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."

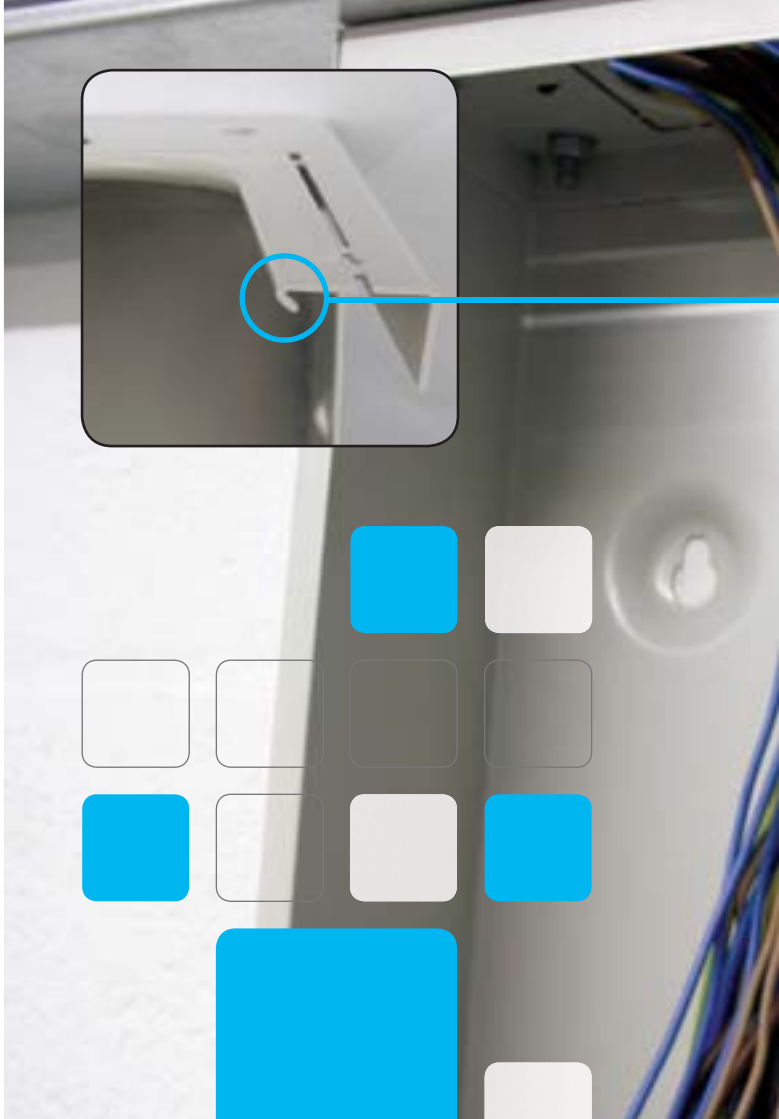
Cable entry

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.

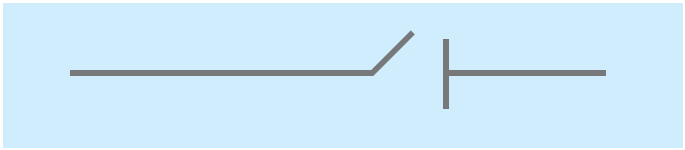
The neutral conductor is also a live conductor. In a TN-S or TN-C-S installation, however, regulation 537.1.2 allows the neutral conductor to not be isolated where it is reliably connected to earth.

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

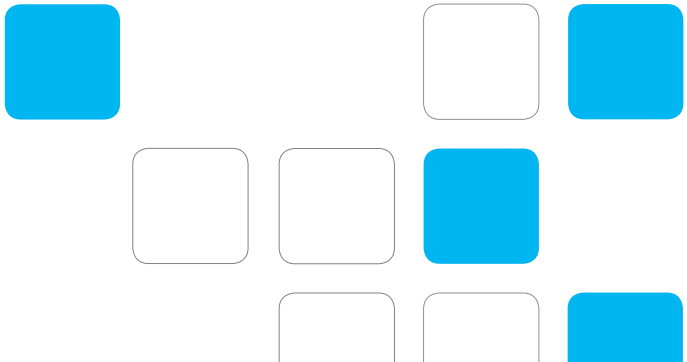
Section 443 of BS 7671 deals with the protection of electrical installations against transient overvoltages. These can be from the supply distribution system or generated by equipment.

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 5859 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.

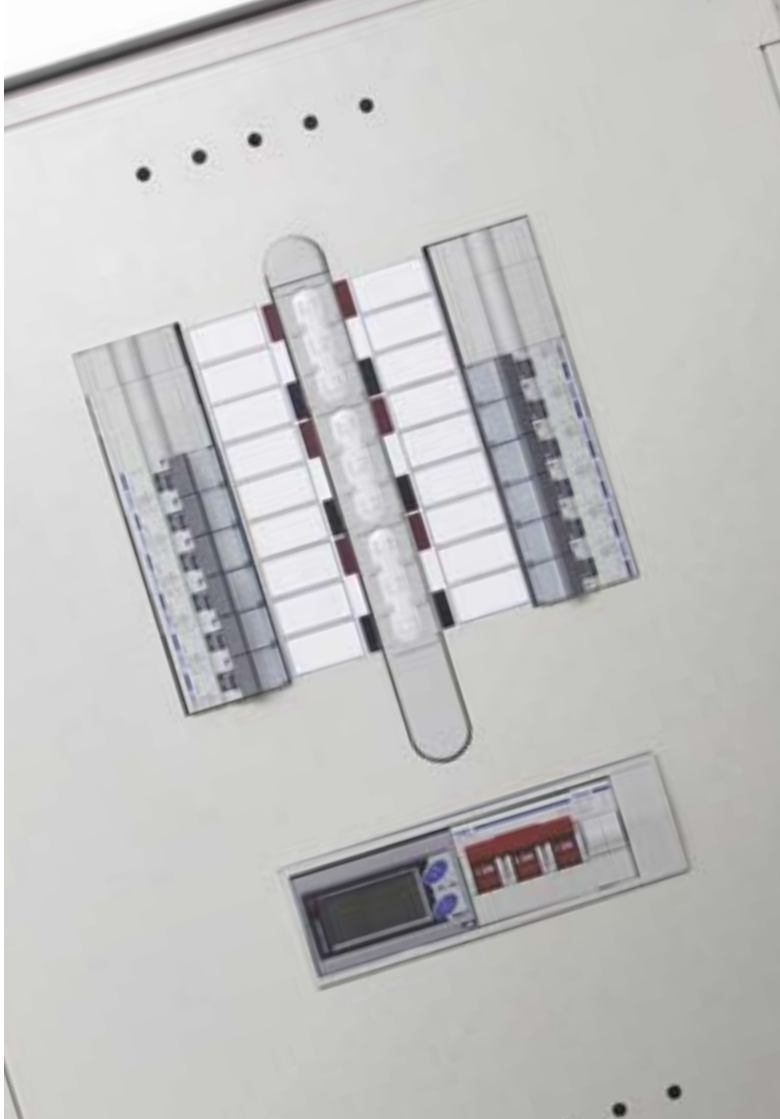
Building regulations

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
- 125A 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	100A Switch
	125A Switch	125A Switch
	63A Contactor AC3	250A MCS
	100A Contactor AC3	250A MCCB
	Direct Connection	160A Contactor AC3
		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