



WIRING MATTERS

Autumn 08 Issue 28

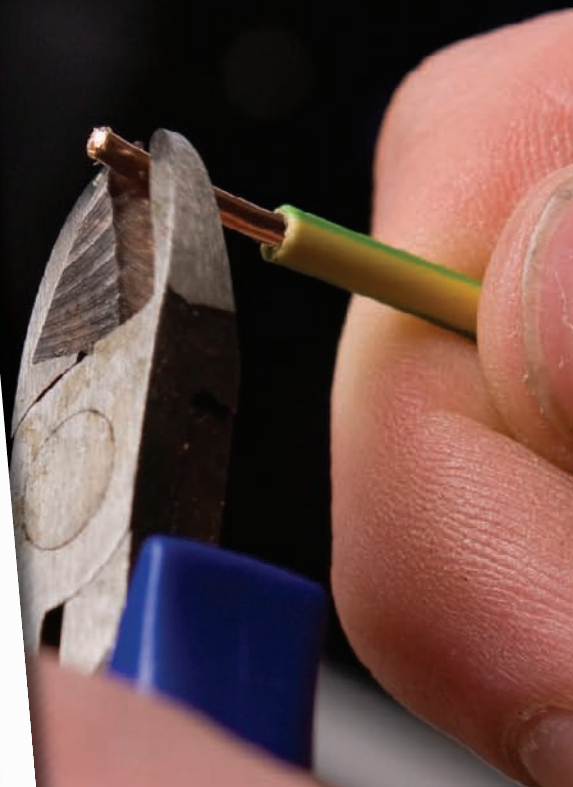


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BS 7671:2008 Requirements for Electrical Installations

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Section 559 luminaires and lighting installations

An overview

by Geoff Cronshaw

SECTION 559 (of BS 7671:2008) luminaires and lighting installations is a new series of Regulations giving particular requirements for fixed outdoor lighting installations, extra-low voltage lighting installations and lighting for display stands.

Section 559 includes requirements from Regulations 553-03 (lampholders) and 553-04 (lighting points) in the 16th Edition. This new section also includes requirements from Section 611 (Highway Power Supplies and Street Furniture) of the 16th Edition.

The impact of this new section is that additional requirements are now included in the Regulations for general lighting including requirements for protection against fire, connection of luminaires to the fixed wiring, fixing of the luminaires, requirements for through wiring in a luminaire, requirements for control gear, e.g. ballasts and compensation capacitors. A further new requirement is the need to give consideration to stroboscopic effects.

The Regulations for outdoor lighting

installations has been expanded, compared to Section 611 in the 16th Edition, to cover car parks, gardens, parks, places open to the public, illumination of monuments and floodlighting. Other lighting arrangements specifically mentioned include telephone kiosks, bus shelters, advertising panels and town plans, which it is recommended are provided with additional protection by a 30mA RCD.

Regulation group 559.11 is a completely new series of Regulations that were not included in the 16th edition covering requirements for extra-low voltage lighting installations. The particular requirements of these Regulations apply to extra-low voltage lighting installations supplied from sources with a maximum rated voltage of 50 V ac rms or 120 V dc. The Regulations include requirements for protection against electric shock (SELV), protection against the risk of fire due to short circuit, types of wiring systems including special

requirements where bare conductors are used, the types of transformers and converters and requirements for suspended systems.

LUMINAIRES

Protection against fire

Regulation 559.5.1 requires that in the selection and erection of a luminaire the thermal effects of radiant and convected energy on the surroundings are to be taken into account, including:

- (i) the maximum permissible power dissipated by the lamps
- (ii) the fire-resistance of adjacent material at the point of installation and in the thermally affected areas
- (iii) the minimum distance to combustible materials, including material in the path of a spotlight beam.

Luminaires are usually installed on non-combustible surfaces, defined in BS EN 60598-1 as “material incapable of supporting combustion” and taken to include metal, plaster and concrete. However, sometimes it may be

necessary to mount luminaires on materials that may be considered to be flammable (e.g. wood and wood based materials of more than 2 mm thick) and in such cases a classified luminaire to BS EN 60598 marked with the following symbol should be selected:



Luminaire suitable for direct mounting on normal flammable surfaces

Where luminaires are marked with this symbol, the excessive temperatures which may arise in operation, or due to the failure of a component, will not cause the mounting surface temperature to exceed 90 °C and, thereby, cause a risk of fire. Originally this mark only covered luminaires with integral control gear but is now applicable to all luminaires complying with the BS EN 60598 series of standards.

Luminaires which cannot comply with this criterion are required to carry a warning notice or have the following symbol:

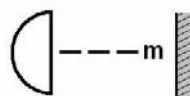


Luminaire suitable for direct mounting on non-combustible surfaces only

NOTE: These symbols are referenced within BS EN 60598-1:2004. However, some of these symbols, at the time of

writing this article are the subject of change; the reader is advised to consult the latest edition of BS EN 60598 for current luminaire marking requirements.

From a thermal view the temperature of illuminated objects is also important and the heat from a wrongly placed luminaire can initiate combustion. Luminaires to BS EN 60598, where required to be so, can also be marked with a symbol to indicate the minimum distance from a lighted object and a maximum lamp wattage.



The above figure shows minimum distance from a lighted object (m).

Regulations 422.3.1 and 422.4.2 give the following minimum distances at which spotlights and projectors shall be installed from combustible materials:

- (i) rating up to 100 W - 0.5 m
- (ii) rating over 100 W up to 300 W - 0.8 m
- (iii) rating over 300 W up to 500 W - 1.0 m.

Table 55.2 of BS 7671 gives a full explanation of symbols used in luminaires, in controlgear for luminaires and in the installation of luminaires

Connection of luminaires

Regulation 559.6.1.1 has requirements for Connection to the fixed wiring.

The Regulation states:

At each fixed lighting point one of the following shall be used:

- (i) A ceiling rose to BS 67
- (ii) A luminaire supporting coupler to BS 6972 or BS 7001
- (iii) A batten lampholder or a pendant set to BS EN 60598
- (iv) A luminaire to BS EN 60598
- (v) A suitable socket-outlet to BS 1363-2, BS 546 or BS EN 60309-2
- (vi) A plug-in lighting distribution unit to BS 5733
- (vii) A connection unit to BS 1363-4
- (viii) Appropriate terminals enclosed in a box complying with the relevant part of BS EN 60670 series or BS 4662
- (ix) A device for connecting a luminaire (DCL) outlet according to IEC 61995-1.

NOTE: In suspended ceilings one plug-in lighting distribution unit may be used for a number of luminaires.

Fixing of the luminaires

Regulation 559.6.1.5 requires that adequate means to fix the luminaire shall be provided.

The fixing means may be by mechanical accessories (e.g. hooks or screws), boxes or enclosures which are able to support luminaires or supporting devices for connecting a luminaire.



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In places where the fixing means is intended to support a pendant luminaire, the fixing means shall be capable of carrying a mass of not less than 5 kg. If the mass of the luminaire is greater than 5 kg, the installer shall ensure that the fixing means is capable of supporting the mass of the pendant luminaire.

The installation of the fixing means shall be in accordance with the manufacturer's instructions.

The weight of luminaires and their eventual accessories shall be compatible with the mechanical capability of the ceiling or suspended ceiling or supporting structure where installed.

Any cable or cord between the fixing means and the luminaire shall be

installed so that any expected stresses in the conductors, terminals and terminations will not impair the safety of the installation.

Through wiring in a luminaire

In some instances, it may be necessary to link the wiring through the luminaire on to the next luminaire. This method of installation should only be used if the luminaire is designed for such practice.

A cable for through wiring shall be selected in accordance with the temperature information on the luminaire or on the manufacturer's instruction sheet, if any, as follows:

(i) unless specified in the manufacturer's instructions, for a luminaire complying with BS EN 60598

but with no temperature marking, heat resistant cables are not required
(ii) for a luminaire complying with BS EN 60598 but with temperature marking, cables suitable for the marked temperature shall be used
(iii) in the absence of information, heat-resistant cables and/or insulated conductors of type H05S-U, H05S-K, H05SJ-K, H05SS-K (BS 6007) or equivalent shall be used.

Stroboscopic effects

Stroboscopic effects can be extremely dangerous in particular circumstances. In the case of lighting for premises where machines with moving parts are in operation, consideration shall be given to stroboscopic effects which can give a misleading impression of moving parts being stationary. Such effects may be avoided by selecting luminaires with suitable lamp controlgear, such as high frequency controlgear, or by distributing lighting loads across all the phases of a three phase supply.

OUTDOOR LIGHTING

Regulation group 559.10 has requirements for outdoor lighting, highway power supplies and street furniture. Similar to the 16th Edition, the protective measures of placing out of reach and obstacles must not be used; Regulations 559.10.1 gives an exception. Also the protective measures non-conducting location and earth-free local equipotential bonding must not be used. A relaxation is permitted giving a maximum disconnection time of 5 s (Regulation 559.10.3.3) for all circuits feeding fixed equipment used in highway power supplies for compliance with Regulation 411.3.2.3 (TN system) or 411.3.2.4 (TT system).

The Regulations now clearly state in 559.10.3.4 that the earthing conductor of a street electrical fixture shall have a minimum copper equivalent cross-sectional area not less than that of the supply neutral

conductor at that point or not less than 6 mm, whichever is the smaller.

Regulation 559.10.3.2 now gives recommendations for lighting installations in places such as telephone kiosks, bus shelters, town plans, etc. and requires that additional protection by an RCD having the characteristics specified in Regulation 415.1.1 is provided.

EXTRA-LOW VOLTAGE LIGHTING INSTALLATIONS

Scope

The particular requirements of these Regulations apply to extra-low voltage lighting installations supplied from sources with a maximum rated voltage of 50 V a.c. rms or 120 V d.c.

Protection against electric shock (SELV)

Regulation 559.11.2 requires that an extra-low voltage luminaire without provision for the connection of a protective conductor shall be installed only as part of a SELV system. The protective measure FELV is not permitted.

Protection against the risk of fire due to short circuit

Regulation group 559.11.4 has particular requirements for protection against the risk of fire due to short circuit. The Regulation states:

559.11.4.1 Where both the live circuit conductors are uninsulated, either:

- (i) They shall be provided with a protective device complying with the requirements of Regulation 559.11.4.2, or
- (ii) The system shall comply with BS EN 60598-2-23.

559.11.4.2 A device providing protection against the risk of fire in accordance with Regulation 559.11.4.1 shall meet the following requirements:

- (i) The device shall continuously monitor the power demand of the luminaires
- (ii) The device shall automatically disconnect the supply circuit within 0.3 s in the case of a short-circuit or failure which causes a power increase of more than 60 W
- (iii) The device shall provide automatic disconnection while the supply circuit is operating with reduced power (for example,

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by gating control or a regulating process or a lamp failure) or if there is a failure which causes a power increase of more than 60 W

(iv) The device shall provide automatic disconnection upon connection of the supply circuit if there is a failure which causes a power increase of more than 60 W

(v) The device shall be fail-safe.

NOTE: Account needs to be taken of starting currents.

Bare conductors

If the nominal voltage does not exceed 25 V a.c. or 60 V d.c., bare conductors may be used providing that the extra-low voltage lighting installation complies with all the following requirements:

- (i) the lighting installation shall be designed, and installed or enclosed in such a way that the risk of a short-circuit is reduced to a minimum, and
- (ii) the conductors used shall have a cross-sectional area of at least 4 mm, for mechanical reasons, and
- (iii) the conductors shall not be placed directly on combustible material.

For suspended bare conductors, at least one conductor and its terminals

shall be insulated for that part of the circuit between the transformer and the short-circuit protective device to prevent a short-circuit.

Types of transformers and converters

Where the SELV source of a SELV lighting system is a safety isolating transformer, it should meet the requirements of BS EN 61558-2-6. Regulation 559.11.4.2 requires that the transformer has a protective device on the primary side or it should be short-circuit proof and marked with the following symbol:



Where an electronic converter, such as a switch-mode power supply, is used to supply an extra-low voltage lighting installation, it should comply with BS EN 61347-2-2 bearing the following symbol:



Suspended systems

Regulation 559.11.6 has requirements for Suspended systems.

Suspension devices for extra-low voltage luminaires, including supporting conductors, shall be capable of carrying five times the mass of the luminaires (including their lamps) intended to be supported but not less than 5 kg. Terminations and connections of conductors shall be made by screw terminals or screwless clamping devices complying with BS EN 60998-2-1 or BS EN 60998-2-2.

Insulation piercing connectors and termination wires which rely on counterweights hung over suspended conductors to maintain the electrical connection shall not be used. The suspended system shall be fixed to walls or ceilings by insulated distance cleats and shall be continuously accessible throughout the route.

CONCLUSION

Under the 17th Edition, designers and persons involved in general lighting, fixed outdoor lighting installations and extra-low voltage lighting installations now have detailed requirements to follow. For further information consult BS 7671:2008.

Also, help is at hand, in the form of a new edition of IEE Guidance Note 1 (*Selection & Erection* edited by Mark Coles) available soon. ■



Updating the IEE guidance publications

by Nick Canty, Publishing Director, the IET

DURING THE course of 2008 the Institution of Engineering and Technology (IET) is updating all the books relating to the Wiring Regulations.

As well as being responsible for publication of the IEE Wiring Regulations 17th Edition, the Institution provides guidance on various activities relating to electrical installation work.

All the books published by the Institution are written by experienced engineers with expert knowledge in their area. Draft copies of the books are sent to the key industry and government bodies for comment and review. All comments are considered before the book is finally published.

On Site Guide and Electrician's Guide to the Building Regulations

Both these popular books have been updated to align with the 17th Edition. The On Site Guide covers small installations (up to 100 A, 3-phase) and this edition is produced in full colour for the first time.

The Electrician's Guide to the Building Regulations (including Part P) has been fully updated and now includes a chapter on Scottish building standards for electrical contractors. Both these books are A5 size and spiral-bound for convenient use.

Guidance Notes

The IET published a series of Guidance Notes, each of which enlarges upon and amplifies a particular requirement of the IEE Wiring Regulations. All these are in the course of being updated and will be published over the coming months.

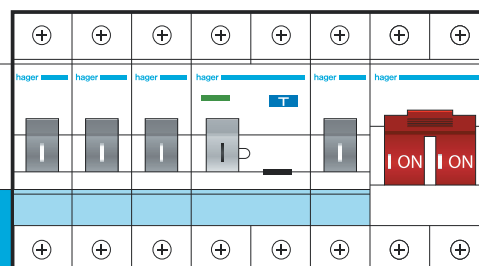
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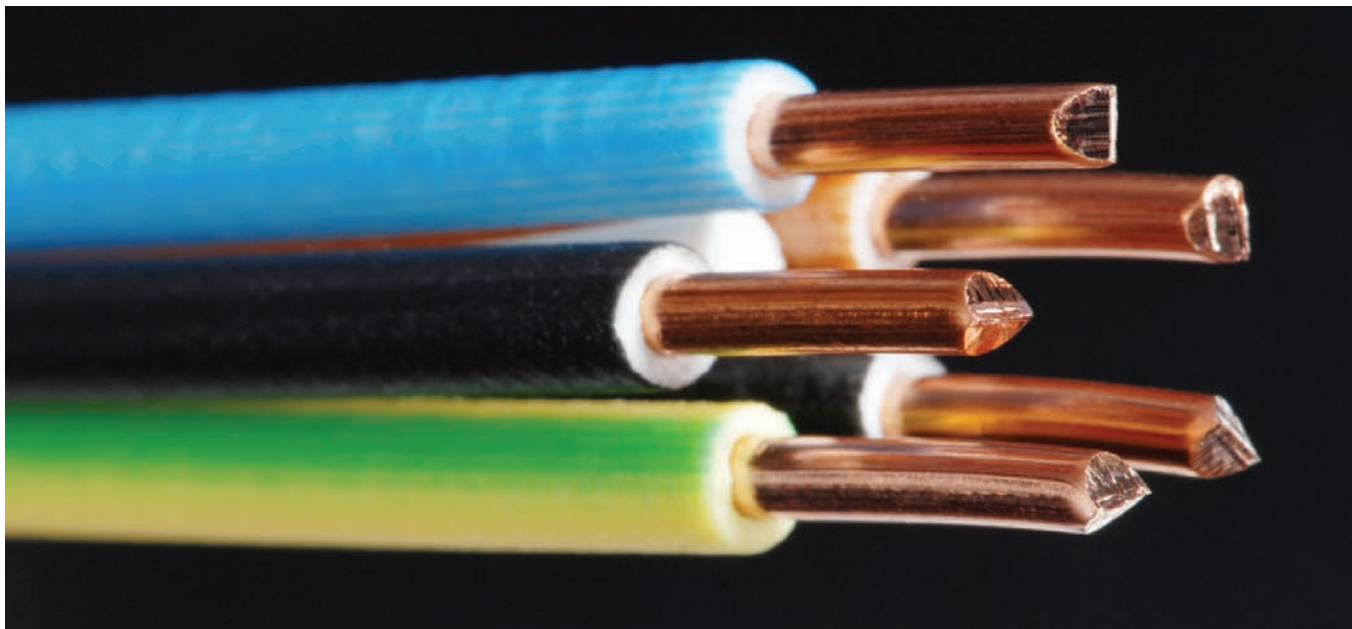
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Appendix 4 of BS 7671

by Mark Coles

Appendix 4, *Current-carrying capacity and voltage drop for cables and flexible cords*, has seen significant changes with the publishing of BS 7671:2008. This article looks at some of the changes and shows examples of cable calculations.

SELECTING THE correct cable for the application is imperative to ensure a satisfactory life of conductors and insulation subjected to the thermal effects of carrying current for prolonged periods of time in normal service.

Choosing the minimum size cross-sectional area of conductors is essential to meet the requirements for:

- Protection against electric shock (Chapter 41)
- Protection against thermal effects (Chapter 42)
- Overcurrent protection (Chapter 43),
- Voltage drop (Section 525), and
- Limiting temperatures for terminals of equipment to which the conductors are connected (Section 526).

Current-carrying capacity and voltage drop for cables

The 17th Edition brought about some significant changes when calculating the current-carrying capacity and voltage drop for cables. For both the 16th and 17th Editions, most of the current ratings have been taken from IEC 60364-5-52 and the CENELEC HD 384.5.52 +A1 1998. These IEC and CENELEC documents do not, however, provide current ratings for armoured single-core cables, therefore, the ratings for these cables are based on data provided by ERA Technology Ltd and the British Cables Association.

The tables have been updated to reflect present cable standards and

introduce current ratings for buried cables. Generally, the current ratings for commonly used cables have not changed between the 16th and 17th Editions.

Installation methods

The 16th Edition recognised 20 methods of installation, the 17th Edition, however, recognises 57 methods in Table 4A2. It is impossible, of course, to cover every possible method or installation permutation but, with the 17th Edition recognising a further 37 methods of installation, more possibilities are now covered. Note that all installation numbers in table 4A2 are different from those in the 16th Edition.

Reference method

It is impractical to calculate and publish current ratings for every installation method, since many would result in the same current rating. Therefore a suitable (limited) number of current ratings have been calculated which cover all installation methods, known as Reference Methods. There are 7 reference methods, A to G, shown in table 1 overleaf.

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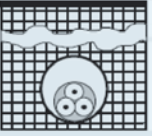
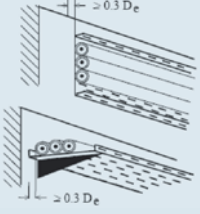
Reference method	Example of installation method		Relevant table from BS 7671:2008	Image
A	Non-sheathed cables in conduit in a thermally insulated wall	The wall consists of an outer weatherproof skin, thermal insulation and an inner skin of wood or wood-like material having a thermal conductance of at least 10 W/m ² .K. The conduit is fixed such that it is close to, but not necessarily touching, the inner skin. Heat from the cables is assumed to escape through the inner skin only. The conduit can be metal or plastic.	Installation Method 1 of Table 4A2	
	Multicore cables in conduit in a thermally insulated wall		Installation Method 2 of Table 4A2	
B	Non-sheathed cables in conduit mounted on a wooden or masonry wall	The conduit is mounted on a wooden wall such that the gap between the conduit and the surface is less than 0.3 times the conduit diameter. The conduit can be metal or plastic. Where the conduit is fixed to a masonry wall the current-carrying capacity of the non-sheathed or sheathed cable may be higher.	Installation Method 4 of Table 4A2	
	Multicore cables in conduit mounted on a wooden or masonry wall		Installation Method 5 of Table 4A2	
C (clipped direct)	Single-core or multicore cable on a wooden or masonry wall	Non-sheathed cables in conduit mounted on a wooden or masonry wall	Installation Method 20 of Table 4A2	
D	Multicore unarmoured cable in conduit or in cable ducting in the ground	Non-sheathed cables in conduit mounted on a wooden or masonry wall. The cable is drawn into a 100 mm diameter plastic, earthenware or metallic duct laid in direct contact with soil having a thermal resistivity of 2.5 K.m/W and at a depth of 0.8 m. The values given for this method are those stated in this appendix and are based on conservative installation parameters. If the specific installation parameters are known (thermal resistance of the ground, ground ambient temperature, cable depth), reference can be made to the cable manufacturer or the ERA 69-30 series of publications, which may result in a smaller cable size being selected. NOTE: The current-carrying capacity for cables laid in direct contact with soil having a thermal resistivity of 2.5 K.m/W and at a depth of 0.7 m is approximately 10 % higher than the values tabulated for Reference Method D	Installation Method 70 of Table 4A2	
E, F and G	Single-core or multicore cable in free air	The cable is supported such that the total heat dissipation is not impeded. Heating due to solar radiation and other sources is to be taken into account. Care is to be taken that natural air convection is not impeded. In practice, a clearance between a cable and any adjacent surface of at least 0.3 times the cable external diameter for multicore cables or 1.0 times the cable diameter for single-core cables is sufficient to permit the use of current-carrying capacities appropriate to free air conditions.	Installation Method 70 of Table 4A2	

Table 1: Reference methods

Other methods of installation

Other methods of installation are recognised but are, essentially, variations of other methods and are therefore allocated appropriate reference methods, shown in table 2 overleaf.

It is worth noting that the 17th

Edition now references cables buried in the ground (installation methods 70 to 73). The current-carrying capacities tabulated for cables in the ground are based upon a soil thermal resistivity of 2.5 K.m/W and are intended to be applied to cables laid in and around buildings, i.e. disturbed soil. For other

installations, where investigations establish more accurate values of soil thermal resistivity appropriate for the load to be carried, the values of current-carrying capacity may be derived by the methods of calculation given in BS 7769 (BS IEC 60287) or obtained from the cable manufacturer.

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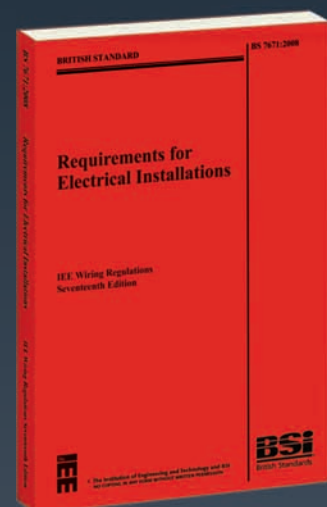


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In locations where the effective soil thermal resistivity is higher than 2.5 K.m/W, an appropriate reduction in current-carrying capacity should be made or the soil immediately around the cables should be replaced by a more suitable material, i.e. such cases can usually be recognised by very dry ground conditions. Rating factors for soil thermal resistivities other than 2.5 K.m/W are given in Table 4B3.

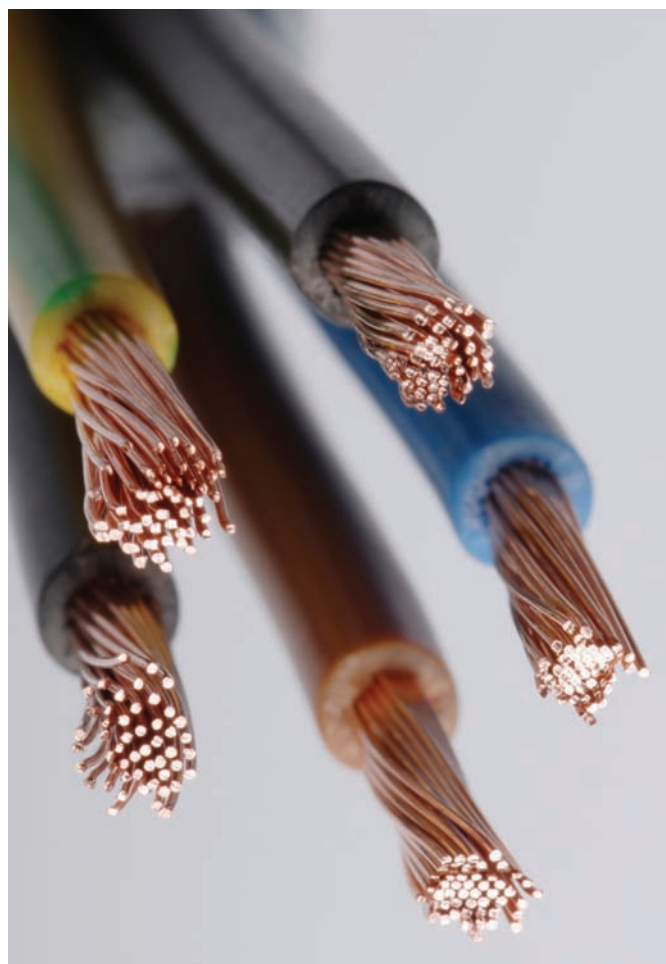
Flat, twin and earth cables installed in thermal insulation are also recognised by installation methods 100 to 103.

Sizing of cables

Relationship of current-carrying capacity to other circuit parameters
The relevant symbols used in the Regulations are shown in Table 3:

Example of installation method	Reference method
Cable on a floor	Reference Method C applies for current rating purposes.
Cable under a ceiling	This installation may appear similar to Reference Method C but because of the reduction in natural air convection, Reference Method B is to be used for the current rating.
Cable tray systems	A perforated cable tray has a regular pattern of holes that occupy at least 30% of the area of the base of the tray. The current-carrying capacity for cables attached to perforated cable trays should be taken as Reference Methods E or F. The current-carrying capacity for cables attached to unperforated cable trays (no holes or holes that occupy less than 30% of the area of the base of the tray) is to be taken as Reference Method C.
Cable ladder system	This is a construction which offers a minimum of impedance to the air flow around the cables, i.e. supporting metalwork under the cables occupies less than 10% of the plan area. The current-carrying capacity for cables on ladder systems should be taken as Reference Methods E or F.
Cable cleats, cable ties and cable hangers	Cable supports hold the cable at intervals along its length and permit substantially complete free air flow around the cable. The current-carrying capacity for cable cleats, cable ties and cable hangers should be taken as Reference Methods E or F.
Cable installed in a ceiling	This is similar to Reference Method A. It may be necessary to apply the rating factors due to higher ambient temperatures that may arise in junction boxes and similar mounted in the ceiling. NOTE: Where a junction box in the ceiling is used for the supply to a luminaire, the heat dissipation from the luminaire may provide higher ambient temperatures than permitted in Tables 4D1A to 4J4A (see also Regulation 522.2.1). The temperature may be between 40 °C and 50 °C, and a rating factor according to Table 4B1 must be applied.

Table 2: Other recognised methods of installation



Iz	It	Ib
The current-carrying capacity of a cable for continuous service, under the particular installation conditions concerned.	The value of current tabulated in this appendix for the type of cable and installation method concerned, for a single circuit in the ambient temperature stated in the current-carrying capacity tables.	The design current of the circuit, i.e. the current intended to be carried by the circuit in normal service. In the rated current or current setting of the protective device.
In	I2	C
The rated current or current setting of the protective device.	The operating current (i.e. the fusing current or tripping current for the conventional operating time) of the device protecting the circuit against overload.	A rating factor to be applied where the installation conditions differ from those for which values of current-carrying capacity are tabulated in this appendix.
The various rating factors are identified as follows:		
Ca	Cg	Ci
For ambient temperature.	For grouping.	For thermal insulation.
Ct	Cc	
For operating temperature of conductor.	For the type of protective device or installation condition.	

Table 3: Symbols used in the Regulations

The rated current or current setting of the protective device (*In*) must not be less than the design current (*Ib*) of the circuit, and the rated current or current setting of the protective device (*In*) must not exceed the lowest of the current-carrying capacities (*Iz*) of any of the conductors of the circuit, see fig. 1.

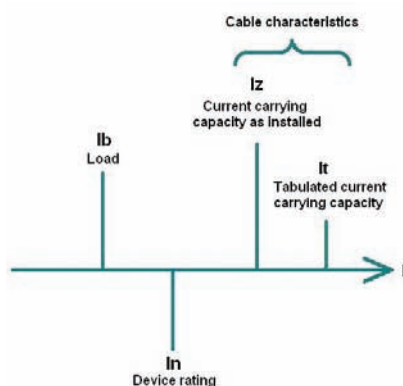


Fig. 1: Coordination of load, device and cable characteristics

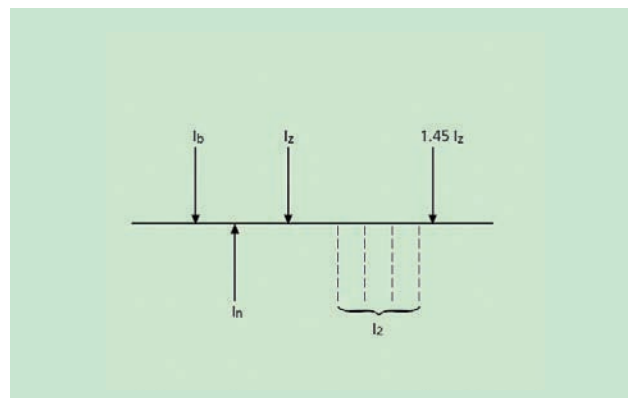


Fig. 2: Coordination for overload protection

Where the overcurrent device is intended to afford protection against overload, I_2 must not exceed $1.45 I_z$ and I_n must not exceed I_z , see fig. 2.

Where the overcurrent device is intended to afford fault current protection only, I_n can be greater than I_z and I_2 can be greater than $1.45 I_z$. The protective device must be selected for compliance with Regulation 434.5.2.

Determination of the size of cable to be used

When overcurrent protection is to be provided, the current-carrying capacity of the cable, I_z , is determined by applying correction factors to the tabulated cable ratings, I_t , from Appendix 4 of BS 7671.

$$I_z = I_t C_a C_g C_i C_c$$

where:

C_a is rating factor for ambient temperature, see Table 4B1 of BS 7671
 C_g is rating factor for grouping see, Table 4C1 of BS 7671

C_i is rating factor for conductors surrounded by thermal insulation
 C_c is a rating factor applied when overload protection is being provided by an overcurrent device with a fusing factor greater than 1.45, e.g. $C_c = 0.725$ for semi-enclosed fuses to BS 3036, and when the cable is laid in the ground.

By referring to fig. 1, the current-carrying capacity of the cable, I_z , must equal or exceed the circuit overcurrent device rated current, I_n .

$$I_z \geq I_n$$

and, hence, by combining the two equations above, we get:

$$I_t \geq \frac{I_n}{C_a C_g C_i C_c}$$

This equation can be read as, when overcurrent protection is to be provided, the tabulated cable ratings from Appendix 4 of BS 7671 must equal or exceed the circuit overcurrent device rating corrected for ambient temperature, grouping, thermal insulation and the use of a rewirable fuse if applicable.

Example 1

A circuit supplying a shower with a loading of 6 kW would have a design current I_b given by:

$$I_b = \frac{6 \times 1000 \text{ W}}{230 \text{ V}} = 26 \text{ A}$$

The nominal current rating in amps, I_n , of the protective device (fuse or circuit-breaker) for a circuit is selected

so that I_n is greater than or equal to the design current, I_b , of the circuit.

$$I_n \geq I_b$$

So, in the example of the 6 kW shower I_n must be ≥ 26 ;

select say a 32 A circuit-breaker, that is

$$I_n = 32 \text{ A}$$

A cable must now be selected so that its rating, I_z , in the particular installation conditions exceeds the design current of the load, I_b .

$$I_z \geq I_b$$

In the example of the 6 kW shower load, $I_b = 26$, so $I_z \geq 26$.

Where overload protection of the cable is to be provided, as is usual, the cable is also selected so that its rating in its installed conditions I_z exceeds the current rating of the circuit protective device.

$$I_z \geq I_n$$

In the example of the 6 kW shower circuit with overload protection, $I_z \geq 32$. It may be argued that no overload need be provided for a shower as the load is fixed.

Therefore, $I_z \geq I_n \geq I_b$

In the example of the 6 kW shower with overload protection, this relationship will be satisfied if $I_b = 26$ A, $I_n = 32$ A and the circuit conductors are sized such that $I_z \geq 32$ A.

To calculate the tabulated cable ratings, I_t , the following formula (from Appendix 4 of BS 7671) is used.

$$I_z = I_t C_a C_g C_i C_c$$

Overload protection is provided in practically all circuit designs in order to protect the cable should the load be increased, e.g. by adding further lights to a lighting circuit or changing a shower for one of a higher rating without proper checks being made.

However, for a fixed load e.g. a shower circuit, this is not an actual requirement of BS 7671.

Note that the term overcurrent includes both overload current and fault current.

Where protection is being provided against overload, protection will also be provided against fault currents, however, the reverse is not true

Knowing I_z , it is necessary to select a tabulated cable rating such that

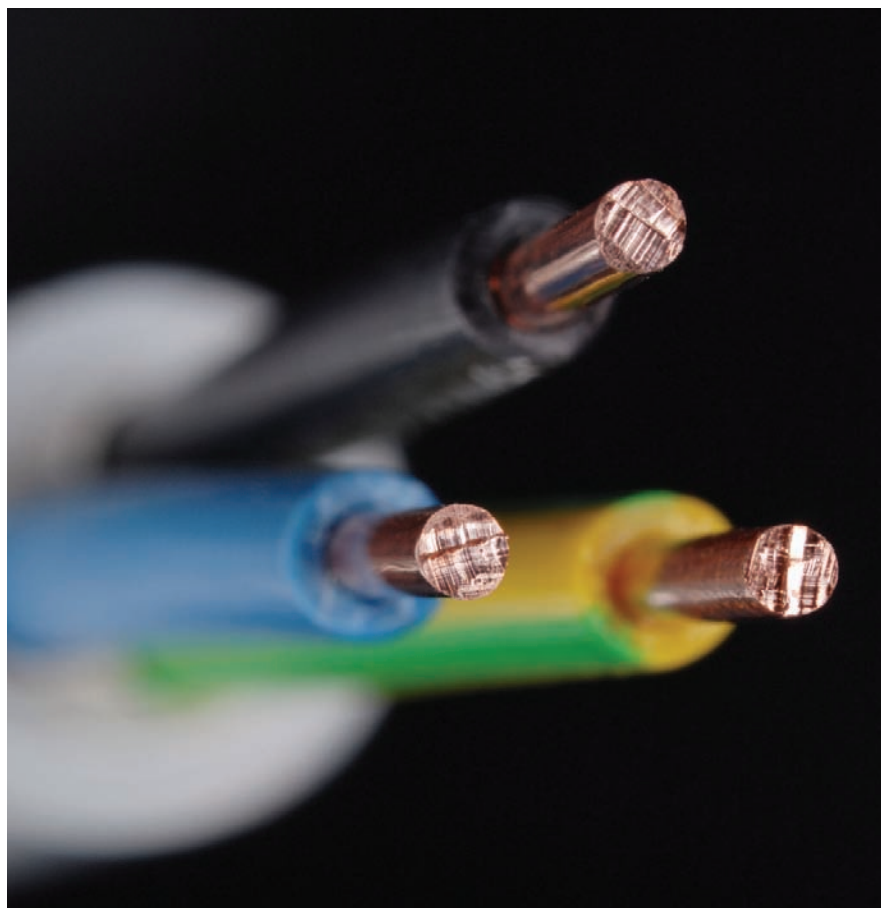
$$I_t \geq \frac{I_z}{C_a C_g C_i C_c}$$

Example 2

For the shower circuit above: the ambient temperature is assumed (as is usual) to be 30 °C, so $C_a = 1$ the cable is not grouped so $C_g = 1$ the cable is not installed in thermal insulation so $C_i = 1$, and it is not a semi-enclosed (rewirable fuse) so $C_c = 1$.

Hence

$$I_t \geq \frac{32}{1 \times 1 \times 1 \times 1}$$



For a thermoplastic (PVC) insulated and sheathed flat cable with protective conductor from Table C.1 or Table 4D5A of BS 7671 or Table 6F of the On-Site Guide, installed in an insulated wall, 6 mm² cable is adequate as it has a tabulated rating of 32 A for installation method A.

Further information

Further information and reading can be found in the following publications:

- BS 7671:2008 *Requirements for Electrical Installations, IEE Wiring Regulations, Seventeenth Edition Guidance Note 3 - Inspection and Testing*
- Electrical Installation Design Guide - Calculations for Electricians and Designers (2008), IET publication ISBN 978-0-86341-550-0
- IET Guidance Note 6 - Protection

against overcurrent

- BS 7769 (BS IEC 60287) *Electric cables. Calculation of the current rating. Thermal resistance. A method for calculating reduction factors for groups of cables in free air, protected from solar radiation*
- IEC 60502-1 *Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) – Part 1: Cables for rated voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ kV)*
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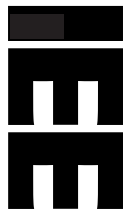
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Guidance Note 3:

Inspection & Testing, 5th Edition

Suitable for the City & Guilds 2391 Certificate in Inspection, Testing and Certification, this guidance note is concerned principally with Inspection and Testing. It has been updated to align with the "IEE Wiring Regulations (BS 7671) 17th Edition". It includes detailed coverage of initial verification, periodic inspection and test instruments.

General note on Guidance Notes:

The IET issues a series of Guidance Notes, each of which enlarges upon and amplifies the particular requirements of a part of the 17th Edition Wiring Regulations. Each of these guides is extensively cross-referenced to the Regulations, thus providing convenient and ready access. Some Guidance Notes contain information not included in the 17th Edition but which was included in earlier editions of the IEE Wiring Regulations. All of the Guidance Notes contain references to other relevant sources of information.

Full details of publications can be found at www.theiet.org/wiringregs.

Contents

- Introduction
- General requirements
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- Periodic inspection and testing
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17th Edition Training

by Jon Elliott

Hopefully readers of *Wiring Matters* will already be aware that the 17th Edition of the IEE Wiring Regulations was issued on 1st January 2008 and came into effect fully from the 1st July 2008.

Any installation works designed after 30th June should now be based upon, and comply with the requirements of the 17th Edition (Introduction to BS 7671:2008 refers). For this to occur, persons involved in the design, installation/construction and inspection and testing of electrical work need to develop a sound working knowledge of the 17th Edition and its application. As an aid to achieving this, a number of training options and qualifications have been developed which are aimed at providing the necessary updating of existing skills or indeed for persons new to the electrical industry the necessary initial training.

This article explains the 17th Edition qualifications options that are available and aims to clarify broadly which qualifications would be most appropriate taking into account the experience and prior qualifications of the person seeking training. It mentions briefly the impact that the 17th Edition has had upon qualifications relating to inspection and testing. It also highlights a number of publications that may assist a candidate to achieve successful completion of various electrical installation related qualifications that the IET has produced in partnership with City & Guilds and the courses currently offered by the IET Courses unit.

Initial training

Persons coming into the electrotechnical industry should obtain an appropriate initial qualification by attending a training programme at a Further Education College which leads to a recognised qualification at level 3 of the National qualification framework (NQF). Probably the most widely available currently being the City & Guilds 2330 Certificate in Electrotechnical Technology and the EAL level 3 Diploma in Electrotechnical services. Both may be offered on a full-time or a part-time (day-release) basis.

As a result of the modular nature of the City & Guilds 2330 qualification, candidates can choose from a range of vocation-specific pathways by completing the core unit and two units relating to their chosen occupation. The following Pathways are available:

- Installation (Building and Structures)
- Electrical Maintenance
- Installing Instrumentation and Associated Equipment

- Installing Public Lighting Systems and Associated Equipment
- Electrotechnical Panel Building
- Electrical Machine Repair and Rewind

Where the candidate is in appropriate employment, all of the above can contribute towards a candidate's completion of a Level 3 National Vocational Qualification (NVQ) or Scottish Vocational Qualification (SVQ).

Upgrading from 16th edition to 17th edition

A number of options are open to persons who are currently working within the electrotechnical sector wishing to improve their knowledge of the current (17th) Edition of the Wiring Regulations and obtain a 17th Edition qualification. They are particularly suited to persons directly engaged "on the tools" in installation and maintenance work. However, they would also provide extremely useful subject updating for those involved in roles within the electrotechnical industry such as design, supervision and inspection & testing - subject updating should not after all be confined only to those at the "coal-face".

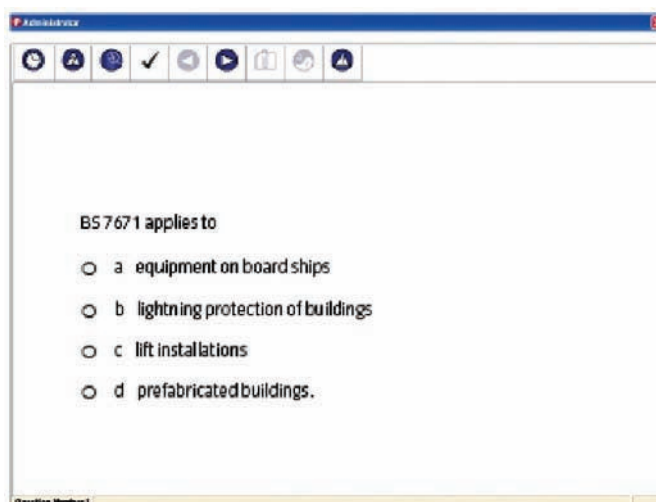
When considering which course is most appropriate for a particular person, the key factors will be having sufficient relevant work experience/knowledge and, most importantly when an individual obtained a 16th Edition qualification.

The entry requirements and course content of the various options available are considered below.

City & Guilds 2382-10 and EAL Level 3 Diploma in Requirements for Electrical Installations

These qualifications are primarily aimed at practising electricians with a working knowledge of the 16th Edition of BS 7671 and who have already achieved a qualification addressing BS

Fig 1: The way a typical multiple-choice question appears when sitting a City & Guilds GOLA computer based examination.



7671 such as the City & Guilds 236 part A & B or 2360 part 1 & 2 certificates in electrical installation work.

Due to the amount of time elapsed since their 16th Edition qualification was obtained, these qualifications do not focus solely on the changes incorporated into the new edition but rather take candidates through the whole of the 17th Edition. As a result, these qualifications consist of around 30 hours of instruction which is typically delivered over four days or twelve evenings.

Candidates have 2 hours to answer 60 questions. In the case of the City & Guilds qualification, assessment is by a multiple-choice test sat via a computer using the GOLA online system. In the case of the EAL qualification, candidates may sit either a conventional paper format or online examination.

Candidates who can demonstrate that they possess sufficient knowledge/experience of electrical installation work but do not have a 16th Edition qualification may be able to enrol on these qualifications subject to assessment of their suitability for the course by the college/training provider. However, due to the specific focus being on the Wiring Regulations only, these qualifications are not suitable, nor were they intended, for persons entering or seeking

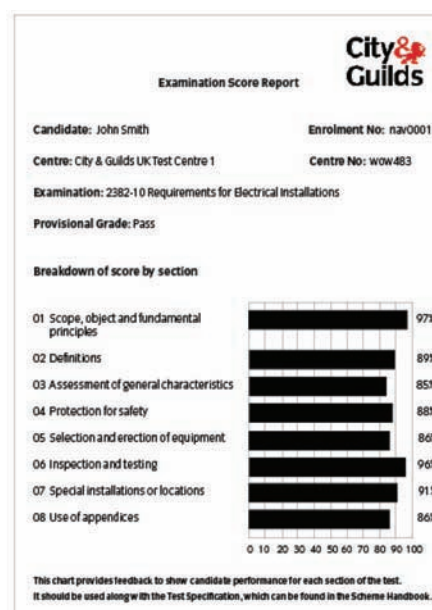


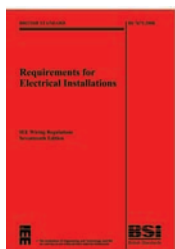
Fig 2: Examination score report. What a candidate sees immediately after the completing the City & Guilds 2382-10 GOLA examination. Instant feedback on how they have performed.

employment within the electrotechnical sector for the first time for whom the initial training options described earlier would be appropriate.

City & Guilds 2382-20 and EAL Level 3 Diploma in Requirements for Electrical Installations (Update)

These qualifications are also primarily aimed at practising electricians with a

The Institution prepares regulations for the safety of electrical installations for buildings, the IEE Wiring Regulations (BS 7671), which has now become the standard for the UK and many other countries. It has also prepared the Code of Practice for Installation of Electrical and Electronic Equipment In Ships (BS 8450) and recommends, internationally, the requirements for Mobile and Fixed Offshore Installations. The Institution provides guidance on the application of BS 7671 through publications focused on the various activities from design of the installation through to final test and certification with further guidance for maintenance. This includes a series of eight Guidance Notes, two Codes of Practice and model forms for use in wiring installations. **During the course of 2008 all guidance publications will be updated to align with the 17th Edition of the IEE Wiring Regulations (BS 7671:2008)**



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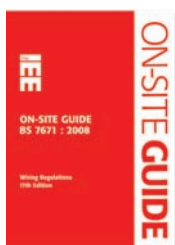
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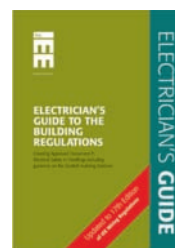
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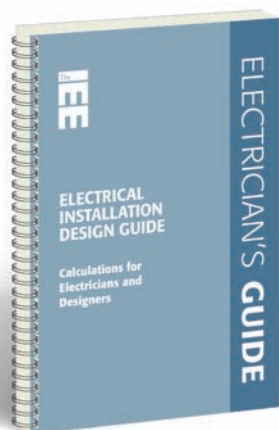
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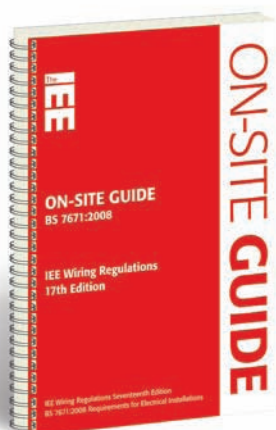


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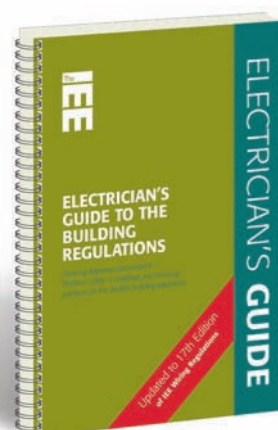
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- City & Guilds Level 3 Certificate in the Requirements for Electrical Installations BS 7671: June 2001 (2381), or
- City & Guilds Level 3 Certificate in Electrotechnical Technology Installation (Building and Structures) (2330-07), or
- City & Guilds Level 3 Certificate in Electrotechnical Technology Electrical Maintenance (2330-08), or
- City & Guilds Level 3 Certificate in Electrical Installation Part Two (2360) (from January 1st 2004 onwards only)

On completion of these updating qualifications, candidates should be

conversant with the format, content and application of the current edition of BS 7671. Given the relatively short time that will have elapsed since candidates obtained their 16th Edition qualification, these qualifications focus on the main additions and alterations from the 16th Edition that have been incorporated in the 2008 17th Edition.

These qualifications consist of around 7½ hours of instruction, typically delivered over one day or three evenings.

Candidates have 1 hour to answer 30 questions. In the case of the City & Guilds qualification, assessment is by a multiple-choice test sat via a computer using the GOLLA online system and the case of the EAL qualification, candidates may sit either a conventional paper format or online examination.

It is worth mentioning at this

point that persons sitting any of the 17th Edition examinations described above may only make reference to the 17th Edition during the examination.

Inspection, testing and certification

Although the 17th Edition contains a number of changes relating to inspection, testing and certification, these should be covered in sufficient depth during a course leading to the City & Guilds 2382 or EAL 17th Edition qualifications and as such it has not been considered necessary to require persons who have successfully completed a 16th Edition era (2391-01) City & Guilds inspection and testing qualification to have to undertake any inspection and testing specific upgrading training. However, the current version of the City & Guilds qualification (the 2392-10) and the EAL



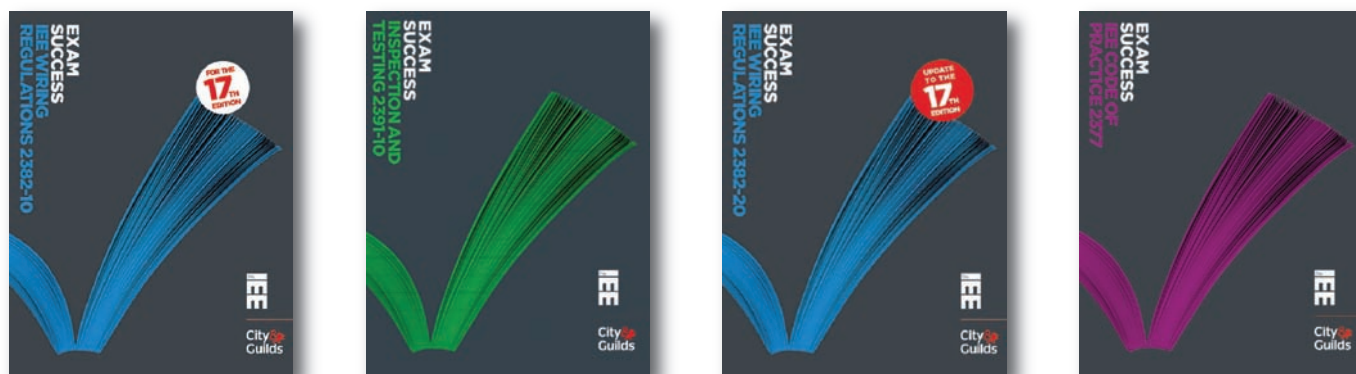


Fig 3: The complete Exam Success series of books

Level 3 Diploma in Inspecting and Testing Electrotechnical Systems and Equipment have been updated such that they now relate to the 17th Edition requirements.

Help with the examinations

The IET and City & Guilds have worked together to produce a series of books called *Exam Success*, the aim of which is to assist candidates in their preparation for sitting City & Guilds electrical installation/maintenance related examinations and which are intended to complement the tuition provided from attendance on a course of study. Where necessary these have been revised to reflect the content of the 17th Edition.

These books contain useful tips to aid in revision for and sitting the examinations and contain a number of sample question papers and model answers with explanations. In the case of the 2377 and 2382 17th Edition examinations, advice is also given on what to expect when sitting a GOL A computer based examination for the first time. Although not specifically designed to accompany the EAL qualifications, the sample questions and model answers would also be of use to persons attempting the EAL equivalents of the City & Guilds qualifications.

The *Exam Success* series of publications is as follows:

Relating to the 17th Edition

- **2382-10** 17th Edition.
To accompany the 2 hour, 60 question examination
- **2382-20** 16th to 17th Edition update.
To accompany the 1 hour, 30 question examination
- **2391-10** Inspection and testing

Relating to the *IEE Code of practice* for In-service inspection and testing of electrical equipment

- **2377** Covers both the *Management of electrical equipment maintenance* (2377-100) and the *Inspection and testing of electrical equipment* (2377-200) examinations.

A newly revised version of the On-site Guide based upon the content of the 17th Edition has also been released recently.

Summary

Regulation 16 of The Electricity at Work Regulations 1989 requires persons involved in electrical work to be competent to do so. Technical knowledge is one of the elements of the measure of competency. As such anyone involved in low voltage electrical installation or maintenance work should develop a sound working knowledge of the 17th Edition (BS 7671:2008).

A number of training courses and

qualifications are available to help persons to become conversant with the current requirements contained within the 17th Edition. The IET also offer a wide range of training options relating to electrical installation, maintenance, safety and legislation. The IET courses unit offers a wide range of courses relating to the electrical design, inspection and testing full details of which can be obtained from the current course brochure or from <http://www.theiet.org/careers/courses/electrical/index.cfm>

Courses are provided at venues throughout the UK and can also be offered in-house to organisations.

Assistance to aid the successful completion of these qualifications can be obtained from the Exam Success series of books produced by The IET in collaboration with City and Guilds.

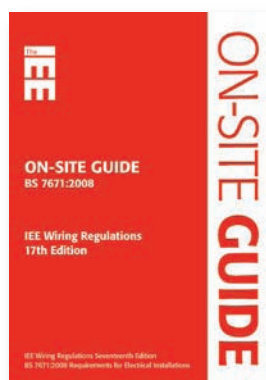
The On-site Guide and *Exam Success* series of books can be obtained directly from the IET or from most large bookshops.

Anyone seeking further information on City & Guilds courses should refer to City & Guilds directly or consult their website at www.cityandguilds.com/

Anyone seeking further information on EAL courses should refer to EAL directly or consult their website at www.eal.org.uk ■

The On-Site Guide

by Mark Coles



THE ON-SITE GUIDE has been rewritten to reflect the requirements of the 17th Edition of the IEE Wiring Regulations, BS 7671:2008.

The On-Site Guide is intended to enable the competent electrician to deal with small installations up to 100 A, 3-phase. It includes simple circuit calculations and provides essential information in a convenient, easy-to-use form, avoiding the need for detailed calculations.

The Guide is restricted to installations:

- (i) at a supply frequency of 50 hertz
- (ii) at a nominal voltage of 230 V a.c. single-phase or 230/400 V a.c. three-phase
- (iii) fed through a distributor's cut-out having a fuse or fuses to BS 1361 Type II or through fuses to BS 88-2 or BS 88-6
- (iv) with a maximum value of the earth fault loop impedance outside the consumer's installation as follows:

- TN-C-S system - 0.35 Ω
- TN-S system - 0.8 Ω
- TT system - 21 Ω excluding consumer's earth electrode

Content

The 17th Edition introduces a number of requirements for RCDs, such as, for socket-outlet circuits in domestic and similar installations for use by non skilled people, for circuits of locations containing a bath or shower and for cables without earthed metallic covering installed in walls or partitions at a depth of less than 50 mm and not protected by earthed steel conduit or similar; amongst others.

The On-Site Guide offers guidance on meeting these requirements by showing different permutations of RCDs, RCBOs and circuit-breakers at consumer units. Two examples are given here.

Example 1 - RCBOs

The use of RCBOs, see figure 1, will minimize inconvenience in the event of a fault and is applicable to all systems. Such a consumer unit arrangement also easily allows individual circuits, such as to specifically labelled sockets or fire alarms, to be protected by a circuit-breaker without RCD protection. Such circuits will usually need to be installed in earthed metal conduit, wired with earthed metal-sheathed cables or, in some cases, installed on the surface.

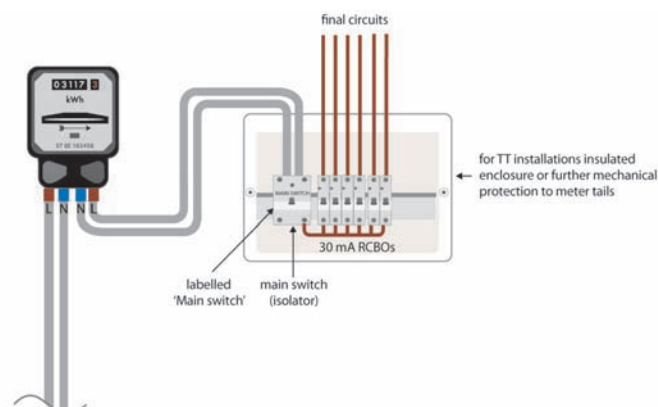


Fig 1: Consumer unit with RCBOs, suitable for all installations (TN and TT)

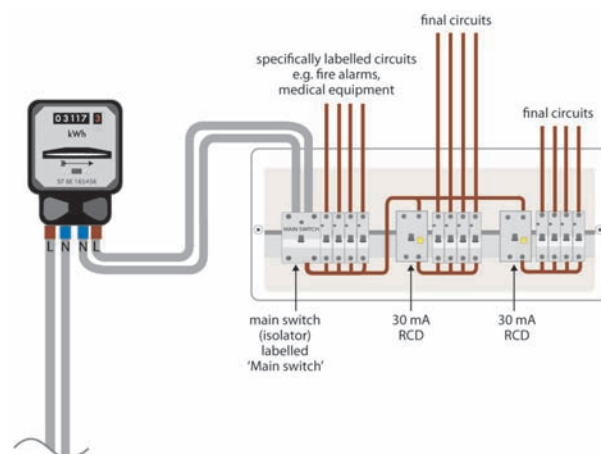


Fig 2: Three-way split consumer unit with separate main switch, two 30 mA RCDs and circuits without RCD protection

Example 2 - Three-way split board with two 30 mA RCDs

The three-way division of an installation to provide ways unprotected by RCDs for, say, fire systems and for two separate 30 mA RCDs to ensure that part of the installation will remain energised in the event of a fault. Unprotected circuits will usually need to be installed in earthed metal conduit or wired with earthed metal-sheathed cables or, in some cases, installed on the surface; see figure 2.

Further information

The On-Site Guide forms part of the suite of guidance publications issued by the IET, for which, there is a rolling programme to update and publish. The On-Site Guide is available now. ■

Price: £20

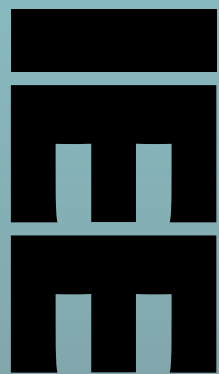
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- Level 3 Certificate in Inspection, Testing & Certification of Electrical Installations (City & Guilds 2391-10)



Also available from the IET:

Portable Appliance Testing
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