACEABILITY INFORMATION <sup>1</sup></b>          | <input checked="" type="checkbox"/> |
| <b>Cable is INCORRECTLY PACKAGED WITHOUT ANY MANUFACTURER'S TRACEABILITY INFORMATION <sup>1</sup></b> | <input type="checkbox"/>            |
| <b>Cable CONFORMS TO THE DELIVERY NOTE AND TO THE ORDER PLACED</b>                                    | <input checked="" type="checkbox"/> |
| <b>Cable does not CONFORM TO THE DELIVERY NOTE AND TO THE ORDER PLACED</b>                            | <input type="checkbox"/>            |

**HOW YOU CAN HELP. WHAT TO DO IF YOU FIND FAULTY CABLE.**  
 If you have concerns or suspicions about any cable supplied to you, contact ACI on: **01908 267300** or [report@aci.org.uk](mailto:report@aci.org.uk) for advice and assistance. Please keep a short (~5m) sample with markings and packaging for examination and testing.

that there have been 15 fatalities in the last five years. This, then, is a very real danger. If the current trend of using low-quality cables, from a cost driven commercial aspect, continues to increase, the fatality rate can only grow.

It is vital that everyone – designer, wholesaler, and installer – involved in the

installation process understands the grave implications of admitting sub-standard cables. Every calculation used to design or give disconnection times, etc. is reliant on the resistance and quality of the cables you install; if you install a sub-standard cable, you will not be able to comply with BS 7671 which is fundamental to the industry.

# Solar photovoltaic (PV) power supply systems

This article looks to aid the understanding of some of the complex issues associated with PV installations.

By Mark Coles

Photovoltaic (PV) systems are unique. Common logic used in other methods of electricity generation, such as motor-generators, wind turbines, UPS and Stirling Engines cannot be applied. Significant changes are occurring in standardisation at international standard level where PV systems are concerned.

## Standards

Section 712 of BS 7671:2008 is Solar photovoltaic (PV) power supply systems; the section is likely to remain largely unchanged in the first amendment of the standard, due for publication in June 2011. The origins of Section 712 of BS 7671:2008 can be found in IEC 60364-7-712 as no CENELEC HD currently exists. Note that IEC 60364-7-712 is intended to provide requirements for the installation of PV systems. Requirements for the equipment – IEC 62548 Installation and Safety

Requirements for Photovoltaic (PV) Generators (currently in development by IEC TC 82) – will set out general installation and safety requirements for the PV equipment.

## Systems

The Scope of Section 712 in BS 7671:2008 includes PV power supply systems including systems with a.c. modules but, currently, excludes any form of battery storage. There are many systems across the world that feature battery storage but no single standard has as yet been developed to reflect this.

## System components

There are many possible configurations of PV systems but, first we'll look at the components and their function.

## Modules

Photovoltaic or PV cells convert sunlight directly into



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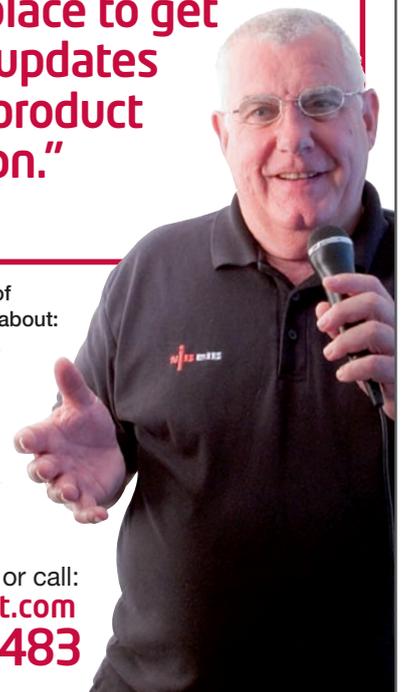
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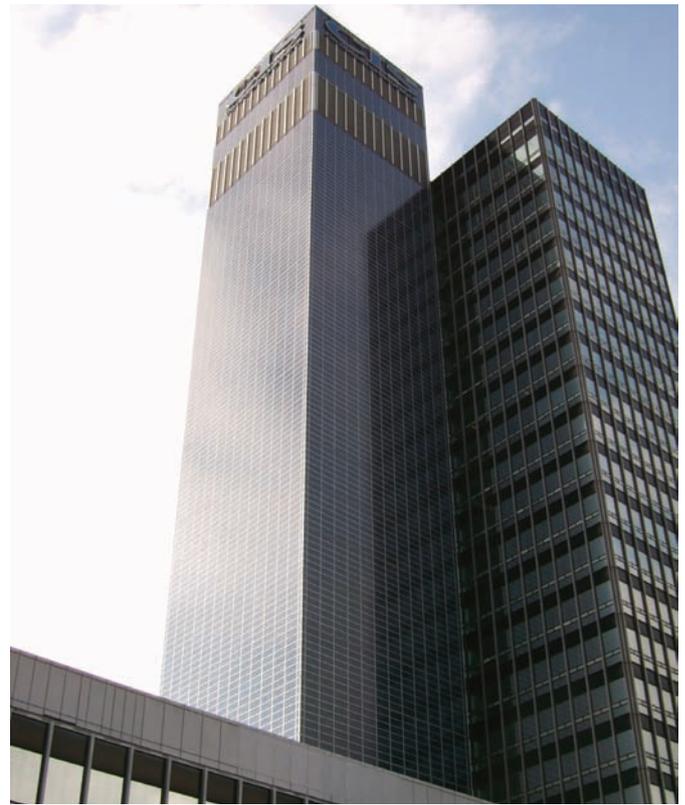
PV system on open ground

electricity and generate d.c. A typical single PV cell is a thin semiconductor wafer made of highly purified silicon; crystalline silicon is the most widely used. During manufacture, the wafer is doped: boron on one side, producing a surplus of electrons; phosphorous on the other side, which has a deficit of electrons. When the wafer is bombarded by sunlight, photons in the sunlight knock off some of the excess electrons creating a voltage difference between the two sides as the excess electrons try to move to the deficit side. In silicon cells

this produces an open circuit voltage of around 0.6 volts.

PV cells are interconnected to form a PV module. The module is manufactured with the cells laminated between a transparent front sheet (usually glass) to allow sunlight to pass and a protective waterproof material on the back. A module is the smallest commercially available unit bought as a panel.

Modules can be linked together to create a string, i.e. connected in series.



PV system incorporated into a building

Strings can, of course, be connected in a parallel formation to create an array.

Optimum operation is achieved when modules are in direct sunlight but electricity is still generated on cloudy days.

Depending on the location and land available, PV arrays are frequently roof-mounted, sometimes integrated directly into the fabric of a building, but they can also be fixed to framework on open ground.

Figures 712.1 and 712.2 of BS 7671:2008 show bypass

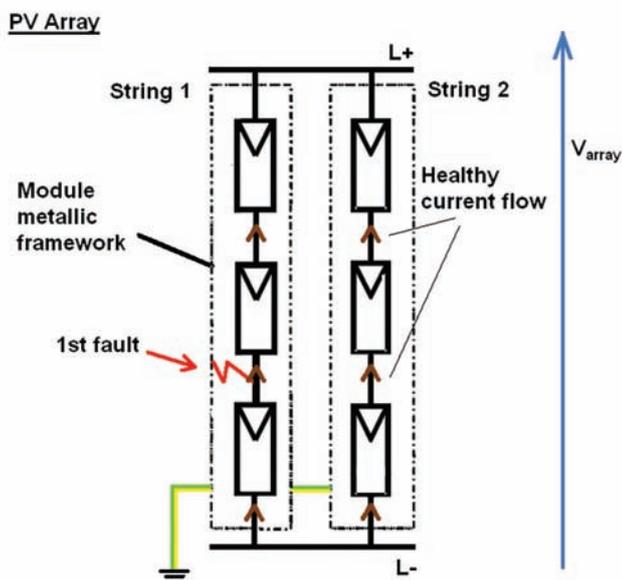


Fig 1 First fault on a PV array

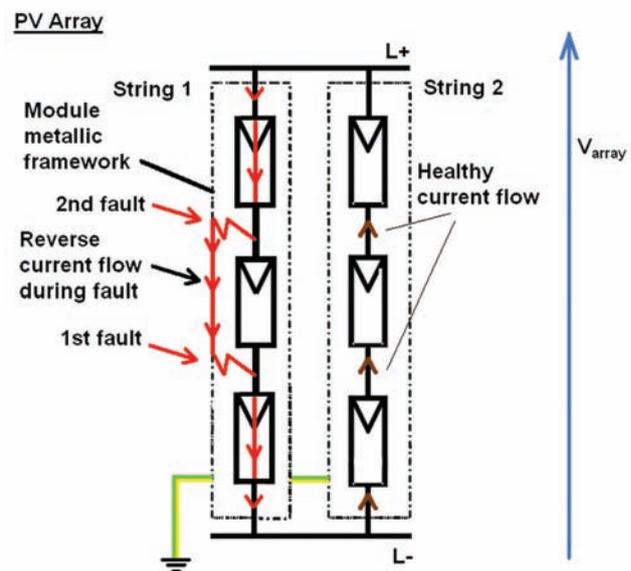
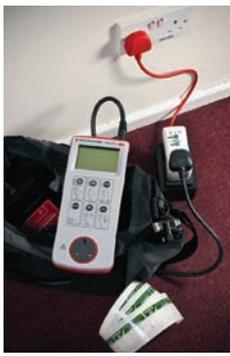


Fig 2 Second fault on a PV array



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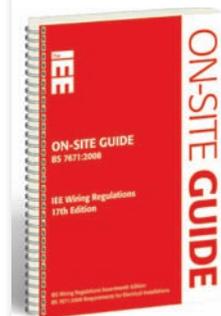
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and blocking diodes and reference is made to blocking diodes in Regulation 712.512.1.1. Diodes, which pass d.c. in one direction only, are used to bypass or block reverse currents caused by faults.

Consider the scenario where a fault has developed on one d.c. module connecting a current-carrying part with the module's metallic framework, shown as first fault (Fig 1).

There are many PV configurations, for example, for functional reasons, some are earthed on the positive side whilst some on the negative. Some are referenced to the mains supply through a non-separated (transformerless) inverter and

some are effectively floating. Note that Figures 1 and 2 show a floating system as neither conductor (L+ or L-) is connected to Earth. The module's metallic framework is shown to feature protective bonding as may be required in certain installations

Unlike a TN-S electrical supply, for example, where the neutral or star point of a generator is connected to Earth, a PV system is effectively floating, hence, this first fault doesn't affect the operation of the array nor does it present any great risk of electric shock. The problems arise when a second fault occurs.

Depending on where the faults occur, circulation currents will

flow and, as shown in Figure 2, modules can be driven into a reverse current situation. Each module will have a maximum permitted reverse current as stated by the manufacturer but, of course, the manufacturer has no idea where the fault will occur. High reverse currents will overstress and overheat the units which can result in fire if overcurrent protection is not fitted.

For a design where the number of parallel connected strings is such that the potential reverse fault current exceeds the manufacturers permitted reverse current, some form of overcurrent protection is required. This is usually achieved by the use of string fuses.

Blocking diodes can be installed in series with each string and are sometimes suggested as a method of preventing reverse currents that could result in such fires. Blocking diodes are prevalent in systems installed in Japan but evidence demonstrates that such diodes can fail to short-circuit (through voltage transients), which negates the reverse current protection without anyone being aware of the failure. Therefore, blocking diodes should not be used as a replacement for overcurrent protection in PV strings.

Bypass diodes are installed in parallel with modules to prevent reverse voltage conditions that could develop on modules as a result of shading, caused by, for



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**Manufacturer's label fixed to a module**

example, buildings obstructing direct sunlight, a covering of snow or array loading conditions.

The design of some types of modules require that one of the live conductors is connected to the main earthing terminal of the a.c. electrical system (functional earthing) as they need to be electrically biased in order to operate correctly. Such a conductor may carry current in the event of a first fault. To mitigate this issue, some manufacturers require that the functional earthing of their equipment is through a protective device which would operate upon detection of the first fault.

Much discussion has taken place within PV committees on how to deal with module failures and faults. Some inverters are pre-programmed to run an insulation resistance test initiated at sunrise just as the modules begin to generate. This is compounded by debates over the class of PV modules, i.e. whether they are class I or class II. Many manufacturers state that modules are class II but

research on very large arrays has shown that, particularly on thin film modules, low resistance readings, e.g. 500k $\Omega$  on systems circa 1,000 modules, are common at daybreak. Module cracking and delamination can occur under some conditions, which compromises the module's insulation leading to opinions that modules are not class II. Once a first fault is found or detected it is paramount that owners of the system repair/replace/remove the faulty module immediately as research has shown that a second fault on that module is not far off.

### Inverters

Inverters are used to change d.c. generated by PV modules into a.c. for use on a.c. systems. The output of the inverter may, in some cases, be connected and synchronised to the local electrical distribution network and operate under the UK's feed-in tariff scheme (see *Wiring Matters* Autumn 2010 Issue 36 for more information) and also the Electricity, Safety, Quality and Continuity Regulations 2002 (as amended) (ESQCR).

BS 7671:2008 has a particular requirement for inverters in Regulation 712.411.3.2.1.2. The Regulation requires that if simple separation is not provided between the a.c. and d.c. side of the system then a type B RCD is to be installed to provide fault protection. Simple separation is a component part of Electrical Separation in Regulation 413.1.1:

413.1.1 Electrical separation is a protective measure in which:

(i) basic protection is provided

by basic insulation of live parts or by barriers or enclosures in accordance with Section 416, and  
(ii) fault protection is provided by simple separation of the separated circuit from other circuits and from Earth.

Simple separation can be provided by having separate windings within a transformer or, particularly for PV installations, the manufacturer may state that the inverter provides this function.

The current standard for type B RCDs, which will be reflected in Section 712 of BS 7671:2008(2011), is IEC 62423:2009; note that there is not an EN or BS version of this standard as yet. Regulation 712.411.3.2.1.2 does not state an operating time or residual operating current; refer to Section 411 and Table 41.1 of BS 7671:2008.

The concern is that d.c. fault currents can feed into the a.c. side of the electrical installation and corrupt upstream devices, such as type A and type AC RCDs. Type B RCDs will provide protection against d.c. earth fault currents; see Guidance Note 1 - Selection and Erection for more information. Type B RCDs are able to provide protection against alternating residual

sinusoidal currents up to 1,000Hz, pulsating direct residual currents and smooth direct residual currents.

One other issue regarding RCDs is pertinent here. In a domestic installation which will not be under the supervision of a skilled or instructed person, Regulations 522.6.6 and 522.6.7 would require that additional protection by an RCD meeting the requirements of Regulation 415.1 is installed. This differs from the RCD requirement in Regulation 712.411.3.2.1.2 which calls for a type B RCD to provide fault protection.

### Further reading

**BS 7671:2008 Requirements for Electrical Installations**  
**IEC 62423:2009 - Type F and type B residual current operated circuit breakers with or without integral overcurrent protection for household and similar uses**  
**Guidance Note 1 – Selection and Erection, The IET, 5th Edition Electricity, Safety, Quality and Continuity Regulations 2002 (as amended)**

### Thanks

**Martin Cotterell – Sundog Energy, co-convenor IEC TC 82 WG3**  
**Ted Spooner – University of New South Wales, co-convenor IEC TC 82 WG3**  
**Eur.Ing Leon Markwell – Ecovert**  
**Bob Cairney – SELECT**



**Large array installation**

# Development of Standards

Do you know the process that supports the development of standardisation? Here we discuss some of the key aspects towards making electrical installations as safe as possible.

By Paul Bicheno

As an electrical installation engineer there may be any number of solutions to a given customer request. However, not every possible solution would be regarded as safe for users or property. This is where standardisation becomes an important aspect of electrical installation. In the UK we use the standard BS 7671 'Requirements for Electrical Installations'. This has been developed over many years and currently electrical installation engineers look to comply with BS 7671:2008 (17th Edition). However, many people are not aware of the process that supports the development of a standard like

BS 7671, therefore this article will describe some of the key aspects of development.

The origin of the wiring regulations stems from 1882, when the Society of Telegraph Engineers and electricians appointed a committee to consider and report on rules to recommend the prevention of fire risks arising from the use of electric light. This resulted in what became known as the First Edition (1882). Subsequent editions have been developed and published by the Institution of Electrical Engineers (IEE), now the Institution of Engineering and

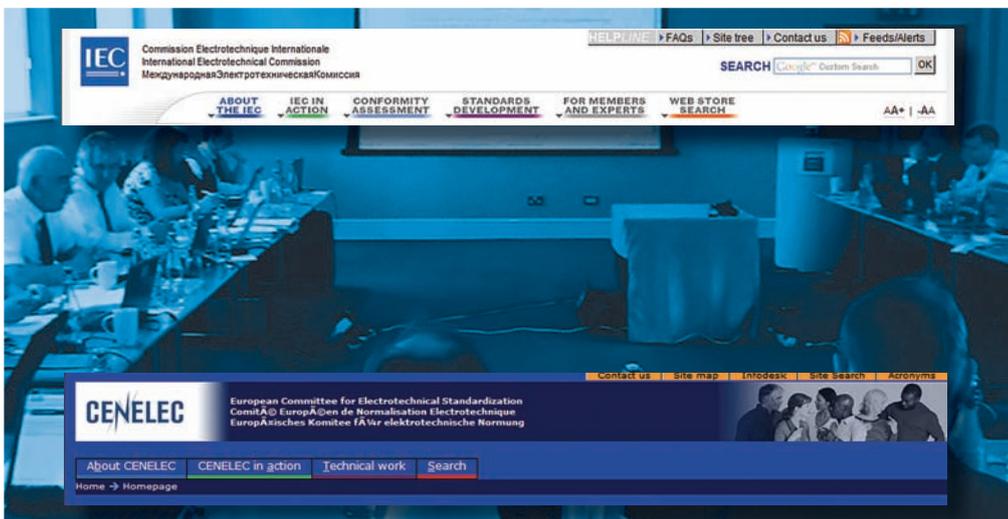
Technology (IET). These non-statutory regulations have been employed throughout this time by electrical installation engineers to design, install and commission safe electrical installations. After publishing the 16th Edition in 1991 the

IEE agreed with the British Standards Institute (BSI) that the 16th Edition would become a British Standard. Therefore in 1992 the 'Wiring Regulations' became the new standard BS 7671:1992 'Requirements for Electrical Installations'.

This is important because it meant that the new standard would be developed in the same way as other standards by following the rules of the BSI and not just by the IEE.

## JPEL/64 Committee

Development of British Standards is carried out in conjunction with BS 0: 'A standard for standards'. As the title suggests, this provides the principles that govern the development of a standard of



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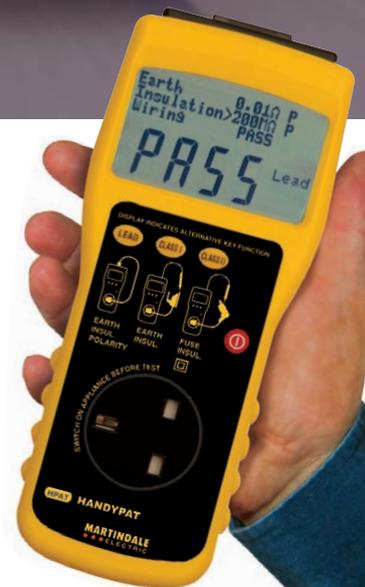
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| <b>British Cables Association</b>                                      | <b>Lighting Industry Federation Ltd</b>                          |
| <b>CIBSE - Chartered Institution of Building Services Engineers</b>    | <b>M o D - U K Defence Standardization</b>                       |
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| <b>DC Power Users Forum</b>  | <b>Royal Institute of British Architects</b>                     |
| <b>Department for Communities and Local Government</b>                 | <b>S C E M E</b>   |
| <b>E N A - Energy Networks Association</b>                             | <b>S E L E C T</b>   |
| <b>ECA - Electrical Contractors Association</b>                        | <b>Safety Assessment Federation</b>                              |
| <b>Electrical Safety Council</b>                                       | <b>Scottish Health Services</b>                                  |
| <b>Energy Institute</b>  | <b>Society of Operations Engineers</b>                           |
| <b>G A M B I C A Association Limited</b>                               | <b>U N I T E - The Union</b>                                     |
| <b>H E V A C Manufacturers Association</b>                             | <b>United Kingdom Accreditation Service</b>                      |
| <b>H S E - Health and Safety Executive</b>                             |  |

**Table 1 – Current organisations represented on JPEL/64 Committee**

UK origin. A technical committee would be responsible for the development of a particular standard. For BS 7671 the responsible technical committee is JPEL/64 – Low-Voltage Electrical Installations. The purpose of the JPEL/64 committee under the joint direction of the IET and BSI is to produce and maintain National Standards relating to

electrical installations, namely the IEE Wiring Regulations (BS 7671), taking into account International and European Standards developments. The committee is also responsible for providing the UK input into the development of related International (IEC/TC64) and European (CLC/TC64) standards. A number of member organisations are currently

| <b>JPEL/64 Panel</b>  | <b>Responsibility in BS 7671:2008</b>  |
|---|--|
| <b>A (Verification)</b>   | Part 1<br>Part 2<br>Part 3<br>Part 6<br>Appendix (1, 2, 6, 9, 13)  |
| <b>B (Thermal Effects)</b>  | Part 4 (Chapter 42 and 43)<br>Part 5 (Chapter 52, Section 559, Chapter 56)<br>Part 7 (Section 753)<br>Appendix (3, 4, 8, 10, 11, 12)           |
| <b>C (Shock Protection)</b>   | Part 4 (Chapter 41, Section 442)<br>Part 5 (Chapter 53, Chapter 55)<br>Part 7 (Section 704, 712, 740)<br>Appendix (14, 15)                     |
| <b>D (External Influences)</b>  | Part 4 (Chapter 44)<br>Part 5 (Chapter 51, Chapter 54)<br>Part 7 (Section 701, 702, 703, 705, 706, 708, 709, 711, 717, 721)<br>Appendix (5, 7) |
| <p><b>Note 1: The JPEL/64 committee can decide to create a temporary project team (PT) and a Panel can decide to create a specific working group to carry out a particular activity.</b></p> <p><b>Note 2: A Panel has responsibility for the area of BS 7671 listed, however some topics may require input from more than one Panel.</b></p> |  |

**Table 2 – JPEL/64 Panels area of responsibility for BS 7671:2008**

represented on the JPEL/64 committee which are summarised in table 1. As can be seen there is a wide spectrum of organisations that provide input into the development of both BS 7671 and the related International and European standards. An organisation that has an interest in electrical installations can become a member of the committee and,

as such, the membership of the JPEL/64 Committee is continuously evolving to cater for the developments of the electrical installation field. A large amount of work is involved in the development of BS 7671, therefore four sub-committees in the form of Panels JPEL/64/A, B, C and D are used. Each panel is allocated responsibility for particular areas of BS 7671,



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| BSI Committee Responsibility | BSI Committee Name | Example Standards         |
|------------------------------|--------------------|---------------------------|
| Low-voltage electric cables  | GEL 20/17          | BS 6004, BS 7919          |
| Electrical accessories       | PEL 23             | BS 1363, BS 4177          |
| Fuses                        | PEL 32             | BS 88-2, BS 88-3, BS 3036 |
| Earthing                     | GEL/600            | BS 7430, BS 951           |
| Cable management             | PEL/213            | BS EN 50085, BS EN 61386  |

**Table 3 – Examples of technical committees related to BS 7671**

summarised in table 2. Panels can have a membership from organisations related to the area of panel responsibility not just JPEL/64 organisations. In some instances individuals who have the appropriate expertise can be co-opted as a member onto the JPEL/64 committee or Panels.

It is worth highlighting that, in reality, certain topics of discussion may require input from more than one panel. One example is the sections in Part 7. In addition to dealing with National Matters the panels will generate comments and proposals for International and European documents related to their particular area of BS 7671. The decisions of the panels are typically ratified by the JPEL/64 committee or, depending on the situation, the JPEL/64 committee will agree to delegate responsibility to a panel, for example for submission of UK comments on a draft of a European standard or IEC standard document. In some instances a specialist project team (PT) will be created to develop a particular area of BS 7671. An example of this would be to draft a new section for inclusion in BS 7671.

#### The IET Role in BS 7671

Within the IET organisation, engineers from the Standards and Compliance department fulfil the role of secretariat for the JPEL/64 committee and panels. In addition, IET members represent the IET as

a member organisation on the JPEL/committee and panels (see table 1) and thus the IET is just one of many organisations who contribute to the development of BS 7671.

The role involves organising the various JPEL/64 and panel committee meeting agendas and producing the documented minutes as a record of proceedings. The IET also manages the many supporting documents that are generated via an electronic document database. The IET has responsibility for collating the technical content, which is gathered into a single publication in the form of BS 7671 for JPEL/64 committee approval. Finally the IET provides the publishing services. In some instances the IET engineers are active members on International and European standards development committees.

#### International standards and BS 7671

The International Electrotechnical Commission (IEC) publishes the 60364 standard specific to electrical installations of buildings. This has numerous parts and is the responsibility of the IEC TC64 committee, which is composed of many national technical committee representatives.

The development of the various parts is carried out by maintenance teams (MTs), where specific experts agree the technical requirements.

A formal process is followed where committee drafts for a part of 60364 are generated for national committees to comment on the content. Eventually a mature document will be published for committee voting. When a successful vote has been achieved a document will be published as an international standard. The UK National technical committee via JPEL/64 takes an active part in the maintenance teams and thus the development of the content.

The European technical standards body CENELEC publishes an equivalent 60364 standard (previously 384) in the form of Harmonised Documents (HDs). These are developed by the CENELEC CLC/TC64 Committee in the form of Working Groups (WGs).

Again, the UK National committee takes an active part in the working groups. The HDs are published as a number of parts to the 60364 series, which is gradually replacing the 384 series and align to the relevant IEC document. One of the requirements of being a member of CENELEC is that the UK National Committee has to publish the technical intent of a HD and withdraw any conflicting standards.

The UK includes the technical intent of the HDs as a single publication in the form of BS 7671, the structure of

which was updated to align with the IEC structure for BS 7671:2008. Reference to page 9 of BS 7671:2008 shows the alignment to the HD's during the 17th Edition programme. Some European technical committees publish separate parts of HD 60364, instead of a single complete document like BS 7671.

#### Related British Standards

BS 7671:2008 has requirements that reference many 'BS' or 'BS EN' British Standards. Development of these standards is slightly different to that of BS 7671 in that they are managed by a specific BSI technical committee not a joint IET/BSI committee. However they still follow the same principles with regards to the technical content and in some instances withdrawing existing standards so that they do not conflict. Table 3 lists some technical committees and some example standards that they would be responsible for.

#### Further Information

The following link to the IEC website will show the various publications and work in progress for TC 64 (type 64 in the 'committee' field and click submit): [www.iec.ch/searchpub/cur\\_fut.htm](http://www.iec.ch/searchpub/cur_fut.htm)

The following link to the CENELEC website will enable a report to be run showing standards that are published or in progress (type 'CLC/TC64' into the 'Technical body' field and click Run report): [www.cenelec.eu/Cenelec/Code/Frameset.aspx](http://www.cenelec.eu/Cenelec/Code/Frameset.aspx)

The following link is to the BSI standards development website (type JPEL/64 into the search field): <http://standardsdevelopment.bsigroup.com/Home/Committee/50001574#tabs-representation>



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