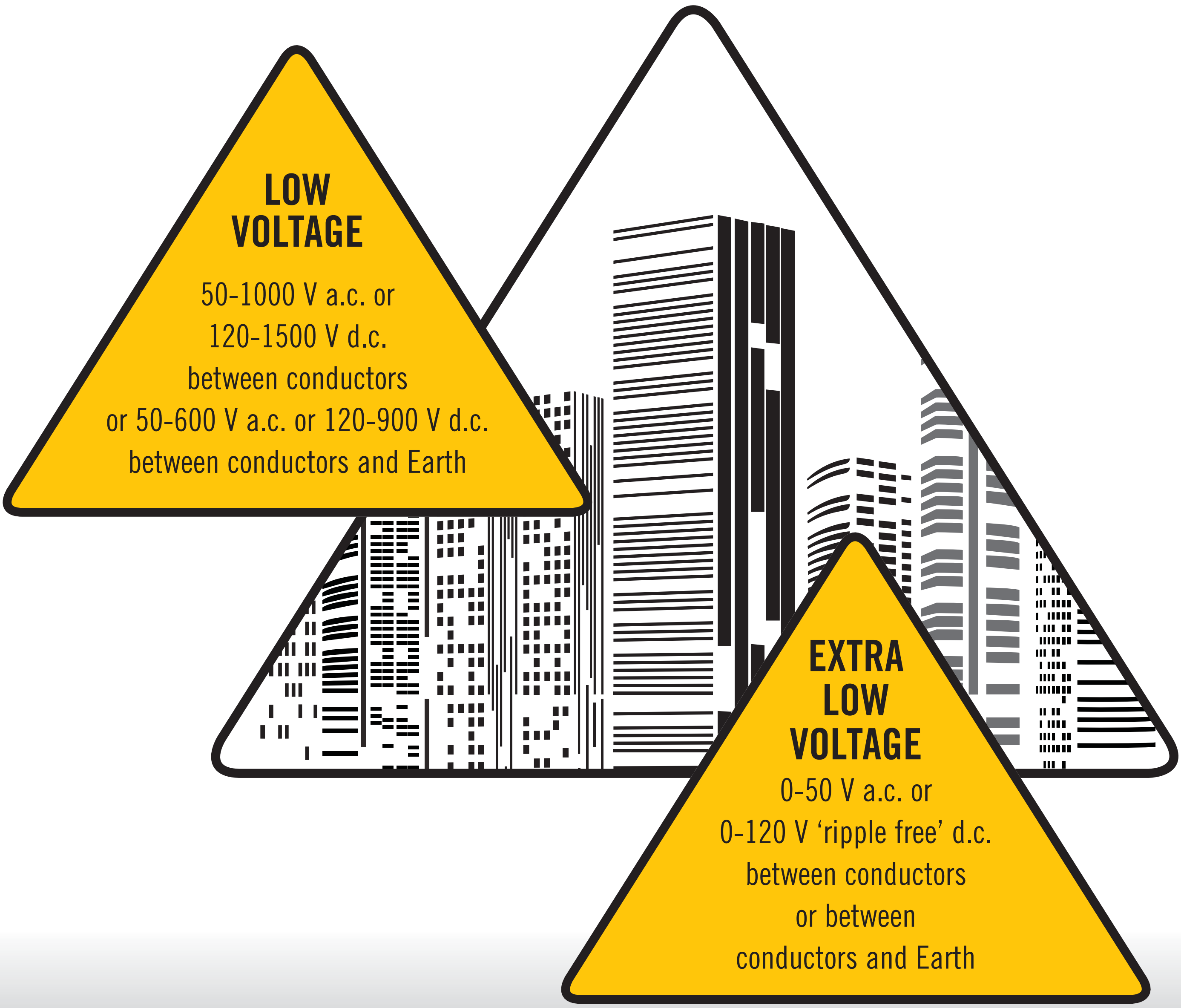
IET Standards

IET Standards Technical Briefing

Practical considerations for d.c. installations



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Publication Information

Published by The Institution of Engineering and Technology, London, United Kingdom

The Institution of Engineering and Technology is registered as a Charity in England & Wales (no. 211014) and Scotland (no. SC038698).

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SECTION 1

1 Introduction

Currently, the public low voltage (LV) supply throughout the EU is predominantly harmonised, via BS EN 50160, at 230 V/400 V 50 Hz a.c. (or 230 V/50 Hz a.c. for three-wire three phase systems earthed at one of the phases). Many EU countries have operated similarly-rated public supplies for more than 50 years. It is therefore no surprise that general electrical installations, accessories and equipment for use within the EU, and their associated harmonised standards, have been developed with these supply characteristics in mind.

Historically, publicly distributed direct current (d.c.) supplies were used in parts of the UK. d.c. systems are once again seen to offer a number of benefits. The reasons for this include the prevalence of extra-low voltage (ELV) d.c. equipment and the increased use of solar photovoltaic (solar PV) and battery systems. The use of d.c. distribution within buildings offers carbon/energy savings, and the integration of building services and information technology networks using a common d.c. system allows for the optimisation of space management and utilisation in buildings. The IET has therefore published a *Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings* (www.theiet.org/dc-cop), which aims to ensure the safe, effective and competent application of cabling/wiring installations for LV and ELV d.c. power distribution in buildings.

This Technical Briefing is intended to support the IET *Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings* and provides advice on the handling of d.c. circuits. The information is of particular relevance and importance in relation to the following sections of the Code of Practice:

- Section 6: Proprietary d.c. power distribution over proprietary cabling;
- Section 7: Proprietary d.c. power distribution over conventional single-phase a.c. power supply cabling;
- Section 8: Proprietary d.c. power distribution over conventional 3-phase a.c. power supply cabling.

This document addresses both the differences in handling of d.c. and a.c. circuits and those issues that are specific to d.c. circuits.

2 LV and ELV d.c. supplies: common considerations

2.1 Sources of supply

Sources of d.c. supplies generally found at present, in both LV and ELV ranges, include:

(a) rectifiers or a.c.-to-d.c. converters, which may be connected to generators or alternators;
(b) PV arrays;
(c) wind turbines;
(d) fuel cells;
(e) primary batteries; and
(f) secondary batteries charged by any of the above means.

As with a.c. supplies, d.c. supplies may be unearthed (IT-type LV supply and SELV for ELV supplies) or earthed (TN system for LV supplies and FELV or PELV for ELV supplies).

A key decision to be made relating to earthed d.c. systems is whether to provide a positive-earth, negative-earth, or mid-point-earth. Important factors to consider include:

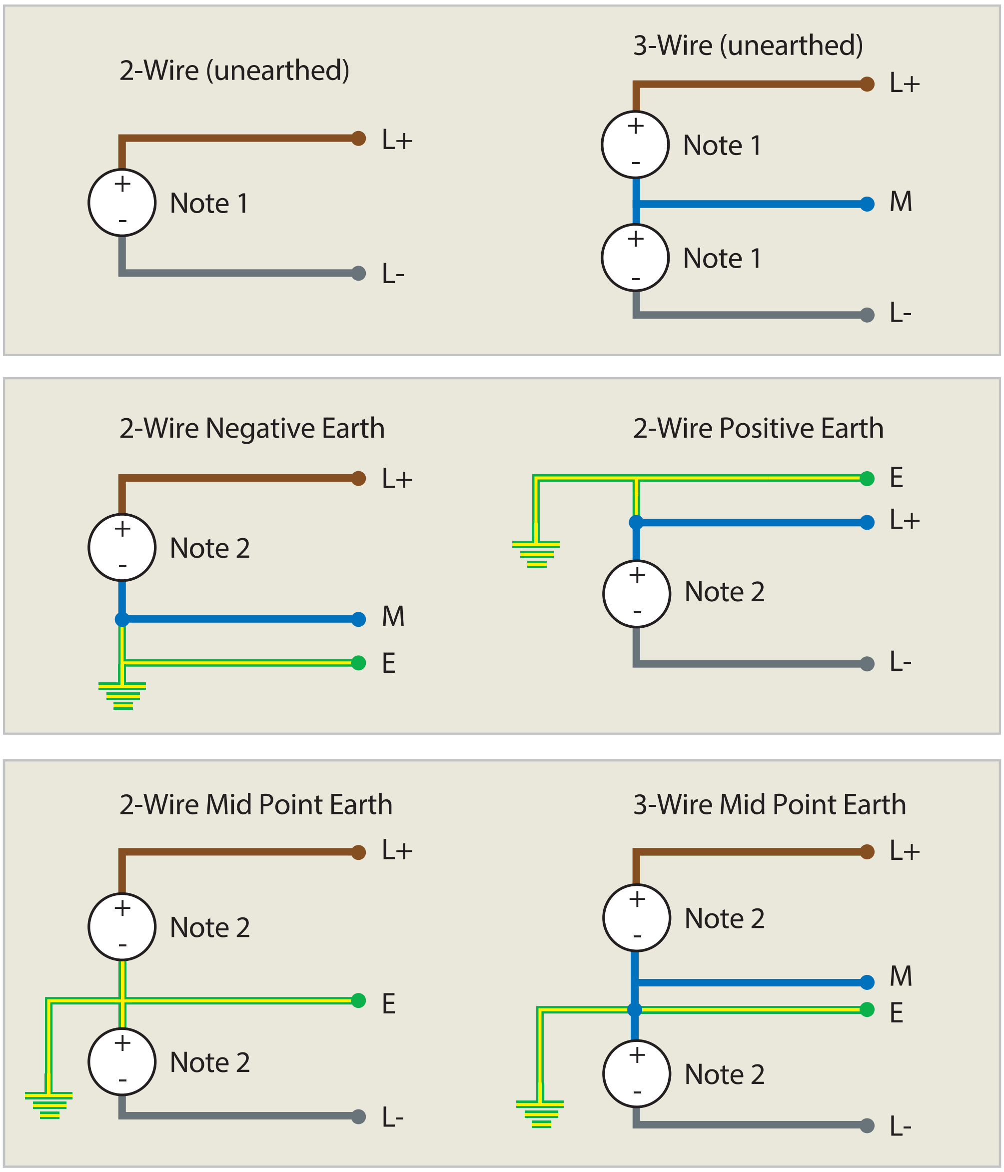
(a) safety during installation, commissioning and maintenance;
(b) standards and conventions in use for the equipment or discipline in question;
(c) selection and operation of devices for isolation, switching and circuit protection; and
(d) the risks associated with galvanic corrosion.

Where earthing is required for a d.c. supply, and that supply may continue to operate during maintenance as an alternative to the normal supply (for example, because it is battery-backed), care must be taken to ensure that the means of earthing continues to be provided, for example, by meeting the requirements of BS 7671 for LV generating sets.

If the d.c. supplies may operate independently of the main a.c. supply, it is important for designers to consider a means of safe isolation of electrical services that is adequately communicated to, and understood by, users, maintainers and emergency services.

Common arrangements of d.c. supply are illustrated in Figure 1.

Figure 1 d.c. supply source types



NOTE 1: *Isolated source, for example, battery, isolated converter (e.g. SELV supply), isolated generator.*

NOTE 2: *Earthed source, for example, earthed battery, earthed generator, non-isolated converter, or earthed isolated converter (e.g. an otherwise SELV-compliant source used to deliver PELV).*

NOTE 3: *Colours and alphanumeric identification of conductors follows BS 7671.*

NOTE 4: *2-wire mid-point earth and 3-wire systems are likely to require protective and isolation devices on both L+ and L−.*

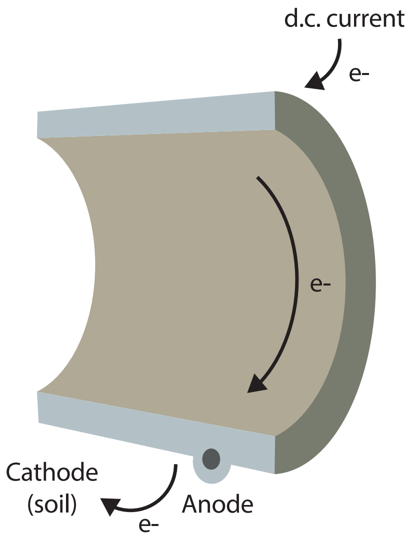
NOTE 5: *The Earth conductor (E) may be a protective and/or a functional earth dependent on the system. The earth is distributed with the remaining circuit conductors but does not carry any circuit current under normal conditions.*

Source: G Kenyon Technology Ltd

2.2 Electrolytic corrosion of metalwork

Electrolytic corrosion of metalwork in contact with the earthing networks of a d.c. system may occur because of the uni-directional current flow. Building steelwork and metallic services require protection from such corrosion if they are not to fail. The corrosion normally occurs where the metal acts as the d.c. anode with the surrounding ground acting as cathode, and the corrosion is therefore normally hidden from view below ground (Figure 2).

Figure 2 Mechanism of electrolytic corrosion in a metal pipe



Source: http://water.me.vccs.edu/courses/env110/Lesson8_print.htm

The risks increase with the magnitude of the d.c. current, and is a key consideration where large d.c. earth currents are anticipated. Isolation from earth (IT system) and earth leakage monitoring are possible solutions to this problem, as is earthing the 'mid-point' of the d.c. source.

The effects of corrosion from d.c. currents used in electric transit systems are well documented; however, because d.c. supplies are not in widespread use in buildings, protection against it may not have been considered in the structural metalwork and metallic services during the construction of existing buildings.

2.3 Switchgear and protective device operation

When a circuit-breaker, switch, fuse, or other protective device operates on d.c. systems, or a plug is withdrawn from a socket-outlet 'on load', an arc is drawn for a longer period than on a.c. systems. This is because when an a.c. current waveform drops to zero, it helps extinguish the arc more readily.

Manufacturers of switchgear intended for use with d.c. systems must therefore ensure that fast clearance is achieved during the operation of the device. Fuses of a suitable breaking capacity often have suitable electrical characteristics for circuit protection in d.c. systems. However, fuses are not always suitable for replacement by unskilled persons and may not be an ideal choice in all installations, for example, fixed installations in dwellings.

When designing electrical installations for d.c. systems, consideration should be given not only to the selection of products used to initially erect and commission the system, but also to ensuring that suitable devices are used during maintenance or repair. This is especially important where a particular manufacturer's specification enables a product to be used with a d.c. system, but the product standard(s) to which it is made specify 'a.c. only' operation. Under these circumstances, adequate information should be provided in the operation and maintenance documentation for the installation.

Table 1 provides a commentary on common standards for equipment/accessories used in UK electrical installations and their suitability for use with d.c. systems.

When considering the re-use of older devices for conversion of a circuit from a.c. service to d.c. service, the specification, age, and information about the standards to which the older devices were manufactured and tested/certified should be taken into account. Their replacement with suitable devices to more recent standards is likely to be necessary. Mixing of devices within a system should be avoided; installation of devices other than those declared by the system manufacturer may invalidate any testing/certification and warranty. Further information on safe selection of devices can be found in the 'BEAMA Technical Bulletin – *Safe Selection of Devices for Installation in Assemblies.*'

Table 1: Suitability of common standards for wiring system components with d.c. systems

Standard	Title	Issues for d.c. systems
BS 1363-series	13 A plugs, socket-outlets, connection units, adaptors and conversion plugs. (5 parts).	The standard specifically states products that are suitable for a.c., at voltages not exceeding 250 V r.m.s, and no d.c. ratings (or tests within the standard) are prescribed. *BS 1363 plugs, sockets and accessories should not be used on d.c. systems.*
BS 5733	General requirements for electrical accessories. Specification.	This standard covers general accessories that are intended for a nominal voltage up to 250 V a.c. single-phase (50 Hz or 60 Hz), or 250 V d.c. The manufacturer of the equipment may determine the rated voltage, which should be marked on the accessory. *Accessories that are only marked for a.c. ratings, and not marked with any d.c. ratings, should NOT be used on d.c. systems.*
BS EN 60669-1	Switches for household and simlar fixed-electrical installations. General requirements.	The standard covers a.c. switches only (rated voltage not exceeding 440 V). *Such devices should NOT be used on d.c. systems – in such cases, appropriate alternatives sourced.*
BS 1362	General-purpose fuse links for domestic and similar purposes (primarily for use in plugs)	This fuse link type is often found in connection units to BS 1363-4, as well as in UK standard plugs. *The standard states that these fuses are rated for a.c. use only, and should therefore NOT be used on d.c. systems.*
BS 3036	Semi-enclosed electric fuses (ratings up to 100 amperes and 240 volts to earth)	*These re-wireable semi-enclosed fuses are suitable for a.c. operation only and should NOT be used on d.c. systems.*
BS 88-series (BS EN 60269-series and BS HD 60269-2)	Low-voltage fuses	*This series of standards cover fuse-links from 2 A upwards typically having 415/550 V a.c. or 660 V a.c. ratings and 250/400 V d.c. or 460 V d.c. ratings. Fuses having d.c. ratings are suitable for use in d.c. systems.*
BS EN 60898-1 **BS EN 60898-2**	Electrical accessories – circuit-breakers for overcurrent protection for household and similar installations. Part 1: Circuit-breakers for a.c. operation Part 2: Circuit-breakers for a.c. and d.c. operation	*Circuit-breakers to BS EN 60898-1 are only suitable for a.c. operation and must NOT be used on d.c. systems.* *Circuit-breakers to BS EN 60898-2 are suitable for a.c. and d.c. operation, but the d.c. rated voltage is slightly less than the a.c. rated voltage as described in the standard.*

Standard	Title	Issues for d.c. systems
BS EN 61439-series	Low-voltage switchgear and controlgear assemblies.	The manufacturer is permitted to define the rated voltage of the switchgear/controlgear assembly, and the manufacturer's literature should therefore be checked to ensure that the equipment is suitable for d.c. use. Particular consideration must be given to the protective devices to be used within the assembly, which will comply with other standards and may not be suitable for d.c. use. *Note that assemblies to BS EN 61439-3 (covering consumer units and distribution boards for use by ordinary persons) are generally suitable for a.c. use only, and may therefore NOT be suitable for use on d.c. systems. Similar considerations apply to older consumer units to BS EN 60439-3.*
BS EN 61008-series	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs). Part 1: General rules Part 2-1: Applicability of the general rules to RCCBs functionally independent of line voltage	The devices specified by this standard are intended to be operated from 50 Hz a.c. supplies. *Residual current devices to BS EN 61008 are generally NOT suitable for use on d.c. systems, unless the manufacturer clearly states otherwise.*
BS EN 61009-series	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs). Part 1: General Rules Part 2-1: Applicability of the general rules to RCBOs functionally independent of line voltage	The devices specified by this standard are intended to be operated from 50 or 60 Hz a.c. supplies. *Residual current devices to BS EN 61008 are generally NOT suitable for use on d.c. systems, unless the manufacturer clearly states otherwise.*
BS EN 62423	Type F and type B residual current operated circuit-breakers with and without integral overcurrent protection for household and similar uses	This standard builds on the requirements of the BS EN 61008 series and BS EN 61009 series for residual current-operated circuit-breakers for use on sinusoidal supplies where the fault currents are not necessarily alternating currents. *This does NOT mean that compliance with BS EN 62423 implies suitability for use on d.c. systems.*

2.4 Electromagnetic compatibility (EMC)

The need to comply with manufacturers' installation instructions and good EMC practice is equally important with d.c., as recommended in Section 444 of BS 7671. Switching interference from d.c. supplies may well be more problematic than a.c. for similar loads due to d.c. contact arcing, particularly as the contacts open.

BS EN 50310 and BS IEC 61000-5-2 should be consulted together with the BS EN 50174 series to determine appropriate earthing and bonding guidance for installations and to support the equipment and systems that are to be served.

As with a.c. supplies, and as recommended by BS EN 50310, the use of IT and TT supply types are less preferred for systems of interconnected equipment, unless equipment contains local converters with galvanic isolation to enable equipment to be earthed independently of the supply earthing arrangements. This is primarily because the design of equipment and wiring systems often rely on the protective earth connection for the discharge of any interconnecting cable screen currents and the proper functioning of supply-side EMC filters, both of which could be impacted by either the absence of a connection to earth or a high impedance connection.

2.5 Current waveform and current-carrying capacity of cables

Where current waveform is not pure d.c., any unfiltered ripple will flow through the conductors in a cross-sectional area limited by the skin depth. The Skin Effect may increase resistive conductor heating, and the cable resistance correspondingly increased. It may be necessary to take this into account when determining the current-carrying capacity of conductors that are to be used for the particular application.

2.6 Stored energy

Stored energy in capacitors, or stray capacitances in wiring, can be prevalent on a.c. systems, but because the a.c. voltage is variable over time the voltage of the stored energy depends on the voltage at the time that the power is disconnected. With d.c. systems, the voltage is constant and the stored energy will therefore be at the supply voltage.

Within a.c./d.c. converters and d.c./d.c. converters, voltages found on capacitors, even after the removal of supply power, may well be higher than the input or output voltages, and the energy stored in power supply/converter capacitors, as well as battery systems, may be considerable. Clear guidance on how the stored energy should be discharged, if required for maintenance or disposal, should be made available by the manufacturer.

2.7 Identification of conductors and wiring systems

The identification of conductors of cables by colours and alphanumeric marking is specified for UK installations in Table 51 of BS 7671, and aligns with the harmonized standard BS EN 60445. For LV d.c. systems, the requirements of these standards are very specific in terms of the basic lettering and/or colour-coding that is to be applied, unless the conductor is:

(a) a conductor in a concentric cable (for example, coaxial cable);
(b) a bare conductor where permanent identification is not practicable;
(c) a protective conductor that is formed from the metal sheath, or armour, of a cable, or an extraneous- or exposed-conductive-part.

Where it is necessary within an installation to avoid confusion, it is recommended to separately identify d.c. conductors from a.c. conductors by the use of additional alphanumeric over marking on the conductors. Cables or containment can likewise be over-marked or labelled, clearly stating 'd.c.' on the marking for d.c. cables. It is recommended that wiring systems consisting of singles in containment do not mix a.c. and d.c. LV cables in the same containment.

Identification of conductors for ELV, control and other applications is less stringently specified in the standards; however, BS 7671 (supported by BS EN 60445) reserves the colour-combination green and yellow for protective conductors, the colour blue for a neutral or earthed mid-wire, and prohibits the use of the colour green. Local conventions used for ELV distribution should be consistent and documented. Over-marking or labelling of cables or containment is also recommended.

When documenting colour code conventions for wiring colours in operation and maintenance documentation or drawings, the harmonised standard BS 7645 (IEC 757), implementing CENELEC HD 457 S1, should be followed, as outlined in Table 2.

▼ **Table 2:** BS 7645 colour code abbreviations for conductor identification colours in documentation and drawings

Code	Colour
BK	Black
BN	Brown
BU	Blue *(NOTE 1)*
GN	Green *(NOTE 2)*
GNYE	Green & yellow *(NOTES 3 and 4)*
GY	Grey
OG	Orange
PK	Pink
RD	Red
TQ	Turquoise (or cyan)
VT	Violet
WH	White
YE	Yellow

NOTE 1: *Reserved by BS 7671 for a neutral or earthed mid-wire conductor*
NOTE 2: *Prohibited by BS 7671 as identification for a conductor*
NOTE 3: *Reserved by BS 7671 for protective conductors*
NOTE 4: *Bi-coloured cable should be documented as AABB, where AA is the predominant colour, and BB is the secondary colour, e.g. GNYE for green and yellow, OGWH for orange with white trace, etc.*
NOTE 5: *Colour codes for gold (GD) and silver (SR) are listed in BS 7645; however, they are not specified for conductor identification in either BS 7671 or BS EN 60445.*

2.8 Competence

The statutory requirements of the Electricity at Work Regulations 1989 apply equally to d.c. systems as to a.c. systems, including the duty of Regulation 16 for persons to be competent to prevent danger and injury. Regulation 134.1.1 of BS 7671 requires:

> *'Good workmanship by skilled or instructed persons and proper materials shall be used in the erection of the electrical installation. The installation of electrical equipment shall take account of manufacturers' instructions.'*

Experience of electrotechnical professionals with d.c. systems may, in recent years, have been limited to specialist areas rather than general application of d.c. systems within installations.

Designers of d.c. installations will have to take care when carrying out their calculations for d.c. instead of the traditional a.c., and electricians will need to be skilled in d.c. installations.

3 Issues specific to LV d.c. supplies

3.1 Electrical safety

The question of safety is obviously of prime importance when considering the introduction of d.c. electrical installations. The old argument from the days of Edison and Tesla about which is more dangerous, a.c. or d.c., still persists.

When a certain level of electric current is applied to the heart, the heart will fibrillate instead of its normal pumping action. This occurrence, termed 'ventricular fibrillation', causes cessation of effective blood circulation and will result in death within a matter of minutes.

For both a.c. and d.c., the threshold of ventricular fibrillation for any given individual depends on physiological factors (such as the condition of the heart and the anatomy of the body) and on electrical parameters (including the duration and magnitude of current flow).

The threshold of perception, independent of time, is often assumed to be 0.5 mA for a.c. and 2 mA for d.c. A widely accepted figure for the threshold of 'let-go' for a.c. is 10 mA but there is no figure available for d.c.

Suffice it to say that a.c. and d.c. are both dangerous as the voltage increases above low values of ELV.

More information on electrical shock is contained in the following documents available from BSI: DD IEC/TS 60479-1, PD 6519-2 and PD 6519-3.

3.2 Selection of socket-outlets and inadvertent connection of a.c. equipment

Inadvertently connecting a.c. equipment to d.c. supplies for which they are not rated may result in irreversible equipment damage, and possibly overheating, causing fire/explosion. It is therefore necessary to distinguish between a.c. and d.c. outlets in an installation.

In the UK, the Plugs and Sockets (Safety) Regulations apply to plugs, socket-outlets and electrical equipment, rated 200 V or more, at a current of 13 A or less, and ordinarily intended for domestic or similar use. Consequently, the standards required by this legislation restrict the use of general-purpose socket-outlet circuits for currents of 13 A or less operating at LV d.c. in relevant parts of electrical installations.

3.3 Availability of switchgear and protective devices

Availability of d.c.-rated switchgear and protective devices requires consideration, particularly because a.c. devices may not be suitable as indicated in Table 1.

Although suitable fuses (such as BS 88 types) are excellent protective devices, they may not be the preferred choice for all installations, as some technical knowledge may be required to ensure that they are replaced with a device of the correct type. As more electrical installations in dwellings are using modern consumer units with circuit-breakers, the ability of the general public to replace fuses may be diminishing.

4 Issues specific to ELV d.c. supplies

4.1 Voltage drop

With both a.c. and d.c. ELV supplies, voltage drop requires careful consideration to avoid excessive losses in wiring and to prevent the voltage at the point of use being too low.

For installations meeting particular product-related or system-related standards, any voltage drop requirements of the respective standard should be considered.

For general ELV supplies, the voltage-drop requirements in BS 7671 should be used. With higher current loads and distribution circuits there is a trade-off between the cost of larger CSA cables and the losses associated with voltage drop and this will provide constraints for higher current distribution circuits.

4.2 Device charging systems

The principal risks associated with ELV systems for charging devices come from overheating, which causes fires and explosion. There is currently a general lack of standardisation in ELV d.c. power plugs, including polarity.

Many device manufacturers have now adopted the Universal Serial Bus (USB) standard, for charging. Whilst this is supposed to ensure that new chargers are not required for a new device, it is currently the case that certain products require a specific rating or specification for safely charging their batteries, which may not be fully cross-compatible with other manufacturers' charging devices, even though the connectors are the same.

There is perhaps an increasing worry in the industry of mobile device fires that appear to have been caused by the use of incompatible or unsafe chargers with equipment.

4.3 High current ELV supplies

▼ **Figure 3** Example battery ELV supply

Source: Emech Entertainment Engineering Ltd

ELV supplies that provide currents in excess of 5 A, or short-circuit currents exceeding 10 A, may present a particular safety problem. Because of the reduced electric shock risk, there may be more of a temptation to work with SELV and PELV voltages 'live'. However, this does not consider the principal electrical safety hazard of high-current ELV supplies: that of heating of conductors and arcing/sparking, leading to fire.

The following are to be strongly recommended:

(a) avoid working 'live' on energised high-current ELV systems;
(b) use insulated tools and adequately-fused test equipment and test leads;
(c) remove metallic rings and other jewellery (which could otherwise become very hot if they inadvertently become a short-circuit in the system);
(d) consider the use of PPE, such as flame-retardant coveralls and associated eye or face protection, where there may be increased risk of arcing and/or fire; and
(e) consider risks of working with energised ELV systems when working at height as the risks are increased due to the potential for falls and falling objects.

4.4 Fault protection, switchgear and protective devices

Fault protection in order to prevent fire requires particular consideration.

The model of 'fault of negligible impedance' used with LV systems does not always apply, often resulting in local heating at the point of fault. Purely electronic supplies may incorporate various forms of electronic overcurrent and/or overvoltage protection;

however, these should be used in conjunction with suitably selected overcurrent protective devices, such as fuses or circuit-breakers, in case electronic protection fails.

It should be noted that overcurrent protective devices may have a minimum operating voltage in addition to a maximum operating voltage, which, if the source impedance is not insignificant in relation to the loop impedance, may result in the circuit protective device having to operate outside its intended voltage range. This, in turn, may have indeterminate results.

Circuit-breakers (even if rated for d.c.) may 'weld closed' and fail to operate. This may occur if the source impedance is not insignificant in relation to the loop impedance.

HRC/HBC fuses provide a good option for circuit protection for d.c. systems, however, it should be noted that 'blown' fuses must be replaced by one of the correct type and rating. Standards prevalent for fuses for ELV use (for example, BS EN 60127-series) do not by design prevent lower current-breaking capacity fuses being used as a replacement since their dimensions may be the same (Figure 4). The following should therefore be considered by designers electing to specify HBC fuses:

(a) such protective devices are not always suitable for replacement by unskilled persons; and
(b) adequate information should be readily available to inform competent persons to ensure the correct replacement devices are used.

Figure 4 20 mm fuses to BS EN 60127-2

HBC Fuses to BS EN 60127-2. A 5 A fuse has:
Voltage Range: 400 V d.c. / 500 V a.c.
Interrupt Current: 1500 A at 250 V a.c. / 400 V d.c.

Standard Fuses to BS EN 60127-2. A 5 A fuse has:
Voltage Range: 250 V a.c.
Interrupt Current: 50 A at 250 V a.c.

The fuses illustrated are dimensionally the same, 20 mm (L) × 5 mm (dia), and therefore the fuses rated for a lower breaking capacity (right) could be inadvertently fitted as a replacement by someone who was not aware of the requirement for the higher-breaking capacity product (left) for safe operation.

LV switchgear, controlgear and protective devices, even if rated for d.c. operation, may not be suitable for ELV d.c. supplies. Appropriate switchgear is available, as used in the control, automation and automotive industries. Manufacturers' data should be consulted to ensure appropriate selections are made.

Installation of equipment shall take account of manufacturers' instructions.

4.5 Selection of wiring systems

Suitable mechanical protection, such as the use of steel-wire-armoured cable or enclosed metallic containment, helps prevent cable damage and is therefore recommended for even moderate current ELV supplies, particularly where the prospective fault current may be high, for example, close to secondary batteries.

5 d.c. battery supplies

5.1 Safe working practices

Manufacturers' guidance should always be consulted when designing facilities for batteries. Particular consideration needs to be given on how the batteries are to be transported, stored and disposed of safely.

Disposal and recycling of batteries should comply with the Waste Batteries and Accumulators Regulations 2009.

Particular thought should be given to the weight of batteries when considering maintenance and decommissioning operations.

5.2 Design of battery systems and facilities

For fixed battery installations, otherwise known as 'stationary batteries', BS EN 50272-1 and BS EN 50272-2 should be consulted together with BS 7671.

Designers should refer to manufacturers' information for ventilation, charging and maintenance requirements, and information on how to manage potential spillages should any chemical contents of the battery become exposed.

Charging and maintenance arrangements do vary, even between slightly different designs and arrangements of batteries of the same basic type. Certain battery types, such as lithium-ion, can explode if incorrectly charged.

Some manufacturers require regular calibration cycles, which should be considered as part of the maintenance regime.

Good ventilation is required for certain types of batteries (including automotive lead-acid and valve-regulated lead-acid types), which may evolve hydrogen gas under certain conditions. Hydrogen is an explosion risk. For ventilation in domestic premises, the requirements of the appropriate national Building Regulations need to be complied with.

6 Conclusion

To realise d.c. installations effectively and safely in line with the IET *Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings*, it is necessary to ensure that products and installations are correctly specified and that the correct competences are in place to design, erect, and maintain them.

Some further work is required in order to develop product and installation standards relevant to the needs of this industry and, until this occurs, those specifying installations and new or replacement equipment for use in d.c. systems are relied upon to ensure they are appropriate for the use to which they are to be put.

As d.c. systems become more prevalent, availability of equipment, accessories, and the respective standards will increase.

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IET Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings, 2015.

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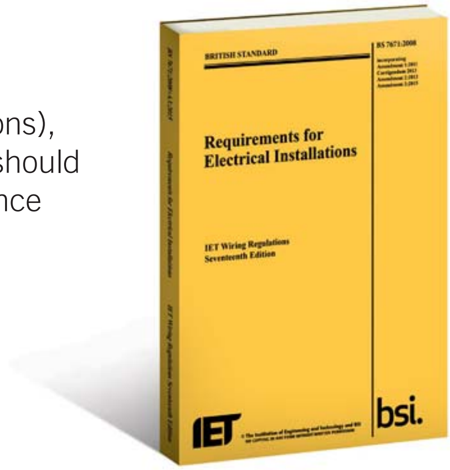

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IET Standards **Technical Briefing**

Practical considerations for d.c. installations

This Technical Briefing is intended to support the IET *Code of Practice for Low and Extra Low Voltage Direct Current Power Distribution in Buildings* and provides advice on the handling of d.c. circuits. The information is of particular relevance and importance in relation to the following sections of the Code of Practice:

- **Section 6:** Proprietary d.c. power distribution over proprietary cabling;
- **Section 7:** Proprietary d.c. power distribution over conventional single-phase a.c. power supply cabling;
- **Section 8:** Proprietary d.c. power distribution over conventional 3-phase a.c. power supply cabling.

This document addresses both the differences in handling of d.c. and a.c. circuits and those issues that are specific to d.c. circuits. It will be of interest to anyone considering, specifying, installing or operating d.c. power distribution in buildings.

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