Technical Guides

Guide to Surge Protection Devices

This guide expands upon some of the requirements found in the 17th Edition of the IET Wiring Regulations and other standards, related to the protection of electrical equipment from electrical surges. It considers protection against voltage transients on the electrical installation only. Consideration should also be given to the protection against transient overvoltages transmitted by data transmission systems. BS EN 50174 refers.

Specification Guide to Prefabricated Wiring Systems

Prefabricated wiring systems may be referred to in generic terms as: "modular wiring" or "plug and play". However, the key question for any prefabricated wiring system is, does it comply with the appropriate safety requirements as a complete system?

Junction Box Guide to the 17th Edition

Discover more about how the 17th Edition of the IET Wiring Regulations is affecting your choice of Junction Box.

sollysta Wiring Accessories Guide

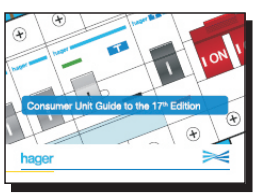
This guide expands upon some of the requirements of the 17th Edition of the IET Wiring Regulations and how they affect wiring accessories.

Commercial Installations Guide Pt 1 (Distribution Boards)

The whole nature of sub and final distribution has changed over the last few years, read this guide to find out more about regulation changes affecting Type B Distribution Boards.

Commercial Installations Guide Pt 2 (Panelboards)

The whole nature of sub and final distribution has changed over the last few years, read this guide to find out more about regulation changes affecting panelboards.



Consumer Unit Guide to the 17th Edition

This guide will help you understand the 17th Edition IET Wiring Regulations and current Building Regulations, providing the necessary facts to construct compliant installations that include Consumer Units.

Knowledge is Power

The Hager Guide to current thinking on the regulations, protection and control of Klik lighting circuits.

Guide to
Surge Protection Devices

hager

Introduction

The whole nature of how electrical equipment is used in homes and at work has evolved; with everyday activities relying on electronic equipment. Products such as computers, printers, flat screen televisions, industrial control equipment such as PLC's, alarms, microwaves and washing machines are common place. These can all be vulnerable to transient overvoltages, which can significantly reduce the equipment's lifespan through degradation and damage.

This guide expands upon some of the requirements found in the 17th Edition of the IET Wiring Regulations and other standards, related to the protection of electrical equipment from electrical surges. It considers protection against voltage transients on the electrical installation only. Consideration should also be given to the protection against transient overvoltages transmitted by data transmission systems. BS EN 50174 refers.

Note: this guide does not ensure compliance with BS 7671 or indeed guarantee that equipment is protected against electrical surges. The electrical specifier should use their own judgment, consulting BS 7671 and the BS EN 62305 series (protection against lightning) to determine the need and correct selection of surge protection devices.

Contents

Risks of electrical surges

Surge protective devices (SPD) assist in the protection of valuable electrical and electronic equipment against transients, originating from lightning and also from switching sources.

These transients can cause damage ranging from the premature ageing of equipment, logic failures and down time, to the complete destruction of equipment within the entire electrical installation. Products such as LCD screens, data servers and industrial equipment such PLC's are critical to business activity. Protecting this equipment may now be a necessity.

The Hager SPD range of solutions may offer protection to prevent damage to this sensitive equipment by diverting the damaging transient over-voltages. In the majority of cases this will eliminate equipment failures and reduce downtime.

The choice of a surge protective device depends upon:

- The exposure of the building to lightning transients
- The sensitivity and value of the equipment that requires protection (it is recommended that the contractor should discuss the installations requirements with the customer)
- The location and therefore the exposure level of the installation
- The equipment used within the installation and whether this equipment could generate switching transients

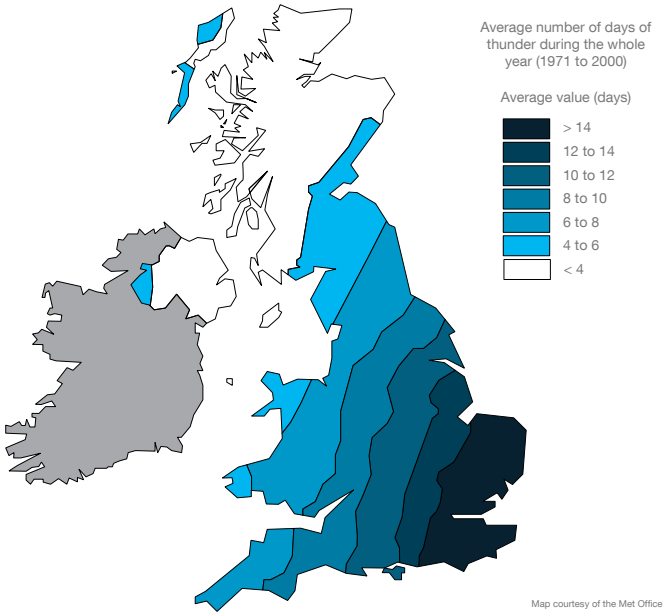
BS 7671 and the AQ criteria method

Lightning discharges could contain currents of 200,000A which if struck at or near power transmission lines would generate a significant voltage transient. This voltage transient could cause significant damage to both domestic and commercial electronic equipment.

The UK regional map illustrates the likely lightning activity caused by the number of thunderstorm days across the country.

Protection against over-voltages is the subject of section 443 of BS 7671. Here the AQ criteria method is introduced which is based on the likelihood of the equipment being subjected to over-voltages caused by lightning strikes, taking account of the probable number of lightning strikes per year.

For electrical installations in the UK, the map shows that the probable number of thunderstorm days per year in any given location is less than 25, and therefore condition AQ1 applies.



Map courtesy of the Met Office

Where this is the case and for installations being supplied by overhead lines, Regulation 443.2.2 indicates that provided the impulse withstand voltage of the equipment is not less than the values given in Table 44.3 (see Table 1 for installations rated at 230 V to Earth), no additional protection by a SPD is required. However, where higher levels of equipment reliability or higher risks (e.g. fire) are expected, additional protection by an SPD against over-voltage may be required.

Similarly, for an installation having overhead lines, no additional protection against overvoltages is required if the equipment meets the minimum voltage withstand values in table 44.3.

There are some words of caution in the notes to this section where it is recognised that transient over-voltages transmitted by the supply distribution system are not significantly attenuated. So an induced voltage some distance away could easily manifest itself at the electrical installation and cause potential harm to the equipment within. It is also worth considering that the AQ data is for thunderstorm days NOT lightning strikes. One storm will usually contain many lightning flashes which could lead to an over-voltage on the installation causing damage to equipment.

"where higher levels of equipment reliability or higher risks (e.g. fire) are expected, additional protection by an SPD against over-voltage may be required."

Impulse withstand category	Example of equipment in category (note 1)	Required minimum impulse withstand voltage (note 2)
I (low impulse voltage)	Sensitive electronic equipment connected to the fixed installation.	1.5 kV
II (normal impulse voltage)	Domestic appliances and portable power tools connected to the fixed installation.	2.5 kV
III (high impulse voltage)	Equipment intended to be installed in a part of the fixed installation where a high degree of availability of overvoltages is expected, such as distribution boards, circuit-breakers and wiring systems.	4.0 kV
IV (very high impulse voltage)	Equipment intended to be installed at or near the intake to the installation, such as the energy meter.	6.0 kV

Table 1: Required minimum impulse withstand voltage for equipment where installation rated voltage is 230V to Earth (based on tables 44.3 44.4 of BS7671)

Notes:
1. Table 44.4 of *BS 7671* gives a fuller list of examples of equipment falling into each category.
2. This table applies only for installations of rated voltage (U_O) 230V. For installations of other rated voltages, see Table 44.3 of *BS 7671*.

Terminology & selection criteria

Surge protection devices are classified according to their standard into different types

• Type 1 - SPD which can discharge partial lightning current with a typical waveform 10/350 µs. Usually employs spark gap technology.

• Type 2 - SPD which can prevent the spread of over-voltages in the electrical installations and protects equipment connected to it. It usually employs metal oxide varistor (MOV) technology and is characterized by an 8/20 µs current wave.

• Type 3 – These SPDs have a low discharge capacity. They must therefore only be installed as a supplement to Type 2 SPD and in the vicinity of sensitive loads. Type 3 SPD's are characterised by a combination of voltage waves (1.2/50 µs) and current waves (8/20 µs).

I_{imp} – Impulse current of 10/350 µs waveform associated with Type 1 spd's

I_n – Surge current of 8/20 µs waveform associated with Type 2 spd's

U_p - The residual voltage that is measured across the terminal of the SPD when I_n is applied.

U_c - The maximum voltage which may be continuously applied to the SPD without it conducting.

Selection of suitable devices

BS 7671 section 534 gives the requirements for correct selection of devices against overvoltages.
Regulation 534.2.1 prescribes that where required by Section 443 or otherwise specified, SPD's shall be installed:

(i) near the origin of an installation, or
(ii) in the main distribution assembly nearest the origin of an installation

The notes to this regulation give further guidance, stating that a Type 1 or a Type 2 SPD may be used at the origin whilst Type 2 and Type 3 are also suited for locations close to the protected equipment.

Type 1 SPD's are often referred to as equipotential bonding SPD's and are fitted at the origin. A lightning protection system employing these devices only, offer no effective protection against failure of sensitive electrical and electronic systems. In order to achieve this, additional coordinated devices will have to be employed.

In summary, a Type 1 SPD is used at the origin of the installation, a Type 2 SPD is used at distribution boards and a Type 3 SPD is used near terminal equipment.

Surge protection needs to be selected such that their voltage protection level (U_p) is lower than the impulse withstand capability of the equipment to be protected. 534.2.3.1.1 suggests that this value should be referred to category II of Table 44.3. This for a 230/400V installation suggests that the value should not exceed 2.5kV. However 534.2.3.1.2 suggests that to protect sensitive and critical equipment, then consideration should be given to reduce this value to that required for category 1 equipment (ie 1.5kV).

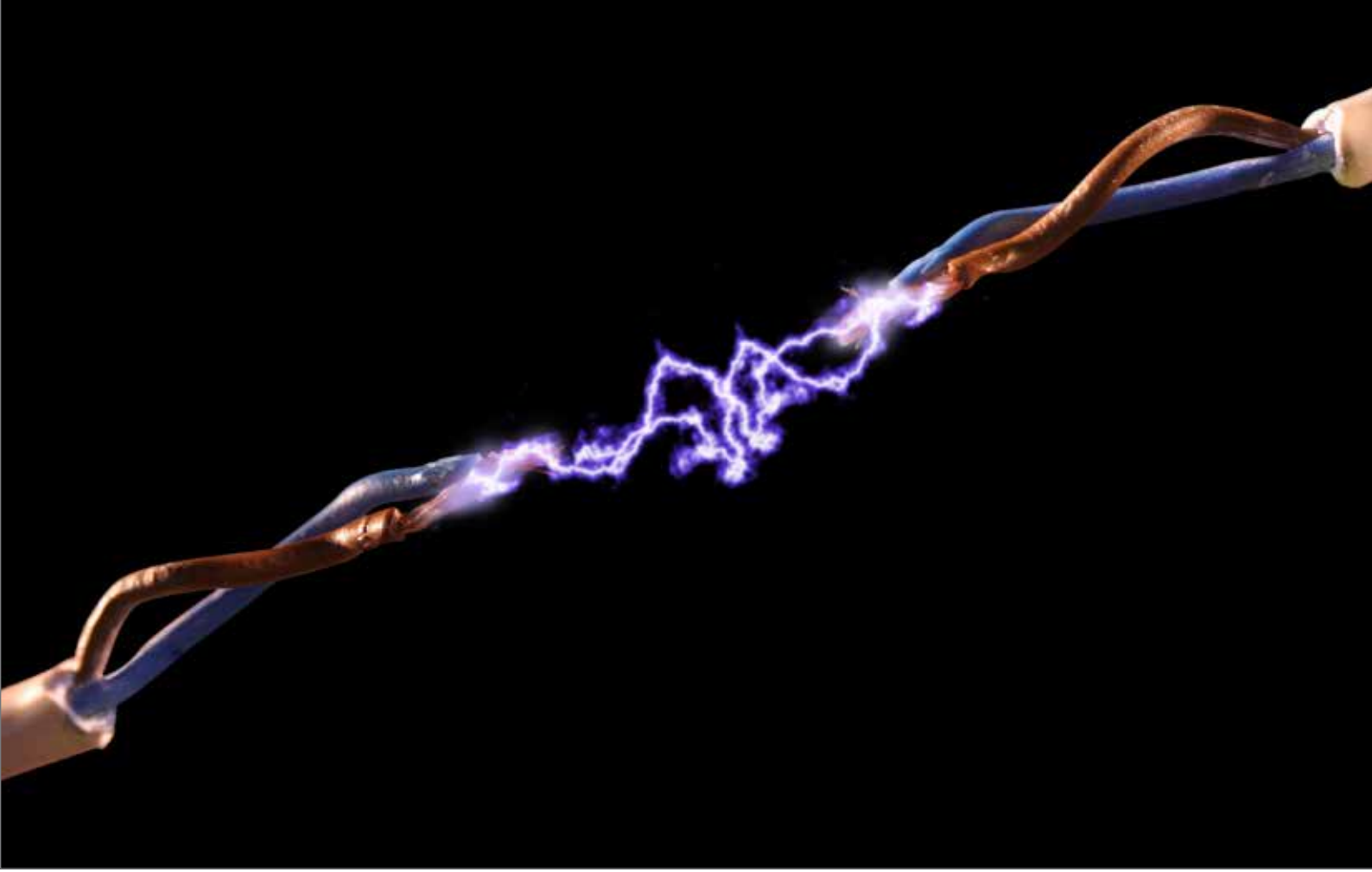
534.2.3.4 also gives guidance as to the selection of an appropriate device.

The specifier should ascertain from BS 7671 which connection type is preferable (CT 1 or CT 2). Hager manufacture devices with connection type CT2.

Type 1 devices need to be selected such that the value if I_{imp} is not less than that which shall be calculated in accordance with BS EN 62305-4. However if this cannot be calculated then this value shall be not less than 12.5kA. Also, due to the connection method, the value of I_{imp} between the neutral conductor and the protective conductor shall be not less than 50kA for three phase systems and 25kA for single phase where the value cannot be calculated.

For Type 2 devices the value of I_n shall be not less than 5kA and the value between the neutral and protective conductor shall be not less than 20kA for three phase systems and 10kA for single phase. Larger values may be required as classified in BS EN 61643-11.

“The specifier should ascertain from BS 7671 which connection type is preferable. Hager manufacture devices with connection type CT2.”



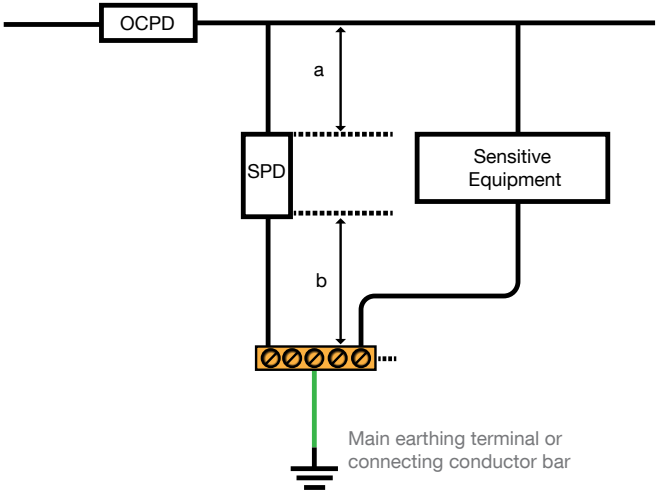
Connection

To gain maximum protection from the SPD, the connecting conductors should be kept as short as possible. This is to minimise any additive voltage drops on the connecting cables.

The connecting conductors of the SPD shall have a cross sectional area of not less than 4mm^2 copper and the total connecting lead length (a+b) should preferably not exceed 0.5m but shall in no case exceed 1m.

Where Type 1 devices have been installed the cross section area shall be not less than 16mm^2 copper. Manufacturer's instructions shall be followed.

Some devices have dual line & neutral terminals. This connection method reduces any additional voltage drop in the connecting cables thereby obtaining the best possible U_p to the installation. There are conditions to this connection method however. With Hager devices it is suitable for installations having a maximum demand up to 125A.

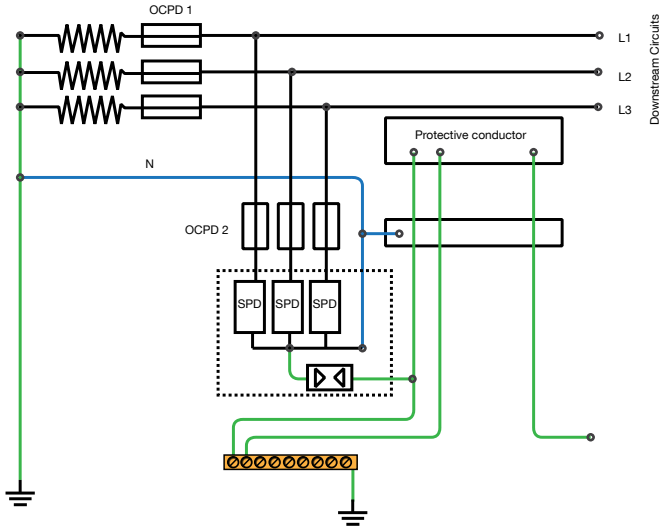


OCPD = overcurrent protection device
SPD = surge protection device

Should the distance between the SPD and the sensitive equipment to be protected be greater than 10m, oscillations could lead to higher voltage values appearing at the equipment. Consideration should be given to additional coordinated surge protection devices closer to the equipment. Again manufacturer's instructions should be followed

Protection against SPD short circuits is often provided by an over-current protective device such as a fuse or circuit breaker. This device must of course permit the flow of surge current through the device without operating. Manufacturers will give instructions as to which device is recommended. In certain circumstances this secondary over-current device may be omitted if the upstream over-current device meets certain conditions.

Should RCD's be required in the installation as additional protection or to ensure the requirements of fault protection are satisfied, then the SPD will need to be installed upstream of the RCD. Where this cannot be avoided, the RCD should be of the time-delayed or S-type.



Cascading

Cascading is the term used to describe the method of combining several levels of surge protection devices into the one installation.

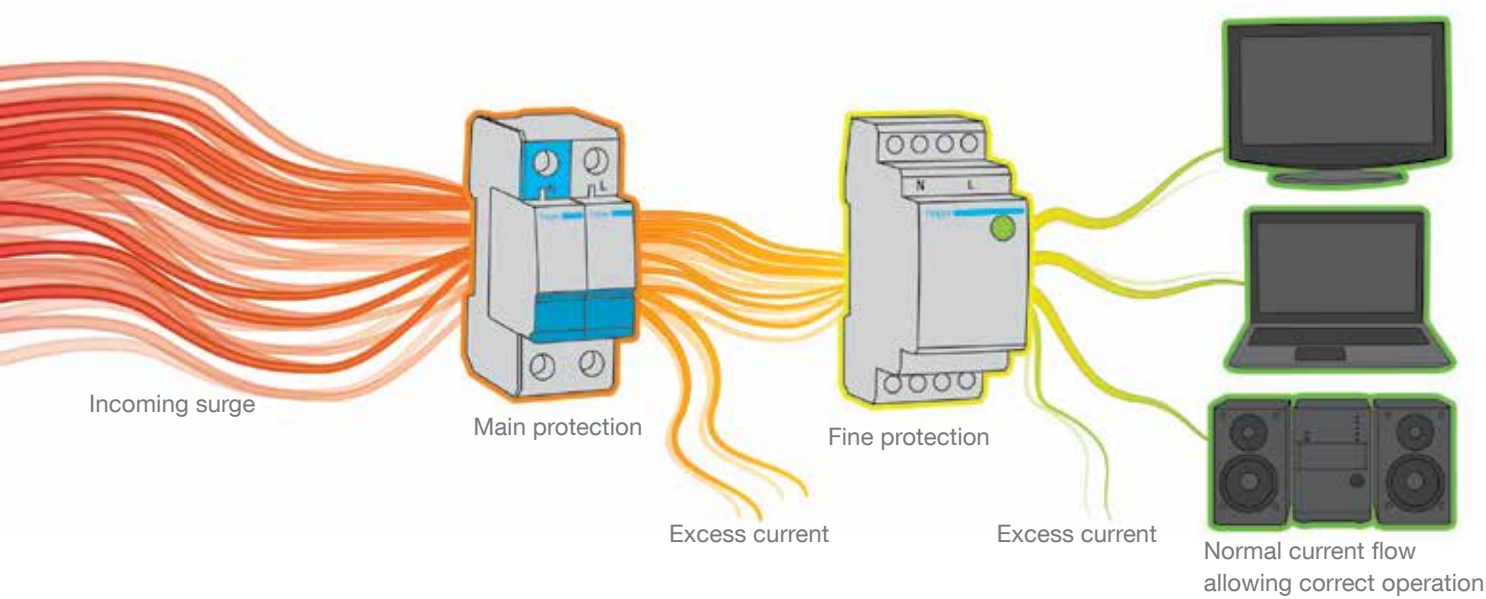
This takes advantage of the best features of each device to improve the protection level for the equipment. Hager recommends using a high surge current capacity device to divert the bulk of the transient over-voltage at the origin of the installation.

In the case of a Class 1 & 2 device this would be either the spark gap arrester or a high current capacity MOV. Should finer protection be required, the next step is to install a Class 3 device SP202N near the terminal equipment.

Cascading increases the current diverting capacity of the SPD system whilst maintaining a low voltage (U_p) to ensure the best protection for valuable equipment.

Selecting SPD of the same manufacturer or make will ensure correct co-ordination between devices

"Cascading increases the current diverting capacity of the SPD system whilst maintaining a low voltage (U_p) to ensure the best protection for valuable equipment."


Incoming surge
Main protection
Fine protection
Excess current
Excess current
Normal current flow
allowing correct operation

Inspection & Testing

During the Initial Verification or as part of a periodic inspection & test, the SPD should be inspected to ensure it is operational. Any over-current protective device associated with the SPD should be intact and should be as instructed by the manufacturer.

There is usually some kind of visual indication on the SPD that the device is still operational. This may be indicated by a GREEN visual indicator window. Should this window indicate RED then it is an indication that the device has reached its 'End of Life' and needs replacing. With some products, this will involve the replacement of the device, but on many of the products in the range, this can simply be carried out by replacing the removable cartridge.

An insulation resistance test of 500V dc carried out with the SPD connected will produce incorrect readings. This is due to the SPD starting to conduct as the value of U_C may have been exceeded. This test then should be conducted without the SPD connected. Alternatively this test can be conducted at the reduced test voltage of 250V dc.

"There is usually some kind of visual indication on the SPD that the device is still operational. This may be indicated by a green visual indicator window."

SPD quick selection guide

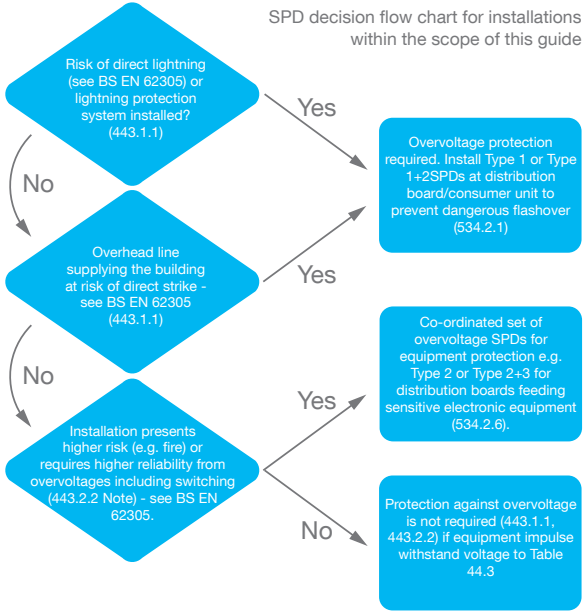
The following is a quick selection guide which may assist in choosing whether SPD's are required and the correct type of device

- Does the installation contain a lightning protection system?
- Is the installation adjacent to any tall structure, tall trees or near a hill top in a lightning prone area?
- Does the installation contain equipment where higher reliability from overvoltages is required

If the answer is YES in the above to the first two questions, it is recommended to install a Type 1+2 device. This will provide protection against surges caused by direct lightning strikes and provide protection against transient over-voltages caused by indirect lightning strikes or by switching events.

If the answer is YES to the third question then it is recommended to install Type 2 devices to provide protection against transient over-voltages caused by indirect lightning strikes or by switching events.

SPD decision flow chart for installations within the scope of this guide



Note: For larger installations beyond the scope of this guide, a risk assessment method used to evaluate the need for SPDs is given in Section 443 of BS 7671:2008(2011)

Benefits of using Hager SPD's

- All applications are covered with a full range of compatible devices. Protection for high rise towers; commercial buildings with essential computer data and expensive office machinery; domestic dwellings with entertainment and computer systems.
- Advanced warning that the device needs replacing. Remote indication option means an audible or visible alarm can warn the user that the cartridge needs replacing.

"Remote indication option means an audible or visible alarm can warn the user that the cartridge needs replacing."

Product configuration

- Thermal and dynamic disconnection
- Increases equipment life (by providing clean power)
- DIN mounted devices
- Removable tabs on replaceable cartridges to give the contractor the option of allowing the consumer to replace the cartridge
- IP20
- Does not disconnect your installation from supply when experiencing a transient over-voltage
- Conforms to BS EN 62305-2 BS / EN 62305-3 / BS EN 61643-11

Type 1 + 2 (Combined in a single device) (with lifetime indicator)													
Poles	**I_{imp} L-N**	**I_{imp} N-PE**	**I_n L-N**	**I_n N-PE**	**U_p kV**	**U_C V**	**Width (mm)**	**Single or Three phase**	**TNS**	**TNC-S**	**TT**	**Cat. Ref.**	**(with remote contact)**
2	12.5	25	-	-	≤ 1.5	255 V ac	35	Single	✓	✓	✓	**SPA201**	-
3	12.5	37.5	-	-	≤ 1.5	255 V ac	70	Three	×	✓	×	**SPA400**	-
4	12.5	50	-	-	≤ 1.5	255 V ac	70	Three	✓	×	✓	**SPA401**	-
3	25	75	-	-	≤ 1.5	255 V ac	105	Three	×	✓	×	**SPN800**	**SPN800R**
4	25	100	-	-	≤ 1.5	255 V ac	140	Three	✓	×	×	**SPN801**	**SPN801R**
4	25	100	-	-	≤ 1.5	255 V ac	140	Three	×	×	✓	**SPN802**	**SPN802R**
Class 2 (with lifetime indicator)													
2	-	-	5	15	≤ 1.2	255 V ac	35	Single	✓	✓	✓	**SPN215D**	**SPN215R**
2	-	-	15	40	≤ 1.5	255 V ac	35	Single	✓	✓	✓	**SPN240D**	**SPN240R**
4	-	-	5	15	≤ 1.5	255 V ac	70	Three	✓	✓	✓	**SPN415D**	**SPN415R**
4	-	-	15	40	≤ 1.5	255 V ac	70	Three	×	✓	×	**SPN440D**	**SPN440R**
Class 3 (fine protection) (with lifetime indicator)													
2	-	-	3	-	≤ 1.5	255 V ac	35	Single	✓	✓	✓	**SP202N**	-
PV Applications (dc side) (with lifetime indicator)													
3	-	-	12.5	25	≤ 4	1000 V dc	52.5	-	-	-	-	**SPV325**	-
Consumer Unit Kit Type 2 SPD Kit with SPN215D (with lifetime indicator)													
2	-	-	5	15	≤ 1.2	255 V ac	35	Single	✓	✓	✓	**VA02SPD**	-

Hager Ltd.
Hortonwood 50
Telford
Shropshire
TF1 7FT

Internal Sales Hotline: 01952 675612
Internal Sales Faxline: 01952 675645

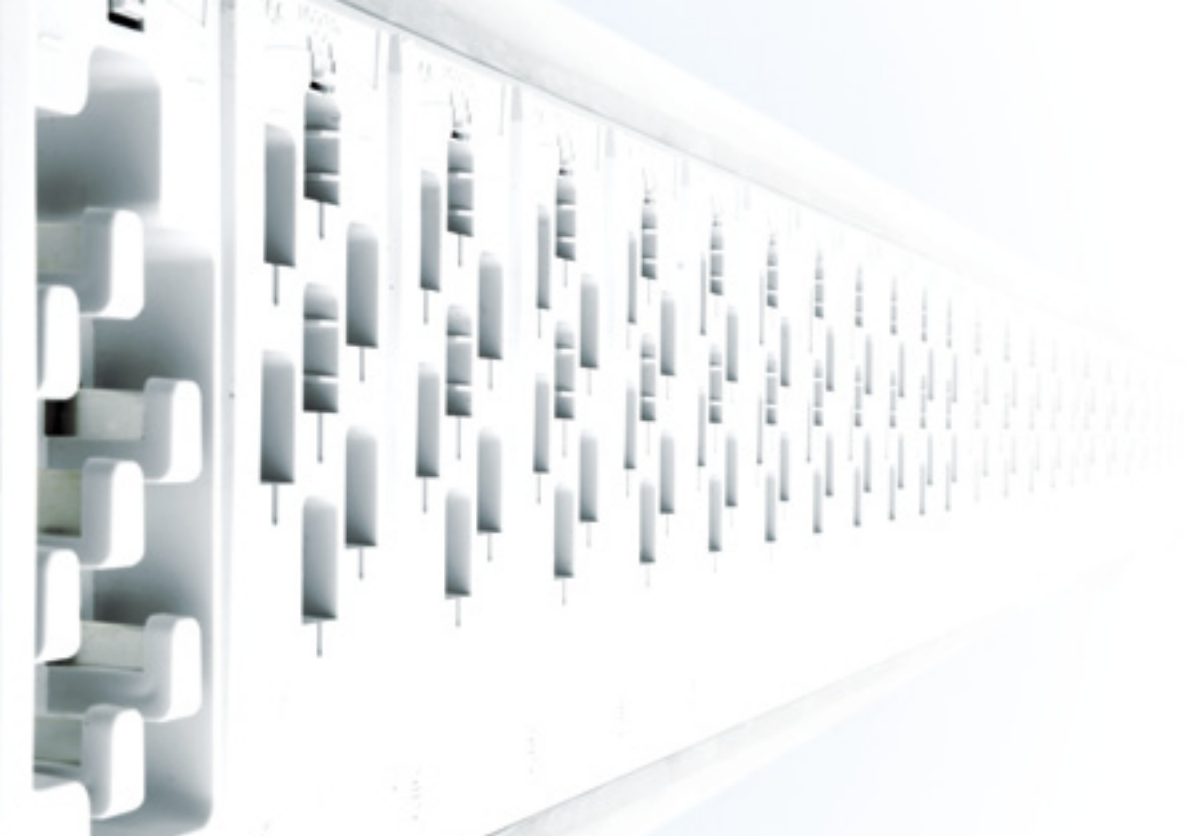
Technical Helpline: 01952 675689
Technical Faxline: 01952 675557
www.hager.co.uk
info@hager.co.uk **technical@hager.co.uk**

Hager Ltd.
Unit M2
Furry Park Industrial Estate
Swords Road
Santry
Dublin 9
Ireland

Northern Ireland Tel: 028 9077 3310
Northern Ireland Fax: 028 9073 3572

Republic of Ireland Tel: 1890 551 502
Republic of Ireland Fax: 1890 551 503
www.hager.ie

GUIDESPD912



Specification guide to
prefabricated wiring systems

hager

Introduction

Prefabricated wiring systems may be referred to in generic terms as: “modular wiring” or “plug and play”. However, the key question for any prefabricated wiring system is, does it comply with the appropriate safety requirements as a complete system?

This guide expands upon some of the key requirements when specifying prefabricated wiring systems, such as; system safety standards and achieving conformity with BS 7671 (Wiring Regulations).

You should be aware that this guide does not ensure compliance with legal requirements, standards or regulations.
You should always consult the relevant documents to ensure compliance.

Contents

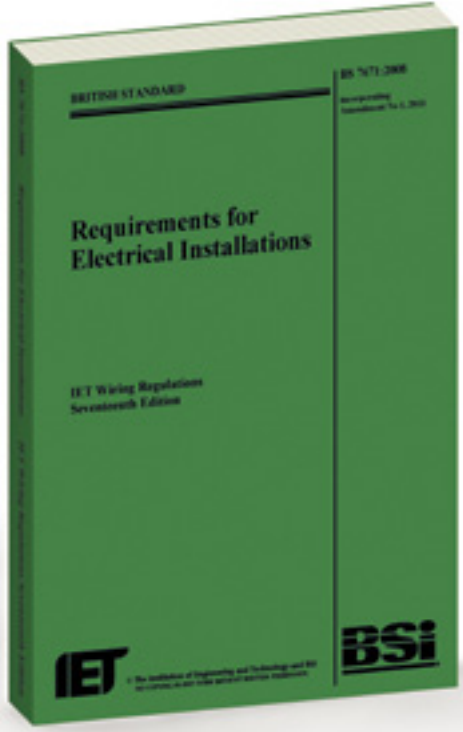
The need for a safety standard

Specifiers and installers have, for a number of years, been keen to exploit the benefits of prefabricated wiring systems as an alternate to conventional fixed wiring methods.

Some prefabricated wiring systems have been associated with serious safety issues. Reversed polarity, under rated couplers and incorrectly sized wiring sections have been areas of concern.

The absence of a system standard that specified safety requirements, together with associated testing, was discussed by the technical committee responsible for the BS 7671 (Wiring Regulations). It was agreed that there was a need for a Product Standard. Consequently, the appropriate BSI committee developed a new British Standard: BS 8488-1, which was published February 2009 and amended November 2010 to become: BS 8488:2009+A1:2010. In this guide, reference to BS 8488 means BS8488:2009+A1:2010.

" Some prefabricated wiring systems have been associated with serious safety issues ".



BS 8488 is specified in BS 7671 under section 521; types of wiring system.

Regulation 521.100 states:
Prefabricated wiring systems intended for permanent connection in fixed installations incorporating installation couplers conforming to BS EN 61535, shall comply with BS 8488.

Importantly, appendix 1, which lists British Standards to which reference is made in the Regulations, identifies the 2010 version of BS 8488 as the appropriate version to specify.

" BS 8488 is specified in the 17th Edition of the IET Wiring Regulations ".

System safety standard specification

BS 7671 recognises equipment complying with an appropriate British Standard or Harmonised Standard without further qualification. This approach means that the person responsible for specifying the prefabricated wiring system must, identify the “appropriate” standard.

BS 8488 specifies safety requirements, together with associated tests, for prefabricated wiring systems incorporating installation couplers conforming to BS EN 61535 (BS EN 61535 has replaced BS 61535).

Some key safety requirements and tests prescribed in BS 8488 are:

- Protection against electric shock
- Insulation resistance and electric strength
- Clearances and creepage distances
- Resistance to heat, fire and tracking
- Routine tests (during and/or after manufacture)

“ BS 8488 specifies safety requirements, together with associated tests, for prefabricated wiring systems ”.

Competency to certify conformity with BS 8488

One aspect that must not be overlooked by the person responsible for specifying the prefabricated wiring system is evidence of competency to test and issue certificates of conformity. This can be overcome, by specifying that the laboratory must, be independently recognized to BS EN ISO/IEC 17025 for BS 8488 (see figure 1).

" A laboratory, independently recognized to BS EN ISO/IEC 17025 provides evidence of competency ".

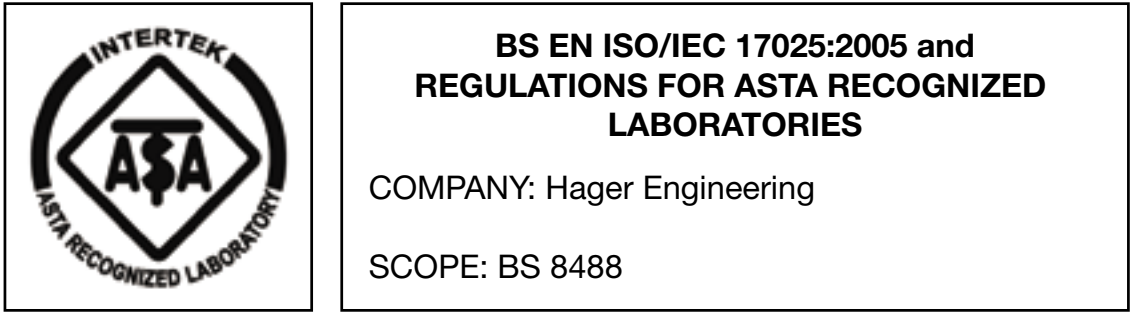


Figure 1 - Example of a laboratory that is independently assessed to BS 8488.

Application of the system

BS 8488 identifies that prefabricated wiring systems are for permanent connection in fixed installations and the associated installation couplers are intended to be engaged or disengaged during first installation, during maintenance or during re-configuration of the installation. Prefabricated wiring systems are intended to be installed by instructed or skilled persons, including the connection and disconnection of installation couplers.

Prefabricated wiring systems can be used in suspended floors and ceilings, which are commonly used in buildings or structures. By using prefabricated wiring systems, the installation work becomes quicker than using traditional methods as they are designed to provide rapid & correct connection. An example is where separate luminaires can be easily linked to form a comprehensive lighting system by using a prefabricated wiring system (see figure 2).

" Separate luminaires can be easily linked to form a comprehensive lighting system by using a prefabricated wiring system ".

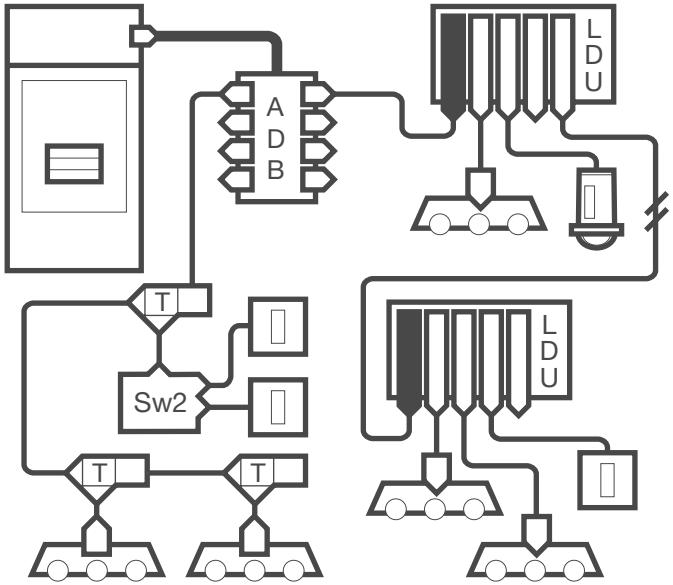


Figure 2 - Comprehensive lighting system using a prefabricated wiring system.

System design to BS 7671

BS 8488 requires the following details to be provided with each prefabricated wiring section, if they are necessary to ensure safe use and maintenance:

- Instructions for safe use
- System design information, validating conformity with BS 7671. The information can be a system design and not provided with each wiring section;
- Information required to facilitate inspection and testing for conformity with BS 7671. The information can be for the complete system and not provided with each wiring section.

Prefabricated wiring systems are an alternative to conventional fixed wiring methods; however, BS 8488 identifies the need for system design, installation & verification for conformity with BS 7671. Design elements of the system to be verified for conformity with BS 7671, includes the following fundamentals:

" If necessary to ensure safe use and maintenance, system design information validating conformity with BS 7671 and information to facilitate inspection and testing for conformity with BS 7671 shall be provided ".

Fundamentals in the BS 7671 design process (this list is not exhaustive)

Design current

The design current for discharge lighting must take into account control gear losses and harmonic current.

Overcurrent protective devices

The characteristics of the overcurrent protective device must take into account inrush and starting currents e.g. those associated with transformers and discharge lighting.

Cross-sectional area of live conductors

BS 8488 prescribes that the rated current shall be assigned according to a reference method defined by the manufacturer from BS 7671:2008, Table 4A2. Also, the rated current and cross-sectional area of the wiring section conductors shall be determined on the following basis:

- The number of loaded cores defined by the manufacturer. A loaded core is where the conductor carries more than 30% of its rating, after applying the rating factor for the total number of current carrying cores
- Not being grouped with other wiring systems or cables
- Not being in contact with thermal insulation
- The ambient temperature not exceeding 30 °C
- The frequency of operating being not greater than 61 Hz

“ BS 8488 requires the rated current to be marked on each section ”.

Marking of a wiring section rated current

BS 8488 requires the rated current (A) and corresponding reference method from BS 7671:2008, Table 4A2 to be distinctly and durably marked on each individual section (see figure 3.).

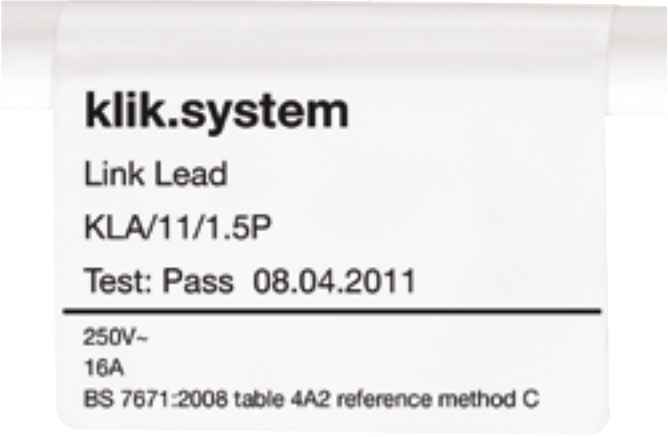


Figure 3 - Example of rated current marking on each individual section.

BS 8488 states that the required current-carrying capacity of a system section should be determined by the system designer by applying rating factors for the specific installation conditions. This current carrying capacity may be different from the rated current.

All applicable rating factors must be applied, including those for grouping, ambient temperature and thermal insulation.

Assuming overload protection and simultaneous overload can occur, this would be the familiar equation from BS 7671 appendix 4 shown in figure 4.

$$I_t \geq \frac{I_n}{C_g\, C_a\, C_s\, C_d\, C_i\, C_f\, C_c}$$

Figure 4 - Equation 2 from BS 7671 appendix 4 to determine the size of cable to be used.

Note: Not all rating factors would necessarily apply and other equations may be suitable

“ The required current-carrying capacity of a system section should be determined by the system designer, by applying relevant rating factors ”.

Current-carrying capacity

Figure 5 - Prefabricated wiring system using flexible cable

BS 8488 identifies that prefabricated wiring systems may employ flexible cables. It should be noted that the calculations related to flexible cables require particular attention.

The current-carrying capacities tabulated in appendix 4 of BS 7671 are based on cables having solid conductors (Class 1), or stranded conductors (Class 2), except for Tables 4F1A to 4F3B. Therefore, to obtain the correct current-carrying capacity for cable types similar to those covered by Tables 4D1, 4D2, 4E1 and 4E2 but with flexible conductors (Class 5), the tabulated values in 4D1 etc are multiplied by factors. The factor for up to and including 16mm^2 is shown in table 1.

Cable Size	Current-carrying capacity factor
≤ 16.0mm^2	0.95

Table 1 Current-carrying capacity factor

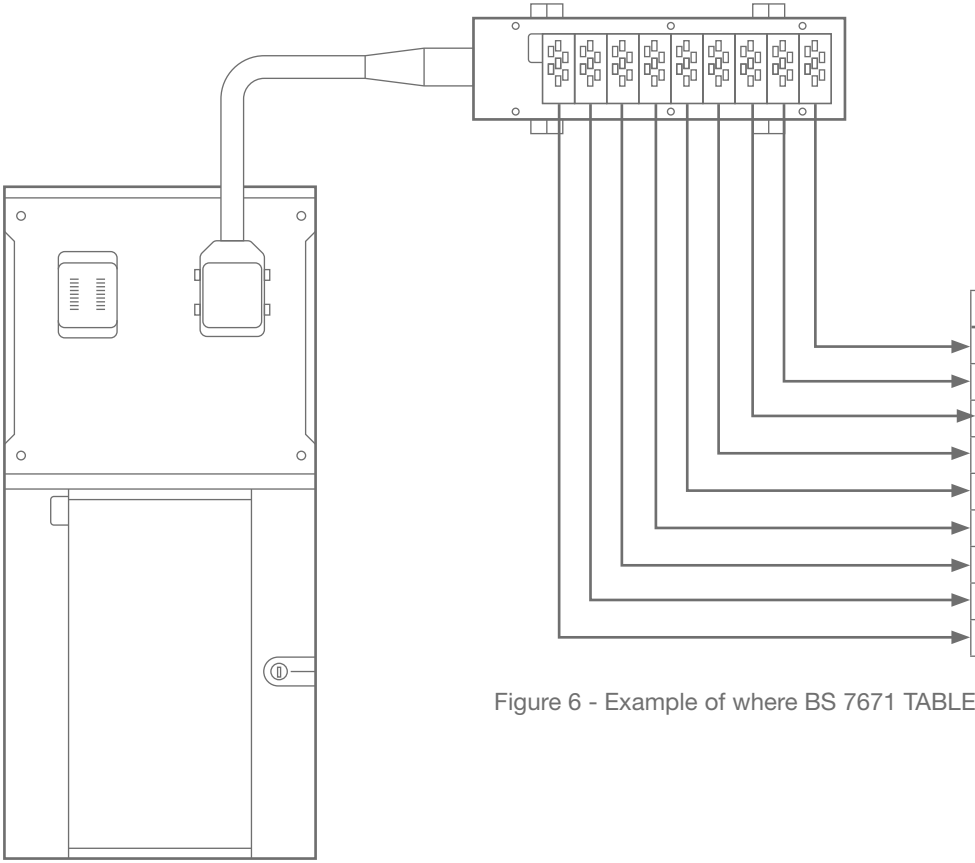
Loaded core factor

An important design aspect identified by BS 8488 is the loaded core factor, which is critical to the correct design of say a multicore SWA cable used for home runs.

A loaded core is where the conductor carries more than 30% of its rating, after applying the rating factor for the total number of current carrying cores.

This was specifically addressed in amendment 1 to BS 7671: 2008 with the introduction of TABLE 4B5 – Rating factors for cables having more than 4 loaded cores and the equation: $I_{zlc} = I_{t2c} \times C_{gN}$. It is important to note, that for single phase circuits, more than "**3** loaded cores" applies; regulations 523.6.1 and 523.6.2 refer.

This means that the current carrying capacity of the multicore cable is derived by applying the rating factor for the number of loaded cores CgN to the tabulated current-carrying capacity of the equivalent 2-core cable. When the exact number of loaded cores is not identified in table 4B5, the next higher number of loaded cores is used.



Circuit	Type	Ib	In
1	Lighting	3A	6A
2	Lighting	4A	6A
3	Lighting	5A	6A
4	Lighting	3A	6A
5	Lighting	5A	6A
6	Socket	20A	20A
7	Socket	20A	20A
8	Lighting	4A	6A
9	Socket	20A	20A

Figure 6 - Example of where BS 7671 TABLE 4B5 - rating factors are applicable

Voltage drop

To avoid an over engineered and unreliable system, key aspects to be accounted for include:

- The voltage drop is determined for individual loads, including any line conductors passing through a switch / control device. The total voltage drop being calculated for each part of the circuit respectively.
- Suitable adjustment for reduced conductor temperature, where the design current of a circuit is less than the effective current-carrying capacity of the cable.
- Suitable adjustment for load power factor.
- Suitable adjustment for influence of connector contact resistance.

" Account should be taken of voltage drop in each part of the circuit, reduced conductor temperature and connector contact resistance ".

Voltage drop and flexible cables

BS 8488 identifies that prefabricated wiring systems may employ flexible cables, however because the nominal resistance of flexible conductors is higher than that for solid or stranded conductors a suitable factor must be applied when basing the flexible cables on the reference methods in appendix 4.

BS 7671 appendix 4 identifies that to obtain the correct voltage drop for cable types similar to those covered by tables 4D1 etc but with Class 5, flexible conductors, the tabulated values are multiplied by the relevant factor. The factor for cables up to and including 16mm^2 is shown in table 2.

Cable size	Voltage drop factor
≤16.0mm^2	1.10

Table 2

Earth fault loop impedance for protection against electric shock (fault protection)

When Steel Wire Armour is used e.g. home run cable, it is important that a suitable multiplier is applied to its tabulated value of resistance at 20°C. This accounts for the magnetic effect of the steel armour.

Again, the influence of connector contact resistance must be accounted for.

Protective conductor cross-sectional area for protection against earth fault current

Where the assumptions of Regulation 435.1 cannot be made, the cross-sectional area of the circuit protective conductors have to meet the adiabatic equation by selection or calculation.

The calculations, should take into account minimum and maximum fault currents, so as to ensure the highest energy let-through (I^2t) is taken into account. This is essential, as I^2t is proportional to the thermal energy let through by the protective device under fault conditions.

> “ The calculations, should take into account minimum and maximum fault currents ”.

Protective conductor arrangement for high protective conductor currents

Regulation 543.7.1.103 stipulates that, when the cumulative protective conductor current of the circuit is likely to exceed 10 mA, it shall have a high integrity protective connection complying with one or more of the five listed options.

Therefore, the designer should evaluate the likely protective conductor currents in relevant parts of the prefabricated wiring system, including those supplying luminaires. This is because it is recognized, that some luminaires can produce currents in the protective conductor e.g. high-frequency fluorescent luminaires. When a significant number of luminaires are supplied from a common system, the protective conductor current may exceed 10 mA. Wherever possible, protective conductor current should be determined by consulting information provided by the luminaire manufacturer.

A protective conductor current not exceeding 10 mA may be difficult to avoid in particular sections of a prefabricated wiring system e.g. the home run cable and link lead to a Lighting Distribution Unit (LDU) therefore, a high integrity protective connection would be required. However, the system arrangement after the home run / LDU link lead could be configured using LDUs supplying a suitable number of luminaires, thus avoiding cumulative protective conductor currents above 10 mA. Table 3 provides examples of luminaire leakage current values.

Example	**Luminaire type**	**Maximum protective conductor current (mA, r.m.s.)**
BS EN 60598-1:2008	Class I intended for permanent connection. Supply current ≤ 7 A.	3.5
Test result for specific luminaire	Fluorescent with HF ballast	0.2
Manufacturers data	Per fluorescent HF ballast	0.5
Manufacturers data	LED driver: output power 150 W	0.7

Table 3 - Examples of leakage current values for conventional luminaires

“ A high integrity protective connection may be required ”.

RCD protected circuits & protective conductor current

The operating range of RCDs is normally from 0,5 $I_{\Delta n}$ to 1 $I_{\Delta n}$. An *international technical report for the correct use of RCDs recommends that, to avoid unwanted tripping, the protective conductor current in a circuit should not exceed 0.3 $I_{\Delta n}$ of the RCD at the rated frequency. For example, this would be a limit of 9 mA protective conductor current for a 30 mA RCD (0.3 x 30 mA = 9 mA).

When RCD protection is employed, the prefabricated wiring system may require appropriate subdivision into several circuits, so as to avoid unwanted tripping.

*PD IEC/TR 62350 Guidance for the correct use of residual current operated protective devices (RCDs) for household and similar use.

Calculation software

To avoid an over engineered system and most importantly, have the capability to demonstrate a safe system, dedicated calculation software may be considered essential. One aspect that must not be overlooked is the validity of the approach and calculation methods set out in the specification for the design software. This can be overcome, by specifying that the calculation methods used by the software have been validated by an independent specialist, e.g. ERA Technology Ltd (see figure 7).

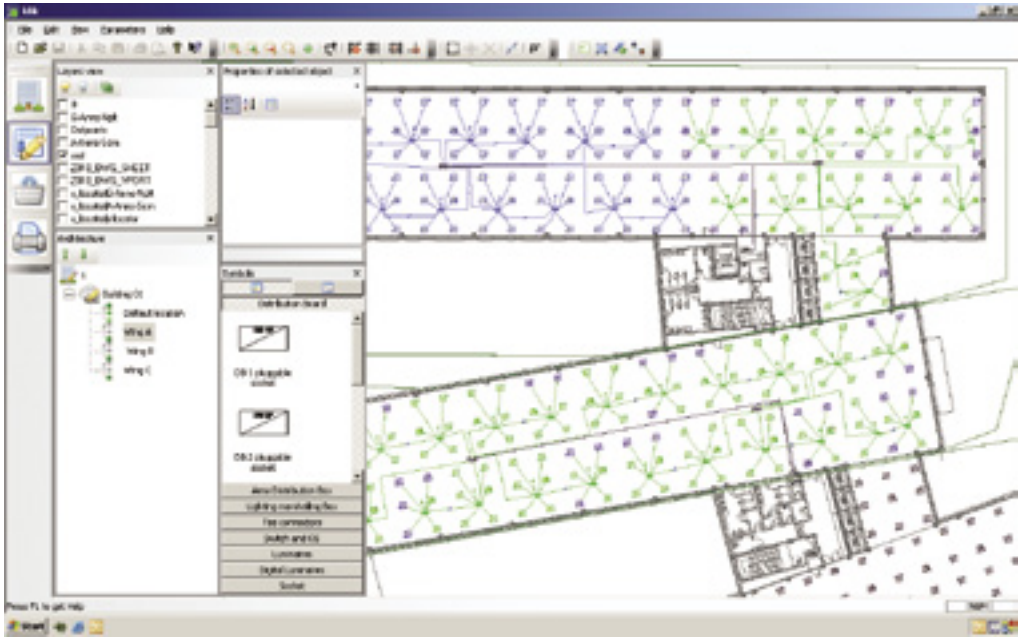
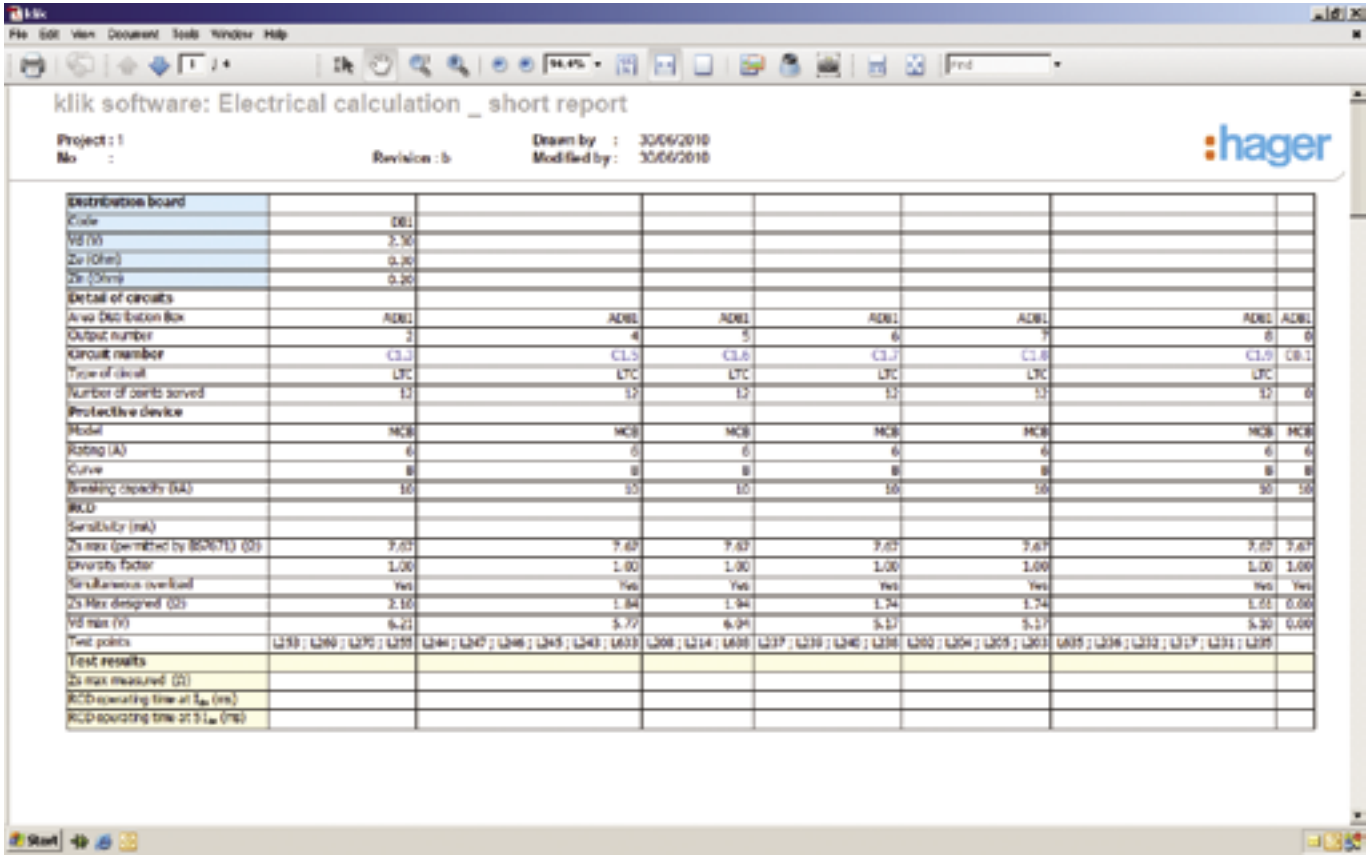


Figure 7 - Example of dedicated calculation software that has been independently validated

" Dedicated calculation software may be essential ".



klik software: Electrical calculation _ short report

Project : 1
No :

Revision : b

Drawn by : 30/06/2010
Modified by : 30/06/2010

hager

Distribution board							
Code	DB1						
Vd (V)	2.30						
Zs (Ohm)	0.20						
Zs (Ohm)	0.20						
Detail of circuits							
Area Distribution Box	ADB1	ADB1	ADB1	ADB1	ADB1	ADB1	ADB1
Output number	3	4	5	6	7	8	9
Circuit number	C1.3	C1.5	C1.6	C1.7	C1.8	C1.9	C0.1
Type of circuit	LTC	LTC	LTC	LTC	LTC	LTC	
Number of points served	12	12	12	12	12	12	6
Protective device							
Model	MCB	MCB	MCB	MCB	MCB	MCB	MCB
Rating (A)	6	6	6	6	6	6	6
Curve	B	B	B	B	B	B	B
Breaking capacity (kA)	10	10	10	10	10	10	10
RCD							
Sensitivity (mA)							
Zs max (permitted by BS7671) (Ω)	7.67	7.67	7.67	7.67	7.67	7.67	7.67
Diversity factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Simultaneous overload	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Zs Max designed (Ω)	2.10	1.84	1.94	1.74	1.74	1.61	0.00
Vd max (V)	6.21	5.77	6.04	5.17	5.17	5.30	0.00
Test points	L159 ; L160 ; L175 ; L155	L144 ; L147 ; L146 ; L145 ; L143 ; L133	L208 ; L214 ; L630	L137 ; L139 ; L140 ; L138	L202 ; L204 ; L205 ; L201	L635 ; L216 ; L212 ; L117 ; L131 ; L195	
Test results							
Zs max measured (Ω)							
RCD operating time at $I_{\Delta n}$ (ms)							
RCD operating time at 5 $I_{\Delta n}$ (ms)							

The approach and calculation methods set out in the specification for the Hager Klik software has been validated by ERA Technology Ltd (currently trading as Cobham Technical).

System distribution board

BS 8488 specifies that a wiring system comprising a number of circuits connected to separate overcurrent protection shall emanate from an LV switchgear and controlgear assembly, complying with the relevant part of BS EN 60439, BS EN 61439 or BS EN 61534.

An appropriate standard for the system distribution board can be BS EN 60439-3, which is known as an MCB distribution board.

BS 8488 requires that where the LV switchgear and controlgear assembly contains the wiring system overcurrent protection, the connector to the assembly shall conform to BS EN 61984 and the installation coupler shall conform to BS EN 61535.

In particular, the specifier for the prefabricated wiring system must ensure that LV assembly e.g. distribution board, has suitable ratings that include the incorporated connector and / or installation coupler. For example, conditional fault current rating (short-circuit) and rated current (temperature rise) (see figure 8).

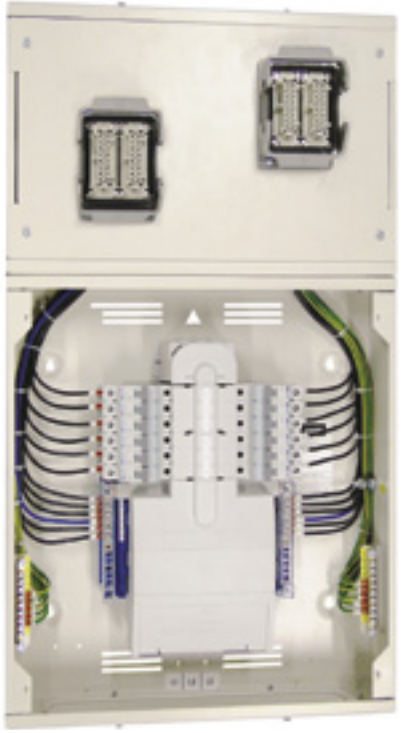


Figure 8 - System distribution board to BS EN 60439-3 with connectors to BS EN 61984.

Area Distribution Box

BS 8488 prescribes the applicable standards for the assembly containing couplers intended for the through connection of circuits that emanate from separate overcurrent protection e.g. circuit-breakers. One example of this arrangement is a multiple circuit distribution cable (known as a home run) originating from a distribution board and terminating at an assembly of couplers (known as an Area Distribution Box “ADB”) (see figure 9).

Depending upon the configuration of the assembly of couplers for through connection, BS 8488 requires conformity with BS 5733 or the relevant part of BS EN 60439, BS EN 61439 or BS EN 61534.

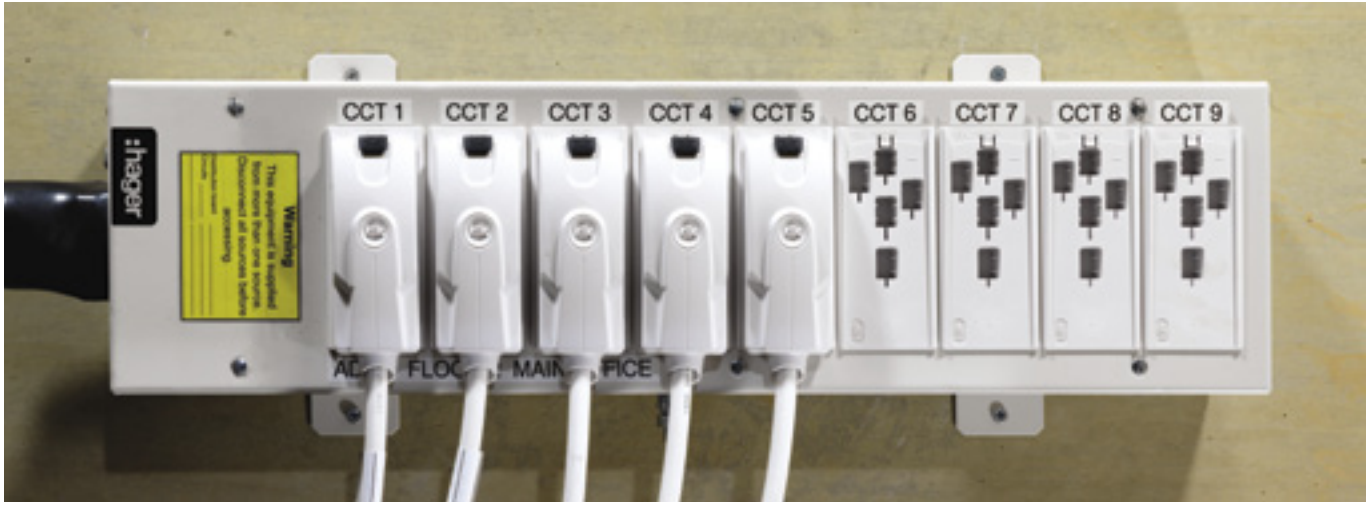


Figure 9 - An assembly of couplers (ADB) complying with BS EN 61439-2

Lighting Distribution Unit

Connection to the fixed wiring

BS 7671 specifies the products that may be used to facilitate connection to each fixed lighting point. A plug-in lighting distribution unit to BS 5733 is identified as an appropriate product, particularly in suspended ceilings, where one plug-in lighting distribution unit may be used for a number of luminaires.

Where a wiring system comprising of a single circuit terminates at an assembly containing couplers intended for branching of a circuit, the assembly is required by BS 8488 to comply with specific standards depending on the assembly designation. Where the assembly containing couplers is specifically designated for the connection of luminaires, it is classified as a lighting distribution unit and must comply with BS 5733 (see figure 10).

Figure 10 - LDU complying with BS 5733:2010

Lighting Distribution Unit safety standard

BS 8488 states that “for dated references, only the edition cited applies.” BS 5733 is dated as 2010. This means that where BS 5733 is specified e.g. “it shall conform to BS 5733 and be classified as a lighting distribution unit as defined in BS 5733” it is a requirement that the product complies with the BS 5733: 2010.

Conformity with BS 5733:2010 is of particular significance for an LDU, as a critical characteristic, is the suitability of the LDU for electrical stresses associated with lighting loads. The amendment to BS 5733 July 2010 acknowledged these stresses and introduced new testing requirements. Therefore, it is a requirement of BS 8488 that an LDU complies with BS 5733: 2010 (see figure 10).

“ It is a requirement of BS 8488 that an LDU complies with BS 5733: 2010 ”.

Installation couplers

BS 8488 requires that prefabricated wiring systems shall incorporate installation couplers that conform to BS EN 61535. (BS EN 61535 has replaced BS 61535). The installation coupler is defined as being not intended to be engaged or disengaged under load or to be engaged or disengaged other than during first installation, during maintenance or during re-configuration of the installation

Installation couplers complying with BS EN 61535 provide confidence that they are designed and constructed so that, in normal use, their performance is reliable and without danger to the user or damage to the surroundings.

BS 8488 lists a number of products that Installation couplers are not intended to be used in place of e.g. luminaire supporting couplers and on load connecting devices to BS 5733.

A prefabricated wiring system will frequently require arrangements to facilitate convenient on-load isolation and switching off for mechanical maintenance of luminaires. The use of computer controlled luminaires and other automatic lighting control systems has introduced further complications to the safety issues related to isolation and mechanical maintenance.

It is essential that the on-load connection device for luminaires is suitable for the prescribed load characteristics e.g. inductive and tungsten loads. A connection device that complies with BS 5733, including its inductive and tungsten load tests would be appropriate.

Therefore, it is an advantage to use a system which provides a convenient on-load connection method that complies with both BS EN 61535 and BS 5733 (see figure 11). However, it is not necessary for the home run distribution connector to be suitable for on-load operation and additionally comply with BS 5733, as home run disconnection is liable to create unacceptable disruption to the system.

Figure 11 - Marking to indicate that an on-load connection method to; BS EN 61535 and BS 5733, provides a convenient luminaire connection method

klik.system

For further information:

Customer Services Hotline: 0870 240 2400
Customer Services Faxline: 0870 240 0400

Technical Helpline: 0870 607 6677
Technical Faxline: 01952 675557

info@hager.co.uk

www.hager.co.uk

Hager Ltd.
Hortonwood 50
Telford
Shropshire
TF1 7FT

Hager Ltd.
Hortonwood 50
Telford
Shropshire
TF1 7FT

Internal Sales Hotline: 0870 240 2400
Internal Sales Faxline: 0870 240 0400

Technical Helpline: 0870 607 6677
Technical Faxline: 01952 675557
www.hager.co.uk
info@hager.co.uk **technical@hager.co.uk**

Hager Ltd.
Unit M2
Furry Park Industrial Estate
Swords Road
Santry
Dublin 9
Ireland

Northern Ireland Tel: 028 9077 3310
Northern Ireland Fax: 028 9073 3572

Republic of Ireland Tel: 1890 551 502
Republic of Ireland Fax: 1890 551 503
www.hager.ie

GUIDEKSV311

Junction Box Guide
to the 17th Edition

:hager

Introduction

For well over one hundred years the Wiring Regulations have provided the rules which must be followed to make sure that electrical installations are safe. The introduction of the 17th Edition of the Wiring Regulations had major implications for all Electrical Contractors, Designers and Consultants.

Hager runs an on-going programme of training courses including City & Guilds targeted towards wholesale trade partners, specification engineers and installations contractors. To register yourself on to one of our training courses in your area, please visit our website www.hager.co.uk/training.

Contents

Building Regulations

Since 2005 the Building Regulations for England and Wales have made direct reference to Electrical Installations, increasing the influence on how Electrical Equipment is installed in buildings.

Part P of the Building Regulations 2000 came into effect on 1st January 2005 and was further amended on 6th April 2006. This document states that the requirements will be met by adherence to the 'Fundamental Principles' for achieving safety given in the Wiring Regulations BS 7671 Chapter 13.

For Scotland, the Building (Scotland) Regulations 2004 apply to domestic and non-domestic buildings. Section 4.5 Electrical Safety in the Scottish Building Standards Agency (SBSA) Technical Handbook prescribes that an electrical installation should be designed, constructed, installed and tested such that it is in accordance with the recommendations of the Wiring Regulations BS 7671.

The 'Fundamental Principles' that are given in chapter 13 are intended to provide for the safety of persons, livestock and the protection of property against dangers and damage which may arise in the reasonable use of electrical installations.

It is recognised that good workmanship by competent persons using proper materials will reduce any hazards that may arise and that every item of equipment shall comply with the appropriate British Standard.

Electrical joints are a potential source of overheating and if not securely made could ultimately cause a fire. For this reason there are several regulations relating to electrical connections. Indeed this is mentioned within chapter 13 in regulation 134.1.4 'Every electrical joint and connection shall be of proper construction as regards conductance, insulation, mechanical strength and protection'

" Good workmanship by competent persons using the proper materials will reduce the risk of overheating or fire ".

Requirements of 17th Edition Wiring Regulations BS 7671:2008

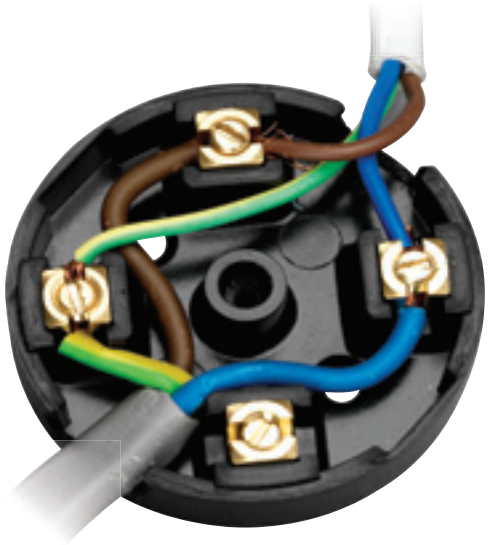
This section aims to explain some of the regulations contained within the 17th Edition Wiring Regulations, regarding the connection of conductors both for lighting and power final circuits.

Electrical Connections

The requirements of the 17th Edition Wiring Regulations concerning electrical connections are covered mostly within section 526. This section states that every electrical connection shall have durable electrical continuity, adequate mechanical strength and protection.

The wiring method illustrated here is a common cause of non-compliance particularly with lighting circuits and the connections to downlighters in particular.

- It can be seen that the sheath of the flex is not enclosed. This is due to the junction box connection method not facilitating an easy means of enclosing the outer sheath, a non-compliance with regulation 526.8.
- Another problem is that during installation and maintenance, mechanical strain may be placed on the terminations of the conductors within the junction box. This is due to the lack of a clamping method for the cable, a non-compliance with the regulation 522.8.5.



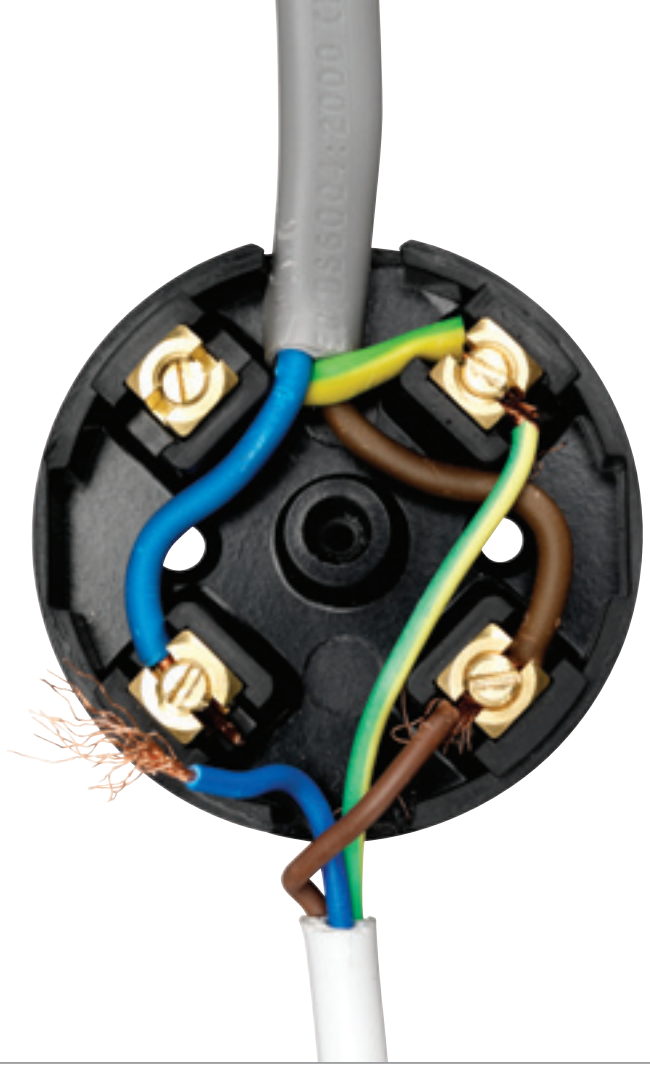
" Connections to downlighters are a common cause of non-compliance ".

Requirements of 17th Edition Wiring Regulations BS 7671:2008

A further potential problem can be found within the junction box (opposite) concerning the type of conductors that are typically terminated. It is often the case in domestic installations that solid twin & cpc cables will be used for the fixed wiring with the conductor to the light fitting (or transformer if the lighting is ELV) being a flexible conductor. Care must be taken to ensure the strands of the flexible cable are secured adequately in the terminal and have not been damaged to ensure compliance with regulation 526.2

Also, as can be seen in this illustration, when the conductor was removed for inspection it is clear that some of the strands have been damaged during termination.

" Ensure that the connection method selected is fully compliant ".



Downlighter Junction Box

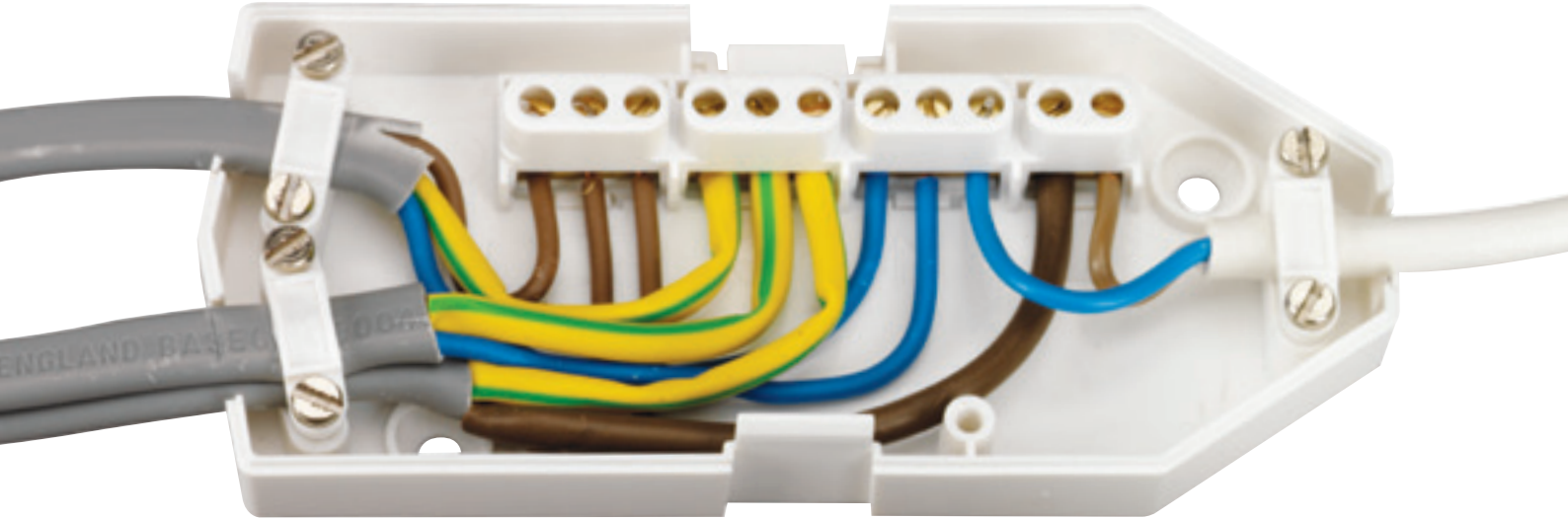
When fitting recessed downlighters the following method would overcome all the issues raised previously.

It can be seen here that the sheath of both solid conductors and flexible conductors for the light fitting can be secured as they enter the enclosure. This enables compliance with regulation 522.8.5 in particular where it states that there shall be no undue mechanical strain on the terminations of the conductors.

Also regulation 526.8, which requires the cores of sheathed cables from which the sheath has been removed to be enclosed, can be seen to be complied with.

" Cable clamps prevent strain on terminations for compliance with regulations ".

Downlighter Junction Box



Regulation 526.2 is complied with where the method of connection shall take account of the number and shape of wires forming the conductor. In this junction box solid conductors and flexible conductors can be terminated separately by means of the unique three plate style terminal arrangement.

Maintenance Free Connections

Junction boxes are commonly used during alterations and additions to an installation.

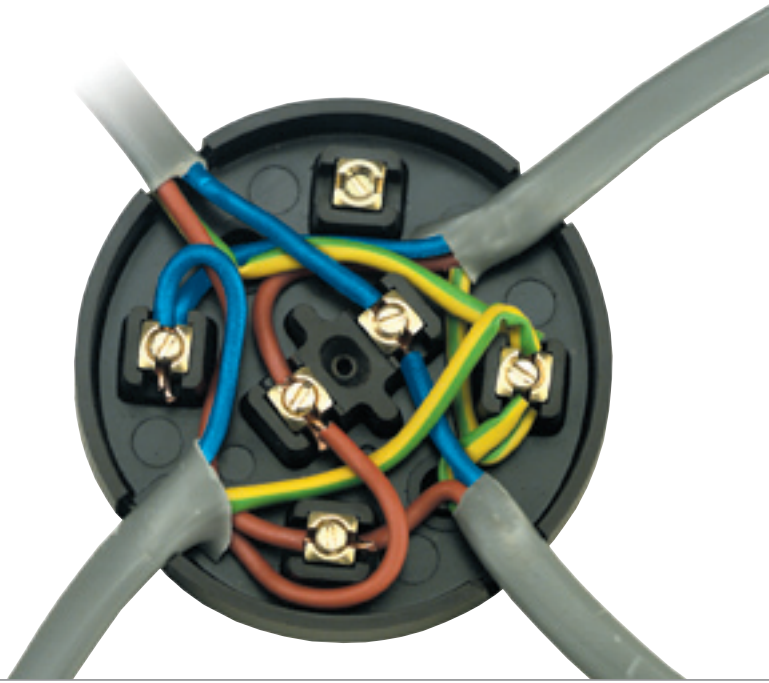
Regulation 526.3 requires that every connection shall be accessible for inspection, testing and maintenance. There are 6 exceptions to this rule. Exception (vi) is:
“Equipment complying with BS 5733 for a maintenance free accessory and marked with the symbol (MF) and installed in accordance with the manufacturer’s instructions”.

BS 5733 defines a maintenance free accessory as:
“An accessory which does not require further inspection, testing or maintenance after installation in a circuit, and which incorporates screwless terminals and cable clamps to secure any associated cables”.

The Electrical Safety Council Technical Manual states that “a junction box with screw terminals must be accessible”. This is to allow inspection of joints which could have relaxed or loosened over time, a potential problem with screwed terminals. So, unless provision is made for access, where boarding, carpet or other similar covering is laid over a junction box, it may not be considered accessible and maintenance free terminals should be used.

This is further reinforced in Appendix 15 of the Wiring Regulations which states “Junction boxes with screw terminals must be accessible for inspection, testing & maintenance or, alternatively, use maintenance-free terminals / connection (Regulation 526.3)”

“ Junction boxes with screw terminals must be accessible for inspection… ”.



Maintenance Free Connections

Screwless terminals do not in themselves meet the requirements of regulation 526.3. Conformity is indicated by marking the (MF) symbol and BS 5733 on the maintenance free accessory.

BS 5733 prescribes additional requirements and tests for terminals for use within maintenance free accessories, to verify that:

- Terminals have long-term connection capability
- Terminals are resistant to the effects of vibration
- Terminals withstand the effects of overloads and shall not cause ignition or damage to the mounting surface
- Terminals are sufficiently resilient to the effects of thermal shock

Hager maintenance free terminals have the additional advantages of allowing the direct insertion of solid, stranded or flexible conductors, and allowing the connection of up to four conductors from 0.5mm^2 to 4.0mm^2.

Another regulation relating to junction boxes is 521.8.3 which requires that where two or more circuits are terminated in a single junction box this shall comply with BS EN 60670-22. An accessory meeting the requirements of both standards could therefore be dual marked BS 5733 and BS EN 60670-22.

" Maintenance free terminals provide a solution where accessibility is an issue ".

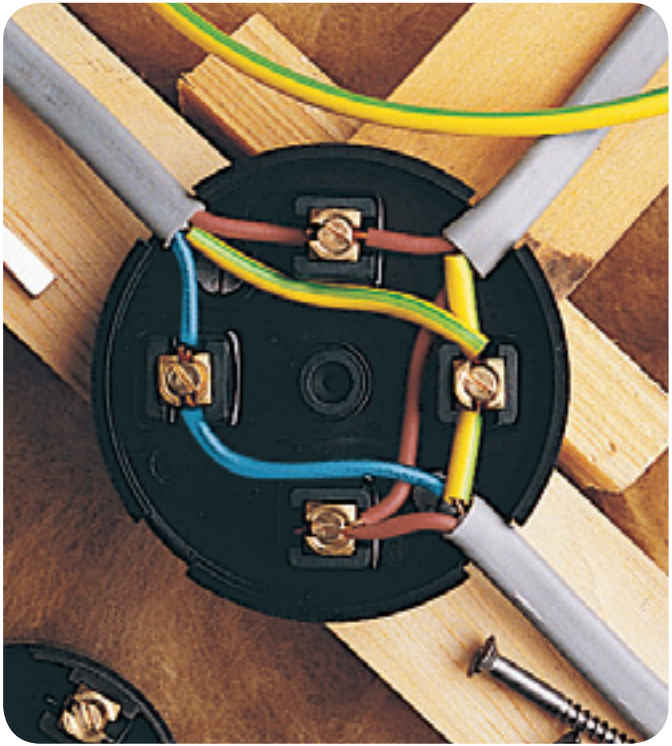
Traditional Junction Boxes

As we have discussed, unless using a solution such as maintenance free terminals, the access to electrical connections should be adequate for their safe and proper inspection, testing and maintenance. In this respect, connections should be in a location where they can reasonably be reached and where there is adequate working space.

Where connections are made in roof spaces and inter-floor spaces the enclosures containing the connections should normally be fixed and provision must be made for their access.

Providing these two constraints are complied with, then the continued use of standard circular junction boxes remains acceptable.

" Providing the enclosure is fixed and accessible traditional junction boxes are acceptable ".



Traditional Junction Boxes

The requirement for accessibility applies equally to the situation where, because of damage to an existing cable, a repair is effected by the introduction of a joint.

The joint must be accessible, alternatively the joint may be made by an appropriate method, a maintenance free terminal for example.

Conclusions

Junction boxes are an integral part of virtually every electrical installation. Unfortunately these connections often do not comply with the Wiring Regulations due to incorrect product selection.

It is clear that careful consideration from designers and installers will be required to meet the requirements of the 17th Edition of the Wiring Regulations.

Training Seminars

In addition to supplying the products required to achieve compliant installation, Hager are committed to training our customers on the latest regulations. To help with the requirements of the 17th Edition we run a series of training seminars to help explain the implications, and how Hager can assist.

To register your interest please visit www.hager.co.uk/training.

City & Guilds

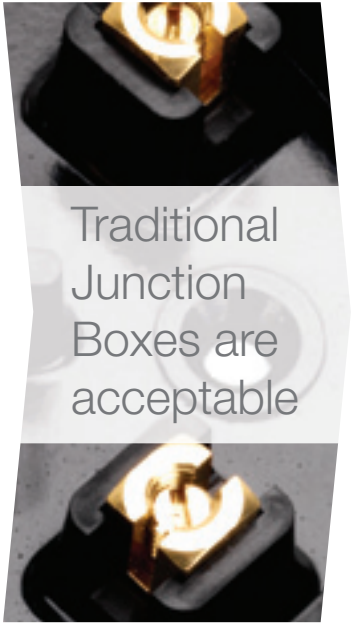
Product Selection Guide

Is the Junction Box accessible

YES

Is there a suitable fixing position

YES



Traditional Junction Boxes are acceptable

NO

Maintenance free terminals required

NO

Cable clamping recommended

Selection Chart

Description	Nº of Terminals	Terminal Rating	Reference	Benefits / Considerations
Downlighter Junction Box	3 x 3 x 1.5mm^2 1 x 2 x 1.5mm^2	16A	**J501**	Provided with cable clamps and separate terminals for flex
Maintenance Free Junction Box	3 x 4 x (0.5 - 4.0mm^2)	32A	**J803**	Suitable for use in inaccessible locations
	4 x 4 x (0.5 - 4.0mm^2)	20A	**J804**	
Traditional Junction Boxes	4	20A	**J201**	Acceptable for locations which are accessible
	4	20A	**J301**	
	3	30A	**J401**	
	6	20A	**J601**	

Hager Ltd.
Hortonwood 50
Telford
Shropshire
TF1 7FT

Customer Services Hotline: 0870 240 2400
Customer Services Faxline: 0870 240 0400

Technical Helpline: 0870 607 6677
Technical Faxline: 01952 675557
www.hager.co.uk
info@hager.co.uk **technical@hager.co.uk**

Hager Ltd.
Unit M2
Furry Park Industrial Estate
Swords Road
Santry
Dublin 9
Ireland

Northern Ireland Tel: 028 9077 3310
Northern Ireland Fax: 028 9073 3572

Republic of Ireland Tel: 1890 551 502
Republic of Ireland Fax: 1890 551 503
www.hager.ie

GUIDEJB811

sollysta
Wiring Accessories Guide

hager

Introduction

This guide expands upon some of the requirements found in the 17th Edition of the IEE Wiring Regulations and Building Regulations and how they affect wiring accessories.

You should be aware that this guide does not ensure compliance with BS7671 or the building regulations. You should always consult the relevant regulations to ensure compliance.

Contents

Selection and erection

All equipment must be correctly selected and erected. BS 7671 states that the following, along with manufacturer's instructions should be considered:

- Compliance with standards
- Operational conditions
- External influences
- Accessibility

BS 7671 recognises equipment complying with an appropriate British Standard or Harmonised Standard without further qualification. This approach means that the person responsible for specifying the equipment must identify the "appropriate" standard. The relevant British Standards for wiring accessories are identified below:

Product Group	Standard
10AX Wall Switch	BS EN 60669-1
Dimmer Switches	BS EN 60669-2-1 (including BS EN 55015
5A Unswitched socket	BS 546
13A Switched & Unswitched Socket	BS 1363-2
13A Fused Spur	BS 1363-4
20A Functional Switches	BS EN 60669-1
20A Isolation Switches	BS EN 60669-2-4
20A Cable Outlets	BS 5733
45A Functional Switches	BS EN 60669-1
45A Isolation Switches	BS EN 60669-2-4
45A Cable Outlets	BS 5733
45A Cooker Control Units	BS 4177
10AX Ceiling Switches	BS EN 60669-1
Fan Isolator Switches	BS EN 60669-2-4
50A Ceiling Switches	BS EN 60669-2-4
Shaver Socket	BS EN 61558-2-5
TV Outlets	BS 3041
Satellite Outlets	BS EN 50083-2
Telephone Sockets	BS EN 6313-2
Surface Boxes	BS EN 60670-1

The wiring accessory is usually the final connection of the fixed wiring. The installer needs to follow manufacturers' instructions in order to install the correct back box at the first fix stage. This will avoid any frustrations later with there being insufficient room within the box for the cables.

The accessory may also provide a termination between solid and flexible conductors such as in a flex outlet plate used, among other applications, for a heated towel rail in a bathroom. The installer needs to consider the type of cables being joined or terminated here as prescribed in 526.2. It would be appropriate to terminate wherever possible solid and stranded conductors into separate terminals in order to fully comply.

" Ensure manufacturer's instructions are followed ".

Lighting

Light switches & load type

Electrical equipment selected shall have suitable characteristics appropriate to the values and conditions on which the design of the electrical installation is based.

These conditions include voltage, current, frequency, power, environmental conditions and prevention of harmful effects. The designer needs to consider the types of loads which are to be controlled taking into consideration any instructions from the manufacturer. Fluorescent loads are commonplace, particularly in commercial installations.

BS EN 60669-1 is the standard for switches for household and similar fixed-electrical installations. The manufacturer is required to declare and mark the switch with the rated current in amperes (A) or rated fluorescent load in amperes (AX). Hence a switched marked AX will not require derating when used with fluorescent loads.

Dimming

Rarely in the modern home is lighting controlled purely by switching on and off, but dimming is required. Also a very popular light fitting is the downlighter which comes in various different forms, (i.e. mains or ELV).

The dimmer switch is an electronic device that controls the energy delivered to the light fitting and hence controls its' light output. Installers need to select the correct dimmer switch especially if ELV lights are being used with dimmable transformers. The selection of the most up to date devices with leading edge technology means that such a dimmer can operate both ELV or mains voltage lights and not cause any loss of performance.

Often dimmers, when used with 2-way switching will only dim from one position, with the secondary position just turning on & off. Today dimmer switches are available offering master/slave capability so dimming and switching is available from more than one position.

" Ensure correct dimmers are used for the type of load ".

Lighting connections

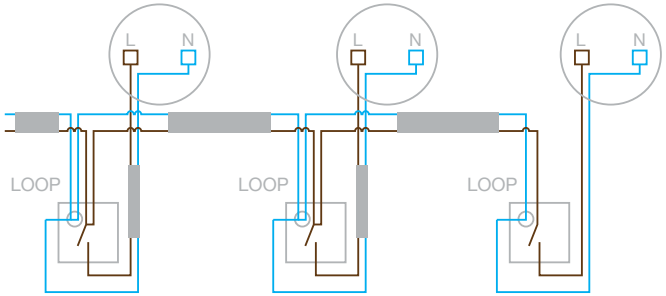
Domestic lighting circuits have for many years been connected using the 3 plate method where the loop terminal is at the ceiling rose.

It is increasing likely however that there will be some kind of decorative light fitting or even downlighters installed in the modern home. The loop connections in this case may be in an inaccessible position within a junction box.

This method is non-compliant with BS7671 as all electrical connections (except for those designed to be inaccessible, 526.3 refers) should be accessible for inspection, testing or maintenance.

For this reason it is becoming increasingly popular to carry out this loop connection at the switch itself. This has the advantage in that the connections are now obviously accessible and the connections can be made at a more convenient working height.

You will require more connections than that which are on the conventional light switch. One solution is to connect the neutral to a connector block inside the wall box. Another is to use a product where there is a dedicated terminal in order to make the required connections.



cpc omitted for clarity

" Consider using switches having additional neutral loop terminal ".

BC lampholders

One of the fundamental requirements of BS 7671 is to provide Basic protection against electric shock. This is usually provided by preventing a current from passing through the body. ie preventing someone from touching a live part.

Section 416 gives the specific requirements of providing basic protection and it is specified that live parts shall be inside enclosures or behind barriers providing the degree of protection to at least IPXXB or IP2X. If there is a horizontal top surface of an enclosure which is readily accessible, this degree of protection shall be at least IPXXD or IP4X.

The requirement of this regulation does not apply to certain items of equipment such as BC lampholders to BS EN 61184 as access is required in order to insert the lamp. There is therefore an electric shock risk if there was no lamp within the holder. Today, safety lampholders are available which incorporate a mechanism so that the exposed pins are not live if there is no lamp inserted, thus providing a safer installation - such bayonet lampholders with enhanced safety comply with BS 7895.

" Safety lampholders provide extra safety when using BC lampholders ".

Power

Requirements for Cooker connections

The cooker switch or cooker control unit is typically installed to provide the following 2 functions:

1. To provide a means of isolation so as to facilitate replacement or repair of the cooker unit without having to isolate at the consumer unit. Table 53.2 of BS 7671 provides guidance as to the standard for such devices. BS EN 60669-2-4 is a suitable standard for isolation switches for household and similar applications. Also identified in Table 53.2 is BS 4177, for cooker control units to provide the function of isolation.

2. Switching off for mechanical maintenance to avoid the risk of burns or mechanical injury when cleaning or maintaining the cooker.

" It is recommended that the cooker control switch is within 2m of the appliance ".

A current rating of up to 45A is sufficient for most household cooking appliances.

The position of such a unit should be should be such that it is accessible and convenient for use. It should not be positioned directly behind the cooking surface in order to avoid someone needing to reach over the appliance in order to access it. The horizontal distance should be such that the switch is under the control of anyone needing to access it. A maximum distance of 2m is likely to meet this requirement.

The final connection to the cooker unit will usually be by means of a cooker connection unit on the wall behind the cooker itself. This enables easier connection and disconnection for maintenance or replacement.

Where two stationary cooking appliances are in the same room, one switch may be used to control both appliances and is recommended that neither appliance is more than two metres from that switch.

BS 1363 socket-outlets

As previously described basic protection is to provide protection against electric shock under fault free conditions.

Socket outlets having apertures for plug pins will fulfil the requirement as the apertures are smaller than that specified by IPXXB or IP2X. In addition to this they will have a shutter mechanism that prevents access to live parts unless the earth pin is also present and has been inserted first.

This however can be either intentionally or inadvertently defeated by inserting something into the earth pin aperture first.

For this reason, a designer could specify a manufacture that uses additional measures so that the shutter mechanism cannot be inadvertently defeated. They usually require all three pins to be present and the earth pin to be inserted first order to gain access

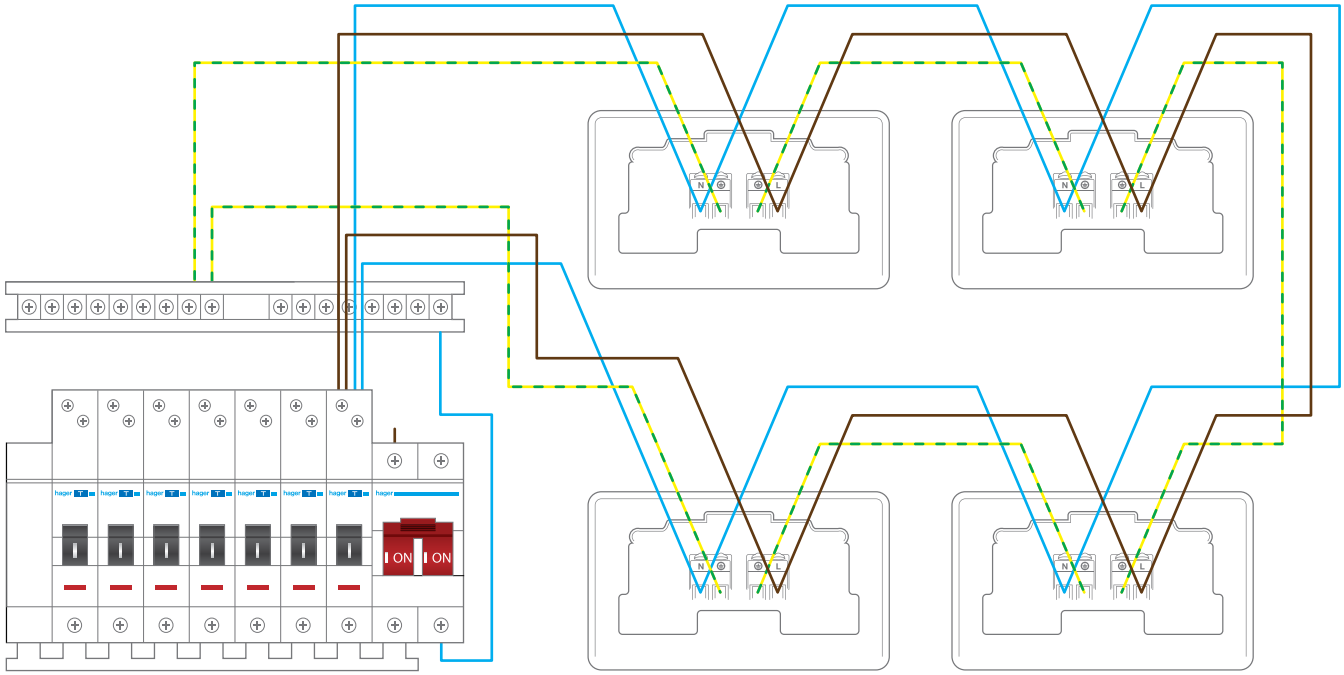
" 3 pin operated shutters are safest ".

High protective conductor currents

This situation is covered in regulation 543.7. Protective conductor currents can be caused by electronic equipment such as computers printers etc. They can also be caused by certain luminaires or heating elements however.

This can be a problem for an individual item of equipment but usually needs to be considered where several items of equipment, each producing a small amount of protective conductor current, are connected on the same circuit. If the accumulated current exceeds 10mA then the requirements of 543.7.1.3 need to be considered.

Of the five options within this regulation, the most common solution is (iii) where two protective conductors are used. 543.7.1.4 specifies that where this solution is used the two ends of the protective conductor must be independently terminated at all connection points throughout the circuit.



In the diagram above it can be seen that the protective conductor is terminated independently at all points throughout the circuit including the distribution board. Radial circuits if used can be wired with the protective conductor similarly as a ring.

A label is required at the distribution board so that anyone modifying this circuit has the required information.

“ Sockets having two earth terminals may be necessary ”.

Fused connection units

A 13A fused connection unit could be used for many applications. One of which could be to supply an electric towel rail in a bathroom. This equipment may need to be isolated for inspection, testing or maintenance.

Such a unit if used for isolation needs to be designed or installed so as to prevent unintentional or inadvertent closure as described in 537.2.2.3. Therefore if the fused connection is not under the immediate supervision of the person working on the towel rail then the whole circuit may have to be isolated at the distribution board.

Alternatively the fused connection unit may have a feature whereby it can be locked with the fuse carrier out and thereby satisfying the regulations as far as securing the isolation is concerned. BS 7671 table 53.2 identifies BS 1363-4 as a device suitable for isolation

" A device used for isolation needs to prevent inadvertent reclosure ".

Connection and switching points in a kitchen

It has become increasingly popular in a kitchen that instead of having several fused connection units around to feed the appliances, one central point is utilised instead. This usually involves a grid switch plate with modular switches and fuses. Overload protection needs to be considered by the designer.

A ring final circuit is the usual method of feeding the sockets and appliances which assumes the power consumed will be distributed from several points on the circuit. Should a central control point be used however, the power for all those appliances are effectively distributed from that one point. Overload protection may not be provided in accordance with regulation 433.1.1. The designer will need to assess the current demand at this point and ensure this would not exceed the current rating for long periods of either part of the ring.

As an alternative a radial system may be considered for the appliances having central control. The cable feeding this control point would need to be suitably rated however for the load and hence may result in a large csa.

" Consider overload protection where kitchen central control is used ".

Other

Fan Isolators

3 pole fan isolation switches are commonly installed in household applications so that the fan in the bathroom can be completely disconnected from the supply. This may be to provide the functions of Isolation or switching off for mechanical maintenance (functions previously described under cooker connections).

Fans in bathrooms are commonly activated by turning on the light and incorporate a run on timer. For this reason a 3 pole device is required to disconnect both the permanent and switched – line conductors.

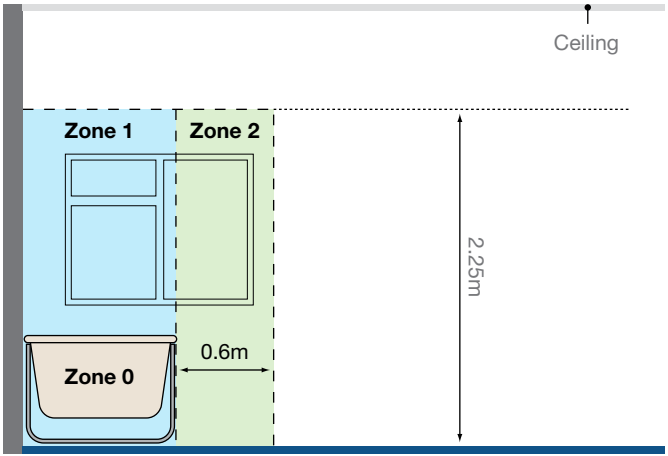
These devices are required to be secured so as to prevent unintentional reclosure or are required to be placed so as under the control of the person working on or replacing the fan. A normal wall mounted fan isolation switch will be required to be located outside of zone 2 as described in BS 7671 section 701. Should this not be practical a ceiling mounted version might be considered that is operated via a pull cord. In either case a suitable device would be one complying with BS EN 60669-2-4.

" 3 pole cord operated fan isolation switches may be required ".

Shaver socket outlets

Shaver sockets are common place in domestic installations, usually in the bathroom. The required standard for this device is BS EN 61558-2-5. This unit provides electrical separation for one item of equipment (i.e. the shaver) as described in BS 7671. This device is permitted in zone 2 as described in regulation 701.512.3.

" Shaver sockets are permitted in zone 2 or outside of zones ".

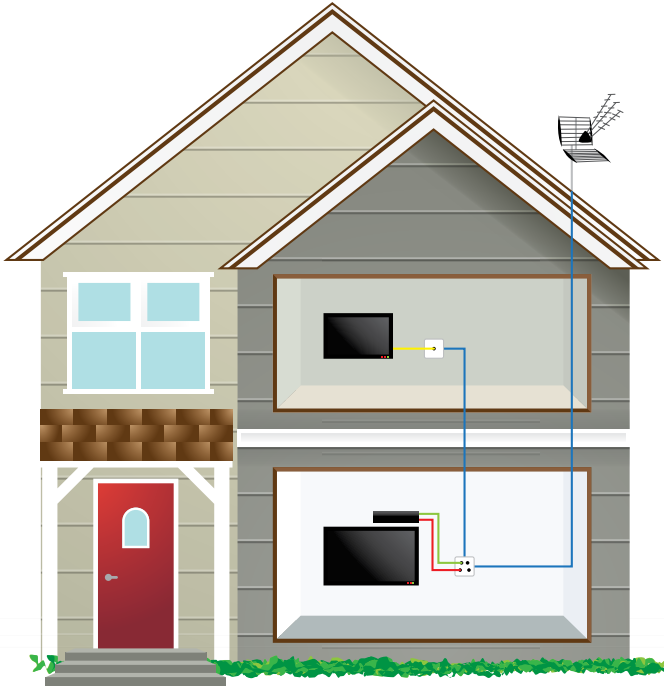


TV systems

Increasingly the wiring of the TV system is falling into the domain of the household electrician. Today however this can be confusing with several systems, ie cable, satellite, freesat etc.

A basic system may have one satellite dish or antenna and a connection point for the TV. The modern home however will have several TV's so the signal cable needs to be distributed accordingly

A modern TV distribution system may involve the use of splitters or amplifiers.



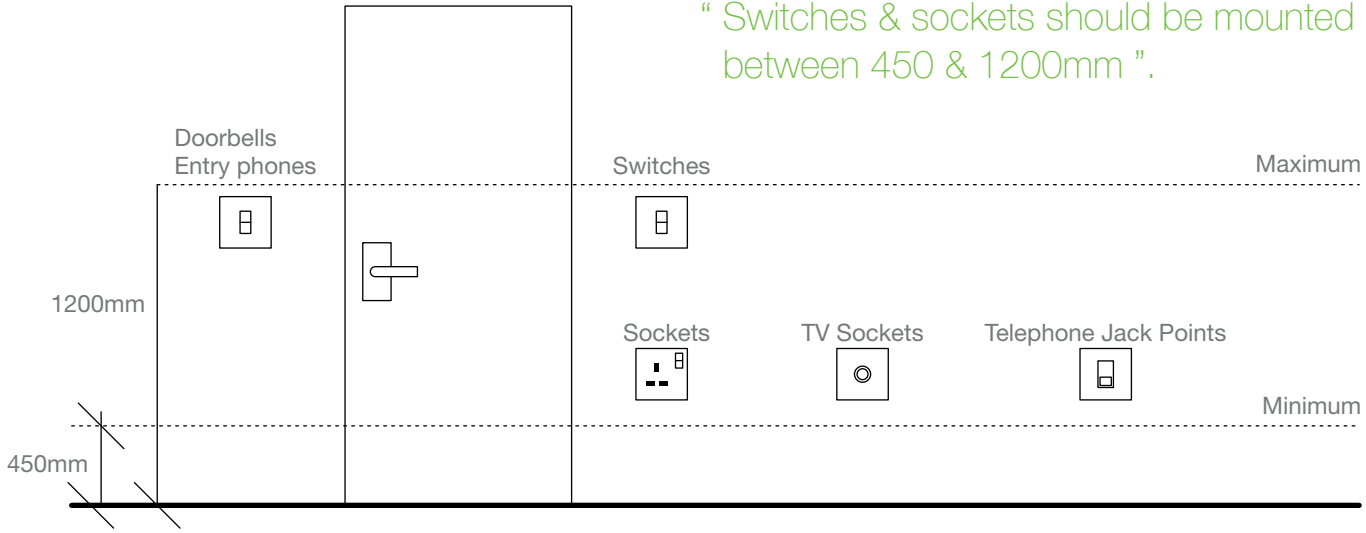
Building regulations

Building regulations part M is for Access to and use of buildings. It relates, among other things, to how easy the controls for the various services and systems for the building can be operated by those who need to do so.

Key factors that affect the use of switches, socket-outlets and controls are ease of operation, visibility, height and freedom from obstruction. It is considered advantageous for those with limited dexterity for switches on multiple socket outlets to be separated and for light switches to have larger rockers. It is also considered reasonable provision to provide these switches, sockets and controls at a height between 450mm and 1200mm from finished floor level

As far as dwellings are concerned, this applies to a new building only not to extensions or rewires.

" Switches & sockets should be mounted between 450 & 1200mm ".



Hager Ltd.
Hortonwood 50
Telford
Shropshire
TF1 7FT

Customer Services Hotline: 0870 240 2400
Customer Services Faxline: 0870 240 0400

Technical Helpline: 0870 607 6677
Technical Faxline: 01952 675557
www.hager.co.uk
info@hager.co.uk **technical@hager.co.uk**

Hager Ltd.
Unit M2
Furry Park Industrial Estate
Swords Road
Santry
Dublin 9
Ireland

Northern Ireland Tel: 028 9077 3310
Northern Ireland Fax: 028 9073 3572

Republic of Ireland Tel: 1890 551 502
Republic of Ireland Fax: 1890 551 503
www.hager.ie

Guide to Commercial Installations

Part 1: Type B Distribution Boards and the Regulations

hager

Introduction

The whole nature of electrical sub and final distribution for commercial installations has changed in the last few years. There is a demand for more RCD protection of final circuits, more metering and often more control to meet energy saving targets.

This guide expands upon some of the requirements found in the 17th Edition of the IEE Wiring Regulations and Building Regulations and how they affect Type B MCB distribution boards and their protective devices.

You should be aware that this guide does not ensure compliance with BS 7671 or the Building Regulations. You should always consult the relevant regulations to ensure compliance.

Type A & B distribution boards

Manufacturers refer to Type A or Type B distribution boards. This terminology refers to the busbar arrangement and the type of overcurrent protective device (OCPD) that it accepts.

Type A distribution boards have a busbar arrangement designed to accept single and/or double pole OCPDs. They typically have a horizontal busbar arrangement that accepts multi-pole and/or single pole OCPDs.

Type B distribution boards have a busbar arrangement designed to accept multi-pole and/or single pole OCPDs. They generally have a vertical busbar with the OCPDs connected to the sides.

Contents

Selection & erection

All equipment must be correctly selected and erected. BS 7671 states that the following, along with manufacturer's instructions should be considered:

- Compliance with standards
- Operational conditions
- External influences
- Accessibility

Compliance with standards
A fundamental principle of BS 7671 is that all equipment must comply with the appropriate British Standard. For distribution boards BS EN 60439-3 is applicable.

If equipment has a foreign standard based on an IEC standard then the designer or specifier must confirm that any differences will not result in reduced safety.

Operational conditions
The electrical designer will need to select distribution boards for operational conditions such as voltage, current and frequency. In the UK the nominal voltage and frequency is typically 400/230V and 50Hz.

Installations and the distribution boards within them will, however, have different current requirements. 512.1.2 in the 17th Edition requires that the equipment is suitable for the design current and the current likely to flow in abnormal conditions. The latter would include short circuit and earth faults.

The specifier will therefore need to assess the current demand taking into account diversity. They will also need to assess the prospective fault current at the distribution board location before selecting the board and the protective devices (see page 10).

External influences
All equipment including the distribution board must be suitable for the external influences that they are likely to encounter.

There will be conditions where a suitably IP rated distribution board will be needed. These installations may include:

- Caravan parks
- Marinas
- Agricultural or horticultural installations
- Temporary electrical installations for structures at fairgrounds, amusement parks and circuses
- Locations where there is a risk of fire due to the nature of processed or stored materials

Accessibility
Equipment should be located to facilitate its operation, inspection and maintenance.

"All equipment including the distribution board must be suitable for the external influences that they are likely to encounter."

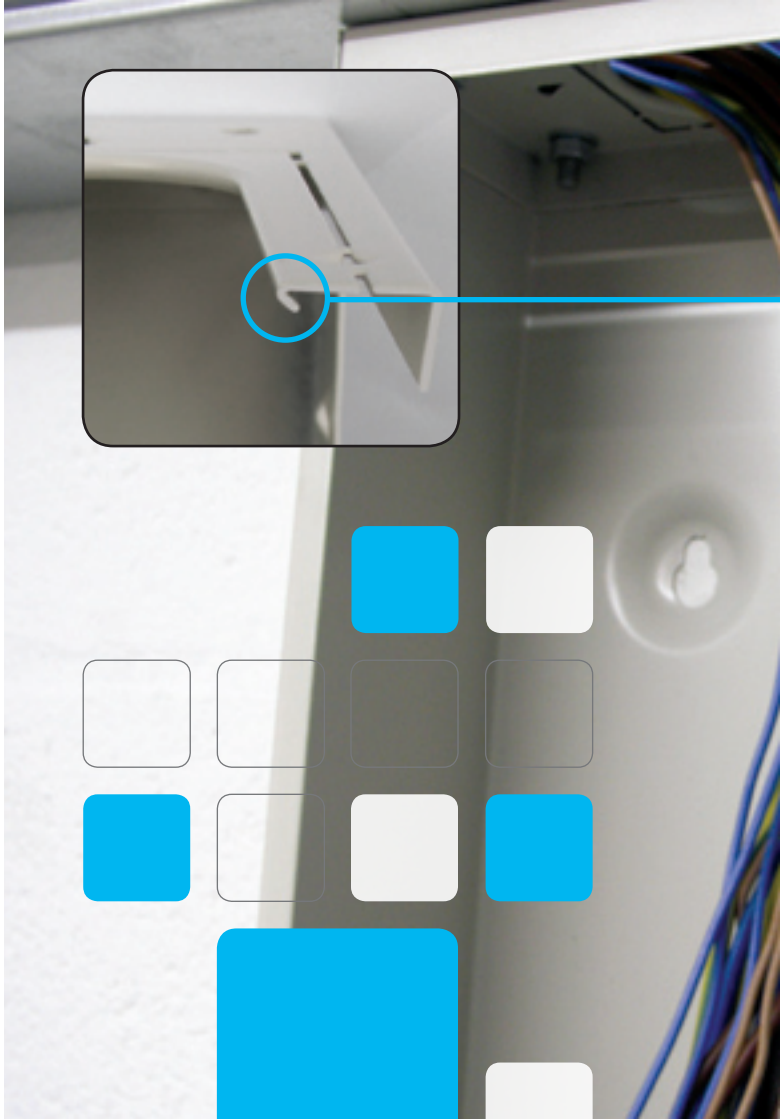
Cable entry

Designers and installers must select a wiring system that avoids damage to the sheath and insulation of cable during installation, use and maintenance.

Where cables enter a distribution board from trunking, the cables must be protected from any sharp edges in order to comply with 522.8.1. Common methods of complying include deburring edges and using grommet strips or manufactured spacers.

Regulation 526.9 requires that the cores of unsheathed cables from which the sheath has been removed and non-sheathed cables at the termination of the trunking etc are enclosed. Complying with these regulations can be difficult when passing the cables from the trunking into a distribution board.

The on-site construction of a spacer using material such as paxolin is a common solution. This is, however, time consuming and produces dust, so appropriate health and safety protection may need providing. Also the installer must take care that the solution fully complies with the regulations by making a proper seal.



"Not only does this cable entry system meet the requirements of the regulations, but it also cuts the time taken to fit the board to trunking by up to four times."

A better alternative

Another answer is to use a distribution board that has an end plate adapted for coupling to trunking. In Hager's new boards, for example, the end plate has a removable section that leaves a smooth edge return that is free from screw heads and nuts.

This allows flush coupling to trunking and a smooth entry for cables to meet the requirements of 522.8.1 and 526.9 of the Wiring Regulations.

Not only does this cable entry system meet the requirements of the regulations, but it also cuts the time taken to fit the board to trunking by up to four times.

In an independent trial, the time taken to fit a typical distribution board to trunking when the installer needs to cut out the gland plate and cut paxolin to shape was 50 minutes. When there is no need to prepare gland plates, use paxolin or adjust the trunking, the same installer took just 13 minutes to fit the comparable Hager board.

Isolation and switching

Isolation aims to make dead, for safety reasons, all or a discrete section of the electrical installation by separating it from every source of electric energy.

This is commonly achieved by switching off an isolation device within the distribution board. Regulation 537.2.2.1 requires that the device shall isolate all live conductors, subject to the provisions of regulation 537.1.2.

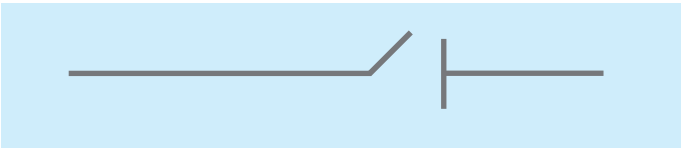
The neutral conductor is also a live conductor. In a TN-S or TN-C-S installation, however, regulation 537.1.2 allows the neutral conductor to not be isolated where it is reliably connected to earth.

If the supply complies with the Electrical Safety, Quality and Continuity Regulations 2002, a three-pole isolating device is sufficient for a three-phase supply.

Regulation 537.2.1.7, however, says that there should be some provision for disconnecting the neutral, for example by using a bolted link.

Three-phase TT supplies will require disconnection of the neutral, so a four-pole isolation device is needed.

For a single-phase supply where the main switch will be used by 'ordinary persons', the isolating switch must interrupt both live conductors.



Symbol indicating suitability for isolation

Table 53.2 identifies that circuit breakers to BS EN 60947-2 are suitable for isolation. These are commonly used as outgoing devices in distribution boards and can be used as isolation devices for individual circuits.

The table below gives guidance as to whether the neutral conductor needs to be switched or not.

Table 53.2

Isolation requirements of Neutral Conductor								
	Origin				Downstream			
	Use by ordinary persons		Use by skilled or instructed persons		Use by ordinary persons		Use by skilled or instructed persons	
	SP	TP	SP	TP	SP	TP	SP	TP
TN	YES	NO*	NO*	NO*	NO	NO	NO	NO
TT	YES	YES	YES	YES	YES	YES	YES	YES

Note* There should be some means of disconnecting the neutral by means of a bolted link

BS 7671 also requires that the device used for isolation is designed and/or installed so as to prevent unintentional or inadvertent closure. Usually this means that you need to fit some kind of locking mechanism to the device.

IEE Guidance Note 2 gives more detailed guidance on isolation and switching.

Protection against fault current

The value of prospective fault current will need to be assessed when selecting a distribution board and devices.

For an installation with several distribution boards there will be different values, so you will need to assess this at different points.

Section 434 of BS 7671 details the requirements of fault current protection. Only faults belonging to the same circuit need to be considered. On a three-phase distribution board, where there is a mixture of three-phase and single-phase circuits we need to look at these individually.

A single-phase (line to neutral) fault will be approximately half that of the three-phase fault (across all lines). This affects the fault current ratings of individual devices for the distribution board.

For example, if a distribution board has a three-phase 10kA prospective fault current, then the single-phase devices need to be selected to have a minimum fault current rating of 5kA, assuming that the line to neutral prospective fault current is equal to or higher than the prospective earth fault current.

434.5.1 states that the short circuit capacity of devices in the distribution board shall not be less than the prospective fault current where the device is installed.

A lower breaking capacity is permitted if another device on the supply side has the necessary breaking capacity. In this case the supply side device provides back up protection for the load side device. Manufacturer's data should be sought to obtain the level of back up protection provided.

Using back up protection can produce a more cost effective installation with perhaps the incomer to a TP&N board being a 250A MCCB. 10kA outgoing devices could then be installed where there is a 20kA fault level at that distribution board, subject to manufacturer's data.

Use by skilled or instructed persons?
Where there are larger fault currents you should also consider the type of person who will operate the devices.

If you can restrict access to the board to ‘skilled’ or ‘instructed’ persons only, perhaps by having the board in a locked riser or ensuring that the door to the board is locked, then BS EN 60947-2 can apply if the device has 947-2 ratings assigned by the manufacturer.

In such a case the 10kA BS EN 60898 devices may be rated to 15kA; again manufacturer’s information must be obtained.

Distribution board fault current rating
The manufacturer is responsible for ensuring the capability of the equipment between the incoming and the outgoing terminals of the distribution board, which includes busbars and connections as well as incoming and outgoing devices.

The manufacturer will have determined the distribution board fault current rating(s), in accordance with the product standard.

Protection against electric shock

Protection against electric shock needs to be provided by offering both basic protection and fault protection.

Basic protection includes the insulation of live parts and barriers or enclosures such as distribution boards. Appropriate devices or blanks must be fitted to maintain IP2X or IPXXB. If the top of the horizontal surface is readily accessible then the level of protection there should be IP4X or IPXXD.

Automatic disconnection of supply will usually provide fault protection. This involves protective earthing, protective equipotential bonding and the automatic disconnection of a device if there is an earth fault. The designer will normally need to ensure co-ordination of protective devices and earth fault loop impedances so that disconnection will occur within the maximum times given in 411.3.2.2, 411.3.2.3 or 411.3.2.4.

An additional requirement for the protection against electric shock is to specify RCDs where they are needed. 415.1.1 recognises that RCDs with a rated residual operating current (IΔn) up to 30mA and an operating time not exceeding 40ms at a residual current of 5 IΔn provides additional protection for ac systems if the basic or fault protection fails, or against carelessness by the end user.

Socket outlets
Regulation 411.3.3 requires that an RCD not exceeding 30mA be provided for:

i. Socket outlets up to 20A that are for general use by 'ordinary persons'.
ii. Mobile equipment up to 32A that is for use outdoors.

One exception is permitted where the use of the socket outlet is under the supervision of someone 'skilled' or 'instructed'.

So, for commercial or industrial applications the designer will need to consult with the client about whether someone who is 'skilled' or 'instructed' will normally supervise the installation before deciding which socket outlets need RCD protection. Another exception is for a specific labelled/identified socket-outlet for a particular item of equipment.

Clearly 'ordinary persons' will use some commercial installations i.e. 'persons who do not have the necessary knowledge to avoid the dangers from electricity.' If this is the case then the designer/installer may decide to provide RCD protection to all socket outlets.

For socket outlets used by cleaners, those in common or circulation areas, in self-catering areas or which might supply outdoor equipment, it is generally considered that RCD protection is required.

Nuisance tripping
In a commercial installation it is likely that socket outlets will supply computers, printers, copiers and other electronic equipment. This type of equipment produces small amounts of protective current.

Nuisance tripping could be a problem if several of these are on one circuit protected by a 30mA RCD. The designer will need to consider this problem and may decide to reduce the number of sockets on each circuit by, for example, increasing the number of final circuits.

Alternatively you can label sockets used for such equipment. This, plus the occupant/employer operational systems and health and safety policy, should ensure compliance where RCD protection is not provided.

"In commercial distribution boards it would be appropriate to use RCBOs for individual outgoing circuits."

Cables in walls
It is likely that metal partitions will separate rooms in a commercial installation. If this wall has a cable inside it then the requirements of 522.6.8 will need to be met.

These requirements are similar to those for socket outlets in that if there is adequate supervision by 'skilled' or 'instructed' persons then you do not need to provide additional RCD protection.

If there is some doubt about this, then the designer could make the decision to apply part (v) of this regulation and provide 30mA RCD protection.

This applies to all circuits, not just socket outlet circuits.

Electric shock protection - conclusion
More circuits need RCD protection since the introduction of the 17th Edition. In commercial distribution boards, it would be appropriate to use RCBOs for individual outgoing circuits.

Protection against overvoltage

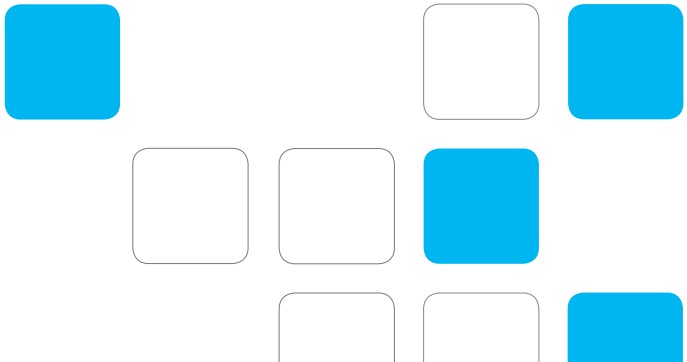
Section 443 of BS 7671 deals with the protection of electrical installations against transient overvoltages. These can be from the supply distribution system or generated by equipment.

Overvoltage protection by surge protection devices (SPDs) is not generally needed for a distribution board where a suitable rated impulse withstand voltage is declared by the manufacturer.

Table 44.4 in BS 7671 provides examples of various impulse categories for equipment and table 44.3 gives the corresponding minimum impulse withstand voltage.

For distribution boards where the nominal voltage of the installation is 230/240V or 277/480V category III, 4kV would be appropriate.

The designer or installer may choose to apply the requirements of regulation 443.2.4. This uses a risk assessment method to determine whether SPDs are required.



Fire detection and alarm circuits
Chapter 56 of BS 7671 covers fire detection and alarm circuits. Regulation 560.7.1 states that these safety services must be independent of other circuits.

This is also a requirement of BS 5839 Fire Detection and Fire Alarm Systems for Buildings. Clause 25.2 states that the mains supply to the fire alarm system should be from the load side of the main isolating device for the building and have its own isolating protective device (such as a circuit-breaker).

The circuit should also be from a point in the electrical distribution system that is close to the main isolating device for the building.

In addition, every protective device that can isolate the supply to the fire alarm system, other than the main isolator for the building, should be clearly labelled: “FIRE ALARM. DO NOT SWITCH OFF” in a durable and fade resistant material.

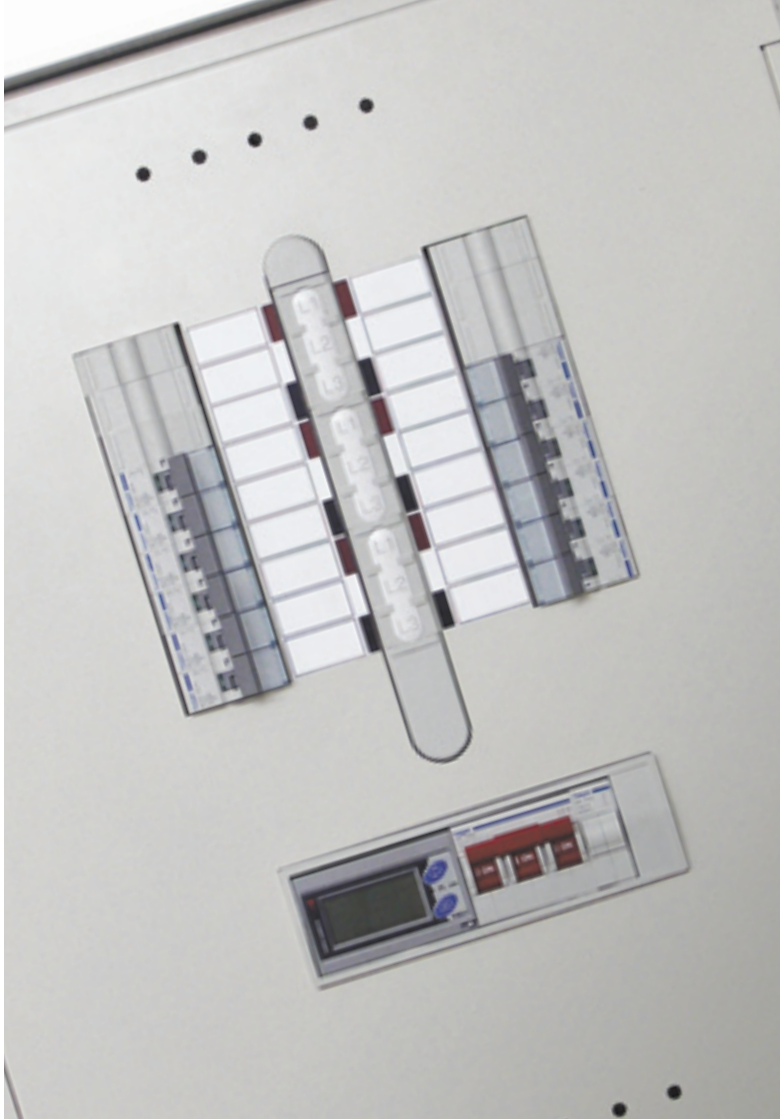
Building regulations

The Approved Documents L2A and L2B provide guidance to the technical requirements of the Building Regulations in respect to the conservation of fuel and power.

While they only affect England and Wales, the principle is still useful for the rest of the UK.

Part of these approved documents is to provide the owner with relevant energy meters so that at least 90% of the annual energy consumption can be traced to end use categories – such as heating, lighting or power.

To help achieve this, you should install an incoming meter for every building that has a floor area greater than 500m^2.
In addition, CIBSE TM 39 recommends sub meters should be provided for a final electrical distribution board that has an input power greater than 50kW.



In order to segregate the energy used by different services, such as lighting and power, you can either use two boards which each have separate meters or you might consider using a lighting and power metered board.

Saving energy
Conservation of power cannot just be about measurement. It is also about using efficient systems and controls.

Timers and photocells help ensure that energy is used efficiently. More sophisticated control such as knx/tebis bus based systems also offer solutions.

Such controls are often DIN rail mounted so provision of extension boxes provides a neat and functional purpose.

Invicta Type B distribution boards

Hager has developed its new Invicta Type B boards as a solution for modern commercial installations.

Electrical distribution is at the heart of a building's services. Modern distribution systems must enable designs that meet the demands of the 17th Edition, the need for more metering and the demands for energy efficient solutions through control devices or building management systems.

The new Invicta range of Type B boards makes it easier for you to design and install electrical distribution systems that meet the needs of today and the future.

Why specify Invicta Type B boards?

- Multiple incomer choices for 125A and 250A boards
- Unique trunking entry system – no need for paxolin
- Earth and neutral bars positioned for easier cabling
- Transparent IP2X shrouds for earth and neutral bars
- Optimal cabling space
- Metering fitted next to incomer within board
- Wide range of extension boxes for side, top and bottom
- No spacers needed to mount boards, cableways or extension boxes
- Removable door and front cover for ease of fitting
- 100A tap off for board extensions or MCB

Transparent IP2X shrouds
for earth and neutral bars

Unique trunking entry system

Metering fitted next to
incomer within board

Invicta 3 125A / 250A Type B TP&N distribution board

Characteristics		
	JK1**	**JK2****
Standards	Designed, manufactured and tested to BS EN 60439-3	Designed, manufactured and tested to BS EN 60439-3
Busbar Current Rating	125A	250A
Busbar Type	Fully Shrouded Copper	Fully Shrouded Copper
Busbar Rating	25kA Conditional	25kA Conditional
Incoming	100A Switch	250A MCS
	125A Switch	250A MCCB
	63A Contactor AC3	160A Contactor AC3
	100A Contactor AC3	Direct Connection
	Direct Connection	
	More incomer options available	
Outgoing Ways	4, 6, 8, 12, 16 Triple pole outgoing ways	8, 12, 16, 18, 24 Triple pole outgoing ways
Outgoing Protection	Type B MCB (0.5A to 63A, 1P and 3P) Type C, D MCB, (0.5A to 63A, 1P & 3P) 1Mod and 2Mod RCBO (6A to 50A Type B & C, 30mA & 10mA)	Type B MCB (0.5A to 63A, 1P & 3P) Type C, D MCB, (0.5A to 63A, 1P & 3P) 1Mod and 2Mod RCBO (6A to 50A Type B & C, 30mA & 10mA)
Voltage Rating in AC	230 / 400V	230 / 400V
IP Protection	IP3X to BS EN 60529	IP3X to BS 60529
Enclosure Body Type and Paint Type	Steel, Powder Coat Grey White RAL 9002	Steel, Powder Coat Grey White RAL 9002
Cable Entry	Obround protected cable entry points	Obround protected cable entry points

For further information

The new range of Invicta 3 Type B TP&N distribution boards is available with a huge range of extension boxes, metering kits and other accessories. There are also several different incomer options and outgoing ways.

Hager also manufactures Panelboards and Type A distribution boards to help you with your commercial electrical distribution needs and consumer units for residential applications.

This is all supported by our CPD accredited training courses and technical and after sales service.

For further information about our complete electrical distribution range of products telephone **0870 240 2400**, or email **info@hager.co.uk** to receive a free copy of our new catalogue. You can also visit our website **www.hager.co.uk**

Hager Ltd.

Hortonwood 50, Telford
Shropshire. TF1 7FT

Customer Services Hotline: 0870 240 2400
Customer Services Faxline: 0870 240 0400
Technical Helpline: 0870 607 6677
Technical Faxline: 01952 675557
www.hager.co.uk

Hager Ltd. Ireland

Unit M2, Furry Park Industrial Estate
Swords Road, Santry
Dublin 9. Ireland

Northern Ireland Tel: 028 9077 3310
Northern Ireland Fax: 028 9073 3572
Republic of Ireland Tel: 1890 551 502
Republic of Ireland Fax: 1890 551 503
www.hager.ie

:hager

Guide to Commercial Installations
Part 2 Panelboard: Standards and Regulations

:hager

Introduction

The whole nature of electrical sub and final distribution for commercial installations has changed in the last few years. There is a demand for more RCD protection of final circuits, more metering and often more control to meet energy saving targets.

This guide expands upon some of the requirements found in the 17th Edition of the IET Wiring Regulations and the Building Regulations and how they affect Panelboards and their protective devices.

You should be aware that this guide does not ensure compliance with BS 7671 or the building regulations. You should always consult the relevant regulations to ensure compliance

Contents

Selection and erection

All equipment must be correctly selected and erected.
In addition to the manufacturers instructions, BS 7671 states that you must consider the following:

- Compliance with standards
- Operational conditions
- External influences
- Accessibility

Compliance with standards

BS 7671 recognises equipment complying with an appropriate British Standard or Harmonised Standard without further qualification. This approach means that the person responsible for specifying the equipment must identify the appropriate standard.

BS EN 60439-1 has been revised and restructured and the new standard for panelboards is BS EN 61439-2: Power switchgear and control gear assemblies.

This new standard applies to assemblies mainly intended for industrial and commercial applications, where skilled or instructed persons will normally operate them. This does not however, exclude panelboards being located in an area accessible to ordinary persons.

As a designer you will need to understand the Electricity at Work Regulations. This document places a duty of care on those who are responsible for the manufacture and selection of electrical equipment. You need to use verified designs to demonstrate compliance with the following two regulations:

Regulations 4(1):
'All systems shall at all times be of such construction as to prevent, so far as is reasonable practical, danger.'

Regulations 5:
'No electrical equipment shall be put into use where its strength and capability may be exceeded in such a way as may give rise to danger.'

In short you must use an assembly that complies with the relevant safety standard. An ASTA recognised laboratory has tested and certified that the Hager Invicta panelboard is compliant to the new BS EN 61439-2 standard.

BS EN ISO/IEC 17025:2005 and REGULATIONS FOR ASTA RECOGNIZED LABORATORIES

COMPANY: Hager Engineering

SCOPE: BS EN 61439-2

Selection and erection

Operational conditions

Distribution boards must be selected for the operational conditions; which includes voltage, current and frequency. In the UK the nominal voltage and frequency is typically 400/230V and 50Hz.

Installations and the panelboards used in them will have particular current requirements. To meet regulation 512.1.2 in the 17th Edition you must ensure that the equipment is suitable for the design current and the current likely to flow in abnormal conditions. The latter would include short circuit and earth fault currents.

You will therefore need to assess the current demand, taking into account diversity, and the prospective fault current at the panelboard before you select the board and the protective devices.

The terminology to define the rating of a panelboard in relation to load/design current used in BS EN 61439 can be summarised as follows:

- The rated current of a panelboard (I_{nA}), is the maximum load current it is designed to manage and distribute.
- The rated current of a circuit I_{nc} is stated by the panelboard manufacturer, taking into consideration the ratings of the devices within the circuit, their disposition and application.

The current rating(s) of a panelboard circuit may be lower than the rated current(s) of the device(s) according to their respective device standard, when installed in the panelboard, therefore, it is essential that the manufacturer's ratings and instructions are followed.

Rated diversity (loading factor) can be stated by the manufacturer, e.g. for groups of circuits. Diversity recognises that all outgoing circuits will not normally be fully loaded at the same time and thereby avoids the need to provide over-designed panelboards for the actual application. It is essential that manufacturer's ratings and instructions are followed. For example, in the case of a panelboard with a diversity factor 0.8, any combination of outgoing circuits within the panelboard can be loaded to 80% of their rated current, provided the total load on the outgoing circuits does not exceed the rated current of the panelboard.

The relationship between rated diversity factor and load current should always be considered i.e. some circuits will be rated on the basis of inrush currents and intermittent or short duration loads.

So, in conclusion, the relevant design current must not exceed the I_{nA} or I_{nc} of the associated panelboard having taken any applicable diversity (loading factors) into account.

Accessibility

You should ensure that equipment is located to facilitate its operation, inspection and maintenance.

Since only skilled or instructed persons should operate a panelboard the location of the board, or use of key locks for its door should be considered.

If door locks are used, it helps if people can see the devices and determine whether they have tripped, so consider using a glazed door.

Isolation and switching

Isolation aims to make dead, for safety reasons, all or a discrete section of the electrical installation by separating it from every source of electrical energy.

This is often achieved by switching an isolation device in the panelboard. Regulation 537.2.2.1 requires that the device must isolate all live conductors.

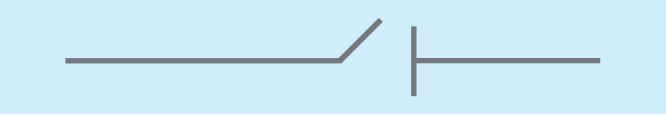
The neutral conductor is a live conductor, but in a TN-S or TN-C-S system, regulation 537.4.1.2 does not require isolation of the neutral conductor where it is reliably connected to earth.

If the supply complies with the Electrical Safety, Quality and Continuity Regulations 2002, a 3 pole isolating device is sufficient for a 3-phase supply; although it is not a requirement to isolate or switch the neutral conductor in installations supplied from a TN supply system, regulation 537.2.1.7 requires the ability to disconnect the neutral. This requirement is normally met by the provision of a suitable terminal or bolted link, which must be in an accessible position, can only be disconnected by means of a tool, is mechanically strong and will reliably maintain electrical continuity.

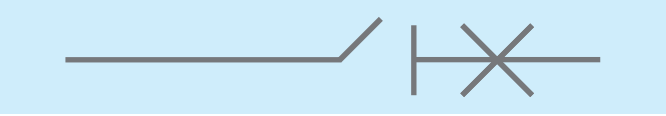
A three-phase TT system will require disconnection of the neutral, so you will need a 4-pole isolation device.

Table 53.4 of BS 7671 gives guidance on the selection of isolating and switching devices. The main switch for a panelboard is typically BS EN 60947 part 2 or 3, while you can use outgoing circuit breakers to BS EN 60947-2 for isolating individual circuits, provided they are marked with the appropriate symbol (see below).

A device to BS EN 60947 part 2 or 3 which is suitable for isolation must be marked with one of the following symbols.



BS EN 60947 part 3 symbol indicating suitability for isolation and BS EN 60947 part 2 for a CBI (circuit-breaker without overcurrent protection. They are capable of being tripped by an auxiliary device, e.g. shunt or undervoltage release).



BS EN 60947 part 2 symbol indicating suitability for isolation for a circuit-breaker

Specifiers must follow the requirements for switching neutral; these are shown in the table below:

Isolation requirements of the neutral conductor								
	Main switch at origin of installation				Outgoing device at the origin and devices within the installation			
	Use by Ordinary persons		Use by Skilled or Instructed persons		Use by Ordinary persons		Use by Skilled or Instructed persons	
System	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase	Single Phase	Three Phase
TN-S TN-C S	YES	NO*	NO*	NO*	NO*	NO*	NO*	NO*
TT	YES	YES	YES	YES	YES	YES	YES	YES
Notes	** Provision shall be made for disconnecting the neutral conductor e.g. a suitable terminal or bolted link*							

BS 7671 also requires that the device used for isolation is designed and/or installed to prevent unintentional or inadvertent closure. You can normally achieve this by fitting a locking mechanism to the device.

IEE Guidance Note 2 provides more detailed guidance on isolation and switching.

Protection against fault current

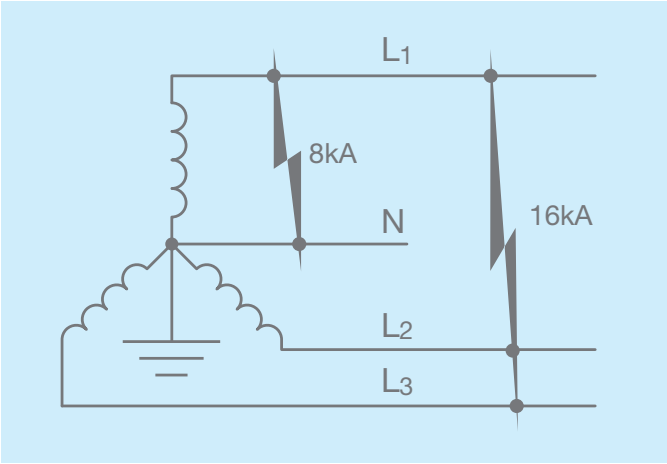
You must take into account the prospective fault current when selecting a panelboard.

If a system is correctly designed and maintained then electrical faults are very rare. When they do occur however, the panelboard is subjected to stresses such as:

- High forces acting on components and between conductors
- High temperatures reached very quickly
- Ionisation of the air. This is due to devices breaking the fault current which leads to lower insulation values of that air.

Section 434 of BS 7671 details fault current requirements. You only need to consider faults belonging to the same circuit. Where there is a mixture of three phase and single phase circuits you need to look at these individually.

A line to neutral fault will be about half that of the three-line fault – or three phase short circuit. This affects the fault current ratings of the individual devices for the panelboard – see example image.



A line to neutral fault will be approximately half that of the three-line fault - or three phase short circuit.

If there is a three-line 16kA prospective fault current at the panelboard, then you need to select single pole devices with a minimum fault current rating of 8kA. This assumes that the line to neutral prospective fault current is equal to or higher than the prospective earth fault current.

The manufacturer is responsible for ensuring the capability of the equipment between the incoming and the outgoing terminals of the panelboard. This includes busbars and connections as well as incoming and outgoing devices. Therefore, the fault current rating is declared for each panelboard as an assembly in accordance with BS EN 61439-2, and is not just selected on the short circuit ratings of the circuit breakers that are employed.

The terminology to define the short-circuit rating of a panelboard is given in BS EN 61439 as follows:

- Rated short-time withstand current I_{cw}
- Rated peak withstand current I_{pk}
- Rated conditional short-circuit current I_{cc}

Protection against electric shock

People and livestock must be protected from electric shock by providing both basic protection and fault protection.

Basic protection

Basic protection includes the insulation of live parts and the use of barriers or enclosures such as distribution boards.

You can provide basic protection during operation of the assembly by fitting appropriate devices or blanks to maintain IP2X or IPXXB. If the top of the horizontal surface is readily accessible then you should ensure that the protection there is IP4X or IPXXD.

If any work or maintenance is required on the panelboard, then you must consider which form of internal separation is suitable. Internal separation is described in BS EN 61439-2 and covers the following:

- Protection against contact with hazardous parts
- Protection against the passage of solid foreign bodies

Forms of separation

The definition of separation in this context is:
Forms of separation are divided into four main criteria from form 1, where there is no internal separation, up to form 4, where there are different levels of internal separation.

Separation is achieved by using partitions or barriers, insulation of live parts or through the integral housing of a device, e.g. a moulded case circuit breaker.

When you need to access the assembly's interior, your first consideration is to isolate the assembly from the supply. This is a requirement of Regulations 14 of the Electricity at Work Regulations 1989 which states:

'No person shall be engaged in any work activity on or so near any live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise unless:

- It is unreasonable in all the circumstances for it to be dead; and

- It is reasonable in all the circumstances for the person to be at work on or near it while it is live; and
- Suitable precautions (including where necessary the provision and use of protective equipment) have been taken to prevent injury'.

Where isolation is not practical then you need to consider using a higher degree of form of separation. In general however, the price of an assembly will be higher for increased levels of separation.
Choosing an assembly with the highest internal separation does not necessarily give the most appropriate or cost effective solution. For general installations, you can usually specify form 3 panelboards.

You can find more information about forms of internal separation in the BEAMA guide, which can be downloaded from www.beama.org.uk.

Metering

There are many reasons to meter the electrical energy at distribution boards, typically these may be:

1. To comply with relevant Building Regulations
2. To bill tenants
3. Monitor power use etc.

Building Regulations

Parts L2A and L2B of the Building Regulations cover the conservation of fuel and power and ensure that building providers have information to see where energy is being used. This enables the owner to introduce systems to reduce this energy use and therefore the building's carbon emissions.

While the regulations only affect England and Wales, the principle is useful for the whole of the UK. They require the end user to be able to trace at least 90 percent of the annual energy consumption to end use categories, such as heating, lighting or power. This is achieved through metering.

The approved document to the Building Regulations considers that you should install incoming meters for every building that has a greater floor area than 500m^2.

It also recommends that any building with a floor area greater than 1000m^2 has automatic meter reading facilities. You can provide this by using data loggers that connect to the pulsed output of various kWh meters in the building; these then transfer this information over a network. Another alternative is to use meters with outputs such as MODBUS that provide a more secure or accurate method of monitoring.

Billing

You can only use approved electricity meters for billing. This is a requirement of section 7 of the Electricity Act 1989. Since 2006, the Measuring Instruments Directive (MID) covers approval for meters to supplies below 100kWh.

Where electricity is to be sub-billed between relevant parties in commercial and industrial applications, the meters must meet the requirements of Annex B of MID. For full billing, the meters must comply with Annex B and Annex F.

To achieve the accuracy of a meter that requires the use of CT's, the cable resistance should not exceed a certain value depending on the power capability of the CT.

The table below gives minimum CSA and maximum lengths.

CT	Max distance from CT to meter (m)	Minimum cable size (mm^2)
SR051	2	1.5
	5	4
SR101	2	1
	5	2.5
	10	4
SR200	2	1.5
	5	2.5
SR250	2	1.5
	5	2.5
SR300	5	1
	10	1.5
SR400	10	1
SR600	10	1

Invicta 3 Panelboard

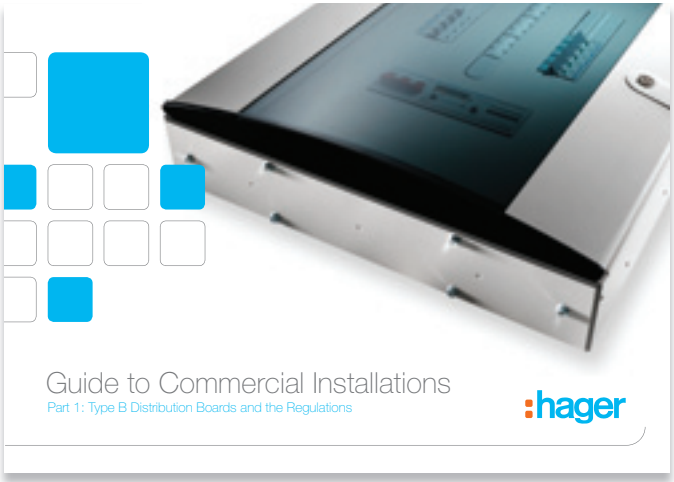
Hager has developed its new Invicta panelboard as a solution for modern commercial installations.

Electrical distribution is at the heart of a building's services. Modern distribution systems must enable designs that meet the demands of the Building Regulations, the 17th Edition and to provide more metering and energy efficient solutions through the use of control devices or linking to building management systems.

The new Invicta range of panelboards makes it easier for you to design and install electrical distribution systems that meet the needs of today and the future.

FURTHER READING

Guide to Commercial Installations
Part 1: Type B Distribution Boards and the Regulations



To request a copy of this guide please visit www.hager.co.uk

The whole nature of electrical sub and final distribution for commercial installations has changed in the last few years. There is a demand for more RCD protection of final circuits, more metering and often more control to meet energy saving targets.

This guide expands upon some of the requirements found in the 17th Edition of the IEE Wiring Regulations and Building Regulations and how they affect Type B MCB distribution boards and their protective devices.

This guide covers the following subjects:

- Selection and erection
- Cable entry
- Isolation and switching
- Protection against fault current
- Protection against electric shock
- Protection against overvoltage
- Building regulations
- Invicta Type B distribution boards
- Invicta Type B board range

FURTHER READING

sollysta
Wiring Accessories Guide

To request a copy of this guide please visit www.hager.co.uk

This guide expands upon some of the requirements found in the 17th Edition of the IEE Wiring Regulations and Building Regulations and how they affect wiring accessories.

This guide covers the following subjects:

- Selection and erection
- Lighting
- Power
- Connection & switching points in a kitchen
- Other
- TV Systems
- Building regulations

FURTHER READING

Junction Box Guide
to the 17th Edition

To request a copy of this guide please visit www.hager.co.uk

For well over one hundred years the Wiring Regulations have provided the rules which must be followed to make sure that electrical installations are safe. The introduction of the 17th Edition of the Wiring Regulations had major implications for all Electrical Contractors, Designers and Consultants.

This guide expands upon the Wiring Regulations and how they have affected the use of junction boxes

This guide covers the following subjects:

- Building Regulations
- Requirements of the 17th Edition Wiring Regulations
- Downlighter Junction Box
- Maintenance Free Connections
- Traditional Junction Boxes
- Conclusions & Training Seminars

Hager Ltd.
Hortonwood 50
Telford
Shropshire
TF1 7FT

Internal Sales Hotline: 0870 240 2400
Internal Sales Faxline: 0870 240 0400

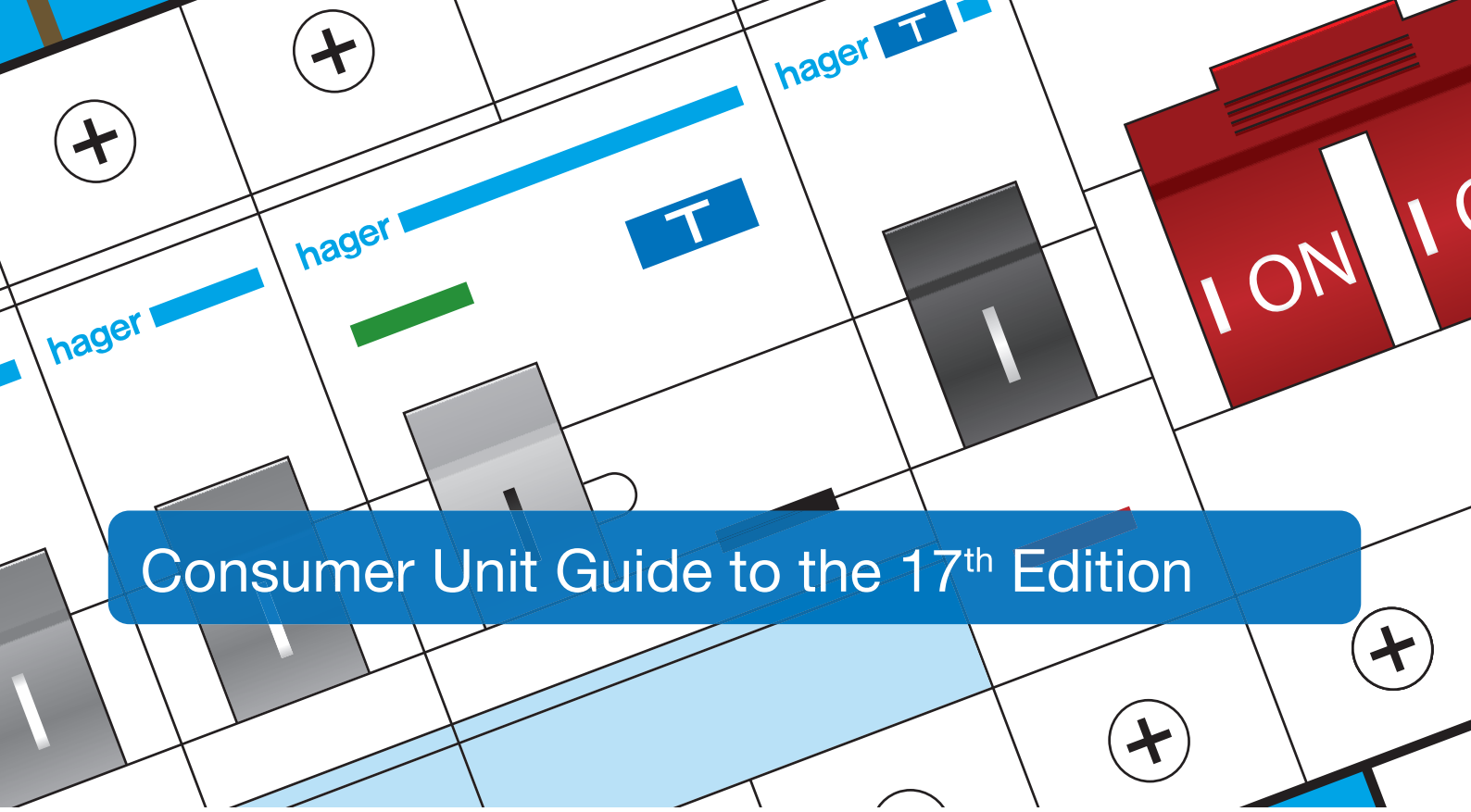
Technical Helpline: 0870 607 6677
Technical Faxline: 01952 675557
www.hager.co.uk
info@hager.co.uk **technical@hager.co.uk**

Hager Ltd.
Unit M2
Furry Park Industrial Estate
Swords Road
Santry
Dublin 9
Ireland

Northern Ireland Tel: 028 9077 3310
Northern Ireland Fax: 028 9073 3572

Republic of Ireland Tel: 1890 551 502
Republic of Ireland Fax: 1890 551 503
www.hager.ie

GUIDEPB11



Consumer Unit Guide to the 17th Edition

hager

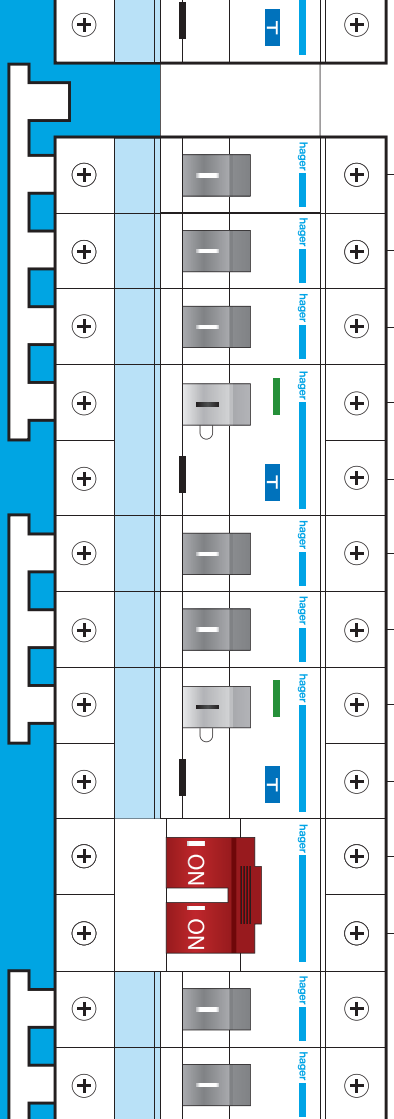
Introduction

For well over one hundred years the Wiring Regulations have provided the rules which must be followed to make sure that electrical installations are safe. The introduction of the 17th Edition of the Wiring Regulations on the 1st January 2008 has major implications for all Electrical Contractors, Designers and Consultants.

Installations designed from 1st July 2008 must comply with this new set of Regulations. Several new Regulations will have an impact upon circuit design and consumer unit layout.

This guide will help you understand the new Wiring Regulations and current Building Regulations, providing the necessary facts to construct compliant installations including Consumer Units.

If after reading this guide you would like to find out further information regarding the new regulations Hager are offering tailored training seminars throughout 2008. If you are interested in registering interest in attending one of these seminars please visit www.hager.co.uk



Since 2005 the Building regulations for England and Wales has made direct reference to Electrical Installations, increasing the influence on how Electrical Equipment is installed in buildings.

Building Regulations

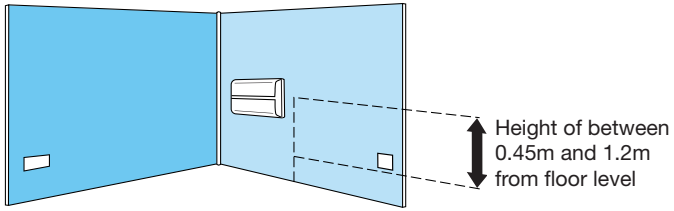
Part P of the building regulations relates to the electrical safety in dwellings. The approved document prescribes that consumer units should be located so that they are easily reachable where this is necessary to comply with Part M of the building Regulations.

Part M requires that reasonable provision be made for people to gain access to a building and use its facilities. The approved document prescribes that switches, socket outlets and "other equipment" needs to be at appropriate heights, these are defined as between 0.45m and 1.2m from finished floor level.

Other equipment may be taken to include the consumer unit, as it contains devices such as MCB's and RCD's that may need operation or resetting by the user of the dwelling.

The consumer unit should therefore be accessible, with the devices mounted at a height no greater the 1.2m above the floor. In addition the consumer unit should not be in a location that would make it difficult to access such as an under stairs cupboard. Neither should it be placed in a position where is likely to be damaged by impact.

Therefore depending on the layout of the dwelling a flush consumer unit may be considered.



"Consumer Units should be easily reachable and be mounted with the switches at a height of between 0.45m & 1.2m above floor level"

Requirements of 17th Edition Wiring Regulations BS 7671:2008

This section aims to explain some of the new Regulations contained within the 17th Edition Wiring Regulations, regarding the consumer unit and final circuits.

Firstly however, to fully understand what is required we need to consider some definitions from Part 2 of the Regulations.

Ordinary Person – Someone who is neither skilled or instructed
e.g. General public / Home owner

Skilled Person – A person with technical knowledge or experience to enable him/her to avoid dangers which electricity may create
e.g. Qualified Electrician

Instructed Person – A person who has been adequately advised or supervised to enable him/her to avoid dangers which electricity may create
e.g. Facilities Manager

Typically commercial installations will be under the control of a Skilled or Instructed Person. However domestic and some commercial installations will not. This is particularly important, as certain Regulations only apply to installations not under the supervision of a Skilled or Instructed Person.

A significant change is the introduction of Regulations requiring additional protection by RCDs.

There are 3 points of consideration,

1. Socket Outlets
2. Cables buried in walls
3. Locations containing a bath or shower

> ***“Certain Regulations only apply to installations not under the supervision of a Skilled or Instructed Person i.e. Ordinary persons”***

The Regulations have introduced new requirements regarding socket outlets, particularly where used by ordinary persons e.g. Home owners.

Sockets Outlets

The definitions for persons are important to consider when we look at the requirements for protection of circuits supplying socket outlets.

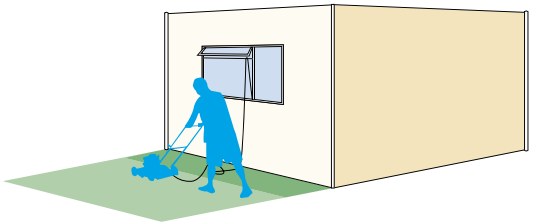
Regulation 411.3.3 requires that an RCD of not exceeding 30mA be provided for:

i. Socket outlets up to 20A that for general use by “ordinary persons”.
ii. Mobile equipment up to 32A that is for use outdoors.

Exceptions to 411.3.3 are permitted where:

iii. Use of socket outlets is under the supervision of someone “skilled” or “instructed”.
iv. Specifically labelled or otherwise suitably identified socket outlets provided for a particular item of equipment.

This is a change from the 16th Edition that required only socket outlets ‘reasonably expected’ to supply equipment used outside the equipotential zone to have RCD protection e.g. used for an Electric lawn mower. Now under the requirements of the 17th edition it is likely that every socket outlet in a domestic installation will require RCD protection not exceeding 30mA.



This may also apply to some commercial installations, like small offices or shops etc where there is no control on the use of those socket outlets. Consideration should also be given to areas where free access to socket outlets is available to the general public e.g. airport lounges.

“Socket outlets for general use in a domestic installation require RCD protection not exceeding 30mA”

Significant changes affect installations where cables are buried in the wall. This is the normal practice in dwellings.

Cables buried in the wall

Here we need to consider Section 522, Selection and erection of wiring systems in relation to external influences. The particular requirements of this section apply to cables which are concealed in a wall or partition at a depth of less than 50mm, or where metal partitions are used.

The definitions for persons are once again important for this section.

> ***"Where buried cables are not mechanically protected additional protection by an RCD not exceeding 30mA must be provided"***

There are 5 options of installing cables in walls. The cables shall:

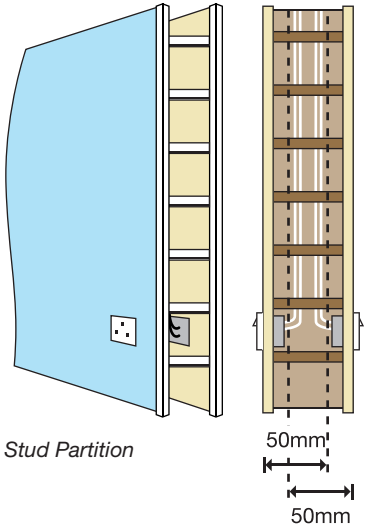
i. incorporate an earthed metal covering which is suitable as a protective conductor. Eg SWA cable.
ii. Be enclosed in earthed metal conduit, such that is suitable as a protective conductor.
iii. Be enclosed in earthed metal trunking, such that is suitable as a protective conductor.
iv. Be protected against damage from penetration by nails or screws.
v. Be installed in a safe zone.

This is much the same as the 16th Edition requirements and the usual option is to install cables in a dedicated safe zone. However, where an installation is not under the supervision of someone skilled or instructed, regulation 522.6.7 applies.

In this regulation where (v) only from above is used then the cable must have additional protection by the use of a RCD not exceeding 30mA. This would apply where thermoplastic (PVC) wiring systems are used, this is typical in most domestic installations and some commercial installations.

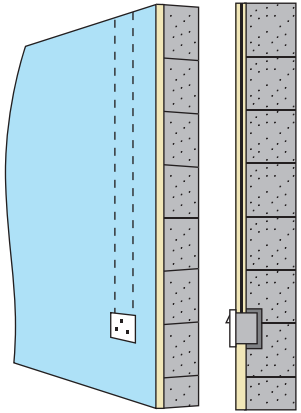
Cables buried in the wall

Requires RCD Protection



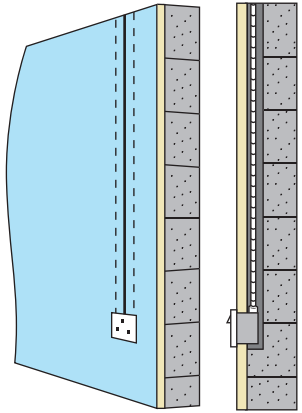
Stud Partition

Requires RCD Protection



Brick / Block or Plaster

Does Not require RCD Protection



Earthed Metal Condut

Although additional regulations relating to bathrooms etc are not new, there are some important changes to consider.

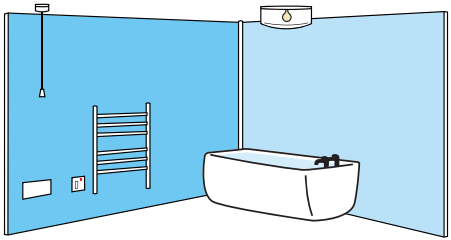
Section 701, Locations containing a bath or shower

Regulation 701.411.3.3 requires that all circuits within this location shall be additionally protected by an RCD not exceeding 30mA. This would mean 230V lighting, the 230V supply to the source for SELV, a shower circuit and bathroom heater for example will all need RCD protection.

A standard 13A socket outlet is now permitted in this location provided however the socket outlet is more than 3m from the boundary of zone 1.

The 16th Edition required local supplementary bonding be provided connecting together all exposed and extraneous conductive parts in the zones. This is no longer required in this location provided the following conditions are met:

- All final circuits of the location comply with the automatic disconnection requirements according to regulation 411.3.2.
- All circuits are RCD protected in accordance with 701.411.3.3.
- All extraneous-conductive parts of the location are effectively connected to the protective equipotential bonding according to regulation 411.3.1.2 (Previously termed main equipotential bonding).



Circuits in locations containing a bath or shower should be protected by an RCD

“All circuits in locations containing a bath or shower shall be protected by an RCD not exceeding 30mA”

Other Considerations

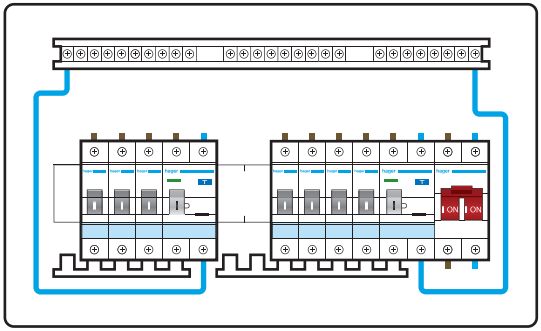
There are additional Regulations and Codes of Practice that need to be considered during the design of an installation. These will affect the choice of consumer unit.

Division of Installation

Section 314 calls for the installation to be so divided to:

a. Avoid hazards and minimize inconvenience in the event of a fault
b. Reduce the possibility of unwanted tripping of the RCD due to excessive protective conductor currents.

To comply with these requirements the circuits of an installation should not be connected to a single RCD, as this could lead to loss of supply to the entire installation in the event of a fault on one circuit, clearly inconvenient for the user of the building.



“All circuits of an installation should not be connected to a single RCD”

The Wiring Rules & Building regulations are not the only documents that need to be consulted, another important document relates to smoke alarms.

BS 5839-6:2004 Fire detection and Fire alarm systems for buildings

This Code of Practice has particular requirements for dwellings.

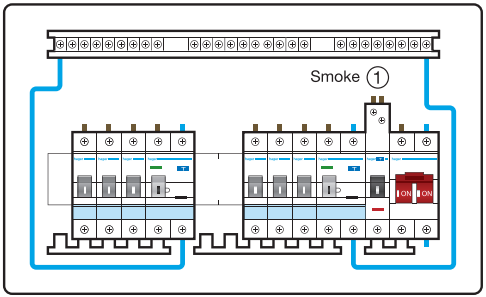
This document makes reference to the power supply to such systems and mentions RCD's. The circuit supplying these systems should preferably not be protected by an RCD. This however is going to be difficult to achieve if the circuit supplying these systems is buried in the walls and standard domestic wiring systems are used. Indeed the supply cables would need to be specially protected in earthed metal conduit etc. for RCD protection not to be used.

Options for circuits supplying fire or smoke alarms in dwellings protected by an RCD include:

i. The RCD serves only that circuit. For example with the use of an RCBO

ii. The RCD operates independently of any RCD feeding socket outlets or portable equipment

So consideration of these points is necessary during the design stage and particular care is needed to select the appropriate consumer unit and wiring system to ensure compliance. BS 5839-6 should always be studied to ensure that all relevant recommendations are complied with.



"Where RCD protection is needed for smoke detector circuits one option is to supply that circuit only"

The following options, each with their own benefits, can be considered by the installation designer.

Consumer Unit Arrangements

Not Permitted

A consumer unit with a 30mA RCD main switch would not be suitable for 3 main reasons:

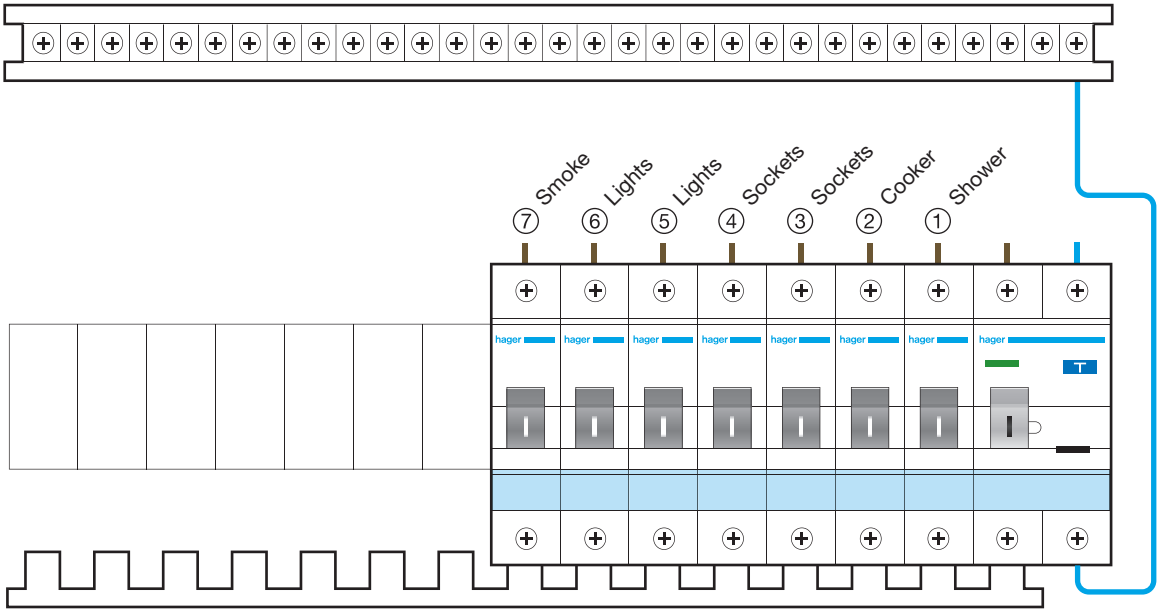
- The Fire detection circuit and the socket outlet circuits share a common RCD. This could reduce the reliability of the mains supply to the Fire detection circuit as appliances and portable equipment are likely causes of RCD tripping.

- The cumulative effects of electronic equipment in the modern home, is such that some current is likely to flow in the protective conductor. A 30mA RCD will trip between 15-30mA. This could cause unwanted tripping, regulation 314.1 (iv) refers.

- Any fault would result in the loss of all the lighting, this could in itself cause a hazard and the lack of power to the fridge/freezer circuit for example would be very inconvenient. Regulation 314.1 (i) asks the designer to consider this eventuality.

An example is shown over page.

“A consumer unit with a 30mA RCD main switch should not be used to protect all the circuits”


⑦ Smoke
⑥ Lights
⑤ Lights
④ Sockets
③ Sockets
② Cooker
① Shower
hager

Consumer Unit Arrangements

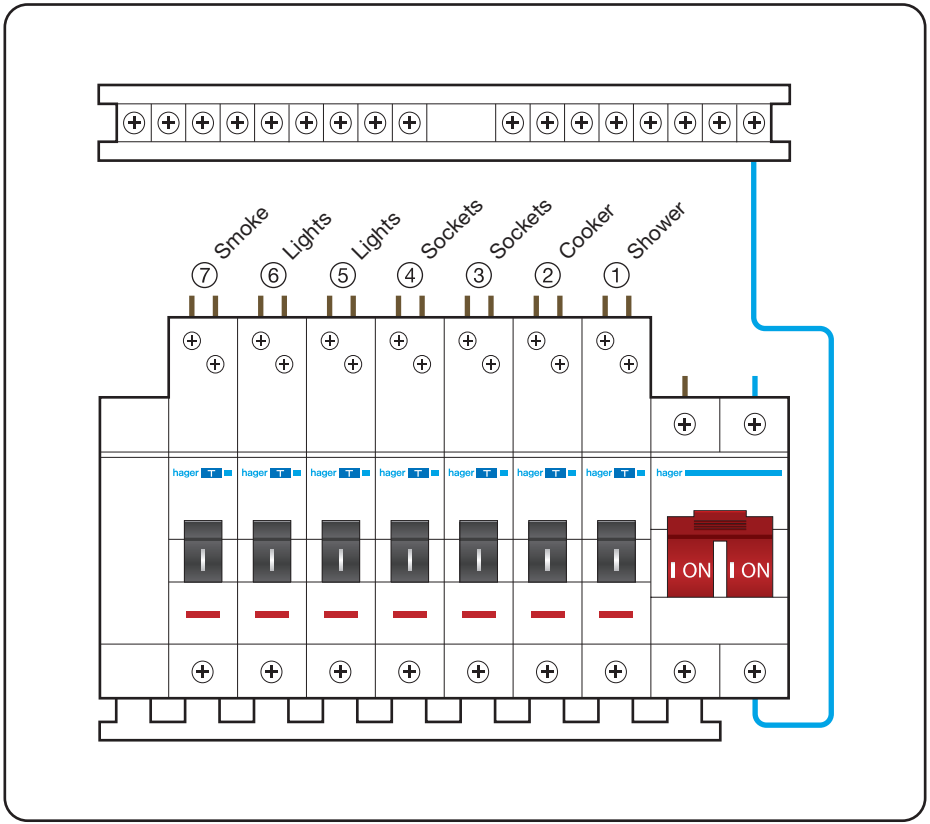
Option 1

Main Switch with RCBO's On All Circuits

A standard main switch disconnector controlled consumer unit could be used with every circuit having individual RCD protection at 30mA. This could be achieved by selecting RCBO's for every outgoing circuit instead of the usual MCB's. A fault on any circuit would not affect other circuits and hence all relevant regulations would be met by such a design.

An example is shown over page.

"Selecting RCBO's for every outgoing circuit meets all relevant regulations"


Smoke
Lights
Lights
Sockets
Sockets
Cooker
Shower
7
6
5
4
3
2
1
hager
ON
ON

Consumer Unit Arrangements

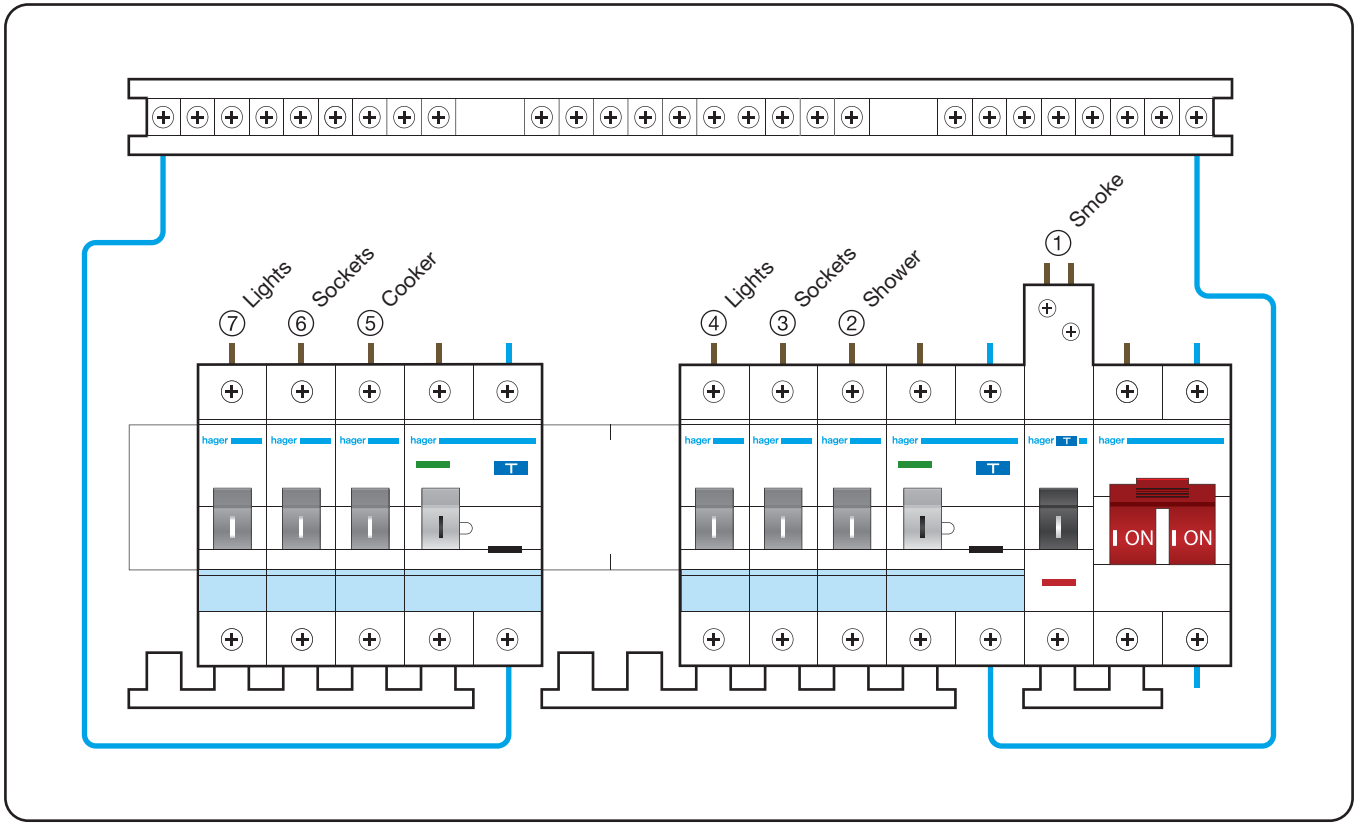
Option 2

Split Load Twin RCCB plus Dedicated RCBO

This arrangement provides a dedicated 30mA RCBO for the smoke detector circuit, but combines the rest of the circuits across two further 30mA RCCB's. Careful arrangements of the circuits can reduce the likelihood of nuisance tripping, thereby limiting the inconvenience or potential hazards that a loss of supply can cause by limiting the number of circuits affected.

An example is shown over page.

"This arrangement provides a dedicated RCBO for the smoke detector circuit"


7 Lights
6 Sockets
5 Cooker
4 Lights
3 Sockets
2 Shower
1 Smoke
hager
ON
ON

Consumer Unit Arrangements

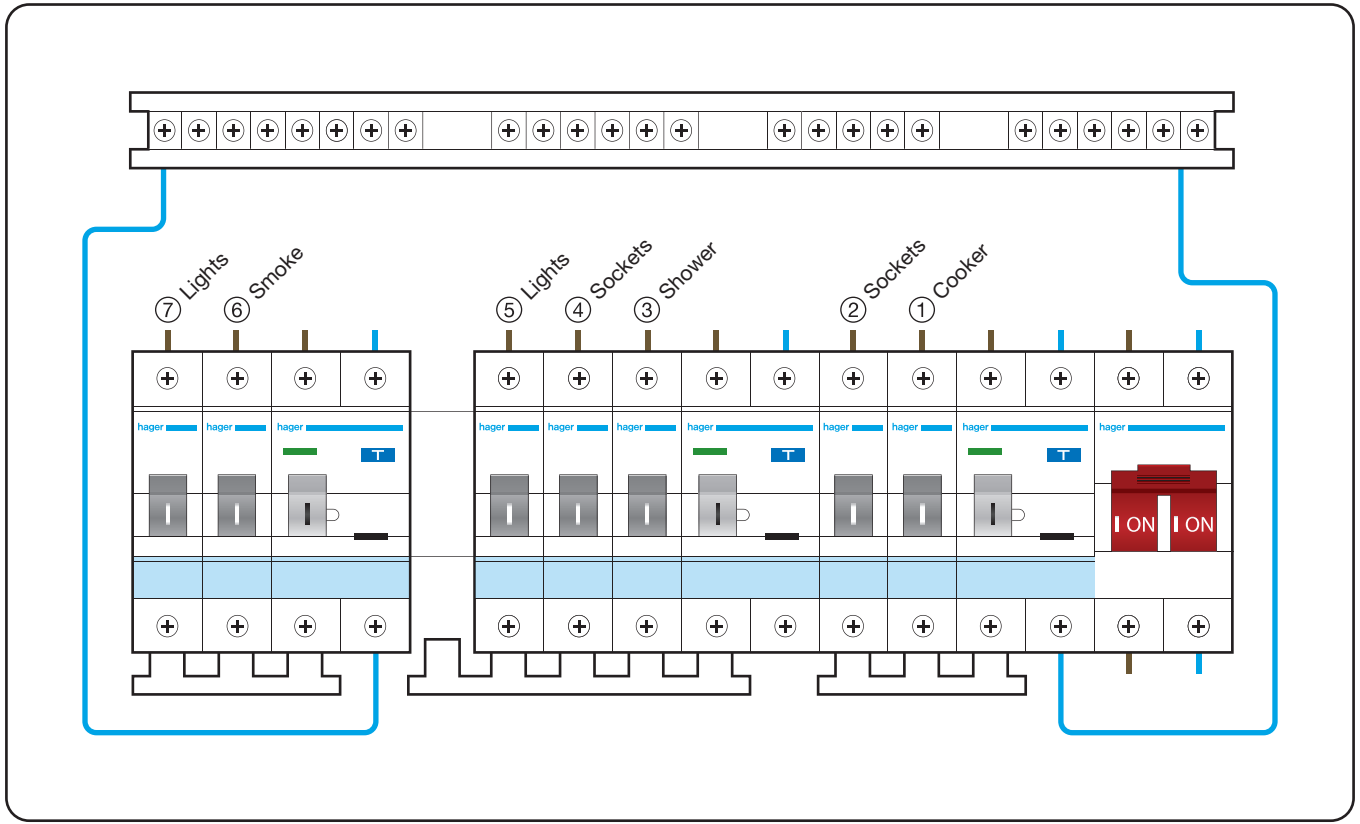
Option 3

Split Load 3 RCCB Board

This arrangement provides a 30mA RCCB for the smoke detector circuit which could also supply other circuits e.g. lighting, and combines the rest of the circuits across two further 30mA RCCB's. Careful arrangements of the circuits can reduce the likelihood of nuisance tripping, thereby limiting the inconvenience or potential hazards that a loss of supply can cause by reducing the number of circuits affected.

An example is shown over page.

"This arrangement provides a RCD for the smoke detector circuit which could also supply other circuits e.g. lighting"


⑦ Lights
⑥ Smoke
⑤ Lights
④ Sockets
③ Shower
② Sockets
① Cooker
hager
ON
ON

Consumer Unit Arrangements

Option 4

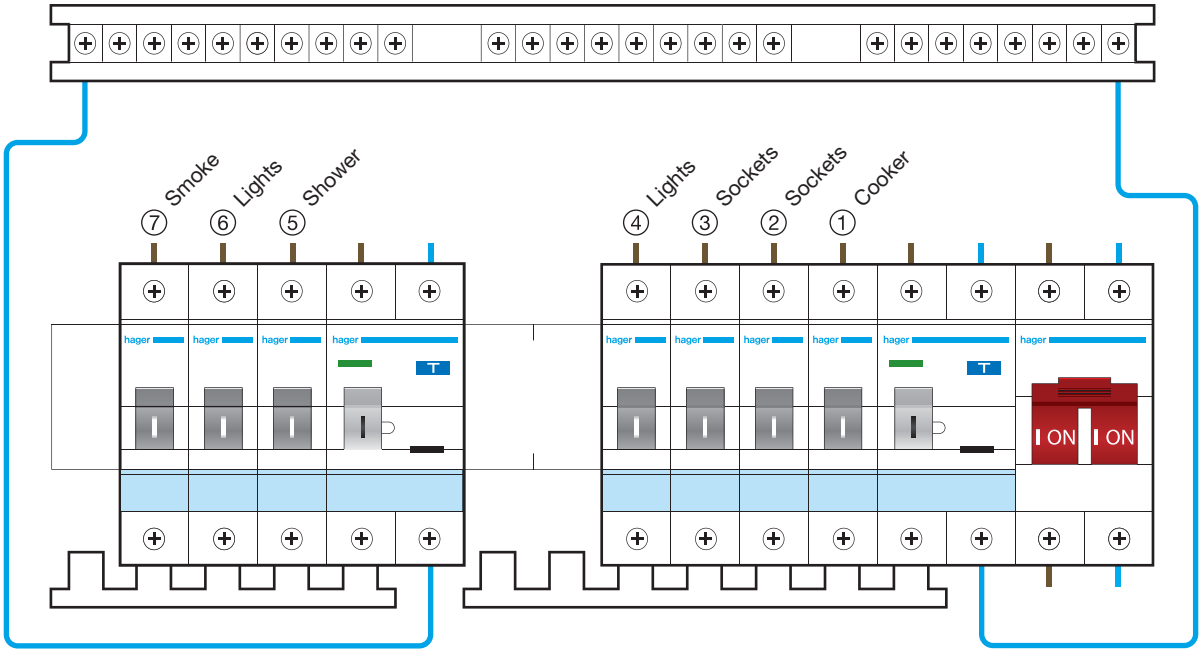
Split Load Twin RCCB

This arrangement provides two separate 30mA RCCBs with the circuits spread across both. The design of the circuit arrangements ensure the smoke detector is not fed from the same RCD as socket outlets to improve the reliability of the mains supply to the Fire detection circuit as appliances and portable equipment are likely causes of RCD tripping.

Careful arrangement of the other circuits can reduce the likelihood of nuisance tripping, thereby limiting the inconvenience or potential hazards that a loss of supply can cause. However with all socket outlets being supplied from one RCD certain compromise must be accepted.

An example is shown over page.

“One option is for the smoke detector not to be supplied from the same RCD as socket outlets”


7 Smoke
6 Lights
5 Shower
4 Lights
3 Sockets
2 Sockets
1 Cooker
hager
ON
ON

Consumer Unit Arrangements

Option 5

Split Load Twin RCCB plus unprotected circuit

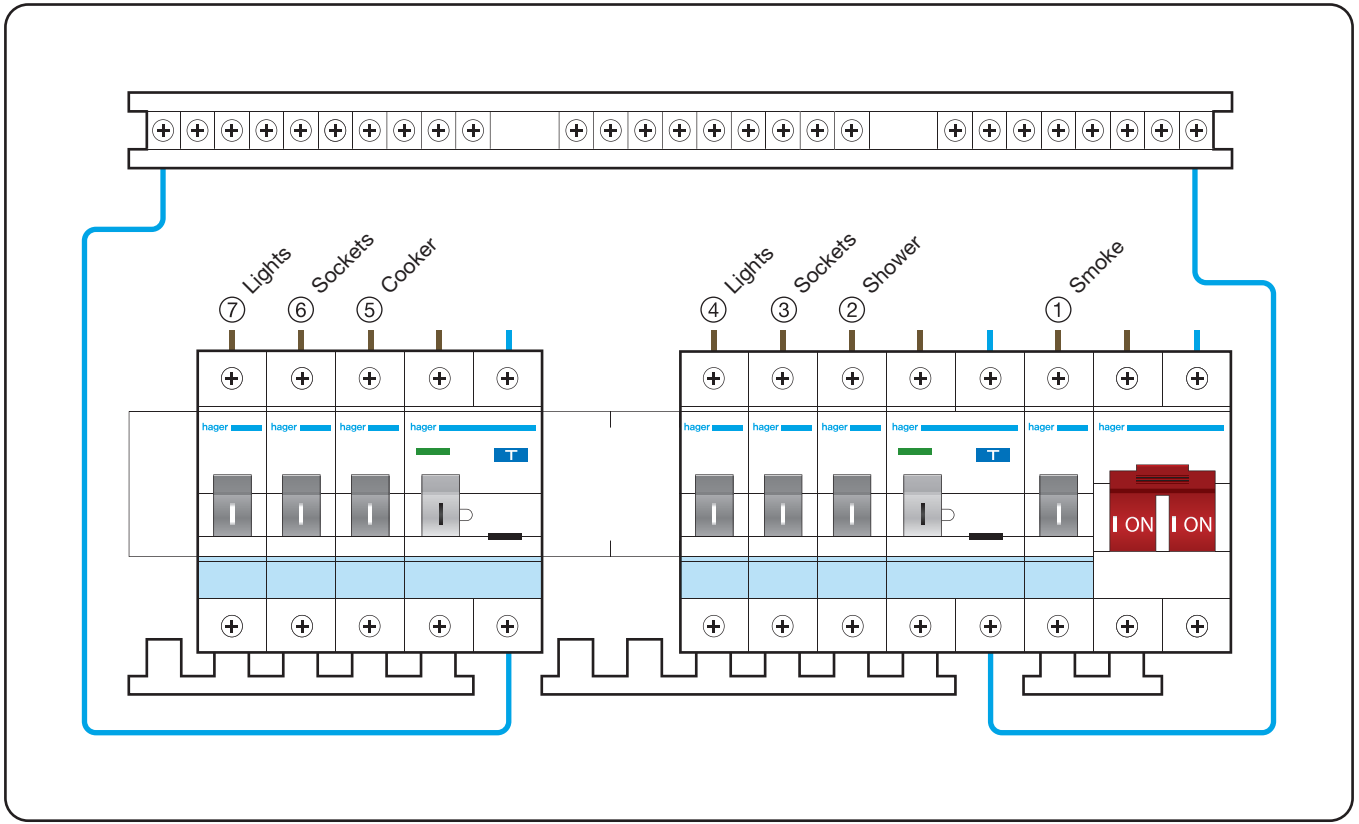
Under the 17th Edition requirements it is still possible to install some circuits in domestic premises that are not fed via an RCD. Different wiring systems would need to be used. The cost of installation could rise considerably if most circuits were installed using armoured cable or earthed metal conduits.

The smoke alarm circuit could be installed in such a way to negate the need for RCD protection, this may be possible by using one of the other wiring methods described in 522.6.6 for the length of run that the cable is in the wall (use of earthed metal conduit for example). Or depending on the layout of the property there maybe an attached garage for example where surface wiring might be possible. The requirements of that regulation are therefore not applicable.

The level of compliance with the Regulations would therefore be the same as option 2 Split Load Twin RCCB plus Dedicated RCBO.

An example is shown over page.

"If the smoke alarm circuit is not to be protected by an RCD it must be installed using a method from (i) to (iv) of regulation 522.6.6"


7 Lights
6 Sockets
5 Cooker
4 Lights
3 Sockets
2 Shower
1 Smoke
hager
ON
ON

Conclusions

It is clear that domestic installations conforming to the 17th Edition of the Wiring Regulations are likely to require increased use of RCD (Residual Current Devices) and careful consideration from designers and installers is required to meet the requirements of the regulations.

Training Seminars

In addition to the products required, Hager are committed to training our customers on the latest regulations. To help with the introduction of the 17th Edition Hager are planning a series of training seminars during 2008 to help explain the differences, what the implications are, and how Hager can help with the transition.

Training seminars are arranged throughout the UK and come at no cost to you. To register your interest please visit www.hager.co.uk and click on the IEE Wiring Regulations link.

Partner in training

Types of Residual Current Devices normally used in Consumer Units

RCD – Residual Current Device

A generic term for devices providing earth fault protection.

RCBO - Residual Current Operated Circuit-Breaker with Integral Overcurrent Protection

A mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions. In addition it is designed to give protection against overloads and/or short circuits and can be used independently of any other overcurrent protective device within its rated short circuit capacity.

RCCB - Residual Current Operated Circuit-Breaker without Integral Overcurrent Protection

A mechanical switching device designed to make, carry and break currents under normal service conditions and to cause the opening of the contacts when the residual current attains a given value under specified conditions. It is not designed to give protection against overloads and/or short circuits and must always be used in conjunction with an overcurrent protective device such as a fuse or circuit-breaker.

Consumer Unit

MCB

RCCB

RCBO

Board Arrangements (all with 100A main switch)	**References**		**Total Ways**	**Benefits / Considerations**
Main Switch with RCBO's On All Circuits 1 x 100A switch, 4 to 20 outgoing ways	**VC110** **VC114** **VC116** For other types see page 1.2 of the Hager General Catalogue	**VC110G** **VC114G** **VC116G**	4 to 20	Selecting RCBO's for every outgoing circuit meets all regulations
Split Load Twin RCCB plus Dedicated RCBO (6A RCBO for Smoke detector / Alarm circuit) 2 x 63A RCCB, 1 x 6A RCBO 5/4/1 Split load 2 x 63A RCCB, 1 x 6A RCBO 7/6/1 Split load 2 x 80A RCCB, 1 x 6A RCBO 5/4/1 Split load 2 x 80A RCCB, 1 x 6A RCBO 7/6/1 Split load	 **VC754R** **VC776R** **VC854R** **VC876R**	 **VC754RG** **VC776RG** **VC854RG** **VC876RG**	 10 14 10 14	This arrangement provides a dedicated RCBO for the smoke detector circuit
Split Load 3 RCCB Board 2 x 80A RCCB, 1 x 40A RCCB 5/5/2 Split load	**VC8552**	**VC8552G**	12	This arrangement provides a RCD for the smoke detector circuit which could also supply other circuits e.g. lighting
Split Load Twin RCCB 2 x 63A RCCB 5/5 Split load 2 x 63A RCCB 6/6 Split load 2 x 80A RCCB 5/5 Split load 2 x 80A RCCB 6/6 Split load 2 x 80A RCCB Configurable	 **VC755H1** **VC766H1** **VC855H** **VC866H** **VC816C**	 **VC755H1G** **VC766H1G** **VC855HG** **VC866HG** **VC816CG**	 10 12 10 12 16	One option is for the smoke detector not to be supplied from the same RCD as socket outlets
Split Load Twin RCCB plus unprotected circuit 2 x 80A RCCB 5/4/1 Split load 2 x 80A RCCB 7/6/1 Split load	 **VC854U** **VC876U**	 **VC854UG** **VC876UG**	 10 14	If the smoke alarm circuit is not to be protected by an RCD it must be installed using a method from (i) to (iv) of regulation 522.6.

Devices	MCBs	RCBOs
6A	**MTN106**	**ADN106**
10A	**MTN110**	**ADN110**
16A	**MTN116**	**ADN116**
20A	**MTN120**	**ADN120**
25A	**MTN125**	**-**
32A	**MTN132**	**ADN132**
40A	**MTN140**	**ADN140**
50A	**MTN150**	**-**
63A	**MTN163**	**-**

Hager Ltd.
Hortonwood 50
Telford
Shropshire
TF1 7FT

Customer Services and Sales Hotline	Call our Customer Services Centre for all your national sales enquiries.	**0870 240 2400** sales@hager.co.uk
Customer Services and Sales Faxline		**0870 240 0400**
Technical Helpline	Technical Engineers offer both national and local support.	**0870 607 6677** technical@hager.co.uk
Technical Faxline		**01952 675557**
Hager Online	Visit our website for up to date news on Hager and for general brand information e-mail us.	www.hager.co.uk info@hager.co.uk

hager

“Knowledge is power”

The Hager Guide to current thinking on the regulations, protection and control of Klik lighting circuits.

Written by:
Paul Sayer
Technical Standards Manager for Hager

klik

klik

Contents

Conductor size

It is now standard practice to use luminaire supporting couplers (LSC), such as Klik from Hager, when designing and installing commercial lighting installations. Designers, inspecting engineers and electrical contractors often misunderstand key areas of specification for compliance with the BS 7671 wiring regulations for LSCs.

Q What product standards do the Wiring Regulations specify for LSCs?

Regulation 511.1 says that equipment should "comply with the relevant requirements of the applicable British Standard or harmonised standard."

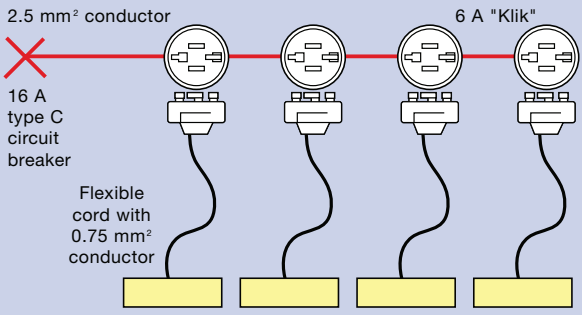
Appendix 1 of the regulations identifies BS 6972 as the specification for general requirements for luminaire supporting couplers for domestic, light industrial and commercial use. It gives general requirements for the construction of LSC plugs and LSC outlets with particular reference to safety. LSCs must comply with either BS 6972 or BS 7001.

Q Where exactly can LSCs be used?

Referring to BS 6972, LSCs are for use in final circuits rated at not more than 16 A, where the supply voltage does not exceed 250 V ac and the electrical load connected to any one LSC plug does not exceed 6 A.

BS 6972 also specifies the conductor cross sectional area of the flexible cord for LSC plugs which are not part of the luminaire as between 0.5 mm^2 to 1.00 mm^2 (see figure 1).

Figure 1: An example of a specification of flexible cord for LSC plugs



Q How can you use a 16 A circuit breaker when the LSC plug and flexible cord are rated at 6 A?

To best answer this, we need to split the question into three parts. Firstly, how is overcurrent defined? Overcurrent is defined as overload currents or fault currents.

Second, how do you define overload current? Overload current is an overcurrent occuring in a circuit that is electrically sound. An example might be a user plugging in more appliances than the circuit is intended for, which may in turn cause an overload.

The designer needs to decide if a circuit is liable to carry overload current. It is clear in figure 1 that the circuit cable with 2.5 mm^2 conductor requires overload protection. In this instance the user may plug in additional luminaires and create higher power consumption than the circuit is intended for.

Finally, can overload protection be omitted? There are some conditions where overload protection is not necessary. Regulation 433.3.1 (ii) tells us that overload protection is not necessary for a conductor, which, because of the characteristics of the load, is not likely to carry overload current.

In figure 1 we can assume that the LSCs and their 0.75 mm^2 flexible cord supplying

the luminaires are protected against overload current by the characteristics of the load.

And so, answering the original question, when overload current protection is not required the nominal current of the protective device can be greater than the current carrying capacity of the flexible cord, as in figure 1.

Q So what if the luminaire is swapped with one that has a higher load current than that of the flexible cord rating?
It is wrong and against the Wiring Regulations' guidance to do this. Before making any addition or alteration to an existing installation, you must check that the rating and condition of any existing equipment is adequate to carry the additional load. This is a fundamental requirement for safety.

Q How do I calculate the conductor cross sectional area of the flexible cord?
Appendix 4 of the Wiring Regulations tells how to go about this process.

$$I_t \geq \frac{I_b}{C_a C_g C_l}$$

Where:
I_t = the value of current tabulated for the type of cable and installation method concerned, for a single circuit in an ambient temperature of 30°C:
I_b = load current;
C_a = rating factor for ambient temperature;
C_g = rating factor for grouping;
C_l = rating factor for thermal insulation.

Having calculated I_t, this value can then be used to select the appropriate cross sectional area of flexible cord from the relevant table in Wiring Regulations.

Q When calculating the load current are there any special factors for discharge lamps?
Discharge lamps take a higher than normal current during starting. This current may be up to several times the conductor current rating.

Generally the duration of this starting current is considered not long enough to cause unacceptable overheating of the conductors.

The important characteristics of the starting current are the magnitude of the current and its duration.

However, the flexible cord must be capable of carrying the total steady current of the lamp(s) and any associated gear and also their harmonic currents.

The IEE Guidance note 1 states: "Where more exact information is not available, the demand in volt-amperes is taken as the rated lamp watts multiplied by not less than 1.8. This multiplier is based upon the assumption that the circuit is corrected to a power factor of not less than 0.85 lagging, and takes into account control gear losses and harmonic current."

Q Does the type of lampholder used affect the current rating of the circuit protection device?
Yes. Regulation 559.6.1.6 specifies a maximum rating of the overcurrent protective device to be 16A where the lighting circuits incorporate B15, B22, E14, E27 or E40 lampholders.

Table 1 Overcurrent protection of lampholders

Type of lampholder	Cap type	Maximum rating of overcurrent protective device protecting the circuit (A)
BS5042 or *BS EN 61184* Bayonet type	B15 SBC B22 BC	6 16
BS EN 60238 Edison screw	E14 SES E27 ES E40 GES	6 16 16

Note: Where overload protection is omitted, then a calculation must be made to ensure that the conductors concerned are large enough to carry the fault currents without damage until the overcurrent device operates.

Fault current protection

Overload protection is not required for the flexible cord from the luminaire supporting coupler plug to the luminaire. However, we need to ensure that the conductors concerned are large enough to carry any fault currents without damage until the overcurrent device operates.

This section describes how to make the necessary calculation.

Q How would you define fault current?

A fault current is an overcurrent caused by either a short circuit (between **live** conductors) or an earth fault (between a live conductor and an exposed conductive part or protective conductor).

Q What do the Wiring Regulations specify to protect the flexible cord against fault current?

If overload protection is not required then a calculation must be made. Regulation 434.5.2 provides an equation for calculating the maximum duration of the fault current, but it is not immediately apparent how to apply it. A simple transposition, however, gives us the equation.

$I^2t \leq k^2S^2$

- where I^2t is proportional to the thermal energy let through the protective device;
- k^2S^2 indicates the thermal capacity of the conductor.

If the conductor is not to be damaged I^2t must not exceed k^2S^2;

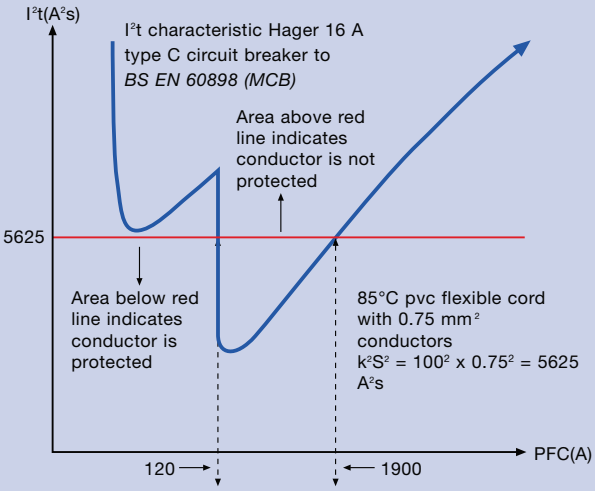
- t = the maximum fault current duration in seconds (disconnection time);
- k = a factor taking account of the resistivity, temperature coefficient and heat capacity of the conductor material, and the initial and final temperatures, derived from BS 7671;
- S = the nominal cross sectional area of the conductor in mm^2;
- I = the value of fault current an amperes, expressed for ac as the rms value, due account being taken of the current limiting effect of the circuit impedances.

Note for very short duration (less than 0.1 secs) and for current limiting devices, I^2t must be designated by the manufacturer's data.

Q How do I apply this formula?

The simplest way of assessing the degree of thermal protection provided by an overcurrent device is by using the manufacturer's I^2t characteristics. Calculate k^2S^2 and superimpose this value as a horizontal line on the graph

Figure 1: Assessing protection using the manufacturer's data



showing the protective device's I^2t characteristics (see figure 1).

Provided that the fault levels are within the minimum and maximum values specified in figure 1, the flexible cord will be protected against thermal damage and comply with the Wiring Regulations.

Q Where are the minimum and maximum fault currents likely to occur?

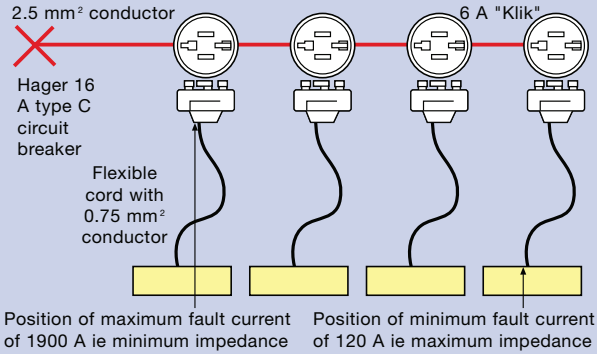
The minimum fault current will probably be determined by the earth loop impedance at the end of the flexible cord at the furthest LSC. The maximum fault current will probably be between live conductors at the LSC closest to the origin of the circuit (see figure 2).

Q Are these calculations always necessary?

Where an overcurrent protective device provides overload protection and has a breaking capacity not less than the prospective fault current at its point of installation, it can be assumed that the conductors on the load side of the device are protected against fault current.

This assumption applies when the neutral and protective conductors are of equal cross sectional area to the line conductor and are manufactured of the same material. Such an assumption must be checked for conductors in parallel and for non-current limiting types of circuit breaker. In this instance no further calculations are necessary for overload or fault current protection (See figure 3).

Figure 2: The maximum fault current usually lies between the conductors at the LSC closest to the origin of the circuit



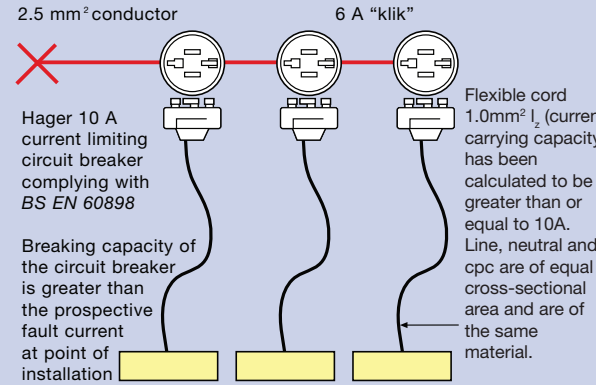
Q Is it possible to purchase flexible cord with 1.0mm² conductors prewired to an LSC plug?

Yes, Klik, for example, offers this as standard.

Q Are there any other key factors affecting the selection of flexible cord?

The flexible cord length is influenced by voltage drop, protection against electric shock, the effects of fault current and the selection and erection of the wiring system.

Figure 3: An example of when further calculation is not required for overload or fault current protection of the flexible cord



Voltage drop & shock protection

Electrical engineers frequently debate how the length of flexible cord between the luminaire supporting coupler (LSC) and the luminaire raises a number of design considerations.

The next two technical sections within this booklet will fully illustrate the technical information and the key requirements necessary to determine the correct length of this flexible cord (see figure 1).

Q Do any British Standards specify a maximum length for the flexible cord?
No.

Q What requirements does the contractor need to consider for the maximum length of flexible cord?
There are four requirements which need to be taken into account:
- Voltage drop;
- Protection against electric shock
- Selection and erection of the wiring system.
- Thermal constraints

Q What needs considering for voltage drop?
The regulations are satisfied for a supply given in accordance with The Electricity Safety, Quality and Continuity Regulations 2002, as amended if; the voltage drop from the origin of the installation to the terminals of the fixed equipment does not exceed 3% of the nominal voltage supply, where the installation is supplied directly from a public low voltage distribution system.

At present the nominal voltage supply in the UK is 230 V + 10% - 6%. The maximum voltage drop permitted is therefore: 230 x 3/100 = 6.9 V (see figure 2).

The requirements for voltage drop in the regulations are concerned solely with safety. The contractor should always consider other effects of voltage drop on the equipment; efficiency, for example.

A mistake often made is to ignore the flexible cord length in the voltage drop calculations. Details of this calculation are available on request.

Q How does the length of flexible cord influence the calculations for protection against electric shock?
The most common method of protection against electric shock is automatic disconnection of supply.

If the protective device is to operate correctly you must always consider the length of flexible cord in these calculations.

Figure 1: The flexible cord length between the LSC and the luminaire

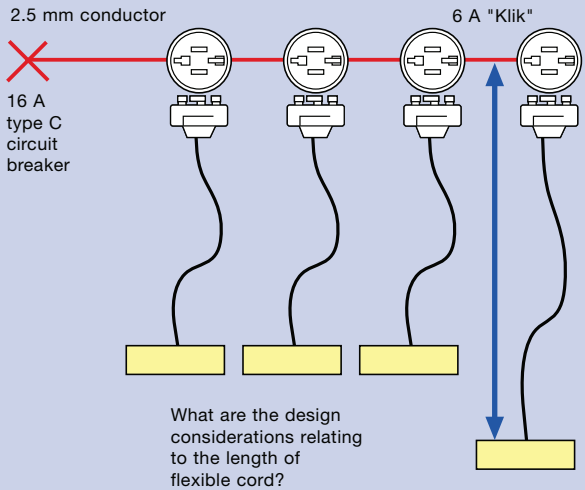
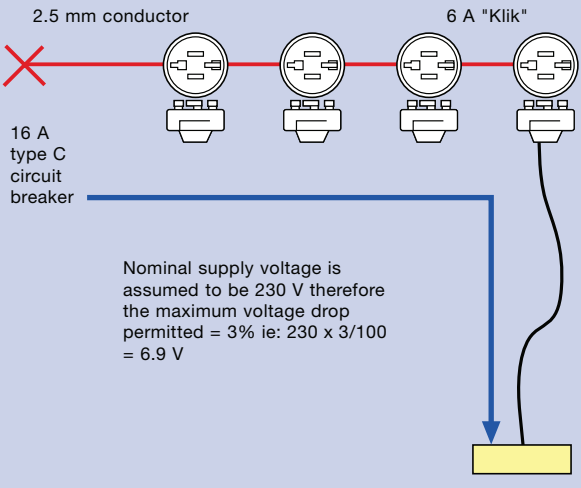


Figure 2: An example showing the maximum permitted voltage drop in installation



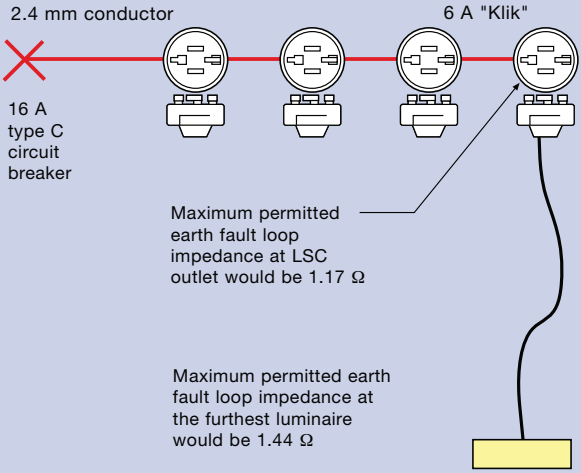
Q How does automatic disconnection apply to the LSC circuit?

The contractor must verify that the earth fault loop impedance does not exceed the maximum tabulated values in BS 7671, or any values derived by applying the appropriate formula specified in BS 7671 for the overcurrent protective device.

Manufacturers frequently provide data derived from this formula.

If the circuit is designed to comply with BS 7671:2008 table 41.3 the maximum earth fault loop impedance for the 16 A type C circuit breaker for 0.4 and 5 second disconnection time would be 1.44 Ω (see figure 3).

Figure 3: Verifying the maximum permitted earth fault loop impedance



Earth fault current protection

In the previous section we illustrated the requirements for complying with voltage drop and automatic disconnection. In this section we will examine the other two factors to be considered, namely that the circuit protective conductor is large enough to carry the earth fault currents and the selection and erection of a wiring system.

Q Why do I need to protect against the effects of fault current?

Fault currents generate heat, so you must ensure that the circuit protective conductor (CPC) can carry the earth fault currents without thermal damage until the overcurrent device operates.

Q How do I protect against the effects of fault current?

If the cross sectional area of the cpc has been worked out by applying table 54.7 of BS 7671, and the overcurrent protective device is providing protection against overload currents and fault currents, no further checks are needed. Table 54.7 details the minimum crosssectional area of the protective conductor in relation to the crosssectional area of the associated line conductor.

Q If the overcurrent protective device is not providing protection against overload current and I have a cpc that does not comply with table 54.7, what do I do?

You need to apply the formula in regulation **543.1.3**:

$$S = \frac{\sqrt{(I^2t)}}{k} \qquad \text{or } I^2t = k^2S^2$$

S = nominal cross sectional area of the cpc in mm^2;
I = fault current in amperes;
t= operating time of disconnecting device in seconds;
k = factor taken from BS 7671.

Q Is there a quick and simple method of applying $I^2t = k^2S^2$?

Yes. Use the manufacturer's I^2t characteristics for the overcurrent protective device. Calculate k^2S^2 and superimpose this value as a horizontal line on the graph showing the protective device's I^2t characteristics. This was illustrated earlier.

Hager has already completed these calculations. They are available upon request.

Q What do the Wiring Regulations specify for the selection and erection of the wiring system?

Chapter 52 specifies the requirements for:

- types of wiring system;
- selection and erection in relation to external influences;
- current-carrying capacity of the conductors;
- cross-sectional area of conductors.

Note: the latter two points have been covered in previous articles.

Q Are there any other British Standards to consider?

BS 7540 provides a guide to the proposed safe use of electric cables. This identifies that cables should be selected so that they are suitable for any external influences that may exist, for example:

- ambient temperature;
- presence of rain, steam or accumulation of water;
- presence of corrosive, chemical or polluting substances;
- mechanical stresses such as through holes or sharp edges in metal work;
- fauna - rodents;
- flora - mould;
- radiation - sunlight.

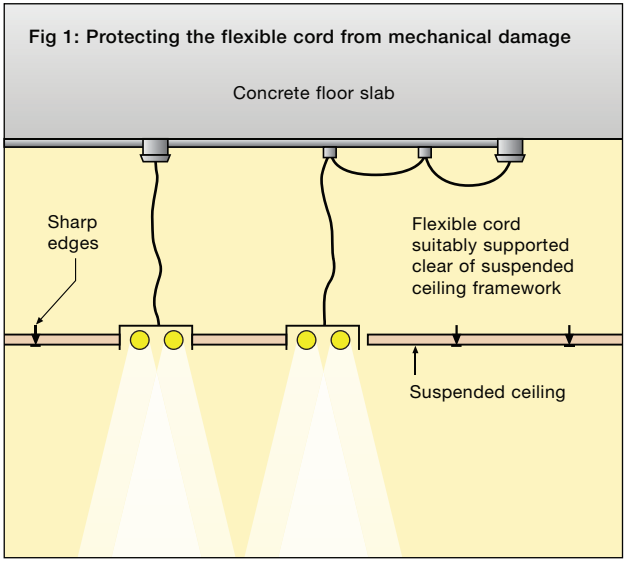
Q Are there any key requirements with respect to the increased use of suspended ceilings in commercial premises?

You must take into account the sharp edges forming the grid of such ceilings. Flexible cords with pvc or similar sheathing should not rest on the grid, but be supported clear of the framework to avoid deviating from BS 7671 regulation 522.8.1, ie avoid damage to the sheath and insulation of the flexible cord during installation and subsequent use (see figure 1).

Q Is there a quick and simple method of supporting the flexible cord?

There are a number of supporting systems available. One of the simplest is to use a self adhesive cable clip. Alternatively, clips are easily attached to a supporting structure using adhesive.

Fig 1: Protecting the flexible cord from mechanical damage



Isolation

Q Why is the isolation and switching off of luminaires important?

Facilities should be designed into every electrical installation so that it can be maintained in a safe condition. The electrical design engineer is duty bound under the Electricity at Work Regulations 1989 to ensure that this is the case.

The advent of computer controlled luminaires and other automatic lighting control systems have introduced further complications to the safety issues of isolation and switching.

Q Is there a difference between isolation and switching off for mechanical maintenance?

Yes.

Q What is isolation?

Isolation is defined in BS 7671 as a function intended to cut off, for safety reasons, the supply from all, or a discrete section of, the installation by separating it from every source of electrical energy.

Q Why do you need isolation?

It prevents death or personal injury from electric shock, electric burn, fires of electrical origin, electric arcing or explosions initiated or caused by electricity.

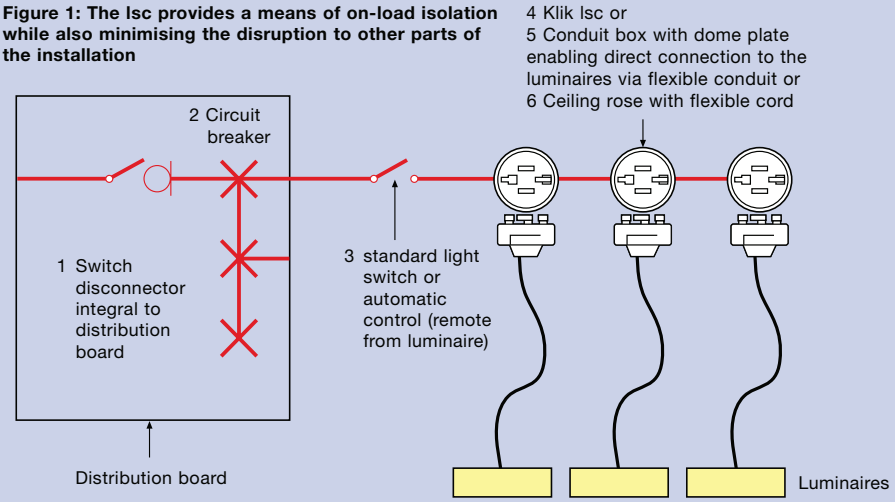
Isolation enables electrically skilled persons to carry out work on, or adjacent to, parts which would otherwise be live, eg replacing a faulty ballast or ignitor in a luminaire.

Q What design considerations are necessary for isolation?

Consider the purpose of the installation and the client's requirements for maintenance and repair?

It should enable simple and safe electrical maintenance and repair with minimum inconvenience and disruption to other parts of the electrical installation. You must also take suitable precautions to prevent equipment from being

Figure 1: The Isc provides a means of on-load isolation while also minimising the disruption to other parts of the installation



inadvertently or unintentionally energised.

Q What are the key requirements for devices used for onload isolation?

You must consider several factors. There must be sufficient isolating distance between contacts and their position must be clearly and reliably indicated.

Also the on-load device must be suitable for the prescribed load characteristics. Note the standard for LSCs, BS 6972, specifies the requirements for load making and breaking with an inductive load and with tungsten filament lamps. Finally the device must be manually operated and it can not be a semiconductor.

Q What do you classify as lamp replacement?

Mechanical maintenance, which Part 2 of BS 7671 defines as: “the replacement, refurbishment or cleaning of lamps and non-electrical parts of equipment, plant and machinery.”

Q What is the objective of switching off for mechanical maintenance?

It enables non-skilled people to carry out maintenance on electrical equipment without risk of burns or injury from mechanical movement.

Switching off for mechanical maintenance is not isolation of live parts.

Q What are the design considerations for switching off for mechanical maintenance?

You must know what the installation is being used for, including your client’s requirements for mechanical maintenance. The system should allow maintenance to be safe and with minimum disruption to other parts of the installation. You must also ensure that there are precautions in place preventing equipment from being inadvertently reactivated.

Q What are the requirements for the devices used in switching off for mechanical maintenance?

The device must clearly indicate its off or open position and be suitable for the prescribed load characteristics.

Q Which device best complies with BS 7671 for the on-load isolation and switching off for mechanical maintenance of a luminaire?

An LSC provides a means of on-load isolation while also minimizing disruption to other parts of the electrical installation (see figure 1).

The advantages of using an LSC for on-load isolation and mechanical maintenance of luminaires are:

- Minimum inconvenience and disruption to the installation;
- A large isolating distance between contacts;
- The position of the contacts is clearly and reliably indicated;
- It is suitable for on-load operation;
- It has manual operation; you can take precautions against inadvertent or unintentional operation;
- It enables bench level maintenance of luminaires.

klik

Hager Ltd.
Hortonwood 50
Telford
Shroshire
TF1 7FT

Customer Services and Sales Hotline	Call our Customer Services Centre for all your national sales enquiries.	**0870 240 2400** sales@hager.co.uk
Customer Services and Sales Faxline		**0870 240 0400**
Technical Helpline	Technical Engineers offer both national and local support.	**0870 607 6677** technical@hager.co.uk
Technical Faxline		**01952 675557**
Hager Online	Visit our website for up to date news on Hager and for general brand information e-mail us.	www.hager.co.uk info@hager.co.uk