The IEE

WIRING MATTERS

Autumn 2006 Issue 20

TEMPORARY POWER DISTRIBUTION

Induced voltages

Small Generators on Construction Sites

Site Safety Toolbox Talk

PART L of the Building Regulations

SMALL GENERATORS
ON CONSTRUCTION SITES By John Ware

EACH YEAR, people are killed or seriously injured by electricity in the construction industry. Most of these accidents could be avoided. Construction sites present one of the most difficult environments for the safe use of electricity because:

- work is often performed outdoors in all weathers meaning electrical equipment may be subject to damp or wet conditions
- sites change as work progresses meaning electrical equipment can suffer damage
- a mains electricity supply may not be available. There is always a risk of improvisation
- cables can suffer damage due to equipment movement
- there may be a reluctance to provide proper earthing.

Effective management is essential to avoid injury

A small generator is considered to be one that has an output from 0.3 to 10 kVA and such a machine is generally single-phase, portable or transportable and provides an output at 230 V and/or 120 V. Winding connections are normally brought out to a three-pin socket-outlet which should conform to BS EN 60309-2 in which the third or protective conductor socket tube is connected to the generator enclosure. In some cases the protective conductor socket tube will also be connected to one pole of the generator winding. A voltage-selector switch may be fitted to enable 230 V or 120 V outputs to be obtained from appropriate BS EN 60309-2 socket-outlets.

A small single-phase generator is often run as a floating system. A means of earthing is not required. In such a system the generator is deliberately not connected to external metallic parts nor is one pole of the single-phase electrical system connected to earth. In such a system there is no path for an earth fault current to return to the 'separated' winding of the generator. Safety must be ensured by meeting the following conditions:

(a) The generator should be used only on a short term basis (for a maximum of a few days, but ideally, less than one day).

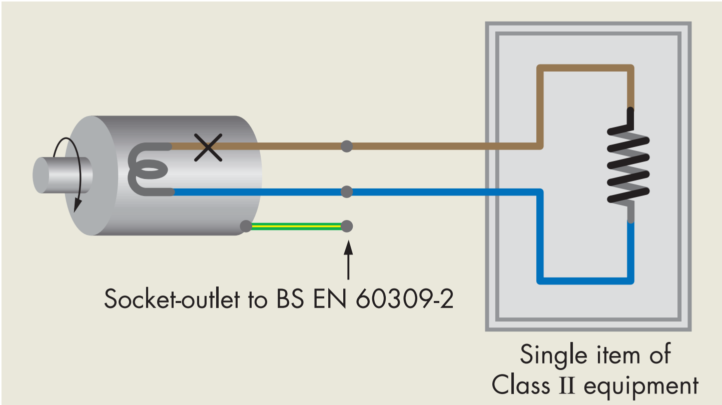
(b) The generator should preferably supply only one item of Class II equipment (See figure 1). Hand-held 110 V (industrial use) or 230 V (domestic use) portable equipment should be Class II construction.

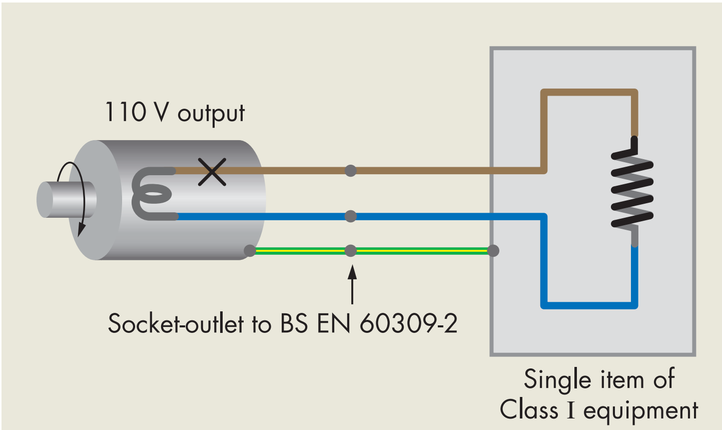
(c) Only cables which are suitable for their environmental exposure should be used to connect the generator to its load. The use of PVC-insulated and sheathed cables with flexible braided wire armour and a PVC oversheath is recommended.

(d) All cables and plugs should be frequently inspected. Users should be alert to risks which arise from damaged cables. The cable, plugs and socket-outlets should be inspected frequently and should be replaced if defective, not repaired. Equipment and cables which are in good condition are vital for the continuous safety of an unearthed system and form the first line of protection against electric shock.

(e) Load cables supplied from unearthed single-phase generator windings should be kept as short as practicable. Load cables should supply compactly located loads which are not widely dispersed. With extensive unearthed or 'floating' systems there is a higher probability of the development of undetected earth faults caused by damaged cables.

Where, on a construction site, it is required to supply a single item of Class I equipment or more than one item of Class II equipment from a small generator, the following additional recommendations should be met:





Top, Fig 1: The generator should supply only one item of Class II equipment

Above, Fig 2: A small generator supplying a single item of Class I equipment

(f) The supply should be 110 V.

(g) The generator should be rated up to about 5 kVA

(h) The equipment and the metal armour or braid of interconnecting cables should be bonded with the frame of the generator (Figure 2). ■

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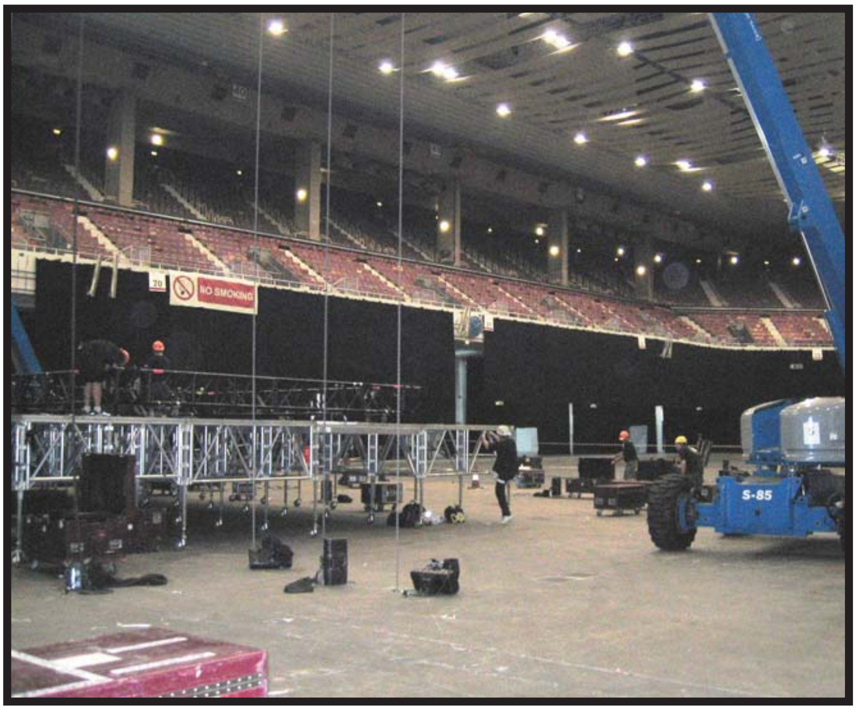

TEMPORARY POWER DISTRIBUTION SYSTEMS AND ELECTRICAL SUPPLIES FOR ENTERTAINMENT RELATED PURPOSES

By Mark Coles

The IET's technical helpline is frequently asked questions relating to the requirements for temporary electrical supplies and power distribution systems to many differing types of installation. This article looks at temporary electrical installations for use within the entertainment industry, the responsibilities associated with the installation in addition to the technical requirements that should be met.

Events

Temporary electrical supplies are required for many different types of events. For example, television and film sets, theatre productions and concerts, both indoor and outdoor, have power requirements ranging from a few kilowatts to many megawatts. Due to the nature of the work, tight schedules, inclement weather, ever-changing plans, etc., the installation will need to be quickly assembled and quickly disassembled, particularly with a touring production.

Overview

When a performance takes place in a small venue, an example of this could be a band in local pub, the electrical equipment will be supplied from local, strategically-positioned, socket-outlets. It is quite likely that extension leads will be used to provide more socket-outlets in places where required.

The method of electrical distribution in a large concert venue follows the same principle; socket-outlets will be provided to cover certain areas, distribution units and extension leads will then be used to distribute power to the point of utilisation.

In effect, beyond the fixed electrical installation, the temporary element is purely a kit-of-parts assembled to suit the situation or event.

The Law

The law requires that electrical installations are maintained and kept in a safe condition. The fact that an electrical installation is of a temporary nature does not permit a lower standard of installation work; the standards of installation and maintenance need to be higher as the operating conditions are more onerous.

The Electricity at Work Regulations 1989, places duties on employers, designers and installers to insure all systems are safe.

Competency

It must be noted that temporary electrical installations, particularly in the entertainment industry, may appear simple but, in reality, can be extremely complex and sophisticated. Certain types of connectors, cables and equipment are designed and manufactured purely for use within the entertainment industry and will not be used on any other type of installation. It is therefore a requirement that all persons working on the installation are competent for the work they undertake and, where required, will be adequately supervised.

Enforcement

Most places of entertainment will need a licence from the local authority. The law does not say what must be contained in the licence; there will usually be requirements for fire precautions and the licence can include conditions relating to electrical safety.

Commonly a venue will request, from incoming contractors, documentation which demonstrates that the electrical distribution equipment and appliances, they plan to install, have been recently tested and inspected for electrical safety.

The requirements of BS 7671

There is no section of BS 7671 that specifically applies to temporary electrical installations for use within the entertainment industry, however, BS 7671 applies generally to exhibitions, fairs and other installations in temporary buildings, as stated in Regulation 110-01-01 (viii).

The IEE publication Guidance Note 7 – *Special Locations*, includes guidance based on IEC Publication 60364-7-711 and the draft CENELEC proposals prHD 384.4.7.711 S1:2002.

The particular risks associated with temporary installations are those of electric shock and fire. These arise from:

- the temporary nature of the installation
- lack of permanent structures
- severe mechanical stresses
- access to the general public

Particular attention should be paid to:

- suitability of the equipment for the environment
- earthing and bonding requirements
- connection to the supply
- use of accessories of the appropriate Degree of Protection (IP code) to suit the particular external influences

Establishing responsibility

When a temporary electrical supply or temporary power distribution system is required, a person, or persons, should be appointed to undertake the responsibility for the design, provision, assembly, co-ordination and control of the installation. This is necessary to ensure that all works are co-ordinated through a single point, particularly on larger sites or installations.

The designer should establish a detailed outline of the temporary installation to meet the client's requirements as a base for their design. Discussions should also take place between the user and the person responsible for the installation. The following points should be addressed:

- System design
- Installation work
- Testing and certification
- Operation
- Safe removal of equipment

Electrical supplies

Due to the practical difficulties of bonding all accessible extraneous-conductive-parts, a TN-C-S (PME) system is not appropriate for temporary outdoor installations. A TN-S system would be acceptable if such a supply was available from the distributor, if not, a TT system should be adopted.

Generators

Installations incorporating generator sets should comply with Section 551 of BS 7671. Where a generator is used to supply the temporary installation using a TN or TT system, it must be ensured that the installation is earthed, preferably by separate earth electrodes. For TN systems all exposed-conductive-parts such as stage structures or lighting grids should be earthed back to the generator. The neutral conductor and/or star point of the generator should be connected to the exposed-conductive-parts of the generator and reference earthed.

Regulation 21 from Part VI of the Electricity Safety, Quality and Continuity Regulations 2002 (ESQCR), has requirements for switched alternative sources of energy (see figure 1) as follows:

Where a person operates a source of energy as a switched alternative to a distributor's network, he shall ensure that that source of energy cannot operate in parallel with that network and where the source of energy is part of a low voltage consumer's installation, that installation shall comply with British Standard Requirements.

The requirements for parallel operation are much more onerous. Often generators may be synchronized and connected together to provide either load sharing (to prevent the loss

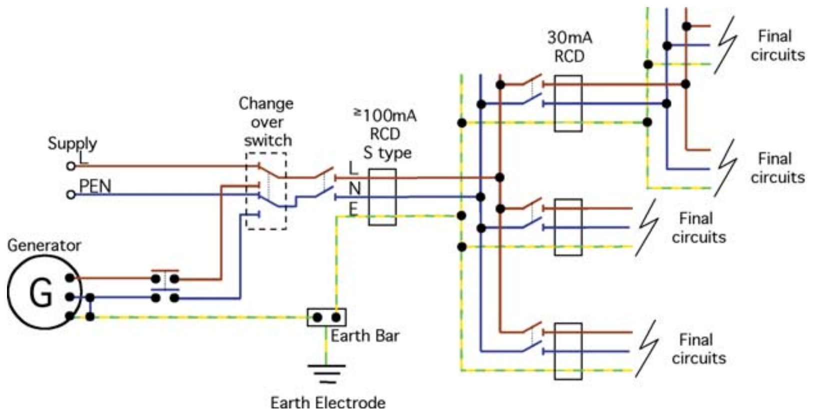

Fig 1: **Exhibition/show distribution with standby generator**

Installation	Final circuit	Multi-circuit	Intake
Theatre	BS 546	TCMCC, QTBMC	BS EN 60309-2
Television	BS EN 60309-2	TCMCC, QTBMC	BS EN 60309-2
Film	BS EN 60309-2	TCMCC, QTBMC	BS EN 60309-2
Pop music	BS 54 BS EN 60309-2	TCMCC, QTBMC	Single pole connectors BS EN 60309-2
Technical and domestic services	BS 1363BS EN 60309-2	Not applicable	Not applicable

Key: TCMCC: threaded cylindrical multi-pin coupling connector; QTBMC: quarter turn bayonet multi-pin connector

Fig 2: **Table showing the preferred power distribution connectors**

of power halting a show) or to provide more power. In such situations, only equipment designed for such purposes shall be used, further, cabling connecting two generating sets should be sized to take the maximum load expected if one set were to fail.

For further information, consult BS 7430, ***Code of practice on earthing***.

Earth fault loop impedance

On temporary distribution installations, special consideration should be made to earth fault loop impedance on final circuits. The use of extension leads in series can cause the earth fault loop impedance to become unexpectedly high resulting in a rise in disconnection time to a value outside the protection limits. The use of residual current devices rated at 30 mA is recommended.

The IEE publication *Code of Practice for In-service Inspection and Testing of Electrical Equipment* recommends that the length of an extension lead should be checked to ensure that the performance of the equipment is not affected by voltage drop.

Residual Current Devices

The functional operation of RCDs should be verified by using the test button when setting up the temporary installation and thereafter at regular intervals, e.g. before each performance or use of the system.

It is good design practice to ensure that lighting does not share the same distribution circuit as the audio equipment which also requires reliable RCD protection. This also helps to prevent mains-borne interference from affecting the audio system. RCDs protecting audio equipment should not be bypassed or disabled.

If a performer or other person is required to handle any piece of energized portable mains-powered class I electrical equipment, it should be protected by an RCD rated at 30 mA or less.

Testing, inspection & certification

The fixed installation

In compliance with Chapter 73 of BS 7671, Periodic Inspection and Testing, the fixed installation will be tested and inspected at regular intervals to determine whether the installation is in a satisfactory condition for continued service.

A periodic inspection report will be made available by the venue to contractors who may be working on behalf of the production.

Portable equipment

The Code of Practice for In-service Inspection and Testing of Electrical Equipment recommends that all electrical equipment is inspected and tested at regular intervals. The frequency of inspection and testing will be established and frequently evaluated by the competent person responsible for the equipment.

Where practicable, cables and connectors should be assembled off-site and tested and certified as safe and satisfactory before delivery to site. Installers and users are encouraged to inspect all cables and couplers prior to energising.

Cables

Temporary power distribution cables should be of the multicore type for distribution circuits less than 125A. Single core cables are used for distribution circuits above 125A.

Cables for use indoor should be PVC or rubber sheathed in accordance with, BS 6500 or equivalent, with a minimum voltage designation of 300 V/500 V (ordinary duty flexible as a minimum, as defined in BS 7540).

Cables for use outdoor should be rubber insulated and sheathed in accordance with BS 6007 (commonly known as HO7RN-F which is widely used), BS 6500 or equivalent, with a minimum voltage designation of 450 V/750 V (heavy duty flexible as a minimum, as defined in BS 7540). Armoured cables or cables protected against mechanical damage should be used wherever there is a risk of mechanical damage, however, the use of steel wire armour protection is usually not necessary. Flexible cords should not be laid in areas accessible to the public unless they are protected against mechanical damage.

Distribution circuits

Cables intended to supply temporary structures should be protected at their origin by residual current devices whose rated residual operating current does not exceed 300 mA. These devices should provide a delay by using a device in accordance with IEC 60947-2, or be of the S-type in accordance with IEC 61008-1 or IEC 61009-1 to enable discrimination with RCDs protecting final circuits.

All circuits for socket-outlets rated up to 32 A and all final circuits other than for emergency lighting should be protected by an RCD with a rated residual operating current not exceeding 30 mA.

Control and protective switchgear

Fig 3: 400A Single pole mains connector Power lock in-line socket

Fig 4: 400A Single pole mains connector Power lock plug

should be placed in closed cabinets which can only be opened by the use of a key or a tool, except for those parts designed and intended to be operated by ordinary persons.

Plugs, socket-outlets and cable couplers

All temporary power connections on site should be made using approved plugs, sockets and cable couplers. Plugs, sockets and couplers should conform to British, or international standards, appropriate for the current and voltage and site conditions. Figure 2, is reproduced from BS 7909 and shows the preferred type of connector for the application.

Connectors not approved to another specific type standard should conform to BS EN 60309-1, or the salient requirements thereof. Plugs, sockets and connectors conforming to BS EN 60309-1 should be used in accordance with the recognised voltage colour code and mandatory keyway positions. Pin connections should conform to international, national or industry standards.

To prevent accidental interconnection of non-compatible circuits, alternative non-interchangeable connectors should be used, such as those shown in figures 3 and 4. Such single pole connectors should provide protection conforming to at least IP 44 when connected in normal use.

Equipment

Electrical apparatus and wiring can be subject to severe abuse and should be designed to withstand the conditions expected. It is essential that correct circuit protection, earthing arrangements and frequent inspection and testing are ensured.

Distribution equipment should have the following features:

a) safety in use;

b) flexibility in application for repeated use, i.e. to allow easy substitution of components for specific duties as required from site to site;

c) suitability for transport, storage and handling;

d) robustness in construction to resist damage;

e) suitability for use in the intended environment.

All switchgear, distribution equipment, etc., not reserved for exclusive interior use, should be of a type approved for outdoor use or protected by suitable covers if used outdoors. Socket-outlets, plugs and cable couplers not reserved for exclusive indoor use should be of the splash-proof type or protected by suitable covers. Equipment should conform at least to the IP categories given in figure 6. ■

Further reading and information

- BS 7909: 1998 Code of practice for Design and installation of temporary distribution systems delivering a.c. electrical supplies for lighting, technical services and other entertainment related purposes
- IEC 60364-7-711 Requirements for special installations or locations – Exhibitions, shows and stands
- HD 384.7.711 S1 2003 Requirements for special installations or locations – Exhibitions, shows and stands
- Guidance Note 7 – Special Locations, IEE Publication
- Code of Practice for In-service Inspection and Testing of Electrical Equipment, IEE Publication
- BS 7430: 1998 Code of practice for earthing
- PLASA - Professional Lighting and Sound Association http://www.plasa.org/

Fig 5: A distribution unit consisting of:
Incoming: 400A Power lock with link through
Outgoing: 3 x 63A, 3Ø, to BS EN 60309-2
3 x 16A, 1Ø, to BS EN 60309-2
3 x 13A, 1Ø, to BS 1363

Place of use	IP category
Indoor	IP 2X
Outdoor (protected)	IP 22
Outdoor (exposed)	IP 44

Fig 6: Minimum IP protection (With all covers in place)

- Electricity Safety, Quality and Continuity Regulations 2002
- HSE Guidance Notes: Electrical Safety for Entertainers; further HSE guidance material:

1. Guidance Note PM 19, Use of lasers for display purposes HMSO, ISBN 0 11 883370 7
2. Health and Safety at Work etc Act 1974 HMSO, ISBN 010 543774 3
3. Electricity at Work Regulations 1989, SI 1989 No 635 HMSO, ISBN 0 11 096635 X
4. Memorandum of guidance on the Electricity at Work Regulations 1989, HS(R)25, HMSO ISBN 011 883963 2
5. The Event Safety Guide - A guide to health, safety and welfare at music and similar events 1999 - First published as 'Guide to health, safety and welfare at pop concerts and similar events', 1993 ISBN: 0717624536

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VOLTAGES INDUCED IN THE NON-MAGNETIC, METALLIC SHEATHS AND/OR ARMOUR OF SINGLE-CORE CABLES

By Mark Coates and John Ware

SINGLE-CORE aluminium wire armoured cables are often employed in high current industrial applications. Such cables are available in sizes up to 1000 mm^2, whereas it is difficult to obtain multicore steel wire armoured cables in sizes above 400 mm^2. Single-core cables have a smaller bending radius than the equivalent SWA multicore cable and are, in general, easier to handle.

Tables 4D3 and 4E3 in BS 7671 give information on current-carrying capacities and voltage drop for single-core cables with non-magnetic armour.

Note that single-core cables armoured with steel wire or tape must not be used for a.c. circuits. (Regulation 521-02-01 refers).

In any armoured cable system the armour is an exposed-conductive-part and has to be connected to earth as required by Regulation 413-02-06 for TN systems or Regulation 413-02-18 for TT systems. The connection with earth has to be made at a minimum of one point, usually one end.

For a single-core armoured cable, carrying an a.c. load current, a voltage will be induced in the armour. Similarly a voltage will be induced in a metallic screen or sheath of a single-core cable. The magnitude of the induced voltage depends on factors which include the load current, the length of the cable, the armour diameter and the cable spacing. The armour is effectively the secondary of a transformer and the conductor is the primary. See figure 1.

Consider a single-phase circuit formed using two single-core armoured cables, the armours are earthed, generally at the supply end as shown in figure 2. There are two possible configurations for the connection of the armours of the line and neutral conductors at the load end of the circuit:

- Solid bonded system. The armours are interconnected forming a loop (figure 2).
- Single point bonded system. The armours are left unconnected (figure 3).

Note that the same two configurations exist in a 3-phase circuit formed by the use of three (or four) single-core armoured cables.

Solid bonded system

In a solid bonded system the induced voltages drive a circulating current around the armour loop. The current in the armour loop is proportional to the load current, the armour resistance and several other factors. The current in the armour loop is independent of the length of the circuit as both the induced voltage and the resistance of the armour circuit are directly proportional to the length of the cable.

The circulating current in the armour has a heating effect in the cable and hence the current rating of the cable is lower for a solid bonded system than for a single point bonded system. The current ratings given in the Tables in Appendix 4 of BS 7671 are for the solid bonded case and they allow for the heating effect of circulating currents. The effect is usually only significant for larger sizes of cable, hence there is no advantage in single point bonding small cables, less than 50 mm^2.

Solid bonding the armour of single-core cables also allows the armour to be used as a protective conductor.

Single point bonded system
If the armour is only bonded and earthed at one end (figure 3) and not bonded at the other end then the circulating currents will not flow but there will be a standing voltage at the unbonded end. As indicated before the magnitude of the induced voltage will be a function of both the load current and the circuit length.

Safety considerations
Two safety considerations arise depending upon whether solid bonding or single point bonding is used.

i. In a solid bonded system, due to the circulating current, there is a risk of overheating of the gland plates if they are undersized.

ii. In a single point bonded system, there is a risk of electric shock if someone touches the armour or gland at the unbonded end of the circuit. The figure of 25 V is stated in Regulation 523-05-01 (rather than 50 V) because of the possibility of wet conditions or where the cables are installed in a special location. Under fault conditions the current will be higher and hence the induced voltage at the unbonded end will be higher and there is a risk of flashover or breakdown at the glands. Although there is a significantly increased risk of shock under fault conditions the possibility of someone touching the unbonded end of a properly designed system at the exact time of a fault occuring is considered remote.

Also, in a single point bonded circuit, if the cable sheath becomes damaged so that the armour comes into contact with earthed metalwork at some point along the run arcing may occur at this point leading to a cable failure or other damage.

Regulation 523-05-01, quoted in full below, states a preference for solid bonding and requires the installation designer to take account of the circulating currents in a solid bonded system or the induced voltages in a single point bonded system.

523-05-01 The metallic sheaths and/or non-magnetic armour of single-core cables in the same circuit shall normally be bonded together at both ends of their run (solid bonding). Alternatively, the sheaths or armour of such cables having conductors of cross-sectional area exceeding 50 mm^2 and a non-conducting outer sheath may be bonded together at one point in their run (single point bonding) with suitable insulation at the un-bonded ends, in which case the length of the cables from the bonding point shall be limited so that, at full load, voltages from sheaths and/or armour to Earth:
(i) do not exceed 25 volts, and
(ii) do not cause corrosion when the cables are carrying their full load current, and
(iii) do not cause danger or damage to property when the cables are carrying short-circuit current. ■

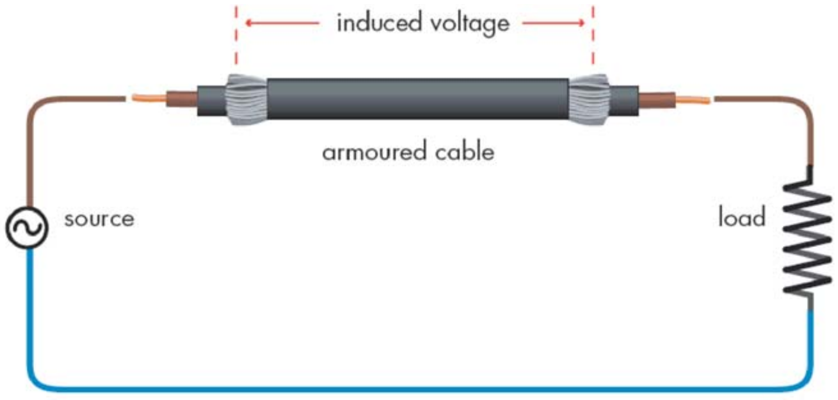


Fig 1: Induced voltage in a cable with a non-magnetic armour

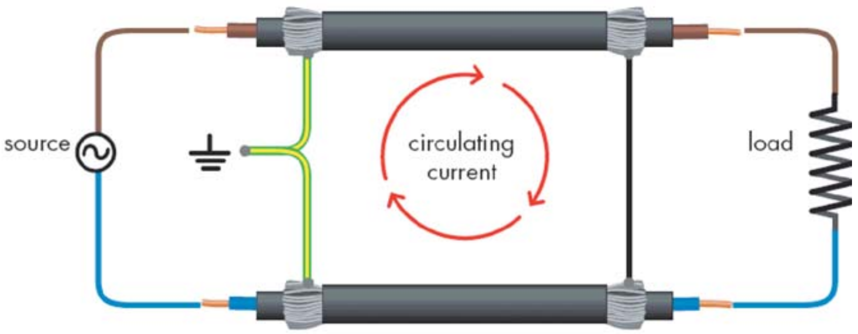


Fig 2: Solid bonded system

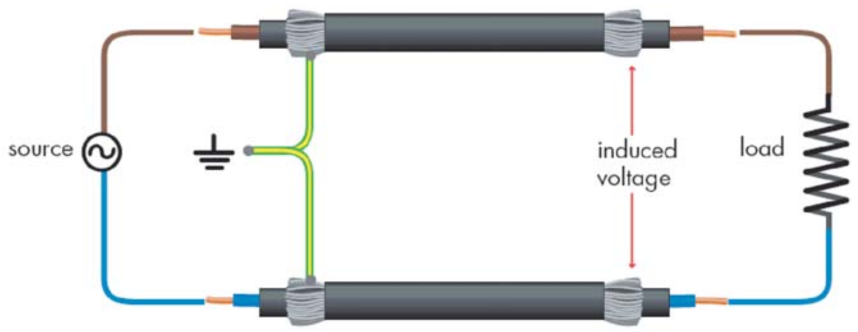


Fig 3: Single-point bonded system

PART L OF THE BUILDING REGULATIONS AND PROVISION OF LIGHTS IN DOMESTIC PREMISES

By Jon Elliott

ON THE 6th April 2006 Approved Documents L1A; L1B; L2A; and L2B came into effect in support of the Building and Approved Inspectors (Amendment) Regulations 2006, SI 2006/652 and the 2002 edition of Approved Document L1 became obsolescent. The full titles of the Approved Documents are given below:

L1A - Conservation of fuel and power (New dwellings) (2006 edition)
L1B - Conservation of fuel and power (Existing dwellings) (2006 edition)
L2A - Conservation of fuel and power (New buildings other than dwellings) (2006 edition)
L2B - Conservation of fuel and power (Existing buildings other than dwellings) (2006 edition)

The changes in the guidance being offered by the Department for Communities and Local government (DCLG), formerly the Office of the Deputy Prime Minister (ODPM) have a number of implications for those involved in the design and installation of electrical building services such as heating control systems, air conditioning, interior lighting and exterior lighting.

This article addresses the guidance given for designers and installers involved in the provision of internal and external lighting services in new and existing dwellings given in Approved Documents L1A and L1B respectively.

Item b. of Requirement L1 in Part L (Conservation of fuel and power) states that reasonable provision shall be made for the conservation of fuel and power in buildings by providing and commissioning energy efficient fixed building services with effective controls.

Local authority Building Control departments will expect to see that measures have been implemented to satisfy this requirement as a condition to achieving Building Control approval for any proposed developments in new or existing domestic premises.

Fixed building services are defined in the Definitions Section of all the aforementioned Approved Documents as *'any part of, or any controls associated with:*

a. Fixed internal or external lighting systems, but does not include emergency escape lighting or specialist process lighting: or

b. Fixed systems for heating, hot water service, air-conditioning or mechanical ventilation.'

Fixed internal lighting

In new dwellings (L1A – Para 42), and existing dwellings (L1B – Para 44), the provision of light fittings that only take lamps having a luminous efficacy greater than 40 lumens per circuit-Watt (l/W) would meet the statutory requirements. The lighting fitting as defined includes the lamp, control gear, and an appropriate housing, reflector, shade or diffuser or other device for controlling the output light). Circuit-Watts is defined as the power consumed in lighting circuits by lamps and their associated control gear and power factor correction equipment.

It is accepted that fluorescent and compact fluorescent lighting fittings would meet this standard. However, it should be noted that lighting fittings for GLS tungsten lamps with bayonet cap or Edison screw bases, or tungsten halogen lamps would not.

In the case of a dwelling being extended, or a new dwelling being created from a material change of use, or an existing lighting system is being replaced as part of re-wiring works such reasonable provision as described above should be made to allow dwelling occupiers to obtain the benefits of efficient electric lighting (L1B – Para 43).

Reasonable provision would be achieved in a new dwelling (L1A – Para 43) or in that part of an existing dwelling affected by the building work (L1B – Para 45) by the provision of fixed energy efficient light fittings numbering not less than the greater of:

a. One fitting per $25m^2$ of dwelling floor area (excluding garages) or part thereof; or
b. One per four fixed lighting fittings.

It should be noted that a light fitting may contain more than one lamp.

In the case of existing dwellings, or where a new dwelling is created from a material change of use, this assessment should be based on the extension, the newly created dwelling or the area served by the lighting system as appropriate to the particular case.

Although the above recommendations would be seen as meeting the requirements of Part L, The Energy Saving Trust (EST) recommended higher performance standards for both new and refurbished domestic dwellings in section 5.2 of CE61(Energy efficient lighting - guidance for installers and specifiers) .

In the case of new dwellings, they suggest the following standards in terms of the percentage of all fixed internal fittings having a luminous efficacy in excess of 40 l/W:

- *Good practice* - *40%*
- *Best practice* - *75%*
- *Advanced practice* - *100%*

In the case of existing dwellings, it is suggested that every opportunity should be taken to replace existing fittings with the aim of providing 75% of an energy efficient type.

Mention is also made of the potential to save energy through the provision of independent switching for lights and the placing of such switches in convenient and user-friendly locations. This will allow the occupants to use only those lights required at any particular time. It is also mentioned that a degree of energy saving may be achieved through the use of automatic controls and dimmers, but it should be borne in mind that dimming needs to be achieved by a reduction in consumed power for it to be considered energy saving. Regular operation of lamps whilst dimmed will result in an extended lamp life. It should be remembered however that dimmers cannot be used with two-pin compact fluorescent lamps.

Where light fittings are installed in less frequented areas like cupboards and other storage areas and loft spaces, these should not be counted (L1A – Para 44; L1B – Para 47).

GIL20 (low energy domestic lighting) published by the Energy Saving Trust , provides guidance on identifying suitable locations within a dwelling to maximise the effectiveness of an energy efficient lighting scheme. It states for example that ‘most rooms can benefit from energy efficient lighting; however the greatest savings will be in rooms that are lit for longer periods and which have fittings that are likely to be retained by the occupants… a study of 39 households showed that those lit for the longest periods were the hall, lounge and landing’.

However, it should be noted that difficulties can arise where energy efficient light fittings are installed in lounges and dining rooms, as owners of properties are most likely to remove and replace the efficient type fittings with fittings of their choice and to their taste in such locations.

Reference to the need to provide lighting fittings including shades, etc., in the 2006 edition of Approved Document L1 (ADL1), is an attempt to overcome the trend where inexpensive bare lamped pendant fittings were previously being installed without shades simply to meet the basic requirements. It is hoped that the need to supply shades or indeed the ability for occupiers to replace the originally fitted shade with one of their own choice, will result in householders retaining the energy efficient light fittings that have been installed.

GIL20 continues, ‘low energy luminaires might sometimes be more appropriate in rooms with lower lighting use (e.g. kitchens) where more discrete light sources can be used, for example in under-cabinet lighting, as these are unlikely to be changed by occupants’.

Documents L1A and L1B both contain a reminder of the dangers associated with stroboscopic effect and the installation of mains frequency fluorescent lighting in garages. There is a possibility that moving parts of vehicles upon which work is being carried out, or the rotating blades or cutting wheels of power tools may appear to be stationary or moving slower than is actually the case. This could result in accidents or injuries occurring. The installation of fluorescent lamps with high frequency electronic ballasts in a garage could substantially reduce this risk.

Fixed external lighting

Fixed external lighting is defined within the Approved Documents L1A and L1B as ‘Lighting fixed to an external surface of the dwelling supplied from the occupier’s electrical system. It excludes the lighting in common areas in blocks of flats and other access-way lighting provided communally.’

In the case of fixed external lighting, reasonable provision would be to enable effective control and/or the use of efficient lamps such that:

a. EITHER: Lamp capacity does not exceed 150W per light fitting and the lighting automatically switches off:

i. When there is enough daylight; and

ii. When it is not required at night

b. OR: the lighting fittings have sockets (meaning lamp holders) that can only be used with lamps having a luminous efficacy greater than 40 lumens per circuit-Watt.

Compact fluorescent lamps would meet the standard in b. GLS tungsten lamps with bayonet cap or Edison screw bases, or tungsten halogen lamps would not. (L1A - Para 45; L1B – Para 48). It should be remembered that the re-wiring works must comply with Part P of the Building Regulations, where applicable. ■

Publications referenced in the text.
CE61. Energy efficient lighting – guidance for installers and specifiers, EST, 2006.
GIL20. Low energy domestic lighting, EST, 2006.
Both of the above may be downloaded from
www.est.org.uk/housingbuildings/standards
All of the Approved Documents to accompany the Building Regulations may be downloaded from
www.planningportal.gov.uk/england/professionals/en/1115314110382.html

SITE SAFETY TOOLBOX TALK NO.1
THE USE OF LADDERS

By Mark Coles, Jon Elliott and John Ware

Electricians and supervisors are often called on to participate in or to give toolbox talks on different issues of site safety. Wiring Matters plans to address a series of safety subjects in this and subsequent issues that can be made the basis of a toolbox talk. In this first issue we will cover the subject of ladders.

LADDERS FORM an everyday part of an electrician's job and, unfortunately, falls from ladders are the single biggest cause of workplace deaths and one of the main causes of major injury. We will look at a survey of accidents and then see the planning necessary before using a ladder, how to check the ladder and then how to use the ladder safely.

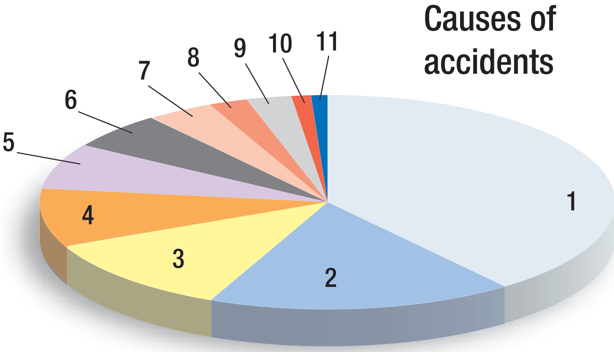
A recent study of 483 falls from fixed and portable ladders disclosed:

- 277 accidents where the ladder slipped, and
- 206 accidents where the ladder remained stable.

Of the 206 accidents where the ladder remained stable, the following causes were given (see pie chart)

1. 81 cases where a foot slipped on a rung
2. 36 cases where the person was carrying tools/materials and missed their footing
3. 18 cases where the person missed their footing
4. 14 cases where the person overbalanced on the ladder
5. 12 cases where the person over reached
6. 7 jumped off to avoid other hazards
7. 5 lost grip
8. 5 obstruction part way up ladder
9. 2 struck by falling material
10. 24 cases where there was a structural defect in the ladder or its anchorage
11. 2 cases where the ladder was struck by a vehicle

What can be done to reduce the risk?
Work at height must be avoided wherever possible. Where work at height cannot be avoided, everything



Causes of accidents

that is reasonably practicable must be done to prevent anyone falling. Where the risk of a fall cannot be eliminated, work equipment or other measures must be used to minimize the distance of a fall and the consequences of a fall should one occur.

Before using a ladder

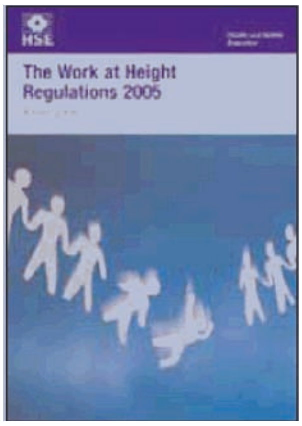
- Avoid working at height wherever possible. Ensure no work is done at height if it is safe and reasonably practicable to do it other than at height.
- Where work at height cannot be avoided, ensure it is properly planned, appropriately supervised and carried out in as safe a way as possible
- Ensure a risk assessment has been made as required by regulation 3 of the Management of Health and Safety at Work Regulations.
- Ensure those involved in the work at height are trained and competent
- Plan for emergencies and rescue
- Take account of the weather conditions
- Ensure the place where work at height is done is safe. Take account of fragile surfaces and the possibility of falling objects
- Check that there is strong fixing to which the ladder can be secured
- Make sure that you have suitable footwear which is unlikely to slip on a rung.

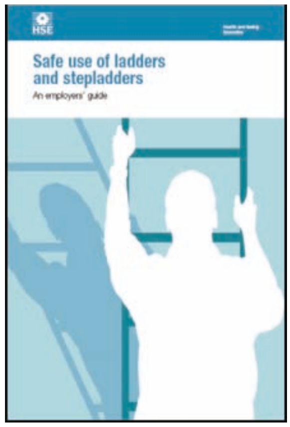
Setting up the ladder

- Always examine ladders before and after use. Report any defects immediately
- Never use a make-shift ladder
- Don't use ladders with cracked or broken rungs or other defects
- Avoid the use of metal ladders if you are doing work on or near live parts
- Don't use ladders that are too short. If you are going to step off the top of the ladder make sure it extends high enough to get a secure handhold
- Set ladders at the correct angle, 300 mm out to every 1,200 mm up (1:4)
- See that the ladder cannot slip. Ask someone to stand at the bottom. Alternatively the ladder should be staked, to prevent slipping outwards and sideways
- Don't stand a ladder on a drum, or box, or other unsteady base
- Ensure the ladder is tied near the top

Using the ladder

- The person using the ladder must be both able and trained. They must know how to avoid falling and how to minimize injury should they fall
- Keep the rungs and footwear clean





- Use both hands when climbing or descending
- Don't overreach from a ladder - always move it
- Never overload a ladder, or support it on its bottom rung from a plank
- Use a tray or hook on the ladder for tools/accessories.

The Work at Height Regulations 2005

The use of ladders is covered by the HSE Work at Height Regulations 2005 SI 2005/735. The document may be obtained directly from the HSE or online at www.hmso.gov.uk.

The Work at Height Regulations do not ban the use of ladders. The Regulations require that ladders should only be considered where a risk assessment has shown that the use of other more suitable work equipment is not appropriate because of the low risk and short duration of the task or considerations of where the work is located. The Regulations apply to all work at height where there is a risk of a fall liable to cause personal injury.

The HSE accepts the practicalities of the use of ladders for work at height and the fact that they are commonly used in a wide variety of situations. Ladders are used in almost all employment sectors, and, unfortunately, sometimes for purposes other than those for which they were designed.

Further information is available from: Work at Height Regulations 2005. The Statutory Instrument can be downloaded from Her Majesty's Stationery Office website. *Safe use of ladders and step ladders - An employers' guide,* HSE INDG402. The HSE has produced an excellent free leaflet entitled *The Working at Height Regulations 2005: A brief guide (INDG401)*. Alternatively, hard copies are available from HSE Books.

Information is available from the HSE's Falls from height website: www.hse.gov.uk/falls

Finally, it is always worth remembering that following the guidance from the HSE will normally be doing enough to comply with the law. ■