

## The IET Regulations, BS 7671 and this Guide

### 1.1 THE NEED FOR THIS ELECTRICIAN'S GUIDE

The BS 7671 Regulations published by the IET (IEE) summarise all requirements for electrical installations. The document has a legal character and is therefore not always easily understood and implemented by electricians.

The principal author of this book has published a guide to the Regulations for over thirty years. The level of detail has been carefully adjusted to ensure relevance as well as ease of understanding and implementation for practising electricians. Over the years, the Electrician's Guide to the Wiring Regulations has proved popular and successful.

This Guide to the 17th Edition is a continuation of the successful series. Again the content has been adjusted to ensure relevance and ease of understanding. It is intended to be accessible to all electricians, including the many electricians who are left to work on their own without the immediate backup of designers. For example, the formulas provided have been simplified in such a way that electricians without advanced maths knowledge can perform the necessary calculations and make the correct installation decision. Students learning to become electricians will also benefit from this approach. If help is needed with electrical principles we recommend *Electrical Craft Principles*, two-volume book by the main author of this Guide, published by the IET.

The authors of this Electrician's Guide realise that there is also the 'Electrical Installation Design Guide' published by the Institution of Engineering and Technology (IET), (which was the Institution of Electrical Engineering (IEE)) and the British Standards Institute (BSI). Although the publication contains useful information, in the opinion of the authors, this Electrician's Guide offers a valuable alternative because of the assumptions and approach taken. That is, it is accessible to all electricians, including those working without the support of designers or without advanced maths knowledge, and to student electricians. Those accustomed to the Guide's previous editions will also find the style and format familiar.

This Electrician's Guide is not intended to replace the complete Regulations, although all the key regulations have been extracted and explained in the book. If an electrician wishes to master the subject, he/she should also equip him/herself with the Regulations and associated documents. It would be foolish to assume that every detail of BS 7671 is covered in this book, which has only a fraction of the space covered by the 495 pages of the document. Regulations concerning a few very specialist types of installation that are unlikely to be met by most practical electricians have been omitted.

**Note on Supply Voltage Level**

For many years the supply voltage for single-phase supplies in the UK has been 240 V  $\pm$  6%, giving a possible spread of voltage from 226 V to 254 V. For three-phase supplies the voltage was 415 V  $\pm$  6%, the spread being from 390 V to 440 V. Most continental voltage levels have been 220/380 V.

In 1988 an agreement was reached that voltage levels across Europe should be unified at 230 V single phase and 400 V three-phase with effect from January 1st, 1995. In both cases the tolerance levels were then  $-6\%$  to  $+10\%$ , giving a single-phase voltage spread of 216 V to 253 V, with three-phase values between 376 V and 440V.

Since the original supply voltages in the UK lie within the acceptable spread of values, Supply Companies in the UK have not reduced their voltages from 240/415 V.

Tables in the 17th Edition have been recalculated to take account of the unified voltage levels. Following this lead, calculations in this book have been based on supply voltages of 230 V and 400 V, but the electrician must bear in mind that true values are higher. To allow for the voltage possibly being lower than the declared value, a new factor  $C_{\min}$ , the “minimum voltage factor”, has been introduced to take account of the lower fault currents that follow from the lower voltage (see {5.3.2}).

In due course, it is to be expected that manufacturers will supply appliances rated at 230 V for use in the UK. When they do so, there will be problems. A 230 V linear appliance used on a 240 V supply will take 4.3% more current and will consume almost 9% more energy. A 230 V rated 3 kW immersion heater, for example, will actually provide almost 3.27 kW when fed at 240 V. This means that the water will heat a little more quickly but there is unlikely to be a serious problem other than that the life of the heater may be reduced, the level of reduction being difficult to quantify. An immersion heater rated at 3 kW at 230 V but used on a 240 V supply will draw a current slightly in excess of 13 A. Long experience has shown us that 13 A plugs overheat when carrying 12.5 A, so here is yet another argument for not using plugs and sockets to feed 3 kW appliances.

Life reduction is easier to specify in the case of filament lamps. A 230 V rated lamp used at 240 V is likely achieve only 55% of its rated life (it will fail after about 550 hours instead of the average of 1,000 hours) but will be brighter and will run much hotter, possibly leading to overheating problems in some luminaires. The fact that filament lamps will be phased out on the grounds of inefficiency may well solve the problem eventually. At the higher voltage the starting current for large concentrations of discharge lamps will increase dramatically, especially when they are very cold. High pressure sodium and metal halide lamps will show a significant change in colour output when run at higher voltage than their rating, and rechargeable batteries in 230 V rated emergency lighting luminaires will overheat and suffer drastic life reductions when fed at 240 V.

There could be electrical installation problems here for the future!

**1.2 THE IET REGULATIONS – BS 7671****1.2.1 International basis**

All electricians are aware of ‘The Regs’. For over a hundred years they have provided the rules that must be followed to ensure that electrical installations are safe. In 2006 the Institution of Electrical Engineers (the IEE) merged with the Institution of

Electronics and Electrical Incorporated Engineers (IEEIE) to form the Institution of Engineering and Technology, known as the IET.

A publication such as 'the Regs' must be regularly updated to take account of technical changes, and to allow for the 'internationalisation' of the Regulations. The ultimate aim is that all countries in the world will have the same wiring regulations. National differences make this still a dream, but we are moving slowly in that direction. The 15th Edition, when it was published in 1981, was the first edition of the IEE Regulations to follow IEC guidelines, and as such was novel in Great Britain. It was totally different from anything we had used before. The 16th and 17th Editions have not come as such a shock.

The international nature of the Regulations sometimes has strange results. For example, in {2.8} there are Regulations covering protection of installations from lightning – in fact, this work can be ignored in the UK because [443/2] points out that no action is necessary if the number of thunderstorm days for the region is less than 25 per annum. Since the UK (but not other parts of Europe) has less lightning activity than this level, these Regulations can be ignored here.

A word is necessary about the identification of parts of this Electrician's Guide and of BS 7671 – the IET Regulations. In this Electrician's Guide, Regulation numbers are separated by a full point (full stop) and indicated by placing them in square brackets. Thus, [515.3.2] is the second Regulation in the third Section of Chapter 15. in Part 5. To avoid confusion, sections and sub-sections of this Electrician's Guide are divided by full points and enclosed in curly brackets. Hence, {5.4.6} is the sixth sub-section of section 4 of chapter 5 of this Electrician's Guide.

### 1.2.2 The Seventeenth Edition

The 17th Edition of BS 7671:2008 Requirements for Electrical Installations, also known as the 17th Edition of the IET Wiring Regulations, was published in January 2008, and amended in July 2011, these changes becoming effective from January 1st, 2012. A second amendment in 2013 introduced a new section [722] dealing with the installation of charging equipment for electric vehicles. The third followed in 2015, is much more extensive and is covered in this book.

As stated earlier, the current trend is to move towards a set of wiring regulations with worldwide application. IEC publication 60364 *Electrical Installations of Buildings* has been available for some time, and the 17th Edition is based on many of its parts. The European Committee for Electrotechnical Standardisation (CENELEC) uses a similar pattern to IEC 60364 and to the Wiring Regulations, which, in the 17th Edition has moved still closer to it. The Regulations now use the IEC dot or point numbering system. For the third amendment regulation numbers ending in 100 series of numbers represent CENELEC Harmonisation Document reference numbers and 200 series numbers represent UK-only regulations.

The introduction of the Free European Market in 1993 might well have caused serious problems for UK electrical contractors because, whilst the IEE Wiring Regulations were held in high esteem, they had no legal status that would require Europeans who were carrying out installation work in the UK to abide by them. This difficulty was resolved in October 1992 when the IEE Wiring Regulations became a British Standard, BS 7671, giving them the required international standing. From 2015 BS 7671, all Guidance Notes and other associated publications were made available in a fully searchable on-line version for an annual subscription thus enabling electricians to have the most up-to-date versions always available.

It does not follow that an agreed part of IEC 60364 will automatically become

part of the IEE Wiring Regulations. BS 7671 recognises all harmonised standards (or Harmonised Documents, HDs) that have been agreed by all member states of the European Union. BS EN standards are harmonised standards based on harmonised documents and are published without addition to or deletion from the original HDs. When a BS EN is published the relevant BS is superseded and is withdrawn. A harmonised standard, e.g. BS 7671, may have additions but not deletions from the original standard. IEC and CENELEC publications follow the pattern that will be shown in {1.2.3}, and it is not always easy to find which Regulations apply to a given application. For example, if we need to find the requirements for bonding, there is no set of Regulations with that title to which we can turn. Instead, we need to consider four separate parts of the Regulations, which in this case are:

- 1 [Chapter 13] Regulation [131.2.2]
- 2 [Section 415] Regulation [415.2]
- 3 [Section 514] Regulation [514.13]
- 4 [Sections 541, 542, 543 and 544] complete.

The question arises ‘how do we know where to look for all these different Regulations?’ The answer is two-fold. First, the Regulations themselves have a good index. Second, this Electrician’s Guide also has a useful index, from which the applicable sub-section can be found. At the top of each sub-section in square brackets is the number(s) of the applicable Regulation(s). This Guide also has a Cross Reference Index, so that if the BS 7671 number is known the explanation can be found quickly.

The detail applying to a particular set of circumstances is thus spread in a number of parts of the Regulations, and the overall picture can only be appreciated after considering all these separate pieces of information. This Guide is particularly useful in drawing all this information together.

### **1.2.3 Third Amendment to the 17th Edition: a summary**

The first amendment was published in 2011 and took effect on Jan 1st 2012. Its changes are, by the time of this publication, well understood. The requirements for electric vehicle charging installations were the sole subject of the second amendment published in 2013. The third amendment was published on Jan 5th 2015, and takes effect from 1st July, 2015. Beside the changes summarised here there are numerous changes to reflect new and altered numbers to Standards referred to in BS 7671.

A summary of the changes is listed below. More details as viewed from the Regulations angle are shown in the next section {1.2.4}.

- the new numbering system mentioned above {1.2.2}
- expanded and modified definitions {2.3}
- switchgear, including consumer units, within domestic premises must be manufactured of non-combustible material or be enclosed in a cabinet made of non-combustible material {6.1}
- skilled and instructed persons both have the word “electrically” added {2.3}
- removal of the term ‘competent person’
- there are new requirements for the support of wiring systems in escape routes {11.2}
- the simplification of the requirements for cables buried in walls {4.4.1}
- a new section dealing with auxiliary circuits is added {6.7}
- there are changes to the requirements for low voltage generating sets {2.5}

- requirements for luminaires and outdoor lighting are included {6.5.1}
- alterations have occurred in the requirements for mobile and transportable units {8.25}
- the introduction of a  $C_{min}$  factor to allow for the fact that supply voltage may be lower than the declared value {2.7, 5.3.2}
- the introduction of the  $C_{min}$  factor has led to changes to the tables for maximum earth fault loop impedance values {5.3.4}

### 1.2.4 Overview of the main changes to BS 7671 with Amendment 3

**Numbering change** ({1.2.2}) (Note: the curly brackets refer to the section number in this book, whereas the square brackets refer to the Regulations).

Previously regulations in the 100 range represented UK-only regulations. With Amendment 3 this was changed so that regulations in the 100 range represent CENELEC Harmonisation Document reference numbers and those in the 200 series of numbers represent UK-only regulations.

#### **Competent Person / Skilled person (Electrically).**

The term competent person has been removed and the term skilled person has been expanded to indicate that the skill set is electrically biased. In Amendment 3 the term 'skilled person' has replaced 'competent person'. 'Skilled person' may be used with the term 'competent' in regulations to indicate that the skillset required is specific to the task specified in that regulation {2.2.4}. For example Regulation [134.2.1] says that initial verification '*... shall be carried out by a skilled person competent to verify...*'.

#### **$C_{min}$ factor and maximum earth fault loop impedances {5.3.2, 5.3.4}.**

$C_{min}$  is the minimum voltage factor to take account of voltage variations depending on time and place, changing of transformer taps and other considerations. For a public supply in the UK,  $C_{min}$  will be 0.95 of the declared voltage. This means that all maximum earth fault loop impedances given in tables [41.2-41.4] are reduced.

#### **Fire Safety.**

Following regulations were introduced after consultation with the fire brigade:

[421.1.201] requires, from 01 Jan 2016, that within domestic dwellings switchgear assemblies including consumer units have their enclosure manufactured from non-combustible material or be enclosed in a cabinet or enclosure constructed of non-combustible material {6.1}. Steel is an example of non-combustible material and most manufacturers of consumer units have adopted this method of compliance.

[521.11.201] requires that wiring systems within escape routes shall be supported so that they are not liable to premature collapse in the event of fire {11.2}. This precludes the use of non-metallic cable clips, cable ties or cable trunking as the sole means of support. Manufacturers produce metal cable retaining clips for use inside plastic trunking and stainless steel cable ties are available for use with cable tray.

#### **Electromagnetic Compatibility (EMC).**

[332.1] clarifies that electromagnetic compatibility (EMC) refers to the equipment of the installation and must be in accordance with the relevant EMC standards