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Code of Practice for the Electricity (Wiring) Regulations 2003 Edition

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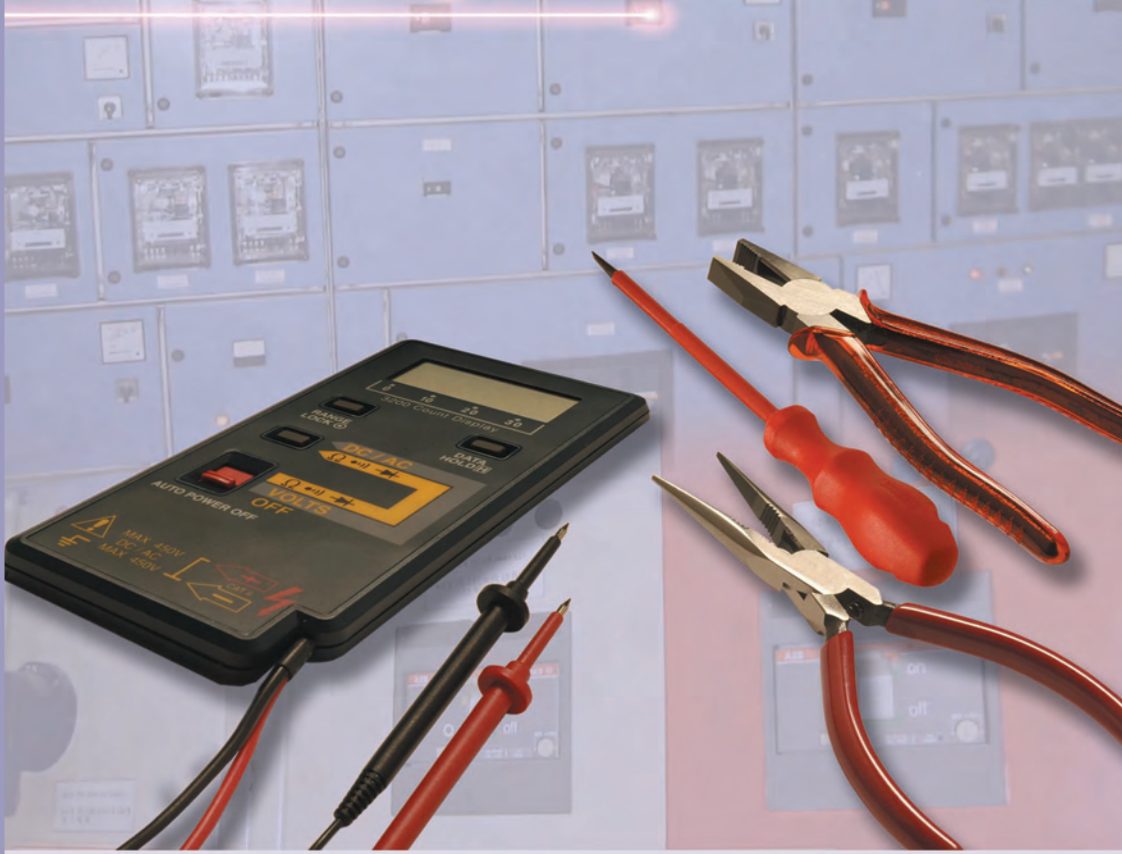
2003 Edition



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CODE OF PRACTICE

FOR THE

ELECTRICITY (WIRING) REGULATIONS

Electrical and Mechanical
Services Department
2003

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ACKNOWLEDGEMENT

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— British Standards Institution :
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  IEC Central Office, 3 rue de Varembé, P.O. Box 131, CH-1211
  Geneva 20, Switzerland

Copies of the complete standards can also be bought through the Product Standards Information Bureau, Innovation and Technology Commission at 36/F, Immigration Tower, 7 Gloucester Road, Wanchai, Hong Kong (tel. no.: 2829 4820).

PART I

Code 1 INTRODUCTION

This Code of Practice should be titled 'Code of Practice for the Electricity (Wiring) Regulations' hereinafter referred as the 'CoP'.

The CoP is published to give general technical guidelines on how the statutory requirements of the Electricity (Wiring) Regulations, hereinafter referred as the 'Wiring Regulations', can be met.

The structure of the CoP corresponds to that of the Wiring Regulations in that a code will be associated with a corresponding regulation of the Wiring Regulations. Additional codes are also included to describe general workmanship and requirements for specific installations and equipment.

Compliance with the CoP should achieve compliance with the relevant aspects of the Wiring Regulations. However, those installations or parts of installation which comply with 1997 edition of this CoP is also deemed to have met the requirements of the Wiring Regulations provided that they:

(*a*) are completed and connected to electricity supplies before 1 January 2006; and

(*b*) comply with the electricity supplier's Supply Rules.

Code 2 INTERPRETATION

In the CoP, in addition to all the definitions used in the Electricity Ordinance and its Regulations, the following definitions shall apply—

‘appliance’ means an item of current using equipment other than a luminaire or an independent motor or motorised drive.

‘appliance, fixed’ means an appliance which is fastened to a support or otherwise secured or placed at a specific location in normal use.

‘appliance, portable’ means an appliance which is or can easily be moved from one place to another when in normal use and while connected to the supply.

‘barrier’ means an effective means of physically preventing unauthorised approach to a source of danger.

‘bonding’ means the permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and has the capacity to conduct safely any current likely to be imposed.

‘bonding conductor’ means a protective conductor providing equipotential bonding.

‘bunched’ means two or more cables to be contained within a single conduit, duct, ducting or trunking or, if not enclosed, are not separated from each other.

‘cable channel’ means an enclosure situated above or in the ground, ventilated or closed, and having dimensions which do not permit the access of persons but allow access to the conductors and/or cables throughout their length during and after installation. A cable channel may or may not form part of the building construction.

‘cable coupler’ means a device enabling the connection or disconnection, at will, of two flexible cables. It consists of a connector and a plug.

‘cable ducting’ means a manufactured enclosure of metal or insulating material, other than conduit or cable trunking, intended for the protection of cables which are drawn-in after erection of the ducting, but which is not specifically intended to form part of a building structure.

‘cable trunking’ means a manufactured enclosure for the protection of cables, normally of rectangular cross section, of which one side is removable or hinged.

‘circuit breaker’ means a mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions and also of making, carrying for a specified time, and breaking currents under specified abnormal circuit conditions, such as those of short circuit.

‘circuit protective conductor’ means a protective conductor connecting exposed conductive parts of equipment to the main earthing terminal.

‘connector’ means a device which is provided with female contacts and is intended to be attached to the flexible cable connected to the supply.

‘danger’ means a risk of bodily injury or loss of life or health from shock, burn, asphyxiation or other causes.

‘dead’ means at or about zero voltage and disconnected from any live system.

‘duct’ means a closed passage way formed underground or in a structure and intended to receive one or more cables which may be drawn in.

‘earth electrode resistance’ means the resistance of an earth electrode to earth.

‘earth fault loop impedance’ means the impedance of the earth fault current loop (phase to earth loop) starting and ending at the point of earth fault.

‘earthed’ means connected to the general mass of earth in such a manner as will ensure at all times an immediate discharge of electrical energy without danger; when applied to electrical equipment, all phases short-circuited and effectively connected to earth.

‘earthing conductor’ means a protective conductor connecting a main earthing terminal of an installation to an earth electrode or to other means of earthing.

‘enclosure’ means a part providing an appropriate degree of protection of equipment against certain external influences and a defined degree of protection against contact with live parts from any direction.

‘equipment’ means electrical equipment.

‘equipotential bonding’ means electrical connection putting various exposed conductive parts and extraneous conductive parts at a substantially equal potential.

‘fuse element’ means a part of a fuse designed to melt when the fuse operates.

‘fuse link’ means that part of a fuse, including the fuse element, which requires replacement by a new fuse link after the fuse element has melted and before the fuse can be put back into service.

‘H.V. enclosure’ means a substation, standby generator house, distribution centre and a room or other enclosure wherein high voltage apparatus is installed. “Danger” notice shall be permanently affixed outside H.V. enclosure access doors.

‘installation’ means electrical installation.

‘live’ means electrically charged.

‘overhead line’ is defined in the Electricity (Wiring) Regulations as a conductor that is placed above ground and is suspended in the open air.

‘PELV (protective extra-low voltage)’ means an extra-low voltage system which is not electrically separated from earth, but which otherwise satisfies all the requirements for SELV.

‘permit-to-work’ means an official form signed and issued by a responsible person to a person having the permission of the responsible person in charge of work to be carried out on any earthed electrical equipment for the purpose of making known to such person exactly what electrical equipment is dead, isolated from all live conductors, has been discharged, is connected to earth, and on which it is safe to work.

‘protective conductor’ means a conductor used for some measures of protection against electric shock and intended for connecting together any of the following parts:

(i) exposed conductive parts,

(ii) extraneous conductive parts,

(iii) main earthing terminal,

(iv) earth electrode(s),

(v) the earthed point of the source, or an artificial neutral.

‘residual operating current’ means residual current which causes the residual current device to operate under specified conditions.

‘responsible person’ means a registered electrical worker of an appropriate grade or a registered electrical contractor appointed in writing by the owner of an electrical installation to operate and maintain his installation.

‘restrictive conductive location’ means a location comprised mainly of metallic or conductive surrounding parts, within which it is likely that a person will come into contact through a substantial portion of their body with the conductive surrounding parts and where the possibility of preventing this contact is limited.

‘rising mains’ means that part of the installation which is used for distribution of electricity throughout any building normally used for multiple occupation.

‘screen’ means an effective means of identifying or shielding the safe working area from a source of danger.

‘SELV’ (Separated Extra-Low Voltage) means an extra-low voltage which is electrically separated from earth and from other systems in such a way that single fault cannot give rise to the risk of electric shock.

‘short circuit current’ means an overcurrent resulting from a fault of negligible impedance between live conductors having a difference in potential under normal operating conditions.

‘socket outlet’ means a device, provided with female contacts, which is intended to be installed with the fixed wiring, and intended to receive a plug.

Code 3 APPLICATION

3A General Application of the CoP

3B Application to Category 2 Circuit

3C Exempted Fixed Electrical Installations

Code 3 APPLICATION

3A **General Application of the CoP**

(*a*) The CoP applies to all low or high voltage FIXED electrical installations in buildings and premises including those of domestic and commercial buildings, factories and industrial undertakings, except fixed electrical installations which are:

(i) exempted by the Director; or

(ii) in mobile units such as aircrafts, motor vehicles and sea-going vessels.

(*b*) Gantry and tower cranes, hoists, conveyors, traction equipment and ropeways that are permanently connected to low or high voltage electricity supply are considered as fixed electrical installations. The wiring of such equipment is required to comply with the Wiring Regulations and the CoP applies to them.

3B **Application to Category 2 Circuit**

Category 2 circuits being supplied from a safety source, are not regulated by the Wiring Regulations (except regulation 5(1)).

3C **Exempted Fixed Electrical Installations**

(*a*) Where the Director is satisfied that an owner is capable of safely installing and maintaining his own fixed electrical installation, the Director may, by order, exempt the owner, his electrical installations, his electrical workers or any combination of them, from any of the provisions of the Electricity Ordinance relating to electrical installations.

(*b*) Although fixed electrical installations belonging to Government and those fixed electrical installations which are exempted by the Director are not required to comply with the Wiring Regulations or the CoP, owners of these installations are at liberty to have their installations complied with the whole or part of the Wiring Regulations and the CoP.

Code 4 GENERAL SAFETY REQUIREMENTS

4A General

4B Workmanship and Materials

(1) Workmanship

(2) Materials

4C Design, Construction, Installation and Protection

(1) Interchangeability of socket outlets

(2) Protection

4D Identification, Maintenance, Inspection and Testing

(1) Identification

(2) Maintainability

(3) Inspection and testing

4E Working Space

4F Switchroom/Substation

(1) Facilities for locking

(2) Arrangement of entrance/exit

(3) Illumination and ventilation

(4) Prohibition of storage

4G Safety Precautions for Work on Low Voltage Installation

(1) Work on low voltage installation

(2) Work involving the use of electric-arc welding set

(3) Precautions for supply connection

(4) Precautions for major alteration

(5) Use of ladder

(6) Use of portable equipment

4H Safety Precautions for Work on High Voltage Installation

(1) General

(2) Access to H.V. enclosures

(3) Work on H.V. electrical equipment

4I General Safety Practices

Code 4 GENERAL SAFETY REQUIREMENTS

4A General

(1) All equipment which is designed, constructed and manufactured to relevant national/international standards or specifications recognised by the Director, and so certified by the national/international organisations or any testing and certification authorities recognised or approved by the Director, is considered to have been properly designed and constructed with good workmanship and suitable materials.

(2) Relevant national/international standards and organisations currently recognised by the Director are listed in Table 4(1).

(3) For the purpose of product testing and certification, the test certificates or reports issued by the following organisations are recognised by the Director:

- (a) CB test certificates issued by national certification bodies participating in the IECEE (IEC System for Conformity Testing and Certification of Electrical Equipment) CB Scheme;
- (b) Endorsed test certificates or reports, bearing the accreditation mark of HKAS/ HOKLAS, issued by laboratories accredited by Hong Kong Accreditation Service (HKAS) or Hong Kong Laboratory Accreditation Scheme (HOKLAS) for the relevant tests;
- (c) Endorsed test certificates or reports issued by laboratories that have been accredited by accreditation bodies which have mutual recognition arrangements with HKAS/ HOKLAS. The mutual recognition arrangement partners of HKAS/ HOKLAS up to May 2003 are listed in Appendix 9.

(4) Relevant short circuit testing organisations currently recognised by the Director are:

- (a) The Association of Short Circuit Testing Authorities (ASTA);
- (b) N.V. tot Keuring van Elektrotechnische Materialen (KEMA);
- (c) Association des Stations d'Essais Francaises d'Apparellage (ASEFA);
- (d) An accredited laboratory in subparagraph 3 above;
- (e) Other short circuit testing authorities internationally recognised as having equal standing as ASTA.

4B Workmanship and Materials

(1) *Workmanship*

(*a*) Good workmanship should be used in the construction and installation of every electrical installation.

(*b*) Descriptions of general workmanship are given in Code 25 of the CoP.

(*c*) Particular attention should be paid to the workmanship employed in making joints, terminations and enclosures for the wiring installations. Reference should also be made to relevant sections in this CoP:

- Code 13—Conductors, Joints and Connections
- Code 14—Wiring Installation Enclosure

(2) *Materials*

(*a*) All materials chosen and used in an electrical installation should be purposely designed for the intended application and should not cause harmful effects to other equipment, undue fire risk or electrical hazard.

(*b*) Special consideration should be given in choosing materials purposely designed for electrical installations which are:

(i) exposed to weather, water, corrosive atmospheres or other adverse conditions;

(ii) exposed to flammable surroundings or explosive atmosphere.

Descriptions of installation in adverse environmental conditions are given in Code 15.

4C Design, Construction, Installation and Protection

(1) *Interchangeability of socket outlets*

To ensure proper matching and interchangeability, socket outlets should be designed, constructed and manufactured to the requirements given in appendices 1, 2, 3 and 4. Socket outlets of standards mentioned in Table 4(1) which have identical physical dimensions and configurations as those shown in appendices 1, 2, 3 and 4 are also acceptable.

(2) *Protection*

(*a*) Electrical equipment should be mechanically and electrically protected so as to prevent danger from shock, burn, or other injury to person or damage to property or from fire of an electric origin.

(*b*) Mechanical protection includes the provision of barriers, enclosures, protective covers, guards and means of identification, the display of warning notices and the placing of equipment out of reach. Where it is necessary to remove barriers or open enclosures, protective covers, guards, this should be possible only by use of a key or tool.

(*c*) Electrical protection includes the provision of isolation, protective devices and earthing facilities as well as equipotential bonding of all the exposed conductive parts and extraneous conductive parts.

4D **Identification, Maintenance, Inspection and Testing**

(1) *Identification*

(*a*) Each switch, fuse switch, switch fuse, busbar chamber, checkmeter and distribution board should be properly labelled on the front cover to indicate the circuit name or number, the rating of the fuse or circuit breaker, and the purpose of each circuit (e.g. lighting, socket outlet, pumps, lifts etc.). For fuses and circuit breakers fitted in a distribution board which are not visible without opening or removing the front cover of the distribution board, labels should be fixed inside the distribution board in such a manner as to allow easy identification of the individual fuses or circuit breakers when the front cover is opened or removed.

(*b*) For the live parts of an item of equipment or enclosure, e.g. a heater inside an electric motor, which are not capable of being isolated by a single device or not provided with an interlocking arrangement to isolate all circuits concerned, a label should be fixed in such a position so as to warn any person gaining access to the live parts, of the need to take special precautionary measures and to operate the designated isolating devices.

(*c*) Labels should be legible and durable. They should be securely fixed to the equipment. Engraved labels and paper labels with a cover sheet of rigid transparent plastic, permanently glued or fixed to the surface of the equipment are also acceptable. For indoor application, the use of paint marking on the equipment is also acceptable. The use of insulation or adhesive tapes for the fixing of labels is not acceptable. Each character or letter printed or engraved on the label should not be less than 5 mm high.

(*d*) Labels for identification purposes should preferably be written in both Chinese and English. Warning labels must be written in *both* Chinese and English.

(2) *Maintenance*

(*a*) In the design, construction and installation of an electrical installation, consideration must be given to its subsequent maintenance. It should be noted that electrical equipment must not only be so constructed and protected as to be suitable for the conditions under which they are required to operate, but must also be installed to be capable of being maintained, inspected and tested with due regard to safety.

(*b*) For the purpose of maintenance, it is important to ensure the safety of persons approaching electrical equipment to work on it or attend to it. Guidelines on the provision of adequate and safe means of access and working space are described in Codes 4E and 4F.

(3) *Inspection and testing*

(*a*) On completion of an installation or an extension of an installation, appropriate tests and inspection shall be made, to verify so far as is reasonably practicable that the requirements of the Wiring Regulations have been met.

(*b*) The power factor measured at consumer's supply point of a consumer's load should be maintained at a minimum of 0.85 lagging and necessary power factor correction equipment should be installed.

(*c*) An assessment should be made of any characteristics of equipment likely to have harmful effects upon other electrical equipment or other services, or impair the supply. Those characteristics include the following:

- overvoltages;
- undervoltages;
- fluctuating loads;
- unbalanced loads;
- power factor;
- starting currents;
- harmonic currents;
- d.c. feedback;
- high-frequency oscillations;
- necessity for additional connection to earth;

4E **Working Space**

(*a*) A minimum clearance space of 600 mm should be provided for the full width and in front of all low voltage switchgear having a rating not exceeding 100 amperes, such as consumer units and isolation switches.

(*b*) A minimum clearance space of 900 mm should be provided for the full width and in front of meters and of all low voltage control panels and switchgear having a rating exceeding 100 amperes, such as switchboards, distribution panels, and motor control centres.

(*c*) A minimum clearance space of 600 mm is required behind or by the side of such equipment where access from behind or the side is required for connection and maintenance purposes.

(*d*) Clearance space may not be provided behind or by the side of such equipment where there are no renewable parts such as fuses or switches and no parts or connections which require access from the back or from the side concerned.

(*e*) The clearance space in front of the equipment referred to in subparagraph (*b*) should be increased to at least 1 400 mm for such electrical equipment operating at high voltage.

(*f*) The clearance space referred to in subparagraph (*a*), (*b*) or (*e*) should not be less than the space required for the operation of draw-out type equipment or for the opening of enclosure doors or hinged panels to at least 90 degrees.

(*g*) The minimum height of all clearance space(*s*) referred to in subparagraph (*a*) should not be less than 1 000 mm measured from the footing and those referred to in subparagraphs (*b*), (*c*) or (*e*) and (*f*), should not be less than 1 800 mm measured from the footing. Under normal operational conditions, where bare live parts are exposed, the minimum height of all such clearance spaces should not be less than 2 100 mm.

4F **Switchroom/Substation**

(1) *Facilities for locking*

(*a*) Every switchroom or substation should have suitable means of entrance/exit, which should be so arranged as to prevent unauthorised entry but give authorised persons ready access at all times. For the purpose of preventing unauthorised entry, or access to low voltage installations, the display of suitable warning notice is acceptable provided that the equipment is not readily accessible to the general public. In the case of high voltage installations, locked enclosure with suitable warning notice should be provided.

(*b*) Where an entrance or exit of a switchroom/substation is provided with locked doors or gates, the arrangement of the lock should be such that it requires a key to open the door or gate from outside.

(*c*) Every high voltage (H.V.) switchroom/substation, except when manned, should be kept locked. A duplicate key for each H.V. switchroom/substation should be available, for emergency purposes, in a key box at a designated location. All other keys for use in the

H.V. switchroom/substation should be kept under the control of a responsible person.

(*d*) Exceptionally, a key may be held by a person whose duties require him to have frequent access to an H.V. switchroom/substation. In such a case, that person should obtain a written authorisation from the responsible person stating the duties for which the person is required to hold the key.

(2) *Arrangement of entrance/exit*

(*a*) At least one exit of a switchroom/substation should open outwards and this emergency exit should be identified clearly.

(*b*) Conductors near the entrance/exit of a switchroom/substation must be so arranged or protected that there is no risk of accidental contact of any live metal by any person entering or leaving.

(*c*) In order to provide free and ready access at all times for the maintenance and operation of the electrical equipment contained in a switchroom/substation, every entrance/exit of a switchroom/substation should be kept free of any obstruction including—

(i) locking facilities other than those in accordance with paragraph (1);

(ii) structures/goods/materials and

(iii) litter or waste,

which impedes the access to the switchroom/substation from a public area.

(3) *Illumination and ventilation*

(*a*) Suitable lighting giving a minimum illumination level of 150 lux measured at floor level in each switchroom/substation and an average vertical illumination level of 120 lux minimum should be provided to allow for the proper operation of electrical equipment. Where electrical equipment in the switchroom/substation is required to be operated in case of mains power failure, adequate emergency electric lighting independent of the mains supply and capable of operation for a minimum period of 30 minutes, should be provided. Additional lighting should be provided during maintenance if only the above minimum level of illumination is provided.

(*b*) Suitable ventilation or air-conditioning should be provided so as to prevent the development of high ambient air temperatures around the electrical equipment in excess of those permissible for such equipment.

(4) *Prohibition of storage*

Switchroom/substation, other than the tools used for the operation and maintenance of the switchgear inside it, must not be used for storage purposes.

4G Safety Precautions for Work on Low Voltage Installation

(1) *Work on low voltage installation*

(*a*) Where practicable, work on low voltage electrical equipment should be carried out after the electrical equipment has been isolated.

(*b*) Where serious inconvenience would arise from isolating circuits, adequate precautions should be taken to avoid danger for work involving the handling of energised parts or working within touchable distance, direct or indirect, of energised parts at low voltage. The following precautions are to be taken:

(i) work on energised low voltage electrical equipment should be done only by registered electrical workers, or in their presence, who has been authorised by the responsible person for such work; and

(ii) screen or other means to avoid danger from inadvertent contact with energised conductors should be provided; and

(iii) fixing of warning notices for repair, barriers and screens.

(*c*) Where danger cannot be avoided for work on energised equipment, the electrical equipment should be isolated and verified dead with a voltage indicator; a permit-to-work (sample shown in Appendix 15) should be issued.

(*d*) Where work is to be done on dead low voltage electrical equipment, controlled by a circuit breaker or switch, the circuit breaker or switch should be locked off where practicable and a warning notice for repair affixed. The keys for locks used to lock off circuit breaker or switch should be kept under the control of a responsible person.

(2) *Work involving the use of electric-arc welding set*

(*a*) Welders should be properly trained to avoid direct contact with exposed energised parts of an electrode clamp or a welding rod such as by wearing protective clothing and gloves.

(*b*) The work piece to be welded should be effectively and electrically connected to the welding return before welding work is commenced.

(3) *Precautions for supply connection*

Temporary or permanent supply should not be connected to a circuit unless:

(*a*) the circuit and its final circuits, if any, are completed and properly terminated, or

(*b*) the part(s) of the circuit or its final circuits which have not been completed, are disconnected or isolated with its associated isolating devices locked off.

(4) *Precautions for major alteration*

Before a major alteration is carried out on a circuit such as repositioning of a circuit, the circuit should be either:

(*a*) disconnected from the supply source at the distribution board concerned; or

(*b*) isolated with the isolating device locked off or its operation handle removed. The key or the handle, being non-interchangeable with any others which are used for a similar purpose for other parts of the installation, should be kept by the responsible person.

(5) *Use of ladder*

A ladder made of wood or other non-conductive material should preferably be used on electrical work. If the use of a metal ladder cannot be avoided, the legs of the ladders should be fitted with proper insulated footing.

(6) *Use of portable equipment*

Portable equipment of electrical work should be regularly checked and maintained, especially for the connections at the plug, to ensure that the equipment are in safe working order at all times.

4H **Safety Precautions for Work on High Voltage Installation**

(1) *General*

(*a*) Precautionary measures should be taken and the procedure of work should be such that no danger to persons or property will occur.

(*b*) Work procedure for High Voltage Installations should be referred to subparagraph (2) and (3) below, and relevant international standards, manufacturers' recommendation, operations and maintenance instructions.

(*c*) Appoint a responsible person to take charge of the operation and maintenance work of the installation.

(2) *Access to H.V. enclosures*

(*a*) No person, except a responsible person or a person having the permission of the responsible person, should enter a H.V. enclosure, and where danger may exist, no one should enter a H.V. enclosure unaccompanied.

(*b*) Every H.V. enclosure, except where manned, should be kept locked. The access door key for entering the H.V. enclosures should be kept under the control of a responsible person and a duplicate key should also be kept in a lockable key cabinet located in the general office or plant manager room of each plant or depot. The key of the lockable cabinet should be issued to the responsible person. When the responsible person is off from his duty he should hand over all keys to his relief.

(*c*) Exceptionally, a key may be held, subject to subparagraph 2(*a*) above, by a person having the permission of the responsible person whose duties required him to have frequent access to a H.V. enclosure. In such case, a responsible person should issue a written authority on which should be stated the duties for which the person having the permission of the responsible person holds the key.

(*d*) A separate key cabinet should be provided in a H.V. enclosure containing keys for locks used to lock out isolators or switches or to lock switchgear in earthed position or other safety devices inside the enclosure. The cabinet should be equipped with hooks labelled to match the items of equipment and should be locked with a master lock. Key of the master lock of equipment safety key box should be issued to responsible person only. One set of log book (sample shown in Appendix 16) should also be maintained inside the key box to record time, date and details of the padlock movements.

(*e*) At all times where inspection or work is to be carried out inside a H.V. enclosure installed with fixed automatic fire fighting system using gas extinguishing system, the fire fighting system should be key-switched to the "Manual" mode. Upon completion of work or inspection, the gas extinguishing system should be reverted to "Auto" mode, after ensuring that all personnel have left the H.V. enclosure and that the access doors have been closed and locked.

(3) *Work on H.V. electrical equipment*

(*a*) Work involving the handling of live parts or working within touchable distance, direct or indirect, of live parts, is not permitted.

(*b*) No person should carry out maintenance, repair, cleaning and testing on any part of high voltage electrical equipment unless such parts of the electrical equipment are:—

(i) dead;

(ii) isolated from live conductors and all practical steps taken to lock off from live sources;

(iii) effectively earthed at all points of disconnection of supply to such apparatus or between such points and the points of work;

(iv) fixed with warning notices for repair, barriers and/or screens; and

(v) released for work by issue of a permit-to-work (sample shown in Appendix 15).

It is the duty of the responsible person to ensure that all the foregoing provisions are complied with prior to the issue of the permit-to-work.

4I General Safety Practices

In addition to the safety precautions stated in Code 4G and 4H above, the following general safety practices should be observed for work on electrical equipment:

(*a*) *Check before Act*

The scope of work and relevant circuit should be checked before starting any electrical work. Suitable lighting and adequate illumination should be provided for the workplace. The condition of tools and instruments should also be checked before carrying out electrical work.

(*b*) *Isolate and Lockout*

The circuit / equipment under maintenance should be isolated as far as practicable. The relevant isolator should be locked out. A suitable warning notice should be placed close to the isolator.

(*c*) *De-energize*

The circuit/equipment to be worked on should be checked to ensure that it is dead.

(*d*) *Others*

(i) The workplace should be kept clean and tidy.

(ii) Keep hands away from any circuit or equipment that are not working on.

(iii) Unauthorized people should not stay in the work place.

(iv) The requirements stated in procedures and check lists should be followed.

Table 4(1)

List of Standards and Organisations Recognised by the Director

Recognised National/International Standards	(i) International Electrotechnical Commission Standards (IEC) (ii) Guo Biao (GB) (iii) British Standards (BS) (iv) Standards approved by the International Commission on Rules for the approval of Electrical Equipment (CEE) (v) European Standards (EN) Harmonization Document (HD) (vi) American National Standards (ANS) (vii) Japanese Industrial Standards (JIS) (viii) Australian Standards (AS)
Recognised National Organisations	(i) International Electrotechnical Commission (ii) Standardization Administration of China (iii) British Standards Institution (iv) International Commission on Rules for the approval of Electrical Equipment (v) European Committee for Electrotechnical Standardization CENELEC (vi) American National Standards Institute (vii) Japanese Standards Association (viii) Standards Australia

Code 5 SEGREGATION OF CIRCUIT CATEGORIES

5A Circuit Category

5B Segregation of Category 1, 2 and 3 Circuits

(1) General

(2) Category 1 and Category 2 circuits (with enclosures)

(3) Category 3 and Category 1 & 2 circuits (with enclosures)

(4) Category 1, 2 and 3 circuits without enclosure or underground

5C Segregation of Category 4 Circuits and Circuits of Other Categories

5D Segregation of Circuits from Overhead Telecommunication Lines and Telephone Lines

Code 5 SEGREGATION OF CIRCUIT CATEGORIES

5A **Circuit Category**

(*a*) There are 4 categories of circuit as defined in the Wiring Regulations as follows:

(i) Category 1 circuit means a circuit that operates at low voltage, but does not include a Category 3 circuit;

(ii) Category 2 circuit means a circuit for telecommunication, radio, telephone, sound distribution, intruder alarm, bell and call, or data transmission which is supplied with electricity from a safety source, but does not include a Category 3 circuit;

(iii) Category 3 circuit means a circuit for emergency lighting, air pressurisation systems and fire services installations including fire detection and alarm, fire pumps, fireman's lifts and smoke extraction; and

(iv) Category 4 circuit means a high voltage circuit.

(*b*) A safety source referred to in subparagraph (*a*)(ii) above means:

(i) a double-insulated safety isolating transformer to BSEN 60742 or equivalent with its secondary winding being isolated from earth, and having a nominal output voltage not exceeding 55 V; or

(ii) a source of electricity providing a degree of safety equivalent to that of the safety isolating transformer referred to in (i) above (e.g. a motor-generator with windings providing equivalent isolation); or

(iii) a source providing electricity at a voltage not exceeding extra low voltage and independent of a higher voltage circuit.

(*c*) Cables used to connect the battery chargers of self-contained luminaires to the normal mains circuit should NOT be considered as emergency lighting circuits under Category 3 circuit.

5B **Segregation of Category 1, 2 and 3 Circuits**

(1) *General*

(*a*) Low voltage circuits should be segregated from extra-low voltage circuits.

(*b*) Fire alarm and emergency lighting circuits should be segregated from all other cables and from each other in accordance with BS 5839 and BS 5266 or equivalent.

(*c*) Telecommunication circuits should be segregated in accordance with BS 6701 or equivalent.

(2) *Category 1 and Category 2 circuits (with enclosures)*

(*a*) Segregation between Category 1 and Category 2 circuits (with enclosures) should be in compliance with one of the permissible arrangements listed in Table 5(1).

(*b*) In conduit, duct, ducting or trunking systems, if common boxes, switchplates or blocks are used for mounting controls or outlets for Category 1 and Category 2 circuits, rigid partition screens or barriers should be provided between the cables and connections of the two categories of circuits.

(3) *Category 3 and Category 1 & 2 circuits (with enclosures)*

(*a*) Segregation between Category 3 and Category 1 & 2 circuits (with enclosures) should be in compliance with one of the permissible arrangements listed in Table 5(2).

(*b*) Cables of Category 1 circuits are not allowed to be drawn into the same conduit, duct or ducting as cables of Category 3 circuits.

(*c*) Cores of Category 1 and Category 3 circuits are not allowed to be contained in a common multicore cable, flexible cable or flexible cord.

(4) *Category 1, 2 and 3 circuits without enclosure or underground*

For cables of Category 1, 2 and 3 circuits that are installed without enclosure or underground, the following requirements should be observed:

(*a*) A minimum horizontal and vertical separation distance of 50 mm should be provided between Category 1, 2 and 3 circuits.

(*b*) For cables laid underground or in trench, if the separation distance of 50 mm cannot be achieved, a separation distance of not less than 25 mm is acceptable provided slabs of concrete are inserted between Category 1, 2 and 3 circuits. The slabs should be of such width and length that at every point, the shortest path between the circuits round the concrete should exceed 75 mm.

(*c*) At point(s) of crossing for surface wiring of Category 1, 2 and 3 circuits, a bridge of durable insulating material at least 6 mm thick should be used for separation of circuits. The bridge should overlap the cables of those circuits by at least 25 mm on either side of the point of crossing.

5C Segregation of Category 4 Circuits and Circuits of Other Categories

(*a*) Cables of Category 4 circuits are not allowed to be drawn into the same conduit, duct, ducting or trunking as cables of other circuit categories.

(*b*) Cores of Category 4 circuits and cores of other circuit categories are not allowed to be contained in a common multicore cable, flexible cable or flexible cord.

(*c*) For cables of Category 4 that are installed underground or without any enclosure, the following points should be observed:

(i) A minimum horizontal or vertical separation distance of 300 mm should be provided between Category 4 circuits and circuits of other categories.

(ii) For cables laid underground, if the separation distance of 300 mm cannot be achieved, a reduced separation is acceptable provided a slab of concrete is inserted between the circuits. The slab should be at least 50 mm thick and of such width and length that at every point, the shortest path between the circuits round the concrete should exceed 180 mm.

5D **Segregation of Circuits from Overhead Telecommunication Lines and Telephone Lines**

For overhead telecommunication and telephone lines, reference should be made to relevant parts of the 'Code of Practice—Protection of Communication Networks from Electrical Power Distribution' issued by relevant authorities.

Table 5(1)

Permissible Arrangements for Segregation of Category 1 and Category 2 Circuits (With Enclosures)

Method of Installation	Conditions to be complied with
Different conduits, ducts, ductings or trunkings	—
Common conduit, duct or ducting	Cables of Category 2 circuits should be insulated for the highest voltage present in the Category 1 circuits
Common channel or trunking	(*a*) Cables of Category 2 circuits should be effectively partitioned from cables of Category 1 circuits *OR* (*b*) Cables of Category 2 circuits should be insulated for the highest voltage present in the Category 1 circuits
Common multicore cable, flexible cable or flexible cord	(*a*) Cores of Category 2 circuits should be separated from cores of Category 1 circuits by an earthed metal screen of equivalent current carrying capacity to that of the cores of the Category 1 circuits *OR* (*b*) Cores of Category 2 circuits should be insulated, individually or collectively as a group, for the highest voltage present in the Category 1 circuits

Table 5(2)

Permissible Arrangements for Segregation of Category 3 and Category 1 & 2 Circuits (With Enclosures)

Method of Installation	Conditions to be complied with
Different conduits, ducts, ductings or trunkings	—
Common channel or trunking	(*a*) Cables of Category 3 circuits should be segregated from circuits of other categories by continuous partitions and these partitions should also be provided at any common outlets OR (*b*) Where mineral insulated cables or cables whose performance complies with BS 6387 are used for Category 3 circuits, such a partition is not normally required

Code 6 CIRCUIT ARRANGEMENT

6A Division of Installation into Circuits

6B Basic Requirements of Circuits

(1) Protection

(2) Control

(3) Identification

(4) Electrical separation for essential circuits

(5) Load distribution

(6) Arrangement of neutral conductor

6C Ring Final Circuit Arrangement

6D Final Circuits Using 5A or 15A Socket Outlets to Requirements Prescribed in Appendix 1

6E Final Circuits Using 13A Socket Outlets to Requirements Prescribed in Appendix 2

(1) General

(2) Spurs

(3) Separate circuits

(4) Permanently connected equipment

6F Final Circuits Using 5A, 15A or 30A Industrial Socket Outlets to Requirements Prescribed in Appendix 3

(1) Socket outlets

(2) Accepted practice

6G Final Circuits Using 16A Industrial Socket Outlets to Requirements Prescribed in Appendix 4

(1) Socket outlets

(2) Accepted practice

6H Final Circuits Using 32A, 63A or 125A Industrial Socket Outlets to Requirements Prescribed in Appendix 4

(1) Socket outlets

(2) Accepted practice

Code 6 CIRCUIT ARRANGEMENT

6A **Division of Installation into Circuits**

(*a*) An electrical installation should be divided into circuits where necessary or practicable and each circuit should be separately protected and controlled.

(*b*) A schematic wiring diagram showing the main distribution system should be displayed near the main switch with rating 100A or above.

6B **Basic Requirements of Circuits**

(1) *Protection*

(*a*) Each circuit should be protected by an overcurrent protective device with its operating current value closely related to the current demand of the current using equipment connected or intended to be connected to it and to the current carrying capacity of the conductor connected. This arrangement will avoid danger in the event of a fault by ensuring prompt operation of the protective device at the appropriate current value which will otherwise cause damage to the cable or the current using equipment.

(*b*) A fault on one circuit should not result in the shutting down of any unrelated parts of the installation as far as reasonably practicable.

For this, it is recommended that—

(i) fixed lighting fittings of an installation should be arranged to be fed by two or more final circuits.

(ii) lighting final circuits should be electrically separated from power circuits except that it may be connected to bell transformers or electric clocks.

(iii) power circuits for kitchens should be electrically separated from other power circuits.

(*c*) Where the supply is designed to be taken from more than one transformer, interconnection facilities between the main incoming circuit breakers should be provided if requested by the electricity supplier. All incoming and interconnection circuit breakers should be of 4-pole type interrupting all live conductors (i.e. phase and neutral conductors) and electrically and mechanically interlocked to prevent the electricity supplier's transformers from operating in parallel.

(2) *Control*

Each circuit should be provided with means of interrupting the supply on load and isolation for electrical servicing and testing purposes without affecting other circuits.

(3) *Identification*

(*a*) Protective devices of each circuit should be clearly labelled or identified so that the rating of the devices and the circuits they protect can be easily recognised.

(*b*) Every socket in a three phase installation should be marked with the appropriate phase colour in a permanent manner.

(4) *Electrical separation for essential circuits*

Final circuits for emergency lighting, fire fighting equipment and fireman's lift should be electrically separated from one another and from other circuits.

(5) *Load distribution*

Single phase loads in an installation with a three phase supply should be evenly and reasonably distributed among the phases.

(6) *Arrangement of neutral conductor*

(*a*) Neutral conductor of a single phase circuit should not be shared with any other circuit.

(*b*) Neutral conductor of a three phase circuit should only be shared with its related phases in a three phase four wire system.

(*c*) For a polyphase circuit, the neutral conductor should have a suitable current carrying capacity to cater for any imbalance or harmonic currents which may occur in normal services.

6C Ring Final Circuit Arrangement

(*a*) The circuit conductor of a ring circuit should be run in the form of a ring, commencing from the origin of the circuit in the distribution board, looping into the terminal of socket outlets connected in the ring, and returning to the same point of the circuit as illustrated in Figure 6(1).

(*b*) The circuit protective conductor of a ring circuit (other than formed by the metal coverage or enclosure containing all conductors of the ring circuit) should also be run in the form of a ring having both ends connected to the earthing terminal at the origin of the circuit.

(*c*) When two or more ring final circuits are installed, socket outlets and equipment to be served by these circuits should be evenly and reasonably distributed among these separate ring final circuits.

6D Final Circuits Using 5A or 15A Socket Outlets to Requirements Prescribed in Appendix 1

(*a*) Radial final circuits should be used.

(*b*) Each 5A and 15A socket outlet should be individually connected and protected by a high breaking capacity (HBC) fuse or miniature circuit breaker (MCB) of rating 5A and 15A respectively.

6E Final Circuits Using 13A Socket Outlets to Requirements Prescribed in Appendix 2

(1) *General*

(*a*) Ring or radial final circuits should be used.

(*b*) The circuit, with spurs if any, may feed permanently connected equipment and an unlimited number of socket outlets in a limited floor area determined by Table 6(1). A typical circuit is illustrated in Figure 6(2).

(2) *Spurs*

(*a*) For a final circuit in compliance with Table 6(1), the number of fused spurs connected is unlimited but the number of non-fused spurs should not exceed the total number of socket outlets and fixed equipment permanently connected in the circuit.

(*b*) A non-fused spur should feed only one single or one twin socket outlet or one permanently connected equipment. Such a spur should be connected to a circuit at the terminals of socket outlets or at joint boxes or at the origin of the circuit in the distribution board.

(*c*) A fused spur should be connected to the circuit through a fused connection unit, with the rating of the fuse not exceeding that of the cable forming the spur, and not exceeding 13A in any event.

(3) *Separate circuits*

Separate circuits are to be used for:

(*a*) socket outlets and fixed appliances in kitchens;

(*b*) electric water heaters;

(*c*) permanently connected space heaters; and

(*d*) air-conditioning units.

(4) *Permanently connected equipment*

Equipment, except shaver supply unit complying with BSEN 60742 or equivalent, connected permanently (i.e. not through a plug-socket arrangement) to a final circuit arranged in accordance with Table 6(1) should be locally protected by a fuse of rating not exceeding 13A and should be controlled by a switch in a readily accessible position or protected by a miniature circuit breaker of rating not exceeding 16A. This is illustrated in Figure 6(3).

6F Final Circuits Using 5A, 15A or 30A Industrial Socket Outlets to Requirements Prescribed in Appendix 3

(1) *Socket outlets*

These are protected type non-reversible socket outlets. Socket outlet without a key and a keyway is for use with non-fused plug and an exclusive radial final circuit must be used for the socket outlet. Socket outlet with a key and a keyway is for use with fused plug.

(2) *Accepted practice*

(*a*) Either radial or ring final circuits may be used.

(*b*) The current demand of the equipment fed by the circuit will depend on the type of equipment and the operational requirements, and should not exceed the rating of the overcurrent protective device. In assessing the current demand, no diversity is allowed for permanently connected equipment.

(*c*) The overcurrent protective device should have a rating not exceeding 32A.

(*d*) The number of socket outlets can be unlimited.

(*e*) The total current demand of socket outlets served by a fused spur should not exceed 16A.

(*f*) A fused spur should be connected to a circuit through a fused connection unit with the rating of the fuse in the unit not exceeding that of the cable forming the spur and, in any event, not exceeding 16A.

(*g*) Non-fused spurs should not be used.

(*h*) Equipment permanently connected to a circuit should be locally protected and controlled by a fuse of rating not exceeding 16A together with a switch, or by a miniature circuit breaker of rating not exceeding 16A.

(*i*) Figure 6(4) illustrates such a circuit arrangement.

6G Final Circuits Using 16A Industrial Socket Outlets to Requirements Prescribed in Appendix 4

(1) *Socket outlets*

These are industrial socket outlets with retaining devices for either indoor or outdoor applications and are for single-phase or three-phase supplies.

(2) *Accepted practice*

(*a*) Only radial final circuits should be used.

(*b*) Fused or non-fused spur is not allowed.

(*c*) The current demand of the equipment fed by the circuit will depend on the type of equipment and the operational requirements, and should not exceed the rating of the overcurrent protective device.

(*d*) The overcurrent protective device should have a rating not exceeding 20A.

(*e*) The number of socket outlets can be unlimited.

(*f*) Figure 6(5) illustrates such a circuit arrangement.

6H **Final Circuits Using 32A, 63A or 125A Industrial Socket Outlets to Requirements Prescribed in Appendix 4**

(1) *Socket outlets*

These are industrial socket outlets with retaining devices for either indoor or outdoor applications and are for single phase or three phase supplies.

(2) *Accepted practice*

(*a*) Only exclusive radial final circuits should be used.

(*b*) The number of socket outlets in a final circuit should not be more than one.

(*c*) The overcurrent protective device should have a rating not exceeding the rating of the socket outlet or that of the cable forming the circuit.

Table 6(1)

Final Circuits Using 13A Socket Outlets Complying to Requirements Prescribed in Appendix 2

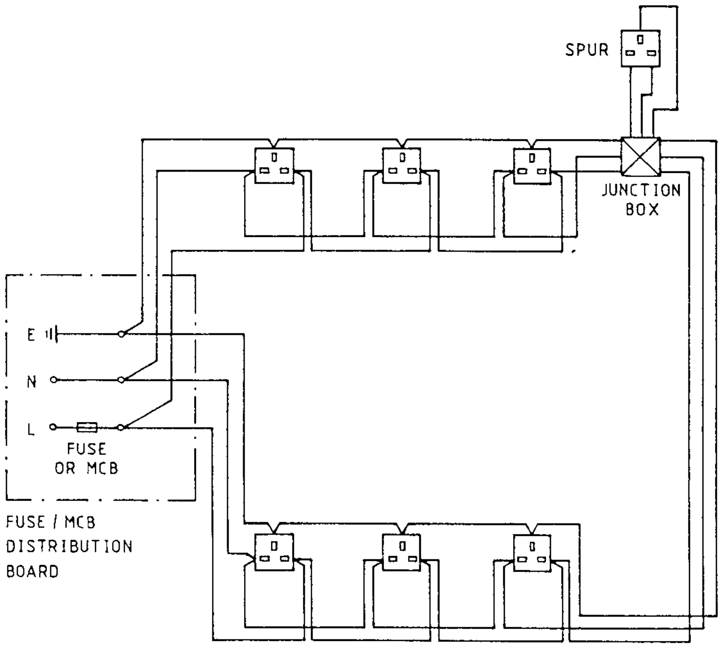
Type of Circuit	Rating of Overcurrent Protective Device (HBC fuse or Miniature Circuit Breaker)	Min. Copper Conductor Size of Rubber or PVC Insulated Cable for the Circuit and Non-fused Spur (Note)	Maximum Floor Area Served
	(Ampere)	(mm^2)	(m^2)
A1 Ring	30 or 32	2.5	100
A2 Radial	30 or 32	4	50
A3 Radial	20	2.5	20

Note: 1. If cables of two or more circuits are bunched together or the ambient air temperature exceeds 30°C the size of conductor should be increased and appropriate correction factors (see Appendix 5) should be applied such that the conductor size should correspond to a current carrying capacity not less than:

(i) 20A for A1 or A3 circuits

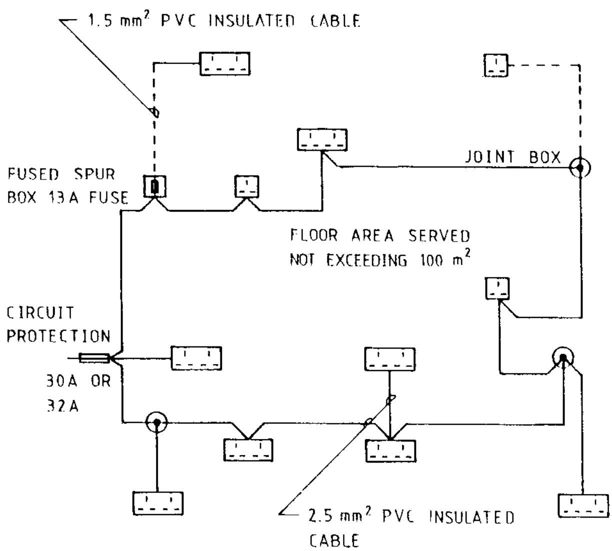
(ii) 30A or 32A for A2 circuits

2. The conductor size of a fused spur should be determined from the total current demand served by that spur, which is limited to a maximum of 13A. When such spur serves socket outlets, the minimum conductor size is 1.5 mm^2 for rubber or PVC insulated cables, copper conductors.



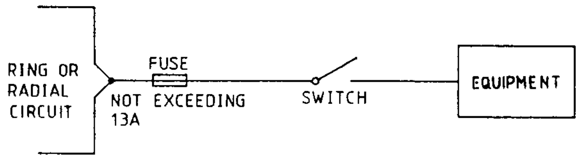
ARRANGEMENT OF CIRCUIT CONDUCTORS OF A RING CIRCUIT

CODE No.	FIGURE No.	
6	6(1)	

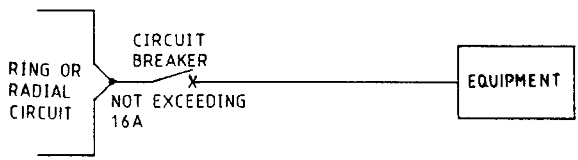


TYPICAL FINAL CIRCUIT USING 13 AMPERE SOCKET OUTLETS

CODE No.	FIGURE No.	
6	6(2)	



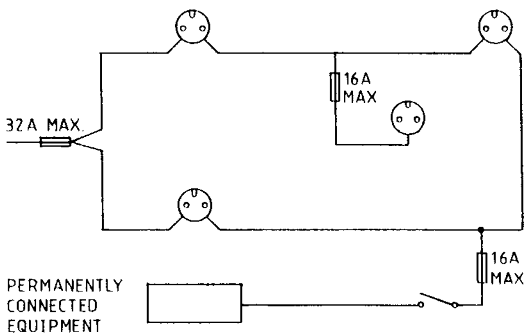
(A) FUSE PROTECTION



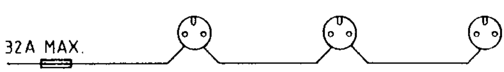
(B) CIRCUIT BREAKER PROTECTION

PERMANENTLY CONNECTED EQUIPMENT IN A FINAL CIRCUIT USING 13 AMPERE SOCKET OUTLETS

CODE No.	FIGURE No.	
6	6(3)	



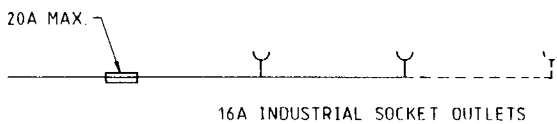
(A) RING CIRCUIT



(B) RADIAL CIRCUIT

CIRCUIT ARRANGEMENT FOR FINAL CIRCUITS USING 5 AMPERE, 15 AMPERE OR 30 AMPERE INDUSTRIAL SOCKET OUTLETS

CODE No.	FIGURE No.	
6	6(4)	



CIRCUIT ARRANGEMENT FOR FINAL CIRCUITS USING 16 AMPERE INDUSTRIAL SOCKET OUTLETS

CODE No.	FIGURE No.	
6	6(5)	

Code 7 CURRENT DEMAND

7A Current Demand of a Circuit

7B Determination of Current Demand

- (1) General
- (2) For circuit supplying non-simultaneous or cyclic loads
- (3) For final circuits
- (4) For circuits supplying a number of final circuits

Code 7 CURRENT DEMAND

7A Current Demand of a Circuit

The current rating of a circuit should not be less than the current demand of the circuit.

7B Determination of Current Demand

(1) *General*

The information and values given in this CoP for determination of current demand are intended for general guidance only as it is impossible to specify the appropriate allowances for diversity for every type of electrical installations.

(2) *For circuit supplying non-simultaneous or cyclic loads*

For a circuit having non-simultaneous or cyclic loads such that only one of these loads can be in use at any one time, the greatest of these loads should be used in calculating the current demand of the circuit.

(3) *For final circuits*

To determine the current demand of a final circuit, the following methods should be used:

(*a*) For standard final circuits designed in accordance with Code 6, the current demand of the circuit concerned should be the same as the rating of the overcurrent protective device of the circuit.

(*b*) The current demand of a final circuit other than subparagraph (*a*) should be assessed by summating the assumed current demands of current using equipment connected or intended to be connected as follows:

(i) each socket outlet in a radial final circuit should be assumed to demand its rated current rating;

(ii) lighting outlets should be assumed to demand the connected load with a minimum of 100W per lampholder;

(iii) electric clock, shaver socket outlet, bell transformer, and current using equipment of a rating not greater than 5 VA may be neglected;

(iv) discharge lighting should be assumed to have a demand in volt-amperes of the rated lamp wattage multiplied by not less than 1.8. This multiplier is based upon the assumption that the circuit is corrected to a power factor of not less than 0.85 lagging, and takes into account control gear losses and harmonic currents; and

(v) all other fixed equipment should be assumed to demand the rated or normal current.

(4) *For circuits supplying a number of final circuits*

The current demand of a circuit supplying a number of final circuits may be determined by applying the allowances for diversity given in Table 7(1) to the total current demand of all the equipment connected to the circuit and not by summating the current demands of the individual final circuits obtained according to paragraph (3).

While using Table 7(1), the following points should be noted:

(*a*) Table 7(1) applies only to low voltage installations having a current demand not exceeding 400A in each phase.

(*b*) For installations having a current demand exceeding 400A per phase, the allowances for diversity should be assessed by a grade B or grade C registered electrical worker as appropriate.

(*c*) In Table 7(1) the allowances are expressed either as a percentage of the current demand or, where followed by the letters f.l., as a percentage of the rated full load current of the current using equipment.

(*d*) Table 7(1) does not apply to installations in factories and industrial undertakings. Allowances for diversity of such installations will depend on the type of plant and machinery and their operational requirements.

Table 7(1)

Allowance for Diversity

This table is applicable to installations having a current demand not exceeding 400 A in each phase.

Purpose of Conductors or Switchgear to which Diversity Applies	Type of Premises		
	Individual Household Installations, Individual Dwellings of a Block	Small shops, Stores, Offices and Business Premises	Small Hotels, Boarding Houses, Guest Houses, etc.
1. Lighting	66% of total current demand	90% of total current demand	75% of total current demand
2. Heating and Power (Also see 3 to 10 below)	100% of total current demand up to 10 amperes+50% of any current demand in excess of 10 amperes	100% f.l. of largest appliance+75% f.l. of remaining appliances	100% f.l. of largest appliance+80% f.l. of 2nd largest appliance+60% f.l. of remaining appliances
3. Cooking Appliances	10 amperes+30% f.l. of connected cooking appliances in excess of 10 amperes+5 amperes if socket outlet incorporated in unit	100% f.l. of largest appliance+80% f.l. of 2nd largest appliance+60% f.l. of remaining appliances	100% f.l. of largest appliance+80% f.l. of 2nd largest appliance+60% f.l. of remaining appliances

Purpose of Conductors or Switchgear to which Diversity Applies	Type of Premises		
	Individual Household Installations, Individual Dwellings of a Block	Small shops, Stores, Offices and Business Premises	Small Hotels, Boarding Houses, Guest Houses, etc.
4. Motors (other than lift motors, see 8)	—	100% f.l. of largest motor+80% f.l. of 2nd largest motor+ 60% f.l. of remaining motors	100% f.l. of largest motor+50% f.l. of remaining motors
5. Water-Heaters (instantaneous type)	100% f.l. of largest appliance+100% f.l. of 2nd largest appliance+25% f.l. of remaining appliances	100% f.l. of largest appliance+100% f.l. of 2nd largest appliance+25% f.l. of remaining appliances	100% f.l. of largest appliance+100% f.l. of 2nd largest appliance+25% f.l. of remaining appliances
6. Water Heaters (thermostatically controlled)	No diversity allowable Note: It is important to ensure that the distribution board is of sufficient rating to take the total load connected to it without the application of any diversity.		
7. Thermal Storage Space Heating Installations			
8. Lift motors	Note: Subject to requirements specified by the lift engineer registered under Cap. 327, Lifts & Escalators (Safety) Ordinance.		
9. Water Pumps	100% f.l. of the largest pump motor and 25% of the remaining motors		
10. Air conditioners	100% f.l. of the air-conditioner(s) in the bed-room(s) or in the living room(s), whichever is larger and 40% f.l. of the remaining air-conditioner(s)	100% of current demand of largest point of utilisation+ 75% of current demand of every other point of utilisation	100% of current demand of largest point of utilisation+ 75% of current demand of every other point of utilisation
11. Arrangements of Final Circuits in accordance with code 6D	100% of current demand of largest circuit+30% of current demand of every other circuit	100% of current demand of largest circuit+ 40% of current demand of every other circuit	
12. Arrangements of Final Circuits in accordance with code 6E	100% of current demand of largest circuit+40% of current demand of every other circuit	100% of current demand of largest circuit+ 50% of current demand of every other circuit	
13. Fixed Equipment of the same type e.g. Refrigerators and freezers other than those listed above	100% of current demand of largest point of utilisation+ 40% of current demand of every other point of utilisation	100% of current demand of largest point of utilisation+ 75% of current demand of every other point of utilisation	100% of current demand of largest point of utilisation+ 75% of current demand of every point in main rooms (dining rooms, etc.) + 40% of every other point of utilisation

Code 8 ISOLATION AND SWITCHING

8A Provision of Isolation and Switching

(1) General installation

(2) Appliance, equipment or luminaire

(3) Unguarded moving parts

(4) Electric motors

(5) Switching off for mechanical maintenance

(6) Emergency switching

8B Requirements of Isolation and Switching Devices

(1) General

(2) Isolating devices

(3) Devices for switching off for mechanical maintenance

(4) Devices for emergency switching

Code 8 ISOLATION AND SWITCHING

8A **Provision of Isolation and Switching**

(1) *General installation*

(*a*) An installation must be provided with a main switch or circuit breaker and a means of isolation to cut off all voltages. These two functions may be incorporated in a single device. The main switch or circuit breaker should interrupt all live conductors (i.e. phase and neutral conductors) and be capable of cutting off the full load current of the installation from supply. For a 3-phase 4-wire a.c. supply, a linked switch or linked circuit breaker may be arranged to disconnect the phase conductors only and in such case, a link should be inserted in the neutral conductor and securely fixed by bolts or screws.

(*b*) For an installation serving more than one building, the installation inside separate buildings should be treated as a separate installation, and a separate main switch or circuit breaker and a separate means of isolation for each building are required as in subparagraph (*a*).

(*c*) Every circuit or group of circuits must be provided with:

(i) a means of isolation; and

(ii) a means of interrupting the supply on load.

(*d*) Where a standby generator is installed, electrically and mechanically interlocked 4-pole changeover devices should be used for interconnection between the normal and standby sources to ensure that any neutral unbalance and fault current return to the correct source of supply.

(*e*) Under no circumstances must a means of isolation or a switching device be provided in a protective conductor.

(*f*) A circuit breaker used to receive supply direct from the electricity supplier's transformer should normally be of draw-out type. An isolator may be used in conjunction with a fixed type circuit breaker provided that it is mechanically interlocked with the circuit breaker.

(2) *Appliance, equipment or luminaire*

(*a*) An appliance, equipment or luminaire, other than that connected by means of a plug and socket outlet should be provided with a means of interrupting the supply on load.

(*b*) For electric discharge lighting installation operating normally at an open-circuit voltage exceeding low voltage, an effective local means for isolation of the circuit from supply (such means being additional to the switch normally used for controlling the circuit) should be provided for the isolation of every self-contained luminaire, or of every circuit supplying luminaires at a voltage exceeding low voltage.

(3) *Unguarded moving parts*

An installation where it is necessary for a person or persons to enter or work in close proximity with normally unguarded moving parts which may constitute a hazard should be provided with a means of isolation near the moving parts in addition to any emergency switching provided.

(4) *Electric motors*

Electric motors except exhaust fans having rated power not exceeding 50W and servo-motors should be provided with:

(*a*) means of isolation suitably placed and so connected that all voltages may thereby be cut off from the motor and all apparatus including any automatic circuit breaker used therewith. If this means of isolation is remote from a motor, an additional means of isolation adjacent to the motor should be installed or alternatively provision should be made so that the means of isolation can be secured against inadvertent operation as required by Code 8B(2)(*e*);

(*b*) means for starting and stopping, suitably placed for ready operation; and

(*c*) means to prevent automatic restarting after a stoppage due to drop in voltage or failure of supply, where unexpected restarting of the motor might cause danger. Such means is not required where the failure of the motor to start after a brief interruption of the supply would be likely to cause greater danger, e.g. motors driving a ventilation fan of a fire protection system. This requirement does not preclude any arrangement for starting a motor at intervals by an automatic control device, where other adequate precautions are taken against danger from unexpected restarting, e.g. various sequential drives in an automatic processing plant.

(5) *Switching off for mechanical maintenance*

Means of switching off for mechanical maintenance must be provided where mechanical maintenance may involve a risk of burns or a risk of injury from mechanical movement. These include every circuit supplying:

(*a*) an electric motor;

(*b*) electrical heating equipment;

(*c*) electromagnetic equipment which may cause mechanical accidents;

(*d*) luminaires (lamp replacement and cleaning are included as mechanical maintenance); and (*e*) any other electrically energised equipment from which possible mechanical or heat hazards can arise from the use of electrical energy.

(6) *Emergency switching*

Means for emergency switching should be provided for the purpose of cutting off the appropriate supply to the circuit concerned as rapidly as possible in order to obviate or to remove a dangerous condition as soon as it becomes apparent. A typical example where means for emergency switching should be provided is a machine driven by electrical means which may give rise to danger.

8B **Requirements of Isolation and Switching Devices**

(1) *General*

Where a common device is used to perform one or more of the following functions:

(*a*) means of isolation;

(*b*) means of switching off for mechanical maintenance;

(*c*) means of emergency switching,

the arrangement and characteristics of the device should satisfy all the requirements of this Code 8 for the various functions concerned.

(2) *Isolating devices*

(*a*) An isolating device should be capable of:

(i) opening and closing all live conductors (i.e. phase and neutral conductors) of the circuit under no-load condition provided that, for a 3-phase 4-wire a.c. supply, a linked isolator may be arranged to disconnect the phase conductors only and in such case, a link should be inserted in the neutral conductor and securely fixed by bolts or screws;

(ii) carrying the normal circuit current;

(iii) carrying for a specified time abnormal currents which may occur during an overcurrent condition (i.e. overload or short-circuit);

(iv) providing sufficient isolating distances between contacts or other means of isolation when in open position not less than that determined for an isolator (disconnector) in accordance with IEC 60947-3;

(v) giving isolating distance between contacts of the device that should be visible or be clearly and reliably indicated by “off” or “open” marking. Such indication should only occur when the isolating distance between open contacts on each pole of the device has been attained; and

(vi) not being unintentionally or automatically reclosed.

(*b*) The following devices satisfying subparagraph (*a*) are acceptable as means of isolation:

(i) isolators (disconnectors),

(ii) fuse switches and switch-fuses,

(iii) links, including fuse-links and fuse cut-outs,

(iv) plugs and socket outlets,

(v) cable couplers,

(vi) circuit breakers, including miniature circuit breakers (MCB), moulded case circuit breakers (MCCB) and residual current circuit breakers (RCCB).

(*c*) Emergency stop push button and semiconductor devices, such as a 'touch control switch' or 'photo-electric switch', must not be used for isolation.

(*d*) An isolating device should be near to the equipment it controls. Where the isolating device is not near to the equipment it controls, provision should be made so that the means of isolation can be secured against inadvertent reclosure during the operation for which it is intended. The main isolating device must be so arranged that it can only be closed by an electrical worker who will ensure that it is safe to close before doing so. Such a main isolating device must be capable of being locked at 'ON' or 'OFF' position, or must have a removable handle. The key or the handle must be non-interchangeable with those used for a similar purpose within the installation to prevent unauthorised operation.

(*e*) All isolating devices should be readily accessible and clearly identifiable to indicate the circuit or equipment which they isolate.

(3) *Devices for switching off for mechanical maintenance*

(*a*) A device used for switching off for mechanical maintenance should:

(i) be capable of being manually operated;

(ii) provide clearance between open contacts of the device that should be visible or be clearly and reliably indicated by "off" or "open" marking. Such indication should only occur when the "off" or "open" position on each pole of the device has been attained;

(iii) be selected or installed in such a way to prevent unintentional or automatical reclosure;

(iv) be capable of cutting off the full load current of the relevant part of the installation; and

(v) be readily accessible for operation.

(*b*) The following devices satisfying subparagraph (*a*) are acceptable as means for switching off for mechanical maintenance:

(i) switches,

(ii) circuit breakers,

(iii) control switches operating contactors,

(iv) plugs and socket outlets.

(4) *Devices for emergency switching*

(*a*) Means for emergency switching should be operated by a single initiative action only to cause the removal of the danger by cutting off the appropriate supply.

(*b*) Means of interrupting the supply for the purpose of emergency switching should be capable of cutting off the full load current of the relevant part of the installation.

(*c*) Emergency switches for operating the devices should be:

(i) clearly marked;

(ii) preferably coloured red; and

(iii) installed in a readily accessible position where danger might occur.

(*d*) The following devices satisfying subparagraph (*c*) are acceptable as emergency switches:

(i) switch in the main circuit (e.g. fireman's switch for high voltage discharge lighting installation),

(ii) push button and the like in a control or auxiliary circuit (e.g. emergency stop for machinery).

(*e*) Plugs and socket outlets are not acceptable as means of emergency switching.

(*f*) Fireman's emergency switch should:

(i) be coloured red and have fixed on or near it a permanent durable nameplate marked with the words '消防員開關掣 FIREMAN'S SWITCH' (the nameplate should have a minimum size of 150 mm by 100 mm and the lettering should be easily legible from a distance appropriate to the site conditions but in no case less than 13 mm high);

(ii) have its 'ON' and 'OFF' positions clearly indicated by lettering legible to a person standing on the ground at the intended site, with the 'OFF' position at the top;

(iii) be provided with a device to prevent the switch being inadvertently returned to the 'ON' position; and

(iv) be arranged to facilitate operation by a fireman.

Code 9 OVERCURRENT PROTECTIVE DEVICES

9A General Requirements

(1) Overcurrent protection for circuit

(2) Examples of overcurrent protective devices

(3) Requirements of overcurrent protective devices

9B Relation Between Circuit Conductors and Overcurrent Protective Devices

(1) Overload protective devices

(2) Faults current protective devices

9C Breaking Capacity of Overcurrent Protective Devices

(1) Overload protective devices

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9D Position of Overcurrent Protective Devices

(1) General

(2) Overload protective devices

(3) Fault current protective devices

9E Other Requirements of Overcurrent Protective Devices

Code 9 OVERCURRENT PROTECTIVE DEVICES

9A General Requirements

(1) *Overcurrent protection for circuit*

Every circuit must be protected by one or more devices for automatic interruption of the supply in the event of overcurrent resulting from:

(*a*) overload, or

(*b*) fault.

(2) *Examples of overcurrent protective devices*

The following devices are acceptable as protective devices against overcurrent:

(*a*) Miniature Circuit Breakers (MCB)

(*b*) Moulded Case Circuit Breakers (MCCB)

(*c*) High Breaking Capacity (HBC) Fuses

(*d*) Semi-enclosed Fuses

(*e*) Circuit Breakers incorporating overcurrent release, or in conjunction with fuse.

(3) *Requirements of overcurrent protective devices*

(*a*) Overload protective devices and fault current protective devices should satisfy the requirements of Codes 9B, 9C, 9D and 9E.

(*b*) For devices providing protection against both overload current and fault current, they should satisfy both the requirements of overload protective devices and fault current protective devices.

(*c*) The characteristics of devices for overload protection should be coordinated so that the energy let-through by the fault current protective device does not exceed that which can be withstood by the overload protective device without damage. For a circuit incorporating a motor starter, this CoP does not preclude the type of co-ordination described in IEC 60947-4-1, in respect of which the advice of the manufacturer of the starter should be sought.

9B Relation Between Circuit Conductors and Overcurrent Protective Devices

(1) *Overload protective devices*

(*a*) Overload protective devices should be capable of breaking any overload current flowing in the circuit conductors before such a current could cause a temperature rise detrimental to insulation, joints, terminations, or surroundings of the conductors.

(*b*) The nominal current or current setting of the devices should not be less than the design current of the circuit.

(*c*) The nominal current or current setting of the devices should not exceed the lowest of the current carrying capacities of any of the conductors in the circuit.

(*d*) The current causing effective operation of the devices should not exceed 1.45 times the lowest of the current carrying capacities of any of the conductors of the circuit.

(*Note:* (i) If the device is a fuse to BS88 part 2 or part 6 or BS1361 or a circuit breaker to IEC 60898 or equivalent satisfying requirement (*c*), it is also considered to have satisfied requirement (*d*).

(ii) If the device is a semi-enclosed fuse to BS3036, compliance with requirement (*d*) is afforded if its nominal current does not exceed 0.725 times the current carrying capacity of the lowest rated conductor in the circuit protected.)

(*e*) When the same protective device protects conductors in parallel, other than that of ring circuits, the value for 'the lowest of the current carrying capacities' mentioned in subparagraphs (*c*) and (*d*) may be taken as the sum of the current carrying capacities of those conductors in parallel provided that those conductors:

(i) are of the same construction, material and cross-sectional area, and are approximately the same length, and appropriate phase disposition;

(ii) have no branch circuits throughout their length; and

(iii) are arranged so as to carry substantially equal currents.

(2) *Fault current protective devices*

(*a*) Fault current protective devices should be capable of breaking any fault current in the conductors of each circuit before such current could cause danger due to thermal and mechanical effects produced in conductors and connections.

(*b*) The devices should be able to interrupt all currents caused by a fault occurring at any point of the circuit in a time not exceeding that which brings the cable conductors to their limiting final temperature.

(*Note:* Table 9(1) gives the limiting final temperatures for some common materials.)

9C **Breaking Capacity of Overcurrent Protective Devices**

(1) *Overload protective devices*

Overload protective devices may have a breaking capacity below the value of the prospective fault current at the point where the device is installed provided that such devices are protected against fault current.

(2) *Fault current protective devices*

(*a*) Fault current protective devices should have a breaking capacity not less than the prospective fault current at the point where the device is installed except if the following requirement in subparagraph (*b*) applies.

(*b*) The device may be permitted to have a lower breaking capacity provided that another protective device having the necessary breaking capacity is installed on the supply side. The characteristics of the devices should be coordinated so that the energy let-through of these two devices will not cause damage to the load side device and the conductors protected by these devices.

(*c*) The breaking capacities of protective devices against fault current should be assessed for all installations. Table 9(2) shows the minimum breaking capacities for general guidance only.

9D **Position of Overcurrent Protective Devices**

(1) *General*

Overcurrent protective devices should be located in places readily accessible for maintenance.

(2) *Overload protective devices*

(*a*) Overload protective devices, subject to subparagraph (*b*), should be placed where a reduction occurs in the value of current carrying capacity of the conductors of the installation.

(*b*) The device may be placed at any point along the run of those conductors provided that the part of run between the point where the value of current carrying capacity is reduced and the position of the protective device has no branch circuits or outlets for the connection of current using equipment.

(3) *Fault current protective devices*

(*a*) Fault current protective devices, subject to subparagraph (*b*) and (*c*), should be placed where a reduction occurs in the value of current carrying capacity of the conductors of the installation.

(*b*) The device may be placed at any point along the run of those conductors provided that between the point where the value of current carrying capacity is reduced and the position of the protective device provided that the conductors are:

(i) not exceed 3m in length, and

(ii) be erected in such a manner as to reduce the risk of fault, fire or danger to persons to a minimum.

(*c*) The device may be placed at a point other than specified in subparagraph (*a*) provided that the conductors between the device and the point of reduction in current carrying capacity are adequately protected against fault current according to Code 9B(2) by a fault current protective device installed on the supply side of the point of reduction.

9E **Other Requirements of Overcurrent Protective Devices**

(*a*) Overcurrent protective devices should be placed in enclosure that are free from easily ignitable materials.

(*b*) Every overcurrent protective device should be provided on or adjacent to it an indication of its intended nominal current as appropriate to the circuit it protects.

(*c*) Fuses which are likely to be removed or replaced whilst the circuits they protect are energised, should be of a type such that they can be thus removed or replaced without danger.

(*d*) Suitable tools for safe withdrawal of fuses at a fuse board should be provided where necessary.

(*e*) Where circuit breakers may be operated by persons other than a registered electrical worker, they should be designed or installed so that it is not possible to modify the setting or the calibration of their overcurrent releases without a deliberate act involving either the use of a key or tool. A visible indication of the setting or calibration is recommended.

(*f*) Operating handles of circuit breakers should be made accessible without opening any door or cover giving access to live parts.

(*g*) All linked circuit breakers for overcurrent protection of equipment run on polyphase supply must be purposely designed by the manufacturer to enable breaking of all related phase conductors simultaneously. Any modified miniature circuit breaker to achieve as a linked circuit breaker is not acceptable.

(*h*) When a consumer's main switch or circuit breaker is connected directly to the electricity supplier's distribution transformer, the overcurrent protection should discriminate with the electricity supplier's high voltage protection settings.

Table 9(1)

Limiting Final Temperatures for Common Materials

Conductor material	Insulation material	Assumed initial temperature °C	Limiting final temperature °C
Copper	70°C thermoplastic (general purpose pvc) 90°C thermoplastic (pvc) 60°C thermosetting (rubber) 85°C thermosetting (rubber) 90°C thermosetting Impregnated paper	70 90 60 85 90 80	160/140* 160/140* 200 220 250 160
Copper	Mineral —plastic covered or exposed to touch —bare and neither exposed to touch nor in contact with combustible materials	 70 (sheath) 105 (sheath)	 160 250
Aluminium	70°C thermoplastic (general purpose pvc) 90°C thermoplastic (pvc) 60°C thermosetting (rubber) 85°C thermosetting (rubber) 90°C thermosetting Impregnated paper	70 90 60 85 90 80	160/140* 160/140* 200 220 250 160

* Where two values of limiting final temperature are given the lower value relates to cables having conductors of greater than 300 mm² cross-sectional area.

Table 9(2)

Minimum Breaking Capacities of Overcurrent Protective Devices

Types of supply to which the protective devices are connected	Current rating of back-up fuses (if provided) to BS 88 or equivalent	Minimum three phase breaking capacities of the protective devices
(i) Supply directly taken from the transformer within the premises in which the installation is situated.	no back-up fuse fitted	40 kA
	not exceeding 160A	4.5 kA (with back-up fuses)
	exceeding 160A but not exceeding 400A	23 kA (with back-up fuses)
(ii) Supply tapped from busbar rising mains (for cable rising mains, the breaking capacities may be smaller in value depending on the design)	not exceeding 160A	4.5 kA (with back-up fuses)
	exceeding 160A but not exceeding 400A	23 kA (with back-up fuses)
	no back-up fuse fitted	not less than the prospective fault current shown in Table 9(3)
(iii) Supply taken from electricity supplier's service box or overhead line	not exceeding 160A	4.5 kA (with back-up fuses)
	exceeding 160A but not exceeding 400A	18 kA (with back-up fuses)

(*Note:* The single phase breaking capacity should be assessed by registered electrical workers of the appropriate grade)

Table 9(3)

Approximate Prospective Fault Current at Tap-off Positions of Busbar Rising Mains Installation in kA (kilo-Amperes)

Length of Busbars (metres)	Rating of Rising Mains			
	200–300A	400–500A	600–800A	1000–2500A
	kA	kA	kA	kA
10	24	26	30	33
13	22	25	30	33
16	21	24	30	33
19	20	23	28	33
22	18	22	28	33
25	18	22	28	33
28	17	21	26	30
31	16	20	26	30
34	15	20	26	30
37	15	19	26	30
40	14	18	24	30
43	13	18	24	30
46	13	17	24	30
49	12	17	24	30
52	12	17	24	28
55	11	16	24	28
58	11	16	22	28
61	11	15	22	28
64	10	15	22	28
67	10	15	22	28
70	10	14	22	28
73	9	14	22	28
76	9	14	20	26
79	9	13	20	26
82	9	13	20	26
85	8	13	20	26
88	8	13	20	26
91	8	12	20	26
94	8	12	20	26
97	7	12	20	26

(*Note:* The information and values given in this Table are intended for general guidance only as the prospective fault current will vary for different kinds of busbars)

Table 9(4)

Classification of MCB to IEC 60898 according to the instantaneous tripping current

Type	Instantaneously Tripping Current
B	$3\ I_n < I \leq 5\ I_n$
C	$5\ I_n < I \leq 10\ I_n$
D	$10\ I_n < I \leq 20\ I_n$

Code 10 NEUTRAL CONDUCTOR PROTECTIVE DEVICES, ISOLATORS AND SWITCHES

10A Linked Circuit Breakers, Linked Isolators and Linked Switches

10B Protection of Neutral Conductor

10C Single-pole Switch in Earthing Conductor

Code 10 NEUTRAL CONDUCTOR PROTECTIVE DEVICES, ISOLATORS AND SWITCHES

10A **Linked Circuit Breakers, Linked Isolators and Linked Switches**

(*a*) Any linked circuit breaker, linked switch or linked isolator with switched neutral should be arranged to have the neutral pole contact open after the phase pole contacts and should close before or at the same time as the phase pole contacts.

(*b*) No fuse, circuit breaker, isolator or switch, other than a linked circuit breaker, linked isolator or linked switch, should be inserted in a neutral conductor.

10B **Protection of Neutral Conductor**

A single pole switch should be inserted in the phase conductor of a single phase circuit only. No fuse, circuit breaker, isolator or switch, other than a linked circuit breaker, linked isolator or linked switch should be inserted in a neutral conductor.

10C **Single-pole Switch in Earthing Conductor**

Notwithstanding Code 10B, a single-pole switch may be inserted between the earthing connection and the neutral terminals of generators running or likely to be running in parallel if it is recommended by the manufacturer and adequate precautions have been taken to avoid danger.

Code 11 EARTH LEAKAGE AND EARTH FAULT CURRENTS

Code 11 EARTH LEAKAGE AND EARTH FAULT CURRENTS

11A **General**

This Code describes one of the means for protection against indirect contact (i.e. contact with exposed conductive parts made live by a fault and which may result in electric shock):—earthed equipotential bonding and automatic disconnection of supply. Other relevant methods for protection against indirect contact in accordance with IEC 60364, BS 7671 or other relevant international standard practices are also acceptable.

11B **Basic Requirements**

(*a*) The characteristics of the protective devices for automatic disconnection, the earthing arrangements for the installation and the relevant impedances of the circuits concerned should be coordinated so that during an earth fault, the voltages on any exposed conductive parts and between simultaneously accessible exposed and extraneous conductive parts occurring anywhere in the installation should be of such magnitude and duration as not to cause danger. Conventional means of compliance with the above requirements are given in this Code but other equally effective means shall not be excluded.

(*b*) Subparagraph (*a*) is considered to be satisfied if:

(i) for circuits supplying socket outlets, every circuit is protected by a residual current device having a rated residual current not exceeding 30 mA.

(ii) for circuits supplying only fixed equipment within the equipotential zone, the earth fault loop impedance at every point of utilisation is such that disconnection occurs within 5 seconds.

(iii) for circuits supplying fixed equipment outside the equipotential zone, the earth fault loop impedance at every point of utilisation is such that disconnection occurs within 0.4 second.

(iv) for installations supplied from overhead line system, the installations are protected against earth leakage by residual current device.

(v) for distribution boards supplying circuits for both socket outlets and fixed equipment, the impedance of the protective conductor between the distribution board and the point at which the protective conductor is connected to the main equipotential bonding does not exceed 50 Zs/Uo ohms, where Zs is the earth fault loop impedance corresponding to a disconnection time of 5 sec.; or alternatively, equipotential bonding provided at the distribution board in accordance with Code 11E is also acceptable.

(*c*) Protective devices for automatic disconnection should be provided by means of one or more of the following types, as appropriate:
  (i) overcurrent protective devices in compliance with regulation 9.
  (ii) residual current devices or an equally effective device.

11C **Protective Conductors**

(1) *Types of protective conductors*

(*a*) Types of protective conductors, as illustrated in Figure 11(1), include:
  (i) circuit protective conductors (CPC);
  (ii) main equipotential bonding conductors;
  (iii) supplementary bonding conductors; and
  (iv) earthing conductors.

(*b*) Protective conductor(s) may be formed by:
  (i) a separate conductor or cable,
  (ii) the metallic sheath or armour of a cable,
  (iii) part of the same cable containing the associated live conductors,
  (iv) rigid steel conduits, trunking or ducting, or
  (v) the metal enclosure of the wiring system.

(*c*) Where the protective conductor is formed by metallic conduits, trunking or ducting, the requirements as stipulated in Code 14 should also be observed as appropriate.

(*d*) Flexible or pliable conduit should not be used as a protective conductor.

(2) *Sizing of protective conductors*

(*a*) If a protective conductor is not an integral part of a cable, or is not formed by conduit, ducting or trunking, or is not contained in an enclosure formed by a wiring system, the minimum cross-sectional area should not be less than that given in Table 11(1).

(*b*) Subject to subparagraph (*a*) above, the cross-sectional area of a protective conductor, other than an equipotential or supplementary bonding conductor and not forming part of a twin or multicore cable, that are selected in accordance with the appropriate Tables 11(2), 11(3), 11(4), 11(5), 11(6) and 11(7) are considered acceptable. Alternatively, the cross-sectional area of the protective conductor can be calculated using the formula given in regulation 543-01-03 of BS 7671.

(*c*) For an earthing conductor, requirements as stipulated in Code 11H also apply.

(*d*) Requirements for the cross-sectional areas of equipotential bonding conductors and supplementary bonding conductors are described in Codes 11E and 11F respectively.

(*e*) Where metallic enclosures for cables, busbar trunking and switchgear and controlgear assemblies are used as protective conductors, they should have cross-sectional area equivalent to that of copper, not less than that resulting from application of the formula given in regulation 543-01-03 of BS 7671, or in accordance with Table 11(2).

11D **Earthing of Exposed Conductive Parts**

(1) *General*

Unless other effective precautions are taken to prevent danger, such as the use of double insulated equipment or the use of isolating transformer to IEC 60742 or equivalent, all exposed conductive parts of equipment (other than live parts) should be connected by means of circuit protective conductors (CPC) to the main earthing terminal of the installation and the terminal should be connected to earth electrode(s) via earthing conductor(s).

(2) *Types of exposed conductive parts*

(*a*) Exposed conductive parts include:

(i) metallic enclosure of current using equipment, other than double insulated equipment;

(ii) metallic conduit, trunking and ducting for enclosure of cable(s);

(iii) metallic enclosures of current distribution equipment such as switchgear and controlgear assemblies.

(*b*) Exposed conductive parts do not include:

(i) wall brackets and metal parts connected to overhead line insulators if such parts are not readily accessible,

(ii) inaccessible steel reinforcement in steel reinforced concrete poles,

(iii) small isolated metal parts such as bolts, rivets, nameplates and cable clips which owing to their small dimensions or their disposition cannot be gripped or contacted by a major surface of the human body in excess of 50 mm × 50 mm,

(iv) fixing screws for non-metallic accessories provided that there is no appreciable risk of the screws coming into contact with live parts,

(v) short lengths of metal conduit for mechanical protection of cables having a non-metallic sheath.

(3) *Circuit protective conductor (CPC)*

(*a*) For every socket outlet, a separate circuit protective conductor of adequate size should be provided connecting the earthing terminal of the socket outlet and the earthing terminal inside the enclosure accommodating the socket outlet if the CPC is formed by the enclosure.

(*b*) For every length of flexible conduit, a separate circuit protective conductor of adequate size should be provided to ensure the earth continuity of the installation between the two ends of the flexible conduit.

(*c*) Adjacent sections of a busbar trunking used as a CPC should be connected by a protective conductor of adequate size e.g. copper tape or link to ensure the earth continuity between the two sections. This requirement may be waived if it is certified by the manufacturer of the busbar trunking that the earth continuity between the adjacent sections of the busbar trunking is ensured by using the connection accessories provided by the manufacturer.

(*d*) The circuit protective conductor of every ring final circuit (other than that formed by the metal covering or enclosure of a cable) should be run in the form of a ring having both ends connected to the earthing terminal at the origin of the circuit.

11E **Equipotential Bonding**

(*a*) In each installation, main equipotential bonding conductors should be connected to the main earthing terminal for all extraneous conductive parts to create an equipotential zone; such conductive parts include:

(i) main water pipes;
(ii) gas installation pipes;
(iii) other service pipes and ducting;
(iv) risers and ductings of central heating and air-conditioning systems;
(v) exposed metallic parts of structural framework; and
(vi) the lightning protection system.

(*b*) In a large installation, where there are a number of equipotential zones, these zones should be bonded together to form one equipotential zone.

(*c*) Aluminium or copperclad aluminium conductors should not be used for bonding connections to water pipes likely to be subjected to condensation in normal use.

(*d*) Main equipotential bonding conductors should have cross-sectional areas not less than half the cross-sectional area of the earthing conductor of the installation, subject to a minimum of 6 mm^2 copper equivalent, and need not exceed 25 mm^2 copper equivalent.

(*e*) (i) Main equipotential bonding connections to any gas or water services should be made as near as practicable to the point of entry of those services into the premises; provided that where there is an insulating section or insert at that point, the connection should be made to the metalwork on the consumer's side of that section or insert.

(ii) In particular, for gas services, the bonding connection should be made on the consumer's side of the meter (i.e. between the meter outlet union and any branch pipework). This connection is recommended to be made within 600 mm of the gas meter.

11F **Supplementary Bonding**

(*a*) Within the zone formed by the main equipotential bonding, local supplementary bonding connections should be made to metal parts, to maintain the equipotential zone, where those parts are:

(i) extraneous conductive parts, and

(ii) simultaneously accessible with exposed conductive parts or other extraneous conductive parts, and

(*Note:* a separation of not more than 2 m is generally considered to be simultaneously accessible.)

(iii) not electrically connected to the main equipotential bonding by permanent and reliable metal-to-metal joints of negligible impedance.

(*b*) Metalwork which may be required to be bonded includes service pipes or substantial parts which are at a distance not exceeding 2 m from exposed conductive parts. Examples are water pipes adjacent to electric heater or window frame supporting a ventilation fan or air-conditioner or adjacent to a socket outlet. (See also Appendix 12(C))

(*c*) Aluminium or copperclad aluminium conductors should not be used for bonding connections to water pipes likely to be subjected to condensation in normal use.

(*d*) The minimum cross-sectional area of a supplementary bonding conductor should comply with Table 11(1), subject to the following conditions:

(i) The bonding conductor connecting two exposed conductive parts should have a cross-sectional area not less than that of the smaller protective conductor connected to the exposed conductive parts.

(ii) The bonding conductor connecting exposed conductive parts to extraneous conductive parts should have a cross-sectional area not less than half that of the protective conductor connected to the exposed conductive part.

(iii) The bonding conductor connecting two extraneous conductive parts, where one of the extraneous part is connected to an exposed conductive part, should have a cross-sectional area not less than half that of the protective conductor connected to the exposed conductive part.

11G **Main Earthing Terminal**

(*a*) In every installation, a main earthing terminal or bar should be provided to connect the following conductors to the earthing conductor:

(i) the circuit protective conductors;

(ii) the main bonding conductors; and

(iii) functional earthing conductors (if required).

(*b*) The size of bonding conductor connecting the consumer's main earthing terminal and the electricity supplier's transformer earth or metallic sheaths of service cable, should not be less than 150 mm^2 copper equivalent. Provisions should be made for disconnection of the bonding conductor for testing purposes.

(*c*) The main earthing terminal should be effectively connected to the earth electrode(s) by the earthing conductor.

(*d*) A warning notice bearing the words 'SAFETY ELECTRICAL CONNECTION—DO NOT REMOVE' and '安全接地終端——切勿移去' should be displayed in a conspicuous position at or near the main earthing terminal. The warning notice should comply with requirements of Code 17.

11H **Earthing Conductor**

(*a*) The size of an earthing conductor should comply with Code 11C(2) and, in addition, where buried underground, should subject to:

(i) a minimum of 2.5 mm^2 copper equivalent if protected against mechanical damage and corrosion;

(ii) a minimum of 16 mm^2 copper equivalent if protected against corrosion but not protected against mechanical damage; and

(iii) a minimum of 25 mm^2 copper equivalent if not protected against corrosion.

(*b*) Aluminium and copperclad aluminium conductors should not be used as earthing conductors for final connections to earth electrodes. Copper conductors or other suitable materials with equivalent resistance to corrosion should be used.

(*c*) (i) Test terminals should be provided in an accessible position for disconnecting the earthing conductor from the main earthing terminal, or from the earth electrode, to permit testing and measurements of the resistance of the earthing arrangements.

(ii) Where the test terminals are located underground, they should be contained within a concrete lined earth pit with a substantial removable cover to ensure readily accessibility for maintenance and inspection.

(iii) Disconnection of the earthing conductor from any test terminals should only be possible by means of a tool.

(*d*) Any joint and connection made for the earthing conductor should be mechanically strong and electrically sound. The contact at the connection with the earth electrode(s) should be tinned where necessary to maintain reliable electrical continuity.

(*e*) A warning notice bearing the words 'SAFETY ELECTRICAL CONNECTION—DO NOT REMOVE' and '安全接地終端——切勿移去' should be displayed in a conspicuous position at or near the point of connection of every earthing conductor to an earth electrode. The warning notice should comply with requirements of Code 17.

11I **Earth Fault Loop Impedance (Zs)**

(*a*) For the purpose of Code 11B, the maximum permissible earth fault loop impedance:

(i) in compliance with Tables 11(8), 11(9) and 11(10) to achieve automatic disconnection within 0.4 second by the protective device in the event of an earth fault are acceptable.

(ii) in compliance with Tables 11(10), 11(11), 11(12) and 11(13) to achieve automatic disconnection within 5 seconds by the protective device in the event of an earth fault are acceptable.

(*b*) Where a residual current device is used to protect a circuit, the maximum earth fault loop impedance of that circuit should not exceed those given in Table 11(14).

11J **Residual Current Device (RCD)**

(1) *Use of residual current device*

(*a*) Residual current devices are to be installed whenever the prospective earth fault current in a circuit is insufficient to cause operation of the overcurrent protective devices within the time specified in Code 11B(*b*).

(*b*) In particular, a residual current device should be installed:

(i) for every socket outlet circuit;

(ii) for an electrical installation supplied from overhead line system.

(2) *Requirements for residual current device*

(*a*) Where a residual current device is installed for compliance with Code 11J(1) above, the device should:

(i) have the product of the rated operating current (in amperes) and the earth fault loop impedance (in ohms) not exceeding 50 volts (also see Code 11I(*b*)); and

(ii) be capable of disconnecting all the phase conductor(*s*) of the circuit.

(*b*) Residual current devices for socket outlet circuit, in addition to requirements of subparagraph (*a*), should have a rated residual operating current not exceeding 30 mA.

(*c*) (i) A residual current device for protection against indirect contact may be incorporated as part of a device which also functions as an overcurrent protective device.

(ii) Where a residual current device for protection against indirect contact is used with, but separately from, overcurrent protective devices, the residual current device should be capable of withstanding, without damage, the thermal and mechanical stresses of a fault occurring on the load side of the circuit which it protects. Values of prospective fault current in a typical installation are given in Table 9(3).

(*d*) Where a residual current device is used, it should:
  (i) pass type test to IEC 61008 or equivalent;
  (ii) be suitable for independent toggle operation;
  (iii) have its tripping operation not dependent on a separate auxiliary supply; and
  (iv) have an integral test device on the front of every RCD to enable the automatic tripping operation to be tested by simulation of an earth fault condition.

(*e*) When two or more residual current devices are installed in series and where discrimination of their operation is necessary to prevent danger, the characteristics of the devices should be arranged to achieve the intended discrimination.

11K Earth Electrodes

Requirements for earth electrodes are described in Code 12.

Table 11(1)

Minimum Cross-sectional Area of Separate Protective Conductor

Installation Method	PVC Insulated (mm^2)		Bare (mm^2)	
	Copper	Aluminium	Copper	Aluminium
Surface wiring	2.5 (sheathed) 4.0 (non-sheathed)	16	> 6	16
In Conduits or trunkings	1.0	16	1.0	16

Table 11(2)

Minimum Cross-sectional Area of Protective Conductor in Relation to the Cross-sectional Area of Associated Phase Conductor

Cross-sectional Area of Phase Conductor (S)	Minimum Cross-sectional Area of the Corresponding Protective Conductor	
	If the Protective Conductor is of the Same Material as the Phase Conductor	If the Protective Conductor is not the Same Material as the Phase Conductor
mm^2	mm^2	mm^2
$S \leq 16$	S	$\frac{k_1 S}{k_2}$
$16 < S \leq 35$	16	$\frac{k_1 16}{k_2}$
$S > 35$	$\frac{S}{2}$	$\frac{k_1 S}{k_2 2}$

Note: For values of k_1 and k_2, please refer to tables 54B, 54C, 54D, 54E and 54F of BS 7671.

Table 11(3)

Minimum Cross-sectional Area of Protective Conductor for Circuits Protected by HBC Fuses to BS88 Part 2

Fuse Rating (Amp)		6	10	16	20	32	50	63	80	100	160	200	250	315	400
Minimum cross-sectional area (sq. mm) of protective conductor for 5 sec. disconnection	Copper	1	1	1	1.5	2.5	4	6	10	10	16	25	25	35	50
	Aluminium	16	16	16	16	16	16	16	16	16	25	35	50	50	70
Minimum cross-sectional area (sq. mm) of protective conductor for 0.4 sec. disconnection	Copper	1	1	1	1	1	2.5								

Table 11(4)

Minimum Cross-sectional Area of Protective Conductor for Circuits Protected by HBC Fuses to BS1361

Fuse Rating (Amp)		5	15	20	30	45	60	80	100
Minimum cross-sectional area (sq. mm) of protective conductor for 5 sec. disconnection	Copper	1	1	1.5	2.5	4	10	10	16
	Aluminium	16	16	16	16	16	16	16	25
Minimum cross-sectional area (sq. mm) of protective conductor for 0.4 sec. disconnection	Copper	1	1	1	1	2.5			

Table 11(5)

Minimum Cross-sectional Area of Protective Conductor for Circuits Protected by Miniature Circuit Breaker Type 1 & 2 to BS 3871 or Equivalent

Earth Fault Loop Impedance Zs (ohm)	Minimum Cross-sectional Area of Protective Conductor (mm^2) for 5 Sec. and 0.4 Sec. Disconnection	
	Copper	Aluminium
$0.2 \leq Zs$	1	16
$0.13 \leq Zs < 0.2$	1.5	16
$0.08 \leq Zs < 0.13$	2.5	16
$0.05 \leq Zs < 0.08$	4.0	16
$0.03 \leq Zs < 0.05$	6.0	16
$0.02 \leq Zs < 0.03$	10	16
$Zs < 0.02$	16	25

Table 11(6)

Minimum Cross-sectional Area of Protective Conductor for Circuit Protected by Miniature Circuit Breaker (MCB) Type 3, Type B & Type C to IEC 60898 or Equivalent

MCB Rating (Amp)		5	10	15	20	30	50	60	80	100
Minimum cross-sectional area (sq. mm) of protective conductor for 5 sec. disconnection	Copper	1	1.5	2.5	2.5	4	10	10	16	16
	Aluminium	16	16	16	16	16	16	16	16	25
Minimum cross-sectional area (sq. mm) of protective conductor for 0.4 sec. disconnection	(Please refer to Table 11(5))									

Table 11(7)

Minimum Cross-sectional Area of Protective Conductor for Circuit Protected by Moulded Case Circuit Breaker (MCCB) to IEC 60947-2 or Equivalent for 5 Sec. Disconnection

MCCB Rating (Amp)		30	50	60	100	150	200	250	300	400
Minimum cross-sectional area (sq. mm) of protective conductor	Copper	6	10	10	10	10	10	10	16	16
	Aluminium	16	16	16	16	16	16	16	25	25

Table 11(8)

Maximum Earth Fault Loop Impedance for 0.4 Sec. Disconnection when the Circuit is Protected by General Purpose (gG) Fuses to BS88 Part 2 with Nominal Voltage Uo 220V

Fuse Rating (Amp)	6	10	16	20	32	50
Zs (ohm)	8.0	4.9	2.6	1.7	1.0	0.6

Table 11(9)

Maximum Earth Fault Loop Impedance for 0.4 Sec. Disconnection when the Circuit is Protected by Fuses to BS1361 or Equivalent with Nominal Voltage Uo 220V

Fuse Rating (Amp)	5	15	20	30	45
Zs (ohm)	10	3.1	1.6	1.1	0.6

Table 11(10)

Maximum Earth Fault Loop Impedance for both 0.4 Sec. and 5 Sec. Disconnection when the Circuit is Protected by Miniature Circuit Breaker (MCB) to IEC 60898 or Equivalent with Nominal Voltage Uo 220V

MCB Rating (Amp)	5	10	15	20	30	40	50	60	100
Zs (ohm) for type 1 MCB	11	5.5	3.7	2.8	1.8	1.4	1.1	0.9	0.6
Zs (ohm) for type 2 MCB	6.3	3.1	2.1	1.6	1.0	0.8	0.6	0.5	0.3
Zs (ohm) for type 3 & type C MCB	4.4	2.2	1.5	1.1	0.7	0.6	0.4	0.3	0.2
Zs (ohm) for type B MCB	8.8	4.4	2.9	2.2	1.5	1.1	0.9	0.7	0.4

Table 11(11)

Maximum Earth Fault Loop Impedance for 5 Sec. Disconnection when a Circuit is Protected by General Purpose (gG) Fuses to BS88 Parts 2 and 6 or Equivalent with Nominal Voltage Uo 220V

Fuse Rating (Amp)	6	10	16	20	32	50	60	80	100	160	200	250	315	400
Zs (ohm)	12.9	7.1	4.0	2.8	1.8	1.0	0.8	0.6	0.4	0.24	0.18	0.15	0.1	0.09

Table 11(12)

Maximum Earth Fault Loop Impedance for 5 Sec. Disconnection when a Circuit is Protected by House-service Fuse to BS1361 or equivalent with Nominal Voltage Uo 220V

Fuse Rating (Amp)	5	15	20	30	45	60	80	100
Zs (ohm)	15.7	4.8	2.7	1.8	0.9	0.67	0.48	0.35

Table 11(13)

Maximum Earth Fault Loop Impedance for 5 Sec. Disconnection when a Circuit is Protected by a Moulded Case Circuit Breaker (MCCB) to IEC 60947-2 or Equivalent with Nominal Voltage Uo 220V

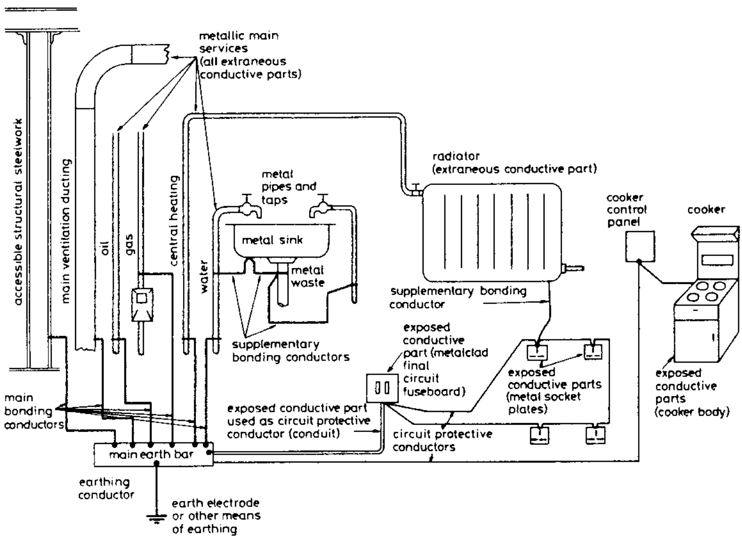
MCCB Rating (Amp)		30	50	60	100	150	200	250	300	400
MCCB Non-adjustable Zs (ohm)		0.56	0.44	0.42	0.125	0.09	0.07	0.06	0.05	0.04
MCCB Adjustable Zs (ohm)	Magnetic setting = 'LO'	—	—	—	—	—	—	0.1	0.08	0.06
	Magnetic setting = 'HI'	—	—	—	—	—	—	0.05	0.04	0.03

Note: Tables 11(8)–11(13) is based on nominal voltage to earth Uo at 220V. If the voltage is 200V the corresponding value of the earth fault loop impedance shall be obtained by multiplying the factor 0.91.

Table 11(14)

Maximum Earth Fault Loop Impedance when a Circuit is Protected by a Residual Current Device

Rated Residual Operating Current (mA)	5	10	20	30	100	300	500	1000	2000
Zs (ohm)	10000	5000	2500	1667	500	167	100	50	25



Note: This Figure is not intended to illustrate requirements for bonding and earthing, but merely to identify the functions of particular protective conductors.

TYPES OF PROTECTIVE CONDUCTORS

CODE No. 11	FIGURE No. 11(1)	

Code 12 EARTHING ARRANGEMENT

12A General

12B Bonding Connections to the Point of Supply

(1) Supply by transformer

(2) Supply by underground cable

(3) To satisfy regulation 11 with bonding disconnected

(4) Application of Code 12B

12C Earth Electrode

(1) Types of earth electrodes

(2) Rod electrode

(3) Tape electrode

(4) Plate electrode

Code 12 EARTHING ARRANGEMENT

12A **General**

(*a*) An installation should have an earthing arrangement such that:

(i) the installation is protected by its *own* earth electrode(s); and

(ii) the main earthing terminal of the installation is bonded to the earthing facilities that are available from the electricity supplier (as described in Code 12B below).

(*b*) For those installations connected to supplies before the commencement of the Wiring Regulations (1 June 1992), they should have one or any combination of the following earthing arrangements:

(i) the installation is protected by its own earth electrode(s),

(ii) the main earthing terminal of the installation is connected to the earthing facilities provided by the electricity supplier, or

(iii) the main earthing terminal of the installation is connected to a common earthing conductor which is connected to earth electrode(s) or the earthing facilities provided by the electricity supplier.

12B **Bonding Connections to the Point of Supply**

(1) *Supply by transformer*

Where the supply is taken directly from the electricity supplier's transformer(s) within the premises in which the installation is situated, the main earthing terminal of the installation should be bonded by a conductor or through a common conductor to a bonding terminal provided by the electricity supplier at the point of supply, for example, near the transit block or the main cable terminations on the incoming circuit breakers.

(2) *Supply by underground cable*

Where the supply is taken from the electricity supplier's underground cable(s) having exposed conductive parts, such as metallic cable endbox, metallic cable glands, cable armour or metallic sheath etc., at the cable termination at the point of supply, the main earthing terminal of the installation should be bonded to these exposed conductive parts via bonding terminal(s) provided by the electricity supplier.

(3) *To satisfy regulation 11 with bonding disconnected*

Where bonding referred to in subparagraphs (1) and (2) above is used to prevent the rise of a dangerous earth potential, the installation should satisfy all the requirements of regulation 11 of the Wiring Regulations (Earth leakage and earth fault currents) event if the bonding is disconnected.

(4) *Application of Code 12B*

Code 12B applies only to an installation that is completed or substantially altered on or after the commencement of the Wiring Regulations (1 June 1992).

12C **Earth Electrode**

(1) *Types of earth electrodes*

(*a*) The material used and the construction of the earth electrodes should be such as to withstand damage due to corrosion. The following types of earth electrodes are acceptable:

(i) earth rods or pipes,

(ii) earth tapes or wires,

(iii) earth plates,

(iv) metallic reinforcement of concrete, including sheet piles.

(*b*) the metalwork of gas and water services should not be used as an earth electrode.

(2) *Rod electrode*

(*a*) The overall diameter of copper rod electrode should not be less than 12.5 mm.

(*b*) The overall diameter of a rod electrode of materials such as stainless steel and galvanised steel should not be less than 16 mm.

(*c*) A hardened steel point may be fitted to the penetrating end of the rod electrode.

(*d*) Additional lengths of rod, whenever required, should each be connected together by a coupling.

(*e*) For installation of additional rods, it is recommended that a mutual separation of 3.5 m or a distance greater than twice the driven length should be maintained. All rods thus installed should be connected together by means of earthing conductors of adequate size enclosed in PVC ducts and laid at a minimum depth of 600 mm below the ground surface.

(3) *Tape electrode*

(*a*) Tape electrodes should be copper strip having a cross-section of not less than 25 mm × 3 mm.

(*b*) In case where several tapes are required for connection in parallel to achieve a low earthing resistance, they may be installed in parallel lines or they may radiate from a point.

(4) *Plate electrode*

Plate electrodes should be of copper not less than 3 mm in thickness and having a maximum dimension of 1 200 mm × 1 200 mm.

Code 13 CONDUCTORS, JOINTS AND CONNECTIONS

13A Selection and Sizing of Cable Conductors

(1) General

(2) Factors to be considered in sizing of cable conductors

(3) Method of sizing cable conductors

(4) Typical sizes of cable conductor used in general installations

13B Protection Against Direct Contact of Live Conductors

(1) Protection by electrical insulation

(2) Protection by other means

13C Joints and Connections

13D Other Requirements of Cables

(1) Voltage grading of cables for low voltage application

(2) Identification of cable cores

(3) Identification of cables buried direct in ground

Code 13 CONDUCTORS, JOINTS AND CONNECTIONS

13A **Selection and Sizing of Cable Conductors**

(1) *General*

A conductor should have a current carrying capacity not less than the maximum current demand it normally carries, be capable of withstanding the prospective fault current, and suitable for operation in the environment and at the design voltage of the installation.

(2) *Factors to be considered in sizing of cable conductors*

In general, sizing of cable conductors should take into account the following factors:

(*a*) the conductor material;

(*b*) the insulating material;

(*c*) the ambient temperature in which the cable is installed;

(*d*) the method of installation;

(*e*) whether or not the cable is affected by thermal insulating material;

(*f*) the use and type of protective device;

(*g*) the voltage drop from the origin of the circuit to the load; and

(*h*) for Category 1 circuits, live conductors should have a cross-sectional area:
- (i) not less than 1.5 mm^2 for surface wiring using PVC insulated PVC sheath copper cables;
- (ii) not less than 1.0 mm^2 for single core PVC insulated copper cables installed in conduit, duct, ducting or trunking;
- (iii) not less than 16 mm^2 for aluminium conductors;
- (iv) not less than 0.5 mm^2 for flexible cables and flexible cords.

(3) *Method of sizing cable conductors*

(*a*) In determining the size of cable conductors to be used, the steps employed, in general, are as follows:
- (i) Determine the design current of the circuit under consideration.
- (ii) Choose a suitable overcurrent protective device (refer to Code 9).
- (iii) Determine the current carrying capacity of the conductors required by applying suitable correction factors to the nominal setting or current rating of the overcurrent protective device as divisors.

Typical correction factors for ambient temperature, grouping, thermal insulation and type of protective device are given in Appendix 5.

(iv) Choose suitable size of the conductors according to the current carrying capacity required. Appendix 6 gives the current carrying capacities for various copper conductor sizes of PVC/XLPE insulated cables according to their installation methods. For other types of cables, reference should be made to BS 7671 or IEC 60364.

(v) The resulting voltage drop in the circuit should be checked so that under normal service conditions the voltage at the terminals of any fixed current using equipment should be greater than the lower limit corresponding to recognised standards relevant to the equipment.

Where the fixed current using equipment concerned is not the subject of a recognised standard, the voltage at the terminals should be such as not to impair the safe function of that equipment.

The above requirements are deemed to be satisfied if the voltage drop between the origin of the installation (usually the supply terminals) and the fixed current using equipment does not exceed 4% of the nominal voltage of the supply.

A greater voltage drop may be accepted for a motor during starting periods and for other equipment with high inrush current provided that voltage variations are within the limits specified in the relevant recognised standards for the equipment or, in the absence of a recognised standard, in accordance with the manufacturer's recommendations.

Table in Appendix 6 also gives the values of voltage drop caused by one ampere for a metre run of PVC/XLPE insulated cables with copper conductors.

If the voltage drop so determined is unsatisfactory, a conductor of larger size should be chosen accordingly.

(*b*) To illustrate the steps used in sizing cable conductors, an example is given in Appendix 9.

(4) *Typical sizes of cable conductor used in general installations*

For general installations under the conditions listed below, the sizes of copper conductor in compliance with Table 13(1) are generally acceptable:

(*a*) the ambient temperature does not exceed 35°C,

(*b*) no more than one circuit of single core cables or one multicore cable are to be grouped together, (*c*) for cables clipped direct on surface, the spacing between groups of single core cables or multicore cables is not less than twice the diameter of the largest cable in the adjacent group of cables,

(*d*) the protective device is not a semi-enclosed fuse, and

(*e*) the cables are not in contact with any thermal insulation.

13B **Protection Against Direct Contact of Live Conductors**

(1) *Protection by electrical insulation*

(*a*) Live conductors should be completely covered with insulation which:
  (i) is durably withstanding the mechanical, electrical, thermal and chemical stresses to which it may be subjected in service; and
  (ii) can only be removed by destruction.

(*b*) Where insulation is applied during the erection of the installation, the quality of the insulation should be verified by tests equivalent to those specified in recognised standards for similar type-tested equipment.

(*c*) Non-impregnated paper, asbestos, fabric, wood or press-hemp should not be used for insulating purposes.

(*d*) Where insulating tapes are permitted to be used in low voltage installations, they should have a minimum thickness of 0.21 mm.

(2) *Protection by other means*

Other means of protective measures against direct contact as stipulated in IEC 60364 or BS7671 are acceptable.

13C **Joints and Connections**

(*a*) Every connection at a cable termination or joint should:
  (i) be mechanically and electrically sound;
  (ii) be protected against moisture, mechanical damage and any vibration liable to occur;
  (iii) not impose any appreciable mechanical strain on the fixings of the connection;
  (iv) not cause any harmful damage to the cable conductor;
  (v) be appropriate to the size and type of conductors with which they are to be used; and
  (vi) be suitably insulated for the voltage of the circuits in which they are situated.

(*b*) No strand of a stranded conductor in a cable core should be cut away in making a cable joint or termination.

(*c*) Joints in non-flexible cables should be made by soldering, brazing, welding, or mechanical clamps, or be of the compression type. All mechanical clamps and compression type sockets should securely retain all the wires of the conductor.

(*d*) Joints in flexible cable or flexible cord should be made by using appropriate cable couplers.

(*e*) Terminations of mineral insulated cables should be made with proper accessories and tools as recommended by the manufacturers.

(*f*) Cable glands should securely retain without damaging the outer sheath or the armour of the cables.

(*g*) Other details relating to the workmanship of cable joint and termination are described in Code 25D.

(*h*) Except for the following, every connection and joint should be accessible for inspection, testing and maintenance:

(i) a compound filled or encapsulated joint;

(ii) a connection between a cold tail and a heating element (e.g. a ceiling and floor heating system, a pipe trace-heating system); and

(iii) a joint made by welding, soldering, brazing or compression tool.

13D **Other Requirements of Cables**

(1) *Voltage grading of cables for low voltage application*

(*a*) PVC insulated non-sheathed cables to BS6004 and BS6007 should be 450/750V grade.

(*b*) PVC insulated, PVC sheathed cables up to 35 mm^2 to BS6004 should be 300/500V grade. For cables greater than 50 mm^2 to BS6346, voltage grade should be 600/1000V.

(*c*) PVC insulated, PVC sheathed armoured cables of any size to BS6346 should be 600/1000V grade.

(*d*) XLPE insulated, non-sheathed or PVC sheathed cables to BS7211 should be 450/750V grade and to BS 5467 should be 600/1000V grade.

(*e*) XLPE insulated, PVC sheathed armoured cables to BS5467 and BS 6724 should be 600/1000V grade.

(2) *Identification of cable cores*

(*a*) Every cable core of a non-flexible cable or bare conductors in a fixed wiring installation should be identifiable at its terminations by appropriate labels, colours or coding. The application of tapes, sleeves or discs of the appropriate colours at terminations is acceptable. The use of colours should be in accordance with Table 13(2).

(*b*) Every cable core of a flexible cable or cord:

(i) for use in a single phase circuit should have its phase conductor coloured brown and its neutral conductor coloured blue throughout its length;

(ii) for use in a polyphase circuit, the phase conductors may be coded L1, L2 and L3; and N for the neutral, if any.

(*c*) Every cable protective conductor should be coloured exclusively in green-and-yellow.

(3) *Identification of cables buried direct in ground*

Where cables are buried underground, they should be identified by cable cover tiles or identification tapes for the entire underground cable route. The cable tiles or identification tapes should be marked with words ‘Danger-cables’.

Table 13(1)

Minimum Size of PVC Copper Conductors in sq. mm under the General Installation Conditions Listed in Code 13A(4)

Current Rating (Amp)	1-Phase 2-Wire							3-Phase 4-Wire									
	5	15	20	30	60	80	100	5	15	20	30	60	100	150	200	300	400
Enclosed Condition	1.0	2.5	2.5	4	16	25	35	1.0	2.5	2.5	6	16	35	70	120	240	400
Clipped Direct	1.5	2.5	2.5	4	10	16	25	1.5	2.5	2.5	4	10	25	50	70	150	240

Table 13(2)

Colour Identification of Non-flexible Cables and Bare Conductors for Fixed Wiring

Function	Colour Identification
Phase of single phase circuit	Red (or yellow or white or blue)
Phase R of 3-phase circuit	Red
Phase Y of 3-phase circuit	Yellow (or white)
Phase B of 3-phase circuit	Blue
Neutral of a circuit	Black
Protective conductor	Green-and-yellow

Code 14 WIRING INSTALLATION ENCLOSURE

14A General Requirements

(1) Enclosures as protective conductors

(2) Support of enclosures

(3) Fire barrier

14B Steel Conduit System

(1) Construction

(2) Installation

14C Steel Trunking System

(1) Construction

(2) Installation

14D Plastic or PVC Conduit or Trunking

(1) Construction

(2) Installation

14E Cable Capacity of Enclosures

(1) General requirements

(2) Determination of cable capacities

14F Enclosures of Busbar Trunking System

14G Workmanship

Code 14 WIRING INSTALLATION ENCLOSURE

14A **General Requirements**

(1) *Enclosures as protective conductors*

(*a*) Metallic enclosures for cables, busbar trunking and switchgear and controlgear assemblies, where used as protective conductors should:

(i) have a cross-sectional area not less than that determined from the application of Code 11C(2)(*e*) or verified by test in accordance with IEC 60439-1 or equivalent;

(ii) have an electrical continuity achieved and maintained to afford protection against mechanical, chemical or electrochemical deterioration; and

(iii) permit the connection of other protective conductors at every predetermined tap-off point.

(*b*) Where conduit, trunking or ducting are used as a protective conductor, the earthing terminal of each accessory should be connected by a separate protective conductor of adequate size to an earthing terminal incorporated in the associated box or enclosure.

(2) *Support of enclosures*

All conduit, ducting and trunking installations should be properly supported and of a type suitable for any risk of mechanical damage to which they may be liable in normal conditions of service or adequately protected against such damage.

(3) *Fire barrier*

(*a*) Where conduit, duct, ducting or trunking pass through fire-resistant structural elements such as floors and walls designated as fire barriers, the opening made should be sealed according to the appropriate degree of fire resistance.

(*b*) Where cables, conduits or conductors are installed in channel, duct, ducting, trunking or shaft which pass through fire-resistant structural elements, suitable internal fire-resistant barriers should be provided to prevent the spread of fire.

14B **Steel Conduit System**

(1) *Construction*

(*a*) Steel conduits and fitting with metric thread, except flexible conduits, should be of heavy gauge, longitudinally welded type and comply with BS4568, BS EN 60423, BS EN 50086, IEC 60423, IEC 60614-1 or equivalent. The nominal minimum outside diameter of any rigid conduit to be used should be 16 mm with a minimum wall thickness of 1.4 mm.

(*b*) Flexible steel conduits should comply with IEC 60614-2-5 or BS731: Part 1 or equivalent. In addition, where flexible conduits are exposed to weather or in damp situations, the conduits should be of the metallic type with PVC oversheath.

(*c*) All steel conduits, conduit fittings and the associated metallic boxes for the enclosure of electrical accessories should be protected against corrosion on both the inside and outside surfaces.

(2) *Installation*

(*a*) The steel conduit installation should be made mechanically and electrically continuous throughout, be effectively earthed and comply with BS4568, BS EN 60423, BS EN 50086, IEC 60423, IEC 60614-1 or equivalent.

(*b*) An adequate number of suitably sized adaptable boxes should be provided in the conduit installation to enable cables to be drawn in easily and without damage.

(*c*) Flexible steel conduit should not be used as a protective conductor and it should have a separate circuit protective conductor of adequate size for earth continuity.

(*d*) Conduits should be installed so as to prevent accumulation of condensed moisture or water in any part of the installations.

14C **Steel Trunking System**

(1) *Construction*

(*a*) Steel trunking and fittings should be fabricated with sheet steel having a minimum thickness as indicated in Table 14(1) and should comply with the requirements specified in BS4678: Part 1 or equivalent.

(*b*) Underfloor trunking should be compatible to the requirements laid down in BS4678: Part 2 or equivalent and should be fabricated with sheet steel of:

(i) not less than 1.2 mm thickness for compartment width up to and including 100 mm;

(ii) not less than 1.6 mm thickness for compartment width over 100 mm; and

(iii) not less than 1.0 mm thickness for the partitions and connector material.

(*c*) Steel trunking installations should be constructed using manufacturer's standard fittings such as tee or angle pieces, connectors etc., throughout as far as practicable.

(*d*) All steel trunking and fittings should be protected against corrosion.

(2) *Installation*

(*a*) The steel trunking installation should be made mechanically and electrically continuous throughout, and be effectively earthed.

(*b*) Electrical continuity should be achieved by means of connecting a protective conductor (e.g. copper tape) of adequate size across the two adjacent ends of the trunking.

(*c*) Every entry to the trunking installation should be so placed as to prevent and/or to be protected against the ingress of water.

14D **Plastic or PVC Conduit or Trunking**

(1) *Construction*

(*a*) Rigid plastic or PVC conduits and conduit fittings should be of such strength to withstand the stress under the installed conditions. They should comply with BS4607: Part 1 and 2 and IEC 60614 or BS EN 50086 or equivalent.

(*b*) Pliable conduits should be made of self-extinguishing plastic material and comply with BS4607: Part 3 or equivalent.

(*c*) Adaptable boxes and boxes for the enclosure of electrical accessories that are made of insulating materials should comply with BS4662 or equivalent and have a minimum wall thickness of 2 mm.

(2) *Installation*

(*a*) Plastic or PVC conduit or trunking systems should only be installed where they are suitable for the extremes of ambient temperature to which they are likely to be subject under the installed conditions. Rigid PVC conduits or trunking should not be used where the normal working temperature of the installation may exceed 60°C.

(*b*) Any exposed conductive parts of a PVC or plastic conduit system or trunking should be connected to earth by protective conductor of adequate size for maintaining an effective continuity. Where the plastic or PVC conduit system is made between metal conduit system, the earthing connection should be made at the steel conduit/trunking and at the nearest boxes with proper terminals.

(*c*) The method of support and installation for rigid PVC conduits should allow for the longitudinal expansion and contraction of the conduits which may occur with variation of temperature under normal operating conditions.

14E **Cable Capacity of Enclosures**

(1) *General requirements*

The numbers of cables drawn into, or laid in, an enclosure of a wiring installation should be such that no damage is caused to the cables or to the enclosure.

(2) *Determination of cable capacities*

Cable capacities of conduit and trunking enclosing single-core PVC insulated cables can be determined by the 'unit system' method described below:

(*a*) Straight runs of conduit not exceeding 3 m in length:
  (i) For each cable to used, obtain the appropriate cable factor from Table 14(2)(*a*).
  (ii) Add all the cable factors so obtained and compare with the conduit factors given in Table 14(2)(*b*).
  (iii) The conduit size is considered satisfactory if the conduit factor is equal to or exceeds the sum of the cable factors.

(*b*) Straight runs of conduit exceeding 3 m in length or in runs of any length incorporating bends or sets:
  (i) For each cable to be used, obtain the appropriate cable factor from Table 14(3)(*a*).
  (ii) Add all the cable factors so obtained and compare with the conduit factors given in Table 14(3)(*b*), taking into account of the length of run and number of bends in that run.
  (iii) The conduit size is considered satisfactory if the conduit factor is equal to or exceeds the sum of the cable factors.
  (iv) The term 'bend' signifies a 90° bend and one double set is equivalent to one bend.

(*c*) Trunking of any length of run:
  (i) For each cables to be used, obtain the appropriate cable factor from Table 14(4)(*a*).
  (ii) Add all the cable factors so obtain and compare with the trunking factors given in Table 14(4)(*b*).
  (iii) The trunking size is considered satisfactory if the trunking factor is equal to or exceeds the sum of the cable factors.

(*d*) For sizes and types of cable and sizes of trunking other than those given in Tables 14(4)(*a*) and 14(4)(*b*), the number of cables drawn into a trunking should be such that the resulting space factor should not exceed 45%.

(*Note:* Space factor is defined as the ratio (expressed as a percentage)of the sum of the overall cross-sectional area of cables (including insulation and any sheath) to the internal cross-sectional area of the trunking in which they are installed. The effective overall cross-sectional area of a non-circular cable is taken as that of a circle of diameter equal to the major axis of the cable.)

14F **Enclosures of Busbar Trunking System**

Requirements for the enclosures of busbar trunking system are described in Code 26B.

14G **Workmanship**

(*a*) Conduits should not be bent in such a manner which appreciably distorts their original cross-sectional shape or causes damage to the conduits.

(*b*) Burrs, sharp edges and projections should be removed from the internal surfaces and ends of conduits, trunking or other enclosures when installed.

(*c*) Where the protective coating on a metallic enclosure has been damaged after installation, such surface should be effectively restored by paint or other suitable coating to prevent corrosion.

(*d*) Other details relating to the workmanship of installation of conduits and trunking are described in Code 25.

Table 14(1)

Minimum Thickness of Body Material for Metallic Trunking

Nominal Size (mm × mm)	Minimum Thickness of Body Material (in mm)
50 × 50	1.0
75 × 50	1.2
75 × 75	1.2
100 × 75	1.2
150 × 100	1.4
150 × 150	1.6

(*Note:* Metallic trunkings having nominal size differing from the table but complying with IEC 61084 or equivalent are also acceptable.)

Table 14(2)

Cable Factors and Conduit Factors for Straight Runs of Conduit not Exceeding 3 m in Length

(*a*) Cable Factor

Type of Conductor	Conductor Cross-Sectional Area (mm^2)	Factor
Solid	1	22
	1.5	27
	2.5	39
Stranded	1.5	31
	2.5	43
	4	58
	6	88
	10	146

(*b*) Conduit Factor

Conduit Diameter (mm)	Factor
16	290
20	460
25	800
32	1 400

Table 14(3)

Cable Factors and Conduit Factors for Conduit Exceeding 3 m in length or in Runs Incorporating Bends or Sets

(*a*) Cable Factor

Type of Conductor	Conductor Cross-Sectional Area (mm^2)	Factor
Solid or stranded	1	16
	1.5	22
	2.5	30
	4	43
	6	58
	10	105

(*b*) Conduit Factor

Length of Run (*m*)	Conduit Diameter (mm)																			
	16	20	25	32	16	20	25	32	16	20	25	32	16	20	25	32	16	20	25	32
	Straight				One bend				Two bends				Three bends				Four bends			
1	Covered by Tables 14(2) (*a*) and (*b*)				188	303	543	947	177	286	514	900	158	256	463	818	130	213	388	692
1.5					182	294	528	923	167	270	487	857	143	233	422	750	111	182	333	600
2					177	286	514	900	158	256	463	818	130	213	388	692	97	159	292	529
2.5					171	278	500	878	150	244	442	783	120	196	358	643	86	141	260	474
3					167	270	487	857	143	233	422	750	111	182	333	600				
3.5	179	290	521	911	162	263	475	837	136	222	404	720	103	169	311	563				
4	177	286	514	900	158	256	463	818	130	213	388	692	97	159	292	529				
4.5	174	282	507	889	154	250	452	800	125	204	373	667	91	149	275	500				
5	171	278	500	878	150	244	442	783	120	196	358	643	86	141	260	474				
6	167	270	487	857	143	233	422	750	111	182	333	600								
7	162	263	475	837	136	222	404	720	103	169	311	563								
8	158	256	463	818	130	213	388	692	97	159	292	529								
9	154	250	452	800	125	204	373	667	91	149	275	500								
10	150	244	442	783	120	196	358	643	86	141	260	474								

Table 14(4)

Cable Factors and Trunking Factors for Trunking of any Length of Run

(*a*) Cable Factor

Type of Conductor	Conductor Cross-sectional Area (mm^2)	Factor
Solid	1.5	7.1
	2.5	10.2
Stranded	1.5	8.1
	2.5	11.4
	4	15.2
	6	22.9
	10	36.3

(*b*) Trunking factor

Dimensions of trunking (mm × mm)	Factor
50 × 37.5	767
50 × 50	1 037
75 × 25	738
75 × 37.5	1 146
75 × 50	1 555
75 × 75	2 371
100 × 25	993
100 × 37.5	1 542
100 × 50	2 091
100 × 75	3 189
100 × 100	4 252

Code 15 ADVERSE CONDITIONS INSTALLATION

15A Presence of Water (AD) or High Humidity (AB)*

(1) Construction of equipment

(2) Conductors and enclosures of wiring installations

(3) Switches and socket outlets

15B Ambient Temperature (AA)

(1) General

(2) Electrical insulations

(3) Conductors and cables

(4) Enclosures of wiring installations

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15D Installation Exposed to Fire or Explosion

(1) General

(2) Electrical equipment selection

(3) Wiring systems

15E Impact (AG)

15F Vibration (AH)

15G Other Mechanical Stresses (AJ)

* For codes of external influences, table 15(3) refers.

Code 15 ADVERSE CONDITIONS INSTALLATION

15A **Presence of Water (AD) or High Humidity (AB)**

(1) *Construction of equipment*

(*a*) A wiring system should be selected and erected so that no damage is caused by high humidity, high condensation or ingress of water during installation, use and maintenance.

(*b*) Where water may collect or condensation may form in a wiring system, provision should be made for its harmless escape through suitably located drainage points.

(*c*) Where a wiring system may be subjected to waves (AD6), protection against mechanical damage should be afforded by one or more of the methods given in Codes 15E, 15F and 15G.

(2) *Conductors and enclosures of wiring installations*

(*a*) Copperclad aluminium conductors should not be used.

(*b*) All exposed conductors and insulations at terminations and joints of cables that are insulated with impregnated paper should be suitably sealed against ingress of moisture.

(*c*) Every joint in a cable should be suitably insulated and protected against the effect of moisture or water.

(*d*) Overall PVC covering should be provided for mineral insulated cable.

(*e*) The ends of mineral insulated cables should be suitably sealed with purposely designed terminations and sealing material, having adequate insulating and moisture proofing properties throughout the range of temperatures to which they may be subjected in service. The mineral insulation of the cables should be thoroughly dried before the sealing material is applied.

(*f*) Every entry to finished ducts, ducting or trunking should be placed so as to prevent the ingress of water, or be protected against such ingress.

(*g*) All metal sheath and armour of cables, metal conduits, ducts, ductings, trunkings, clips and their fixings, should be of corrosion resisting material or finish and should not be placed in direct contact with other dissimilar metals which they are liable to set up electrolytic action.

In particular, contact between bare aluminium sheaths or aluminium conduits and any parts made of brass or other metal having a high copper content should be avoided in damp situation unless the parts are suitably plated.

(*h*) In damp situations, enclosures for cores of sheathed cables from which the sheath has been removed and for non-sheathed cables at terminations of conduit, duct, ducting or trunking systems, should be damp proof and corrosion resistant.

(*i*) Metallic sheaths, conduits etc. in installations underwater or likely to be underwater should not be relied upon as the only protective conductor and a separate copper protective conductor should be used.

(3) *Switches and socket outlets*

(*a*) Switches having watertight enclosures with minimum IP54 or equivalent are acceptable for an installation exposed to weather.

(*b*) Socket outlets complying with IEC 60309-2 or equivalent and provided with a push-on cap and cap retaining ring or a screw-on cap with rubber gasket are acceptable for an installation exposed to weather. The socket outlets should also have a degree of protection of at least IPX4 or equivalent.

15B **Ambient Temperature (AA)**

(1) *General*

(*a*) A wiring system should be selected and erected so as to be suitable for the highest and lowest local ambient temperature likely to be encountered.

(*b*) The components of a wiring system, including cables and wiring enclosures should be installed or handled only at temperatures within the limits stated in the relevant product specification or as recommended by the manufacturer.

(2) *Electrical insulations*

The maximum permissible operating temperature for various classes of insulation complying with IEC 60085 are given in Table 15(1).

(3) *Conductors and cables*

(*a*) The type and current carrying capacity of every conductor, cable and flexible cord, termination and joint should be selected so as to be suitable for the highest operating temperature likely to occur in normal service, account being taken of any transfer of heat from any accessory, appliance or luminaire to which the conductor, cable or flexible cord is connected.

(*b*) The maximum operating and ambient temperatures, in general, for various types of cable insulations are given in Table 15(2).

(*c*) Where cables are to be connected to bare conductors or busbars, it should be verified that their type of insulation and/or sheath is suitable for the maximum operating temperature of the bare conductors or busbars.

(4) *Enclosures of wiring installations*

(*a*) The enclosures of wiring installations for conductors and cables should be selected and installed so that they are suitable for the extremes of ambient temperature to which they are likely to be exposed in normal service.

(*b*) In every vertical channel, duct, ducting or trunking installations containing conductors or cables, internal barriers should be provided between floors or at intervals of 5 m whichever is the less so as to prevent the air at the top of the channel, duct, ducting or trunking from attaining an excessively high temperature.

(5) *External heat sources*

(*a*) To avoid the effects of heat from external sources including solar gain, one or more of the following methods, or an equally effective method, should be used to protect the wiring system:
- (i) shielding;
- (ii) placing sufficiently far from the source of heat;
- (iii) selecting a system with due regard for the additional temperature rise which may occur;
- (iv) local reinforcement or substitution of insulating material.

(*b*) Parts of a cable or flexible cord within an accessory, appliance or luminaire should be suitable for the temperatures likely to be encountered, as determined in accordance with Code 15B(1)(*a*), or should be provided with additional insulation suitable for those temperatures.

15C **Presence of Corrosive or Polluting Substance (AF)**

(*a*) Where the presence of corrosive or polluting substances is likely to give rise to corrosion or deterioration, parts of the wiring system likely to be affected should be suitably protected or manufactured from materials resistant to such substances.

(*b*) Metals liable to initiate electrolytic action should not be placed in contact with each other.

(*c*) Suitable precautions against corrosion should be taken for metalwork and metallic parts of wiring systems that are liable to chemical or electrolytic attack by materials of a structure with which they may come in contact. Materials likely to cause such attack include:

(i) materials containing magnesium chloride which are used in the construction of floors and dadoes;

(ii) plaster undercoats contaminated with corrosive salts;

(iii) lime, cement and plaster, for example on unpainted walls;

(iv) oak and other acidic woods;

(v) dissimilar metals liable to set up electrolytic action.

Application of suitable coatings before erection, or prevention of contact by separation with plastics, are recognised as a suitable precaution against corrosion.

(*d*) Non-metallic materials used in wiring systems should not be placed in contact with materials likely to cause chemical deterioration of the wiring systems. Such materials should either be installed where they will not be exposed to contact with oil, creosote, and similar hydrocarbons, or be of a type designed to withstand such exposure.

(*e*) Overall PVC covering should be provided for mineral-insulated cables that are exposed to risk of corrosion.

(*f*) In onerous dust conditions, enclosures of the wiring installations should have a degree of protection such that dust cannot enter in sufficient quantity to interfere with operation of the equipment. Enclosures built to IP5X or equivalent are considered acceptable.

15D **Installation Exposed to Fire or Explosion**

(1) *General*

(*a*) Electrical equipment and wiring of electrical installations exposed to potentially explosive atmospheres should be constructed and protected to the requirements specified for hazardous areas to IEC 60079 or BS5501 or equivalent.

(*b*) Electrical equipment and wiring of electrical installations in buildings and premises for the storage, manufacture or packing of dangerous goods in Categories 1 to 10 must comply with the provisions of Dangerous Goods (General) Regulations (Cap. 295).

(*c*) Electrical equipment and wiring of electrical installations in building and premises for Categories 2 and 5 Dangerous Goods including those in building and premises for liquid petroleum gas storage and for petrol filling stations should, in addition to subparagraphs (*a*) and (*b*) above, comply with the requirements specified for hazardous areas in the Electrical Safety Code Part 1 and 15 of the Energy Institute/Institute of Petroleum Model Code of Safe Practice for the Petroleum Industry or equivalent.

(*d*) Electrical equipment and wiring of electrical installations in mines should comply with the Mining Ordinance and Mines (Safety) Regulations (Cap. 285), and should be constructed and protected to relevant recognised standards.

(2) *Electrical equipment selection*

(*a*) Type of protection of electrical equipment for achievement of safety should be in accordance to zone of risk listed in Table 15(4).

(*b*) The maximum surface temperature of the T class of an electrical equipment should not exceed the ignition temperature of the gases or vapours involved. Relationship between T class and maximum surface temperature is shown in Table 15(5).

(*c*) Electrical equipment with the appropriate apparatus group should be used.

Group I: Electrical apparatus for mines susceptible to firedamp.

Group II: Electrical apparatus for places with a potentially explosive atmosphere, other than mines susceptible to firedamp.

(3) *Wiring systems*

The type of wiring that may be used for installation in hazardous areas, and the requirements for permitted types of cable and their accessories dealing with individual types of protection should comply with the recommendations laid down in IEC 60079 or equivalent. All cables, conduit and their accessories should be manufactured to appropriate recognised standards.

15E **Impact (AG)**

(*a*) A wiring system should be selected and erected so as to minimise mechanical damage.

(*b*) In a fixed installation where an impact of medium severity (AG2) or high severity (AG3) can occur, protection should be afforded by:

(i) the mechanical characteristics of the wiring system, or

(ii) the location selected, or

(iii) the provision of additional local or general mechanical protection,

or by any combination of the above.

(*c*) Except where installed in a conduit or duct which provides equivalent mechanical protection, a cable buried in ground should be of a construction incorporating an armour or metal sheath or both, or be of insulated concentric construction. Such cable should be marked by cable covers or a suitable marking tape or by suitable identification of the conduit or duct and be buried at a sufficient depth to avoid being damaged by any disturbance of the ground reasonably likely to occur.

(*d*) A wiring system buried in a floor should be sufficiently protected to prevent damage caused by the intended use of the floor.

(*e*) Where a cable is installed under a floor or above a ceiling it should be run in such a position that it is not liable to be damaged by contact with the floor or the ceiling or their fixings. Cable should incorporate an earthed metallic sheath suitable for use as a protective conductor or should be protected by enclosure in earthed steel conduit securely supported, or by equivalent mechanical protection sufficient to prevent penetration of the cable by nails, screws, and the like.

(*f*) Where a cable is to be concealed within a wall or partition, the concealed cable should incorporate an earthed metallic covering which complies with the requirements of this CoP for a protective conductor of the circuit concerned, or should be enclosed in conduit, trunking or ducting satisfying the requirements of this CoP for a protective conductor, or by mechanical protection sufficient to prevent penetration of the cable by nails, screws and the like. In case of a concealed bonding conductor, the conductor should be installed in accordance with the above requirements for a cable, or be installed within 150 mm of the top of the wall or partition or within 150 mm of angle formed by two adjoining walls or partitions in a straight run, either horizontally or vertically to the point or accessory.

(*g*) For where PVC concealed conduit system is applied, all conduits installed and concealed inside floor slab, wall or partition for cable wiring shall have concrete, cement or plaster cover of thickness not less than 30 mm (or 25 mm for short PVC concealed conduit of length less than 150 mm that is installed within 150 mm of the top of the wall/partition or within 150 mm of an angle formed by two adjoining walls/partitions) to prevent penetration of the cables inside conduits by nails, screws and the like.

15F **Vibration (AH)**

A wiring system supported by, or fixed to a structure or equipment subject to vibration of medium severity (AH2) or high severity (AH3) should be suitable for the conditions and in particular shall employ cables with fixings and connections suitable for such a situation.

15G **Other Mechanical Stresses (AJ)**

(*a*) A wiring system should be selected and erected so as to minimise during installation, use and maintenance, damage to the sheath and insulation of cables and insulated conductors and their terminations.

(*b*) There should be adequate means of access for drawing cables in or out and, if buried in the structure, a conduit or cable ducting system for each circuit should be completely erected before cables are drawn in.

(*c*) The radius of every bend in a wiring system should be such that conductors and cables shall not suffer damage.

(*d*) Where a conductor or a cable is not continuously supported it should be supported by suitable means at appropriate intervals in such a manner that the conductor or cable does not suffer damage by its own weight.

(*e*) Every cable or conductor used as fixed wiring should be supported in such a way that it is not exposed to undue mechanical strain and so that there is no appreciable mechanical strain on the terminations of the conductors, account being taken of mechanical strain imposed by the supported weight of the cable or conductor itself.

(*f*) A flexible wiring system should be installed so that excessive tensile and torsional stresses to the conductors and connections are avoided.

Table 15(1)

Maximum Permissible Operating Temperature of Various Classes of Insulation to IEC 60085

Class	Y	A	E	B	F	H	200	220	250
Temperature °C	90	105	120	130	155	180	200	220	250

Note: Temperatures over 250°C should be increased by 25°C intervals and classes designated accordingly.

Table 15(2)

Maximum Permissible Operating and Ambient Temperatures of Some Common Cable Insulations

Type of Insulation	Maximum Permissible Conductor Operating Temperature (°C)	Maximum Permissible Ambient Temperature (°C)
60°C rubber	60	55
General purpose PVC	70	65
Impregnated Paper (note 1)	80	75
85°C rubber	85	80
Mineral-insulated (*a*) 70°C sheath (*b*) 105°C sheath (note 2)	 70 105	 65 95
Thermosetting (XLPE) (note 3)	90	85
150°C rubber	150	145
Glass fibre with 185°C varnish	185	175

Notes: (1) Applicable only to cables of 600/1000V voltage grade.

(2) For mineral insulated cables that are sheathed with PVC, the values for general purpose PVC are applicable. Otherwise, the values shown for mineral insulated cables relate only to terminations; elsewhere the temperature of the cable should not exceed 250°C.

(3) XLPE means cross-linked polyethylene.

Table 15(3)

Concise List of External Influences

AA	**Ambient (°C)**
AA1	− 60°C + 5°C
AA2	− 40°C + 5°C
AA3	− 25°C + 5°C
AA4	− 5°C + 40°C
AA5	+ 5°C + 40°C
AA6	+ 5°C + 60°C
AA7	− 25°C + 55°C
AA8	− 50°C + 40°C
AB	**Humidity**
AC	**Altitude (metres)**
AC1	≤2,000 metres
AC2	>2,000 metres
AD	**Water**
AD1	Negligible
AD2	Drops
AD3	Sprays
AD4	Splashes
AD5	Jets
AD6	Waves
AD7	Immersion
AD8	Submersion
AE	**Foreign bodies**
AE1	Negligible
AE2	Small
AE3	Very small
AE4	Light dust
AE5	Moderate dust
AE6	Heavy dust
AF	**Corrosion**
AF1	Negligible
AF2	Atmospheric
AF3	Intermittent
AF4	Continuous
AG	**Impact**
AG1	Low
AG2	Medium
AG3	High
AH	**Vibration**
AH1	Low
AH2	Medium
AH3	High
AJ	**Other mechanical stresses**
AK	**Flora**
AK1	No hazard
AK2	Hazard
AL	**Fauna**
AL1	No hazard
AL2	Hazard
AM	**Radiation**
AM1	Negligible
AM2	Stray currents
AM3	Electromagnetic
AM4	Ionization
AM5	Electrostatics
AM6	Induction
AN	**Solar**
AN1	Low
AN2	Medium
AN3	High
AP	**Seismic**
AP1	Negligible
AP2	Low
AP3	Medium
AP4	High
AQ	**Lightning**
AQ1	Negligible
AQ2	Indirect
AQ3	Direct
AR	**Movement of air**
AR1	Low
AR2	Medium
AR3	High
AS	**Wind**
AS1	Low
AS2	Medium
AS3	High

(Reference: IEC Publication 364)

Table 15(4)

Selection of Electrical Equipment and Systems according to Zone of Risk

Type of Protection	Zone in which the protection may be used
'ia' intrinsically-safe apparatus or system 's' special protection (specifically certified for used in Zone 0)	0, 1, 2
'd' flammable enclosure 'ib' intrinsically-safe apparatus or system 'p' pressurization, continuous dilution and pressurized rooms 'e' increased safety 's' special protection 'm' encapsulation	1, 2
'N' type of protection N 'o' oil-immersion 'q' sand filling	2

NOTES:

Zone 0 Zone in which an explosive atmosphere is continuously present or present for long periods

Zone 1 Zone in which an explosive atmosphere is likely to occur in normal operation

Zone 2 Zone in which an explosive atmosphere is not likely to occur in normal operation, and if it occurs it will exist only for a short time.

Table 15(5)

Relationship between T Class and Maximum Surface Temperature

T Class	Maximum Surface Temperature (°C)
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

Code 16 OVERHEAD LINE INSTALLATIONS

Code 16 OVERHEAD LINE INSTALLATIONS

16A **General**

Hard-drawn copper or solid aluminium PVC insulated PVC sheathed armoured or non-armoured single or multi-core or bunched cables, suspended on carrier wires, are acceptable for low voltage overhead line installations.

16B **Installation of Overhead Lines**

Cables for overhead lines should be securely supported on insulators. Alternatively, the cables should be attached to the carrier wire by self-retaining nylon fasteners of suitable size and strength and evenly spaced at suitable intervals to prevent undue stress on the cables.

16C **Joints of Overhead Lines**

(*a*) Mid-span joints in overhead lines are not acceptable.

(*b*) Straight joints, if any, should be made at the pole and should be properly designed, installed and insulated from the pole.

16D **Service to Building**

(*a*) Where overhead lines enter into a building, the cables should be taken into the building through an arrangement with sufficient size and adequate protection from mechanical damage.

(*b*) A separate earthing system at each building comprising earth electrodes, earthing conductors, earthing terminal etc. should be provided for each building fed from an overhead line supply.

16E **Conductor to Ground Clearance**

(1) *Termination onto a building*

In cases where an overhead line is to be terminated onto a building and it is not possible to achieve the required height by attaching the overhead line to the roof of the building, an extension pole should be fitted to the building, and the overhead line should be attached to the pole. Alternatively a pole should be erected adjacent to the building, and the supply cable from the pole to the building should be adequately protected from mechanical damage. For this purpose, underground armoured cables are acceptable.

(2) *Any point of the span*

The conductor to ground clearance of any point of the span of the overhead line should be not less than:

(*a*) 5.8 m across any space accessible to vehicular traffic such as roads, car parks etc., or

(*b*) 5.2 m in other positions; or

(*c*) the tallest height restriction where height restriction is imposed on any location.

16F **Pole**

(1) *Material*

Poles should be made of steel, concrete, wood or other durable material of adequate strength.

(2) *Installation*

Poles should be erected in such a manner to withstand the forces acting on them due to overhead lines, carrier wires and wind etc.

16G **Stay Wire**

(1) *Material*

Stay wires should be of stranded galvanised steel not less than seven strands each having a nominal diameter of 2 mm (i.e. 7/2 mm).

(2) *Installation*

(*a*) Stay wires may be used at the terminal poles or at poles where the overhead line changes direction. The stays wires, where used, should be placed in such a manner so as to take the pull exerted by the lines effectively.

(*b*) Stay wires should be properly and securely terminated at each end so as to withstand the forces acting on the wires.

16H **Carrier Wire**

(1) *Material*

Carrier wires should be made of a stranded galvanised steel having a nominal overall diameter not less than 4 mm.

(2) *Installation*

Carrier wires should be firmly fixed to supports.

16I **Earthing of Metallic Parts and Earth Leakage Protection**

(*a*) The metallic poles, the steel carrier wires and the stay wires, should be permanently and effectively earthed at the main earthing terminals at both ends of the circuit. To meet this requirement the steel carrier wire may be used as a protective conductor to earth the metallic poles and stay wires provided that the electrical continuity of the carrier wire is durably maintained throughout the entire run of the circuit.

(*b*) Where an electrical installation is supplied from overhead line system, the installation should be protected against earth leakage by residual current device (see Code 11B).

Code 17 DISPLAY OF LABELS AND NOTICES

17A Warning Notice for Substations and Switchrooms

(1) Warning notice for substations

(2) Warning notice for switchrooms

(3) Warning notice for distribution boards

17B Warning Notice for Connection of Earthing and Bonding Conductors

17C Warning Notice for Repair

17D Notice of Periodic Testing of Electrical Installations

17E Notice of Testing for Residual Current Devices

Code 17 DISPLAY OF LABELS AND NOTICES

17A **Warning Notice for Substations and Switchrooms**

(1) *Warning notice for substations*

'DANGER—SUBSTATION, UNAUTHORISED ENTRY PROHIBITED' and '危險——電力分站，未經授權不得內進' in legible letters and characters. "DANGER" and '危險' should not be less than 30 mm high and each other letters and characters not less than 15 mm high, either painted on the outside of the door of the substation, or engraved on plastic boards permanently fixed on the outside of the door of the substation.

(2) *Warning notice for switchrooms*

'DANGER—ELECTRICITY, UNAUTHORISED ENTRY PROHIBITED' and '危險——有電，未經授權不得內進' in legible letters and characters. 'DANGER' and '危險' should not be less than 30 mm high and each other letter and characters not less than 15 mm high, either painted on the outside of the door of the switchroom or engraved on plastic boards permanently fixed on the outside of the door of the switchroom.

(3) *Warning notice for distribution boards*

'DANGER' and '危險' in red legible letters and characters each not less than 10 mm high, displayed at or near each distribution board is acceptable.

17B **Warning Notice for Connection of Earthing and Bonding Conductors**

'SAFETY ELECTRICAL CONNECTION—DO NOT REMOVE' and '安全接地終端——切勿移去' in legible letters and characters each not less than 5 mm high to be permanently fixed at or near the point of connection of every earthing conductor to an earth electrode, and at or near each main bonding connection.

17C **Warning Notice for Repair**

'CAUTION—EQUIPMENT UNDER REPAIR' and '小心——器具待修' and/or 'CAUTION—MEN AT WORK (小心——工程進行中)' in legible letters and characters each not less than 50 mm high, displayed at or near the electrical equipment and at the isolating device associated with the equipment is acceptable. Examples for display of such notices are:

(*a*) on a distribution board or switch or circuit breaker controlling the circuit on which work is being carried out; and

(*b*) at or near any equipment where bare or live parts which are normally protected from direct contact are uncovered and exposed for work to be carried out.

17D **Notice of Periodic Testing of Electrical Installations**

'This installation must be tested and certified by a grade A/B/C/H/R* electrical worker before (date) **' and '本裝置須於_____年_____月_____日 ** 前由 A/B/D/H/R* 級電業工程人員測試及發出證明書' in legible letters and characters each not less than 5 mm, permanently fixed at or near the main distribution board or main switch of a periodically tested electrical installation referred to in regulation 20 (see Code 20) is acceptable.

(*Note:* * delete whichever inapplicable.

** the date entered on this notice is the date of the next certificate to be issued and is to be up-dated by the registered electrical worker who is certifying the installation.)

17E **Notice of Testing for Residual Current Devices**

'Press to test at least quarterly' and '最少每三個月按鈕測試' in legible letters and characters each not less than 5 mm, permanently fixed at or near a residual current device is acceptable.

Code 18 ALTERATIONS AND ADDITIONS

18A Requirements for Alterations or Additions to a Fixed Installation

18B Approval from the Electricity Supplier

Code 18 ALTERATIONS AND ADDITIONS

18A **Requirements for Alterations or Additions to a Fixed Installation**

(*a*) For any alteration or addition to an existing fixed installation, the registered electrical worker responsible for the work should:

- (i) carry out the alteration or addition in compliance with the Wiring Regulations, *and*
- (ii) verify that the alteration or addition does not impair in any way the safety of the existing installation.

(*b*) For the purposes of subparagraph (*a*) above, the following essential items should be checked and ascertained by the responsible registered electrical worker:

- (i) the total current demand for the installation after the alteration or addition should not exceed the approved loading,
- (ii) the ratings and the conditions of the existing electrical equipment of the affected parts are suitable and adequate for the altered circumstances, and
- (iii) the protection against overcurrent, earth fault currents and dangerous earth leakage currents for the affected parts is altered as necessary for the altered circumstances.

(*c*) In the case of an alteration or addition to an installation which is connected to rising mains, the owner of the installation should, before commencing any alteration or addition, obtain agreement from the owner of the rising mains by completing form "Confirmation of Agreement from Owner of Rising Mains for Connection of Electrical Installation with an Increased Current Demand" provided by Electricity Supplier if the new current demand of the installation after the alteration or the addition will exceed the existing approved loading before the alteration or addition is carried out on the installation.

18B **Approval from the Electricity Supplier**

Any person who wishes to have his electricity supply increased over and above the approved loading, or extended beyond the premises to which the supply is originally intended, should obtain prior approval from the electricity supplier concerned *before* any alteration or addition is carried out.

Code 19 FIRST INSPECTION, TESTING AND CERTIFICATION

19A Certification on Completion of an Installation

19B Work Completion Certificate

Code 19 FIRST INSPECTION, TESTING AND CERTIFICATION

19A Certification on Completion of an Installation

(*a*) Certification on the design—

After the design is completed for new work, alteration or addition to be made to an existing installation, it should be certified, before installation, by a registered electrical worker that the relevant design is in compliance with the Wiring Regulations.

(*b*) Certification on the installation—

After an installation is completed, or work completed subsequent to repair, alteration or addition made to an existing installation and before it is energized for use, it should be inspected, tested and certified by a registered electrical worker that the wiring installation is completed to the relevant design and is in compliance with the Wiring Regulations.

(*c*) If the installation, alteration or addition is designed, inspected and tested by the same electrical worker, he should certify both the design and the installation as required under subparagraphs (*a*) and (*b*).

(*d*) In the case of a repair, alteration or addition to an installation, only the affected parts of the installation need to be inspected, tested and certified.

(*e*) Certification as required in subparagraphs (*a*) and (*b*) should be made on prescribed forms specified by the Director (i.e. Work Completion Certificate).

19B Work Completion Certificate

(*a*) For the purpose of regulations 19(1) and 19(2), the registered electrical worker(s) and contractor(s) should sign work completion certificate(*s*) and issue it to the owner after completion of the electrical installation or any work subsequent to repair, alteration or addition to an existing installation. This should be done before the installation is energised.

(*b*) It is recommended that in order to expedite the application for supply connection, a copy of the certificate may be copied to the electricity supplier concerned.

(*c*) Where an installation is subdivided into more than one part and individual parts are not inspected and tested by the same registered electrical worker, a single certificate may be issued and certified by a registered electrical worker to cover a number or all of the individual parts, provided that he has received the appropriate certificates signed by other registered electrical workers for the individual parts.

(*d*) Every certificate should be signed by the registered electrical worker and/or the registered electrical contractor as required in the certificate. Where a registered electrical contractor is not employed as permitted under section 35(3) of the Electricity Ordinance, the owner of the electrical installation who employs the registered electrical worker to do the work should sign as the registered electrical contractor and should then assume responsibilities of a registered electrical contractor.

(*e*) Proforma of the Work Completion Certificate can be obtained from EMSD's Customer Service Office or downloaded from www.info.gov.hk/forms.

Code 20 PERIODIC INSPECTION, TESTING AND CERTIFICATION

20A Fixed Electrical Installations Specified in Regulation 20(1)

(1) Places of public entertainment

(2) Premises for the manufacturing or storing of dangerous goods

(3) High voltage fixed installations

20B Fixed Electrical Installations Specified in Regulations 20(2), 20(3) and 20(4)

20C Periodic Test Certificate

Code 20 PERIODIC INSPECTION, TESTING AND CERTIFICATION

20A **Fixed Electrical Installations Specified in Regulation 20(1)**

Fixed electrical installations having any approved loading at the following types of premises are required to be inspected, tested and certified at least once every year:

(1) *Places of public entertainment*

Places of public entertainment as defined in the Places of Public Entertainment Ordinance (Cap. 172) including any place, building, erection or structure, whether temporary or permanent, capable of accommodating the public in or on which a public entertainment is present or carried on whether on one occasion or more; including any concert, stage play, stage performance or other musical, dramatic or theatrical entertainment or any part thereof, any cinematography display, lecture, story-telling, circus, exhibition of pictures, photographs or books, exhibition of dancing, conjuring or juggling, acrobatic performance exhibition of abnormal persons or animals, any sporting exhibition or contest, any bazaar, any merry-go-round, flying wheel or other mechanical device designed for amusement.

(2) *Premises for the manufacturing or storing of dangerous goods*

(*a*) Premises for the manufacturing or storing of dangerous goods classified under categories of the Dangerous Goods (Application and Exemption) Regulations (Cap. 295), previously known as the Dangerous Goods (Classification) Regulations, are as follows:

Category 1 — explosives and blasting agents
Category 2 — compressed gases
Category 3 — corrosive substances
Category 4 — poisonous substances
Category 5 — substances giving off inflammable vapour
Category 6 — substances which become dangerous by interaction with water
Category 7 — strong supporters of combustion
Category 8 — readily combustible substances
Category 9 — substances liable to spontaneous combustion
Category 9A — combustible goods exempted from sections 6 to 11 of the Dangerous Goods Ordinance
Category 10 — other dangerous substances

(*b*) Examples of the above are dangerous goods stores, dangerous goods storage tanks, gas stations, petroleum and diesel filling stations and liquefied petroleum gas stations etc.

(3) *High voltage fixed installations*

(*a*) Premises having high voltage fixed installations that are fed directly from a high voltage supply are required to be inspected, tested and certified at least once every year. Examples of such installations are:

(i) high voltage switchrooms and substations under the control of the owners (e.g. of a large commercial complex);

(ii) high voltage fixed installations such as large plant and machinery.

(*b*) High voltage electrostatic equipment and high voltage discharge lighting such as neon signs which are fed from low voltage supplies are not considered as high voltage fixed installations. They are considered as part of a low voltage installation.

20B **Fixed Electrical Installations Specified in Regulations 20(2), 20(3) and 20(4)**

(1) Fixed electrical installations in factories and industrial undertakings having an approved loading exceeding 200 amperes, single or three phase at nominal low voltage are required to be inspected, tested and certified at least once every five years.

(2) Fixed electrical installations in premises other than those mentioned in Codes 20A or 20B(1) above having an approved loading exceeding 100 amperes single or three phase at nominal low voltage are required to be inspected, tested and certified at least once every five years. Examples of such installations are rising mains, protective conductors, earthing facilities, and power supply to lifts, water pumps, public lighting and other communal services in the common area of domestic premises and fixed installations in offices etc.

(3) Low voltage fixed electrical installation located in one of the following type of premises should be inspected, tested and certified at least once every five years:

(*a*) hotel or guest house;

(*b*) hospital or maternity home;

(*c*) school;

(*d*) premises of the institutions listed in section 2 of the Education Ordinance (Cap. 279) including technical institutions and universities;

(*e*) child care centre; and

(*f*) premises that the Director may, by notice posted to or served on the owner, specify that he considers could cause great harm in the event of an electrical accident.

20C **Periodic Test Certificate**

(1) The owner of an installation which requires periodic testing should deliver a test certificate to the Director for endorsement within 2 weeks after the date of the certificate. The owner should submit a current endorsement fee for each certificate delivered to the Director.

(2) Where an installation is subdivided into more than one part and individual parts are not inspected and tested by the same registered electrical worker, a single test certificate may be issued and certified by a registered electrical worker to cover a number or all of the individual parts, provided that he has received the appropriate test certificates signed by other registered electrical workers for the individual parts.

(3) The test certificates should be in prescribed forms specified by the Director and proforma of the certificates can be obtained from EMSD's Customer Service Office or downloaded from www.info.gov.hk/forms.

(4) All installations which require periodic testing and are connected to electricity supplies on or before the commencement date of the Wiring Regulations (1 June 1992) are considered to have been inspected, tested and certified on that date.

Code 21 PROCEDURES FOR INSPECTION, TESTING AND CERTIFICATION

21A Inspection of Low Voltage Installations

21B Testing of Low Voltage Installations

(1) Safety

(2) Sequence of tests

(3) Continuity of ring final circuit

(4) Continuity of protective conductors

(5) Earth electrode resistance

(6) Insulation resistance

(7) Polarity

(8) Earth fault loop impedance

(9) Functions of all devices including protective devices

(10) Additional checks for installations in hazardous environment

21C Inspection of High Voltage (H.V.) Installations

21D Testing of High Voltage Installations

(1) Safety

(2) Testing requirements

21E Points to be Noted by Registered Electrical Workers

(1) Signing of certificates

(2) Dates of tests, inspections and certification

(3) Items to be inspected and tested

(4) Related ordinance and regulations to be observed

(5) Energisation of installation for testing purposes

(6) Standard symbols to be used

Code 21 PROCEDURES FOR INSPECTION, TESTING AND CERTIFICATION

21A **Inspection of Low Voltage Installations**

A visual inspection should be made to verify that the electrical equipment as installed is correctly selected and erected in accordance with the Wiring Regulations and this CoP, and that there is no apparent damage. The visual inspection should include a check on the following items, where appropriate:

(*a*) adequacy of working space, access, and maintenance facilities,

(*b*) connections of conductors,

(*c*) identification of conductors,

(*d*) adequacy of the sizes of conductor in relation to current carrying capacity and voltage drop,

(*e*) correct connections of all equipment with special attention to socket outlets, lampholders, isolators, switches, residual current devices, miniature circuit breakers, and protective conductors,

(*f*) presence of fire barriers and protection against thermal effects,

(*g*) methods of protection against direct contact with live parts (including measurement of distances where appropriate), i.e. protection by insulation of live parts, or protection by barriers or enclosures,

(*h*) presence of appropriate devices for isolation and switching,

(i) choice and setting of protective and indicative devices,

(*j*) labelling of circuits, fuses, protective devices, switches, isolators and terminals,

(*k*) selection of equipment and protective measures appropriate to adverse environmental conditions,

(*l*) presence of danger and warning notices,

(*m*) presence of diagrams, instructions and other similar information,

(*n*) connection of single pole devices for protection or switching in phase conductors only,

(*o*) methods of protection against indirect contact,

(*p*) prevention of mutual detrimental influence,

(*q*) presence of undervoltage protective devices,

(*r*) erection method.

21B **Testing of Low Voltage Installations**

(1) *Safety*

Precautionary measures should be taken during testing and the method of tests should be such that no danger to persons or property can occur even if the circuit being tested is defective.

(2) *Sequence of tests*

(*a*) The following items, where relevant, are to be tested preferably in the sequence indicated below:

(i) continuity of protective conductors, including main and supplementary equipotential bonding,

(ii) continuity of ring final circuit conductors,

(iii) insulation resistance,

(iv) polarity,

(v) earth electrode resistance,

(vi) earth fault loop impedance,

(vii) functions of all protective devices,

(viii) functions of all items of equipment.

(*b*) In the event of any test indicating failure to comply, that test and those preceding, the results of which may have been influenced by the fault indicated, should be repeated after the fault has been rectified.

(3) *Continuity of protective conductors*

Every protective conductor, including all conductors and any extraneous conductive parts used for equipotential bonding should be tested for continuity. The test should be made by connecting together the neutral and protective conductors at the mains position and checking between earth and neutral at every outlet by a continuity tester, which should show a reading near zero.

(4) *Continuity of ring final circuit*

(*a*) The ring circuit should be tested from the distribution board. The ends of the two cables forming the phase conductor should be separated, and a continuity test should show a reading near zero between the two; the same tests to be made between the two cables that form the neutral conductor, and between the two cables that form the protective conductor (see Figure 21(1)).

(*b*) The testing method in subparagraph (*a*) above is only applicable when the ring circuit has been inspected throughout, prior to the test, to ascertain that no interconnection (multi-loops) exists on the ring circuit. Otherwise, the testing methods stipulated in Part 3 of the Guidance Note 3 to BS7671, should be adopted instead.

(5) *Insulation resistance*

(*a*) A suitable d.c. insulation tester should be used to measure insulation resistance. Care should be taken to ensure that the insulation of the equipment under test can withstand the test voltage without damage.

(*b*) To carry out this test, it is acceptable to divide large installation into sections with groups of outlets, each group containing not less than 50 outlets. The term 'outlet' in this case includes every point and every switch. A socket outlet or appliance or luminaire incorporating a switch is regarded as one outlet.

(*c*) When measured with all fuse links in place, all switches and circuit breakers (including, if practicable, the main switch) closed and all poles or phases of the wiring electrically connected together, the insulation resistance to earth should not be less than the appropriate values given in Table 21(1), as illustrated in Figure 21(4).

(*d*) When measured between all conductors connected to any one phase or pole of the supply and, in turn, all conductors connected to each other phase or pole, as shown in Figure 21(5), the insulation resistance should not be less than the appropriate values in Table 21(1).

(*e*) In carrying out the test:

(i) wherever practicable, all lamps should be removed and all current using equipment should be disconnected and all local switches controlling lamps or other equipment should be closed;

(ii) where the removal of lamps and/or the disconnection of current using equipment is impracticable, the local switches controlling such lamps and/or equipment should be open;

(iii) electronic devices connected in the installation should be isolated or short circuited where appropriate so that they are not damaged by the test voltage.

(iv) where the circuits contain voltage sensitive devices, the test should measure the insulation resistance to earth with all live conductors (including the neutral) connected together.

(*f*) Where equipment is disconnected for the test and the equipment has exposed conductive parts required to be connected to protective conductors, the insulation resistance between the exposed conductive parts and all live parts of the equipment should be measured separately and should have a minimum insulation resistance not less than 0.5 megohm.

(6) *Polarity*

(*a*) A test of polarity, as illustrated in Figure 21(6), should be carried out to verify that:

(i) every fuse and single-pole control and protective device is connected in the phase conductor only,

(ii) centre-contact bayonet and Edison-type screw lampholders to IEC 60238 in circuits having an earthed neutral conductor, have their outer or screwed contacts connected to that neutral conductor, and

(iii) wiring has been correctly connected to socket outlets and similar accessories.

(7) *Earth electrode resistance*

(*a*) A proper earth electrode resistance tester should be used to measure earth electrode resistance. An alternating current at 50 Hz of a steady value is passed between the earth electrode T and an auxiliary earth electrode T_1 placed at a separation distance recommended by the manufacturer of the tester but in any case should not be less than 20 metres away. A second auxiliary earth electrode T_2, which may be a metal spike driven into the ground, is then inserted half-way between T and T_1, and the voltage drop between T and T_2, divided by the current flowing between T and T_1, gives a measured earth electrode resistance of earth electrode T.

(*b*) The test method is depicted in Figure 21(2).

(*c*) For an electrical installation having four or more earth electrodes which are installed more or less in line, following a general direction not exceeding 15° deviation and with separation between adjacent electrodes not less than the recommended distance by the manufacturer of the tester but in any case not less than 20 metres, these electrodes can be used in turn as the auxiliary electrodes for the purpose of measuring the earth electrode resistances, as illustrated in Figure 21(3).

(*d*) The following alternative method for measuring the earth electrode resistance may be used if the electricity supply is connected. A loop impedance tester should be connected between the phase conductor at the origin of the installation and the earth electrode with the test link open, and a test performed. This impedance reading could be treated as the electrode resistance.

(8) *Earth fault loop impedance*

(*a*) The earth fault loop impedance should be measured by a phase-earth loop tester with a scale calibrated in ohms.

(*b*) The earth fault loop impedance should not exceed the requirements of Code 11.

(*c*) Before the test begins, it is essential to establish, by inspection, that the earthing conductor and all relevant earth connections are in place, and that the bonding connection to electricity supplier's earthing facilities is disconnected. Measures should be taken, during the impedance tests especially when the earth leakage protective devices are effectively removed for the duration of the tests, to ensure that the installation is not being used other than by person(*s*) carrying out the tests.

(9) *Functions of all devices including protective devices*

(*a*) Functional Test of RCD

(i) Function of residual current devices should be checked by a residual current device tester simulating an earth fault in order to verify its effective operation. The in-built test button should also be tested for proper functioning. One of the testing methods is specified in subparagraph (ii) and (iii) below. Other testing methods complying with relevant national/international standards are also acceptable.

(ii) The test should be made on the load side of the RCD between the phase conductor of the protected circuit and the associated cpc. The load should be disconnected during the test.

(iii) For general purpose RCDs to IEC 61008 or RCBOs to IEC 61009, with a leakage current flowing equivalent to 50% of the rated tripping current of the RCD, the device should not open. When a leakage current is flowing equivalent to 100% of the rated tripping current of the RCD, the device should open in less than 300 ms unless it is of "Type S" (or selective) which incorporates an intentional time delay, when it should trip within the time range from 130 ms to 500 ms.

(*b*) Function of other protective devices, such as miniature circuit breakers, moulded case circuit breakers, air circuit breakers, fused switches, switch-fuses and protective relays etc. should be checked by hand operation as appropriate.

(*c*) Function of all items of equipment such as isolators, switches and indicative devices should be checked by hand operation.

(10) *Additional checks for installations in hazardous environment*

The following additional checks, where appropriate, should be carried out for installations in hazardous environment:

(*a*) Where appropriate, the area involved should be checked to ensure 'gas free' condition before insulation and earth fault loop impedance test are carried out.

(*b*) All equipment should be suitably protected according to the types of protection under Code 15. The integrity of the type of protection provided for the equipment should not be jeopardised by the method of installation. No alteration that may invalidate the conditions of protection can be used.

(*c*) Equipment should be kept clean and free from accumulation of dust, foreign particles and deleterious substances. Equipment is kept free from condensation.

(*d*) All lamps, fuses and replaceable parts should be checked so that correct rating and types are being used.

(*e*) The surface temperature of all equipment should be appropriate to the type of protection being provided.

21C **Inspection of High Voltage (H.V.) Installations**

Inspection of H.V. installations should follow those for L.V. installations listed in Code 21A with additional checks on the following items where relevant:

(*a*) provision of suitable locking facilities for every entry to an H.V. switchroom/substation;

(*b*) continuity of protective conductors especially the bonding of all exposed conductive parts; and

(*c*) provision of padlock facilities for shutters, key boxes etc.

21D **Testing of High Voltage Installations**

(1) *Safety*

Precautionary measures should be taken and the methods of tests should be such that no danger to persons or property can occur even if the circuit being tested is defective.

(2) *Testing requirements*

Testing for High Voltage installations should be referred to relevant recognised standards, manufacturers' recommendation, operations and maintenance instructions.

21E **Points to be Noted by Registered Electrical Workers**

(1) *Signing of certificates*

(*a*) A registered electrical worker should not sign certificates for tests and inspections unless he has carried out or supervised the tests and inspections on site, and is satisfied with the results of the tests and inspections.

(*b*) A registered electrical worker should not sign certificates for tests and inspections carried out by other registered electrical workers unless:

(i) he has received the appropriate certificates for the tests and inspection results certified by other registered electrical workers;

(ii) he is satisfied with the results of the tests and inspections;

(iii) he is satisfied that the certificates or inspection reports submitted to him are completed and signed by registered electrical worker of appropriate grade and in compliance with the Wiring Regulations; and

(iv) he has taken reasonable steps to ascertain that the tests and inspections have been genuinely carried out.

(2) *Dates of tests, inspections and certification*

It is acceptable that the actual dates of all tests and inspections be different from the date of certification. However, for the registered electrical worker to be satisfied that the results of these tests and inspections are valid, he must ensure that the final inspections, insulation resistance tests and functional tests of protective and control devices are carried out as close to the date of certification as possible; and in any case, the date of certification should not be later than two weeks after the date of the tests and inspections. Other tests and inspections listed under Code 21 may be carried out at a reasonable time, normally not exceeding one month, before the date of certification provided that due precautions have been taken to ensure that nothing will have affected the results of these tests and inspections during this period.

(3) *Items to be inspected and tested*

List of items to be inspected and tested for initial tests and periodic tests are shown in Code 22D.

(4) *Related ordinance and regulations to be observed*

Other statutory requirements in relation to electrical installations should also be referred to during the inspection, including in particular:

(*a*) (i) Fire Services Ordinance,

(ii) Fire Services (Installations and Equipment) Regulations,

(*b*) (i) Fire Safety (Commercial Premises) Ordinance,

(ii) Fire Safety (Buildings) Ordinance,

(*c*) (i) Factories and Industrial Undertakings Ordinance,

(ii) Factories and Industrial Undertakings (Electricity) Regulations,

(iii) Construction Sites (Safety) Regulations,

(iv) Factories and Industrial Undertaking (Work in Compressed Air) Regulations,

(v) Factories and Industrial Undertakings (Spraying of Inflammable Liquid) Regulations,

(vi) Factories and Industrial Undertakings (Cargo and Container Handling) Regulations,

(*d*) (i) Dangerous Goods Ordinance,

(ii) Dangerous Goods (General) Regulations.

(5) *Energisation of installation for testing purposes*

To energise an installation or part of it for testing by a registered electrical worker prior to the issue of the relevant certificate is acceptable.

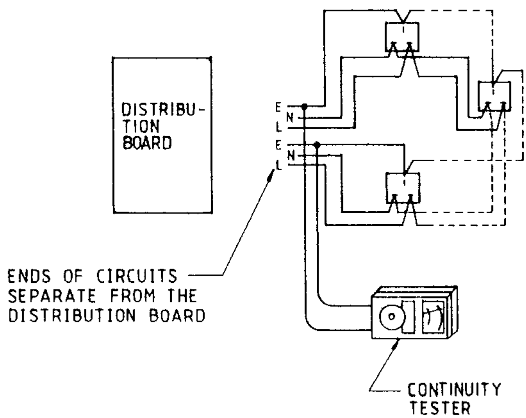
(6) *Standard symbols to be used*

Standard symbols to Appendix 8 should be used in schematic diagrams where appropriate.

Table 21(1)

Minimum Values of Insulation Resistance

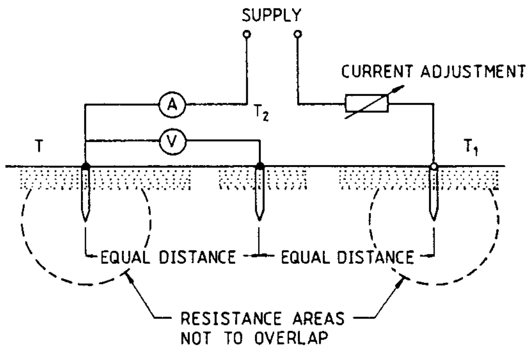
Circuit Nominal Voltage (Volts)	Test Voltage d.c. (Volts)	Minimum Insulation Resistance (megohms)
Extra-low voltage circuits when the circuit is supplied from a safety isolating transformer/SELV	250	0.25
Up to and including 500V with the exception of the above cases	500	0.5
Above 500V	1 000	1.0



(NOTE: THIS TESTING METHOD IS APPLICABLE SUBJECT TO CODE 21B(4)(b))

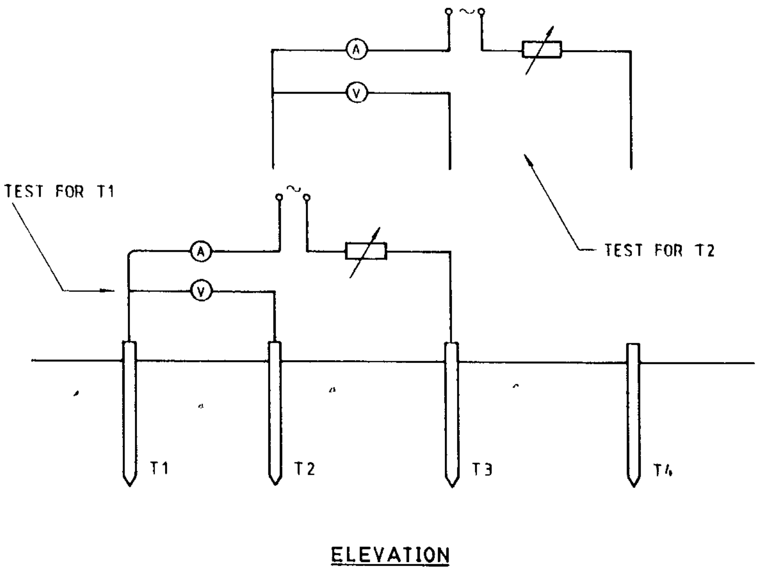
CONTINUITY TEST OF RING FINAL CIRCUIT

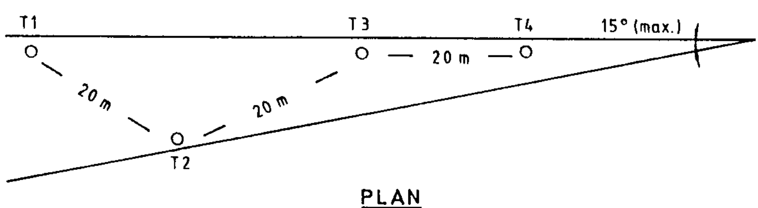
CODE No. 21	FIGURE No. 21(1)	



EARTH ELECTRODE RESISTANCE TEST

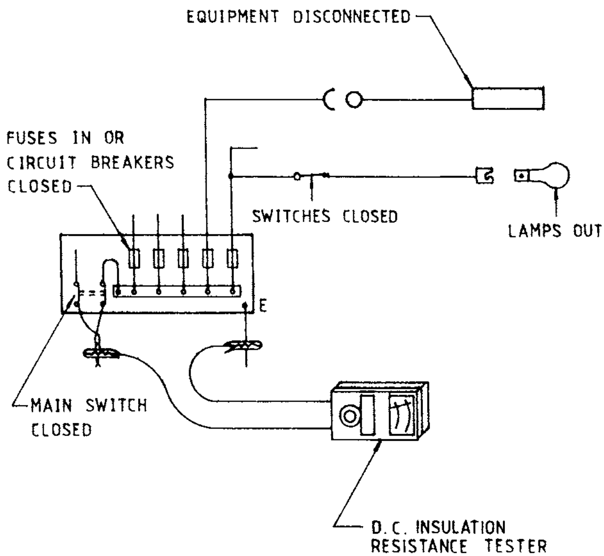
CODE No.	FIGURE No.	
21	21(2)	





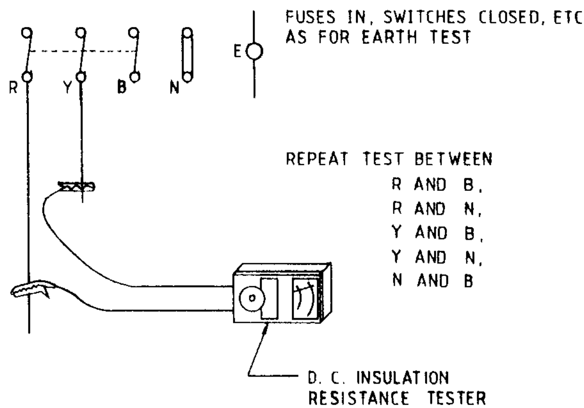
TEST OF EARTH ELECTRODE RESISTANCE HAVING FOUR OR MORE ELECTRODES

CODE No.	FIGURE No.	
21	21(3)	



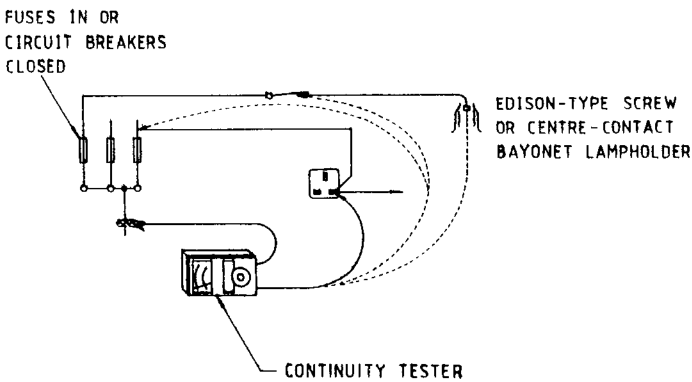
INSULATION RESISTANCE TO EARTH TEST

CODE No.	FIGURE No.	
21	21(4)	



INSULATION RESISTANCE TEST BETWEEN PHASES

CODE No.	FIGURE No.	
21	21(5)	



POLARITY TEST

CODE No. 21	FIGURE No. 21(6)	

Code 22 MAKING AND KEEPING OF RECORDS

22A Keeping of Records by the Owner of an Electrical Installation that Requires Periodic Inspection, Testing and Certification

22B Making and Keeping of Records by a Registered Electrical Contractor

22C Types of Records

22D Checklists

(1) Checklists to be used

(2) Test sequence

(3) Checklist for high voltage installations

(4) Contents of checklists

Code 22 MAKING AND KEEPING OF RECORDS

22A Keeping of Records by the Owner of an Electrical Installation that Requires Periodic Inspection, Testing and Certification

(*a*) It is the responsibility of the owner of a periodically tested electrical installation referred to in Regulation 20 (see Code 20) to keep the latest test certificates and make available for inspection by the Director.

(*b*) For high voltage fixed installation specified in Regulation 20(1)(*c*) (see Code 20A), the owner should also make available for inspection a written summary of safety precautions taken for each event of testing and maintenance work carried out on the installation.

22B Making and Keeping of Records by a Registered Electrical Contractor

(*a*) It is the responsibility of a registered electrical contractor to make and keep proper records on all electrical works carried out by him and his employees for the lesser of 5 years or the time since his registration as an electrical contractor.

(*b*) The registered electrical contractor should also ensure that a copy of the records is made available to the owner of the electrical installation upon completion of work.

22C Types of Reocrds

(*a*) For the purpose of Code 22B, a simple single line diagram with symbols to Appendix 8 and simple test results against the lists of items to be inspected and tested detailed in a number of checklists under Code 22D are acceptable as proper records.

(*b*) For the purpose of Code 22A(*b*), a record of the permit-to-work together with a maintenance log are acceptable.

22D Checklists

(1) *Checklists to be used*

Depending on the varying requirements as indicated in subparagraphs (*a*) and (*b*), records showing the results of the items of inspection and testing performed according to the checklists numbered 1 to 4 in Appendix 13 are generally acceptable.

	Requirements	*Checklists to be Used*
(*a*)	Periodic inspection and testing for a low voltage installation which was connected to supply:	
	(i) before 1.1.1985	1
	(ii) on or after 1.1.1985 and before 1.6.1992	1 and 2

Requirements	Checklists to be Used
(iii) on or after 1.6.1992	1, 2 and 3
(*b*) Inspection and testing carried out upon completion of any electrical work for a low voltage installation	1, 2, 3 and 4

(2) *Test sequence*

Where more than one of the checklists are to be used, the items to be tested should follow the sequence stated in Code 21B(2)(*a*). The records against the items of the checklists used do not indicate the test sequence.

(3) *Checklist for high voltage installations*

For high voltage installations that are required to be inspected, tested and certified at least once every year, records showing the results of the items of inspection and testing performed according to checklist numbered 5 in Appendix 13 are generally acceptable. Recommendation for testing of high voltage installations given in relevant recognised standards and manufacturers for commissioning and periodic tests, where appropriate, should also be used.

(4) *Content of checklists*

(*a*) The checklists given in Appendix 13 contain a number of important items to be recorded after an inspection and testing and they are given to indicate generally the minimum requirements for record purposes only. The registered electrical worker carrying out the inspections and tests should fill in test results and the rating of key items where indicated in the checklists; and must certify with date on each individual item of inspection and testing listed. The use of initials for such certification is acceptable if a sample of the initial against a full signature of the registered electrical worker has been given in the records. Where any item listed in the checklists is not applicable to the installation under inspection and testing, the registered electrical worker should also certify it to be so. The use of the abbreviation 'N/A' is acceptable for this purpose. The registered electrical worker should also ensure that all other relevant inspection and testing results are also properly recorded. All inspection and testing results should be comprehensive; and where necessary, they may be recorded separately and attached as annexes to the checklists.

(*b*) Checks stated in Code 21B(10) should be added to relevant checklists for inspection and testing of installations in hazardous environment.

Code 23 & Code 24 (Reserved for Future Uses)

PART II

Code 25 GENERAL WORKMANSHIP

25A Wiring Installation Using Conduits

(1) General requirements for installation of steel or PVC or plastic conduit

(2) Wiring installation using steel conduit

(3) Wiring installation using PVC or plastic conduit

25B Wiring Installation Using Trunkings

(1) General requirements for installation of steel or PVC or plastic trunking

(2) Wiring installation using steel trunking

(3) Wiring installation using PVC or plastic trunking

25C Installation of Cables

(1) General requirements

(2) Installation of PVC insulated, PVC sheathed non-armoured cable

(3) Installation of armoured or metallic sheathed cable

(4) Use of flexible cable and flexible cord

25D Cable Joint and Cable Termination

(1) Cable joint

(2) Boxes for cable joint and cable termination

(3) General requirements for jointing and termination of cable

(4) Straight-through joint

(5) Jointing of protective conductors

(6) Joints and terminations of non-armoured cables

(7) Jointing and termination of armoured cables

(8) Termination of bonding conductors

25E Installation of Socket Outlets

Part II

Code 25 GENERAL WORKMANSHIP

25A **Wiring Installation Using Conduits**

(1) *General requirements for installation of steel or PVC or plastic conduit*

(*a*) Where a conduit crosses an expansion joint, special arrangements should be made to allow relative movement to occur on either side of the expansion joint and an example is illustrated in Figure 25(1). A separate circuit protective conductor should be installed to maintain an effective electrical continuity across the expansion joint. The circuit protective conductor should have a cross-sectional area rated to suit the largest live conductor drawn into the conduit.

(*b*) During the building construction, all open ends of the conduit termination, which are liable to be filled with water, moisture or other foreign matter, should be plugged with proper conduit stopping plugs; paper, rag or similar materials should not be used for this purpose. Conduit boxes in similar circumstances should also be similarly plugged to prevent concrete or plaster from entering the boxes during building construction.

(*c*) Proper sealant for the prevention of accumulation of condensed moisture should be applied to ceiling conduit outlets installed in a cool space subject to the influx of warm air.

(*d*) Saddles, for the support of surface conduits, should be provided throughout the entire route at regular intervals. The spacing between adjacent saddles should not be greater than those given in Table 25(1).

(*e*) Cables should be drawn into a conduit by using drawn-in tape or steel wire of the appropriate size. If cable lubricant is used, it should not negatively interact with the cable they lubricate and should not increase the flame spread or decrease the fire resistant properties of the cable.

(*f*) All live conductors of the same circuit should be drawn into the same conduit.

(*g*) The neutral cable of a lighting final circuit using single core cables may be routed in the conduit direct to the lighting point without passing through the switch box.

(*h*) Adaptable boxes should be provided immediately after every two bends, or after a bend plus a total maximum straight run of 10 metres or after a maximum straight run of 15 metres.

(i) Adjacent or parallel conduits cast in concrete should be separated by a spacing of not less than 25 mm.

(2) *Wiring installation using steel conduit*

(*a*) (i) Joint in steel conduits should be made by means of a solid coupler into which the adjacent ends of the two conduits should be inserted and screwed up tightly in order to make the conduit run mechanically and electrically continuous. Exposed screw threads should be painted with anti-corrosion paint.

(ii) Running couplings are not recommended.

(*b*) (i) Where a steel conduit terminates at a metal casing, the connection should be made by a coupler or a brass adaptor for flexible conduit together with a brass male bush. The connection between the flexible conduit and the adaptor should be securely fixed and protected against ingress of moisture where required. Length of each flexible conduit should be kept to a minimum of not more than 1 m for general applications or 2 m inside false ceiling.

(ii) Where the metal casing is painted or enamelled, the electrical continuity between the conduit and the casing should be achieved by means of a separate protective conductor of adequate size, connecting the earthing terminal of the conduit and an earthing terminal inside the metal casing. A copper earthing piece placed between the bush and the metal casing may be used as an earthing terminal of the conduit.

(*c*) Conduit should not be bent more than 90 degrees. The internal radius of the bend should not be less than 2.5 times the outside diameter of the conduit.

(3) *Wiring installation using PVC or plastic conduit*

(*a*) Conduit bends should have an internal radius of at least 4 times the outside diameter of the conduit.

(*b*) The method of carrying out the conduit bends, conduit joints, fixing conduits to boxes without spouts, and the tools and materials to be used should be as recommended by the manufacturer of the conduits.

(*c*) Due allowance should be made for the expansion of the PVC tubing at high temperatures. Expansion coupling or other fittings should be included in a straight run of 8 m or more. Saddles or clips should be of sliding fit.

(*d*) Boxes for the suspension of luminaires or other equipment, where considerable heat will be produced, should be fitted with steel insert clips. Plastic boxes used for suspension of luminaires or other equipment should be suitable for the suspended load at the expected working temperature.

25B **Wiring Installation Using Trunkings**

(1) *General requirements for installation of steel or PVC or plastic trunking*

(*a*) Individual pieces of trunking should be independently supported by means of at least two fixed points per piece. On straight runs, supports for trunking should be fixed at regular intervals with maximum spacings as given in Table 25(2). For runs with bends, supports should be fixed as near to the bend as practicable.

(*b*) Holes in trunking should be drilled, punched or cut by ring saw. After cutting, burrs and sharp edges on the trunking should be removed to prevent abrasion of cables.

(*c*) Cables penetrating through trunking should be protected by conduits except PVC insulated and sheathed cables if such cables form part of a surface wiring system. In such case, the holes in the trunking, through which such cables penetrate, should be fitted with suitable rubber grommets or insulated bushes.

(2) *Wiring installation using steel trunking*

Connection between trunking and equipment should be made by means of a standard flange coupling or an adaptor neck, fabricated or cast. For direct attachment of trunking to electrical equipment, the cable entries should be provided with smooth bore bushes or grommets and the return edge of the lid of the trunking should be left intact.

(3) *Wiring installation using PVC or plastic trunking*

(*a*) Trunking should have covers secured by purpose-made rivets. Covers of the clip-on type is acceptable for trunking sizes up to 100 mm × 100 mm.

(*b*) The trunking should be fixed and supported in the normal way by screws, but the holes in the trunking should be made oversize to allow for the movement of expansion. Washers should be used under the head of the screw which should not be tightened to its full extent.

25C **Installation of Cables**

(1) *General requirements*

(*a*) All cables should be run in a vertical or horizontal direction, where practicable, and should be secured flat on the surface of walls, columns, partitions or ceilings, etc. throughout the entire route.

(*b*) Where cables run as a span between beams, trusses, etc., rigid support throughout their entire length should be used. One of the fixing methods of cables hung under beams is illustrated in Figure 25(2).

(*c*) Cables crossing an expansion joint should be formed into a loop such that any movement in the joint should not stress the cables.

(*d*) For cables running on surface of walls or structures:

(i) buckle clip should only be used to fix cables having an overall diameter not exceeding 10 mm.

(ii) saddles and cleats may be used if the diameter of the cable exceeds 10 mm.

(*e*) (i) Cable saddles and cable cleats should be secured by fixing screws and should be provided along the entire cable route at regular intervals. The spacing between adjacent saddles or cleats should not exceed the values given in Table 25(3).

(ii) A saddle or cleat should also be provided at a distance not exceeding 150 mm from a termination and from both sides of a bend.

(*f*) Where cables are installed under floors or within false ceilings, they should normally be supported and fixed throughout their lengths to the permanent ceiling or floor and provision should be made for access to the cable for inspection and maintenance. Such cables, if exposed to the risk of penetration by nails, screws and the like, should be protected by an earthed metallic sheath or enclosed in earthed steel conduit or trunking securely supported.

(*g*) Where a wiring system passes through elements of building construction such as floor, walls, roofs, ceilings, partitions or cavity barriers, the openings remaining after passage of the wiring system shall be sealed according to the degree of fire resistance required of the element concerned (if any).

(*h*) The internal bending radii of PVC insulated stranded copper cables should not be less than the values given below:

Overall Diameter of Cable, D	Minimum Internal Bending Radius	
	Non-armoured	Armoured
Not exceeding 10 mm	3D	6D
Exceeding 10 mm but not exceeding 25 mm	4D	6D
Exceeding 25 mm	6D	6D

(2) *Installation of PVC insulated, PVC sheathed non-armoured cable*

(*a*) Where protection is required for cables running up a wall from the floor, a metal channel cover should be fixed to a minimum height of 1.5 metres above finished floor level.

(*b*) Where cables pass through a building structure such as wall, column or floor slab, the cables should be drawn through PVC or G.I. sleeves inserted into the building structure as illustrated in Figure 25(3) and sealed up with proper fire resisting material of the same Fire Resisting Period.

(*c*) When cables are routed along or across steel joints, beams, stanchions, etc. they should be enclosed in steel or rigid PVC trunking/conduit.

(*d*) Rubber grommets or insulated bushes should be used to protect the non-armoured cables passing through metal box or any other metal work.

(*e*) Buckle clips should be:

(i) provided along the entire cable route at regular intervals not exceeding the spacing in Table 25(3);

(ii) provided at a distance not exceeding 75 mm from a termination and from both sides of a bend;

(iii) fixed and secured by pins with wall plug inserted to a minimum depth of 20 mm to the surface of wall, column, partition or ceiling. The head of every pin should be level with the surface of the clip so that no damage to the sheath of the fixed cables can occur; and every hole in the buckle clip should have a fixing pin.

(*f*) The neutral conductor of a twin core cable for a lighting final circuit should be looped through an insulated connector enclosed in the moulded box or pattress accommodating the switch.

(3) *Installation of armoured or metallic sheathed cable*

(*a*) Cables buried direct in ground should be armoured or metal sheathed. Cables of Category 1 & 3 should be buried at a depth not less than 450 mm and cables of Category 4 should be buried at a depth not less than 750 mm. They should be protected by means of cable cover tiles. The bottom of the cable trench should be first covered by a layer of sand or fine soil to a depth not less than the diameter of the cable before the cables are laid. Another layer of sand or fine soil, to a depth of 100 mm over the cables, should then be provided before the cable tiles are laid to protect the cables throughout entire route.

(*b*) Unless otherwise advised by the cable manufacturer, a tension releasing section should be provided for every 100 metres of vertical cable run.

(4) *Use of flexible cable and flexible cord*

(*a*) Flexible cables or flexible cords for connections to portable appliances or equipment should have suitable length preferably between 1.5 m to 2 m.

(*b*) Exposed lengths of flexible cable or flexible cord used for final connections to fixed equipment or appliance should be as short as possible.

(*c*) Every non-flexible or flexible cable or flexible cord for use at low voltage shall comply with the appropriate recognised standard.

(*d*) Where a flexible cord supports or partly supports a pendant luminaire, the maximum mass supported by the cord should not exceed the appropriate value indicated below, provided that the tension of the cord does not act directly on the termination to the wiring:

Nominal Cross-sectional Area of Conductor (mm^2)	Maximum Mass (kg)
0.5	2
0.75	3
1.0	5

25D **Cable Joint and Cable Termination**

(1) *Cable joint*

Cable joints of any type along cable runs in final circuits are not allowed. "Looping-in" wiring system should be used such that the cables or conductors are properly terminated at the junction box or equipment.

(2) *Boxes for cable joint and cable termination*

(*a*) Boxes for the termination and for joining of cables may be of cast iron, or plastic shell with compound filled and of adequate size.

(*b*) Where hot compound filling is used, the box should be warmed thoroughly before the compound is poured to allow total adhesion between the compound and the box. The compound should then be allowed to cool and be topped up before the box is closed. No air pockets should be allowed to form inside the box.

(*c*) Where cold compound with plastic shell is used, the complete jointing kit, including plastic shell, compound, insulating tape etc. should be from the same proprietary manufacturer. The jointing method and procedure as laid down by the manufacturer should be strictly adhered to.

(*d*) Where the box is of cast iron, it should be fitted with suitable armouring clamps and glands; where the box is of plastic shell, it should be fitted with suitably sized armour bond.

(3) *General requirements for jointing and termination of cable*

(*a*) All joints and terminations should have durable electrical continuity and adequate mechanical strength.

(*b*) Ferrules, compression connectors and bare portions of cable core resulting from a jointing or terminating process should be insulated with an insulating tape or heat shrinkable tubing after completion the jointing or terminating process. Such insulating tape or heat shrinkable tubing should have equal or better electrical and mechanical properties than those of the original insulation removed, and should be adhered to the cores etc. securely and permanently. The final thickness should be in smooth contour throughout the whole length of the joint or termination.

(4) *Straight-through joint*

(*a*) In a straight-through joint for copper conductors, the two conductors should be butted together after the strands have been soldered solid and should be jointed by means of a weak-back ferrule, soldered to the cores. Soldering should be carried out by pouring tinman's solder over the cores and the weak-back ferrule. In no circumstances should direct flame from a blow lamp be used for soldering.

(*b*) Prior to making a soldered joint for aluminium conductors, each conductor should be cleaned by means of steel wool or similar abrasive and then tinned by pouring solder, especially made for use with aluminium, over the cores. Both cores should then be inserted in a weak-back aluminium ferrule which should be closed. The two aluminium cores to be jointed may be butted together. The soldering should be completed by pouring the solder over the ferrule, after applying a layer of flux recommended by the cable manufacturer for this purpose.

(*c*) A compression joint should be made by inserting the conductor cores to be jointed into the opposite ends of a suitable type of compression jointing tube, which should have the correct size for the conductors. The tube should then be compressed onto the cores by means of a compressing tool. The tool used and the working procedure adopted should be as recommended by the compression joint or cable manufacturer.

(*d*) Where specialist jointing kits are used, the complete kit should be from the same manufacturer who specialises in manufacturing products for this purpose. The method and procedure adopted should be strictly in accordance with the manufacturer's recommendations.

(5) *Jointing of protective conductors*

(*a*) Protective conductors should be looped into earthing terminals of exposed conductive parts or extraneous conductive parts. Straight joints in protective conductors should be avoided as far as practicable. Tee-joints in protective conductors are acceptable.

(*b*) Tapes should be jointed by:
   (i) double riveting, or
   (ii) suitable tape clamps (when clamps are used, the tape clamps shall each be provided with at least 4 screws or bolts), or
   (iii) means of exothermic or thermic welding utilizing the high temperature reaction of powdered copper oxide and aluminium, provided that the proper material and equipment are used in accordance with the manufacturer's recommended process, or
   (iv) terminal block of suitable size.

(6) *Joints and terminations of non-armoured cables*

(*a*) Non-armoured cables terminated at a moulded box or pattress, a luminaire or other fittings should have the overall protective sheaths carried into the moulded box or pattress, luminaire or other fittings for a minimum distance of 13 mm.

(*b*) The circuit protective conductor should be terminated at the earthing terminal provided in the moulded box or pattress housing the wiring accessories.

(*c*) Where it is not required to terminate the circuit protective conductor in an accessory, the circuit protective conductor should be coiled away from the live terminals or any bare conductors and should be insulated and sleeved with a green-and-yellow PVC sleeve.

(*d*) Jointing of circuit protective conductors of non-armoured cable should be in the same manner as jointing live conductors.

(7) *Jointing and termination of armoured cables*

(*a*) Cable armours should be terminated at the armouring clamps and the inner sheath should pass through the gland.

(*b*) Earth continuity across joints of a circuit protective conductor having adequate cross-sectional area and of same material as the phase conductors should be installed and connected to maintain the effectiveness of the earth continuity across every cable joint of the armoured cable.

(*c*) PVC insulated armoured cables with copper or aluminium conductors should be terminated in a gland fitted with an amour clamp. Provision should be made to enable a watertight seal between the gland and inner PVC sheath. The gland body should be provided with an internal conical seating to receive the armour clamping cone and a clamping nut which should secure the armour clamping cone firmly to the armour wires ensuring that the armour wires are tightly clamped between the armour cone and conical armour seating. The spigot on the gland body should be threaded to suit standard conduit accessories. A PVC shroud should be fitted to cover the body of the gland and the exposed armour wires.

(*d*) (i) Terminating gland and armour clamp for cables with aluminium conductors should be made from aluminium. Cores should be terminated in a hot tinned brass or copper lug, which should be shaped to suit the sector shape of the conductor. The core should be tinned, and then soldered into the lug. Alternatively a compression termination may be used. In such cases, the cores should be inserted into the sleeve of an aluminium compression type cable lug. The sleeve should then be compressed onto the cores by means of a compressing tool. The tool used and the working procedure adopted should be as recommended by the cable manufacturer.

(ii) Prior to connection to the terminal, the cable lug should be painted with an anti-oxidising paste. The anti-oxidising paste should be suitable for preventing electrolytic action due to contact between the aluminium lug and copper or brass terminal, for an indefinite period. Alternatively, copper/aluminium bimetal cable lugs may be used.

(8) *Termination of bonding conductors*

(*a*) (i) A purpose-designed copper connector clamp should be used to bond the main equipotential bonding conductor to extraneous conductive parts of the non-electrical services, and should be used to bond supplementary bonding conductors to exposed conductive parts or extraneous conductive parts.

(ii) All contact surfaces should be clean and free from non-conducting materials, such as grease or paint, before the connector clamp is installed.

(*b*) For steel surface conduit installations, the supplementary bonding conductors should be terminated at the nearest conduit or conduit box forming an integral part of the conduit installation.

(*c*) (i) For concealed steel conduit installations, the supplementary bonding conductors should be terminated at a copper earthing terminal fitted inside a metal box forming an integral part of the conduit installation. For access to the concealed conduit, an arrangement similar to a telephone cord outlet is acceptable.

(ii) The metal conduit box should be located as near as possible to the bonding position and the exposed part of the supplementary bonding conductor should be made as short as possible.

25E **Installation of Socket Outlets**

(*a*) Wall-mounted socket outlets should be installed with a minimum clear height of 150 mm from floor and 75 mm from surface top measured from the bottom of the socket outlet.

(*b*) Socket outlets installed on floor surface should be suitably protected from ingress of water and from mechanical damage.

(*c*) Socket outlets for household or similar use should be of shuttered type.

(*d*) A socket outlet should be installed as far away as practicable from water tap, gas tap or cooker in order to avoid danger.

Table 25(1)

Spacing of Supports for Conduits

Conduit Size (mm)	Maximum Distance between Supports (Metres)					
	Rigid Steel		Rigid Plastic/PVC		Pliable	
	Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
Not exceeding 16	0.75	1.0	0.75	1.0	0.3	0.5
Exceeding 16 but not exceeding 25	1.75	2.0	1.5	1.75	0.4	0.6
Exceeding 25 but not exceeding 40	2.0	2.25	1.75	2.0	0.6	0.8
Exceeding 40	2.25	2.5	2.0	2.0	0.8	1.0

Notes: (1) The spacings tabulated above assume that the conduit is not exposed to mechanical stress other than that due to the weight of the enclosed cables, the conduit and fittings.

(2) The above figures do not apply to a conduit used for supporting luminaires or other equipment.

Table 25(2)

Spacing of Supports for Cable Trunking (Steel or Plastic or PVC)

Cross-sectional Area of Trunking (mm^2)	Maximum Distance between Support (Metres)			
	Steel Trunking		Plastic/PVC Trunking	
	Horizontal	Vertical	Horizontal	Vertical
Exceeding 300 but not exceeding 700	0.75	1.0	0.5	0.5
Exceeding 700 but not exceeding 1 500	1.25	1.5	0.5	0.5
Exceeding 1 500 but not exceeding 2 500	1.75	2.0	1.25	1.25
Exceeding 2 500 but not exceeding 5 000	3.0	3.0	1.5	2.0
Exceeding 5 000	3.0	3.0	1.75	2.0

Notes: (1) The spacings tabulated above assume that the trunking is not exposed to mechanical stress other than that due to the weight of the enclosed cables, the trunking and fittings.

(2) The above figures do not apply to trunking which is used for supporting lighting fittings or other equipment.

Table 25(3)

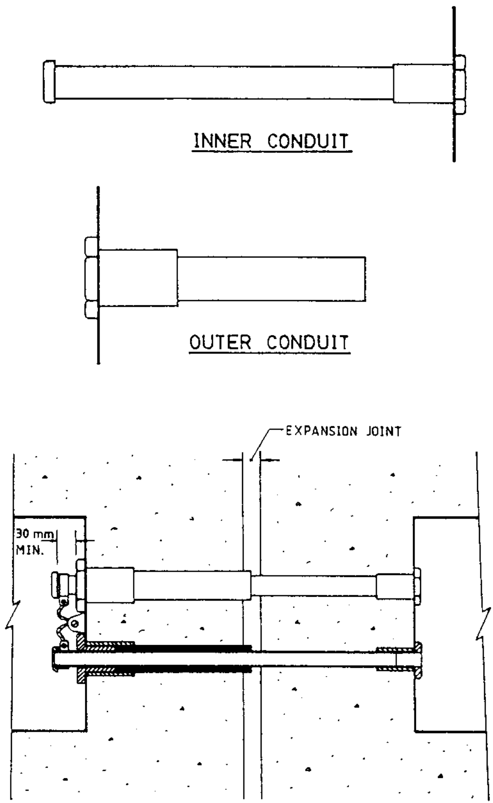
Spacing of Supports for Cables in Accessible Positions

Overall diameter of cable‡ (mm)	Maximum spacing of clips (Metres)					
	Non-armoured rubber, PVC or lead-sheathed cables		Armoured cables		Mineral insulated copper sheathed or aluminium sheathed cables	
	Horizontal†	Vertical†	Horizontal†	Vertical†	Horizontal†	Vertical†
Not exceeding 9	0.25	0.4	—	—	0.6	0.8
Exceeding 9 but not exceeding 15	0.3	0.4	0.35	0.45	0.9	1.2
Exceeding 15 but not exceeding 20	0.35	0.45	0.4	0.55	1.5	2.0
Exceeding 20 but not exceeding 40	0.4	0.55	0.45	0.6	—	—

NOTE— For the spacing of supports for cables of overall diameter exceeding 40 mm, and for single-core cables having conductors of cross-sectional area 300 mm^2 and larger, the manufacturer's recommendations should be applied.

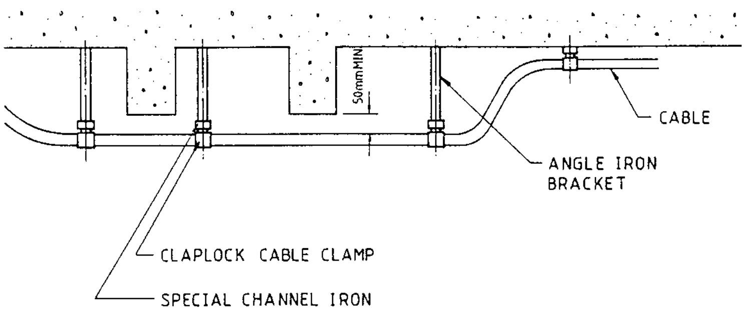
‡ For flat cables taken as the measurement of the major axis.

† The spacings stated for horizontal runs may be applied also to runs at an angle of more than 30° from the vertical. For runs at an angle of 30° or less from the vertical, the vertical spacings are applicable.



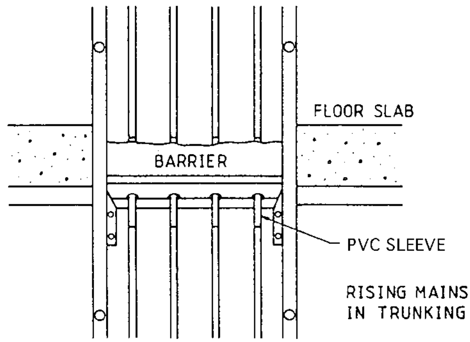
INSTALLATION OF CONDUIT CROSSING AN EXPANSION JOINT

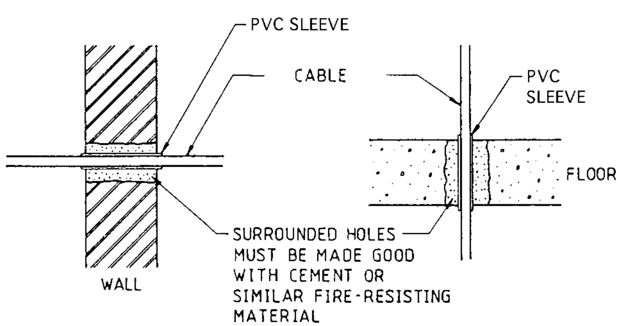
CODE No.	FIGURE No.	
25	25(1)	



FIXING OF ARMOURED CABLES HUNG UNDER BEAMS

CODE NO.	FIGURE No.	
25	25(2)	





DETAILS OF CABLE PASSING THROUGH BUILDING STRUCTURE

CODE No.	FIGURE No.
25	25(3)

Code 26 REQUIREMENTS FOR SPECIFIC INSTALLATIONS AND EQUIPMENT

26A Domestic Installation and Appliance

(1) Supply connection to domestic appliance

(2) Electrical equipment in kitchens

(3) Electrical equipment in bathrooms

(4) Air-conditioners and space heaters

(5) Water heaters

(6) Electrical call bells and electric clocks

26B Busbar Trunking Distribution System

(1) General

(2) Busbar casing

(3) Busbar

(4) Expansion unit

(5) Feeder unit

(6) Tap-off unit

(7) Busbar trunking accessories

26C Electric Motor

(1) General

(2) Rating of circuits supplying electric motors

(3) Starting facilities of electric motors

26D Supply Connection to Transformers

26E Supply Connection to Welding Sets

26F Installation of Fluorescent and Gaseous Discharge Lamps

26G Installation of Category 3 Circuits

26H High Voltage Discharge Lighting Installation (Neon Signs)

(1) Requirements of circuits

(2) Means of isolation

(3) Fireman's emergency switch

(4) Installation

(5) Transformers

(6) Barrier for live parts

(7) Earthing

Code 26 REQUIREMENTS FOR SPECIFIC INSTALLATIONS AND EQUIPMENT

26A **Domestic Installation and Appliance**

(1) *Supply connection to domestic appliance*

(*a*) For a single phase domestic appliance having a current rating exceeding 13A to be used in an installation where only 5A and/or 13A socket outlets are provided, or a domestic appliance having a current rating exceeding 15A to be used in an installation where only 5A and/or 15A socket outlets are provided, it should be connected permanently (i.e. not through a plug socket) to a separate radial final circuit and should be controlled by a double-pole switch in a readily accessible position near the appliance.

(*b*) For supplying a single phase domestic appliance having a current rating not exceeding 13A, the use of a radial or ring final circuit using 13A socket outlets is acceptable.

(*c*) For supplying a single phase domestic appliance having a current rating not exceeding 5A or 15A, the use of a radial final circuit using 5A or 15A socket outlet respectively, is acceptable.

(*d*) Adequate number of socket outlets for supply connections to domestic appliances is to be provided for each individual household. Table 26(1) recommends the acceptable minimum number of socket outlets provided in various locations to afford the lowest quality of service.

(2) *Electrical equipment in kitchens*

(*a*) For a circuit arrangement using 13A socket outlets to Code 6E, separate circuits should be used for supply to electrical equipment in kitchen other than luminaires.

(*b*) Every cooking appliance having more than one boiling or cooking surfaces and with a total current rating exceeding 15A should be fed from an exclusive radial final circuit and controlled by a double-pole switch separate from the appliance and placed within 2 metres of the appliance.

(*c*) Where two fixed or stationary cooking appliances are installed in one room of household premises, one switch may be used to control both appliances provided that neither appliance is placed more than 2 metres from the controlling switch.

(*d*) The switch for the cooking appliance of subparagraphs (*b*) and (*c*) should be so positioned that the user does not have to lean across the appliance in order to operate it.

(3) *Electrical equipment in bathrooms*

(*a*) Except for SELV, for a circuit supplying equipment in a room containing a fixed bath or shower, where the equipment is simultaneously accessible with exposed conductive parts of other equipment or with extraneous conductive parts, the characteristics of the protective devices and the earthing arrangements should be such that, in the event of a fault to earth, disconnection occurs within 0.4s.

(*b*) Except for equipment supplied from a SELV circuit, in a room containing a fixed bath or shower, supplementary equipotential bonding to Code 11 should be provided between simultaneously accessible exposed conductive parts of equipment, between exposed conductive parts and simultaneously accessible extraneous conductive parts, and between simultaneously accessible extraneous conductive parts.

(*c*) Where electrical equipment is installed in the space below a bath, that space should be accessible only by the use of a tool and, in addition, the requirement of subparagraph (*b*) above should extend to the interior of that space.

(*d*) Every switch or other means of electrical control or adjustment should be so situated as to be normally inaccessible to a person using a fixed bath or shower. This requirement does not apply to:

(i) the insulating cords of cord-operated switches which comply with IEC 60669-1 or BS EN 60669-1 or equivalent.

(ii) mechanical actuators, with linkages incorporated insulating components, of remotely operated switches.

(iii) controls and switches of water heaters and shower pumps which comply with the relevant requirements of appropriate recognised standards.

(iv) switches supplied by SELV at a nominal voltage not exceeding 12 V r.m.s. a.c. or d.c.

(v) a shaver supply unit complying with subparagraph (*e*) below.

(*e*) In a room containing a fixed bath or shower, provision for the connection of an electric shaver, toothbrush or similar light current appliance can be by means of a shaver supply unit of approved pattern complying with BS EN 60742 or such a unit incorporated in a luminaire. The earthing terminal of the shaver supply unit should be connected to the protective conductor of the final circuit from which the supply is derived.

(*f*) Surface wiring systems should not employ metallic conduit or metallic trunking or an exposed metallic cable sheath or an exposed earthing or bonding conductor.

(*g*) Lampholders within a distance of 2.5 metres from the bath or shower cubicle should be constructed of or shrouded in an insulating material.

(*h*) No stationary equipment having heating elements which can be touched should be installed within reach of a person using the bath or shower.

(*i*) No electrical installation or equipment should be installed in the interior of a bath tub or shower basin.

(*j*) In a room containing a fixed bath or shower, the provision of socket outlets should comply with IEC 60364-7-701 and to be installed in Zone 3* location (i.e. 0.6m away from shower basin or bath tub) and the socket outlets should be protected by a residual current protective device (RCD) with a residual operating current not exceeding 30mA. When a circuit designer who is a Registered Electrical Worker for Grade A, B or C considers it appropriate for the situations under consideration, additional safety measures may be used. These measures include the use of a dedicated circuit or a dedicated circuit protected by an isolating transformer.

* Zone dimensions in bathrooms should be referred to Figure 26(1)(*a*) and 26(1)(*b*)

(4) *Air-conditioners and space heaters*

(*a*) Fixed air-conditioners and space heaters should be fed by separate radial final circuits controlled by a fuse or miniature circuit breaker at the distribution board.

(*b*) Fixed air-conditioners and space heaters having a rating not exceeding 13A for a final circuit using 13A socket outlets or 15A for a final circuit using 15A socket outlets, may be connected via a plug and socket arrangement of adequate capacity. For this purpose, a switched socket outlet is to be used.

(*c*) A fixed air-conditioner or a space heater having a rating exceeding that of subparagraph (*b*), should be connected to a terminal block adjacent to it and controlled by a double-pole switch.

(5) *Water heaters*

(*a*) *Electrode water heaters and boilers*

(i) Every electrode boiler and electrode water heater should be connected to an a.c. system only, and should be selected and erected in accordance with the appropriate requirements of this CoP.

(ii) The supply to the heater or boiler should be controlled by a linked circuit breaker arranged to disconnect the supply from all electrodes simultaneously and provided with an overcurrent protective device in each conductor feeding an electrode.

(iii) The earthing of the heater or boiler shall comply with the requirements of Code 11 and, in addition, the shell of the heater or boiler should be bonded to the metallic sheath and armour, if any, of the incoming supply cable. The protective conductor should be connected to the shell of the heater or boiler and should comply with Code 11C(2).

(iv) Where an electrode water heater or electrode boiler is directly connected to a supply at a voltage exceeding low voltage, the installation should include a residual current device arranged to disconnect the supply from the electrodes on the occurrence of a sustained earth leakage current in excess of 10% of the rated current of the heater or boiler under normal conditions of operation, except that if in any instance a higher value is essential to ensure stability of operation of the heater or boiler, the value may be increased to a maximum of 15%. A time delay may be incorporated in the device to prevent unnecessary operation in the event of imbalance of short duration.

(v) Where an electrode water heater or electrode boiler is connected to a three phase low voltage supply, the shell of the heater or boiler should be connected to the neutral of the supply as well as to the earthing conductor. The current carrying capacity of the neutral conductor should be not less than that of the largest phase conductor connected to the equipment.

(vi) Except as provided by (vii) where the supply to an electrode water heater or electrode boiler is single phase and one electrode is connected to a neutral conductor earthed by the electricity supplier, the shell of the water heater or boiler should be connected to the neutral of the supply as well as to the earthing conductor.

(vii) Where the heater or boiler is not piped to a water supply or in physical contact with any earthed metal, and where the electrodes and the water in contact with the electrodes are so shielded in insulating material that they cannot be touched while the electrodes are live, a fuse in the phase conductor may be substituted for the circuit breaker required under (ii) and the shell of the heater or boiler need not be connected to the neutral of the supply.

(*b*) *Heaters for liquids or other substances, having immersed heating elements*

Every heater for liquid or other substance should incorporate or be provided with an automatic device to prevent a dangerous rise in temperature.

(*c*) *Water heaters having immersed and uninsulated heating elements*

(i) Every single phase water heater or boiler having an uninsulated heating element immersed in the water should comply with the requirements of (ii) and (iii). This type of water heater or boiler is deemed not to be electrode water heater or boiler.

(ii) All metal parts of the heater or boiler which are in contact with the water (other than current carrying parts) should be solidly and metallically connected to a metal water pipe through which the water supply to the heater or boiler is provided, and that water pipe should be connected to the main earthing terminal by means independent of the circuit protective conductor.

(iii) The heater or boiler should be permanently connected to the electricity supply through a double-pole linked switch which is either separate from and within easy reach of the heater or boiler or is incorporated therein and the wiring from the heater or boiler should be directly connected to that switch without use of a plug and socket outlet; and, where the heater or boiler is installed in a room containing a fixed bath, the switch should also comply with Code 26A(3).

(iv) Before a heater or boiler of the type referred to in subparagraph (*c*) is connected, the electrical worker should confirm that no single-pole switch, non-linked circuit breaker or fuse is fitted in the neutral conductor in any part of the circuit between the heater or boiler and the origin of the installation.

(*d*) Single phase domestic thermal storage or instantaneous water heaters not exceeding 6 kilowatts should be connected to an individual final circuit and be controlled by a double-pole switch of adequate rating. If the water heater is installed in a bathroom, the double pole switch should be installed outside the bathroom in a convenient position.

(*e*) A thermal storage or instantaneous water heaters exceeding 30 ampere or having a current rating exceeding half of the maximum demand of an installation in any one phase, should be connected to a three phase supply except when approved by the electricity supplier.

(6) *Electrical call bells and electric clocks*

(*a*) (i) Call bell transformers should be double wound.

(ii) Call bell transformers should be connected via a plug and socket arrangement or via a connection unit or cable coupler.

(iii) Call bell pushes should be wired to the secondary windings at an extra low voltage.

(*b*) Electric clocks may be connected to a lighting circuit via a connection unit or cable coupler provided that the current demand of the circuit does not exceed the rating of the overcurrent protective device.

26B **Busbar Trunking Distribution System**

(1) *General*

(*a*) The busbar trunking system should be properly supported.

(*b*) The busbar trunking system must be suitable for branch circuit connections to the busbars by tap-off units or cable clamping devices.

(*c*) The cross-sectional area of phase and neutral conductors of the busbars system should be selected taking into account the effects of harmonic current that may be present in the distribution system.

(2) *Busbar casing*

(*a*) The casing of the busbar trunking system should be totally enclosed. It should be rigidly constructed from sheet steel galvanised or suitably protected against corrosion of not less than 1.2 mm thick for the width or height of the casing not exceeding 100 mm; and not less than 1.5 mm thick for a width or height exceeding 100 mm.

(*b*) Facilities should be incorporated in the busbar casing to provide access to the busbars at regular intervals throughout the entire length. Removal of the cover for access facility should necessitate the use of tools.

(3) *Busbar*

(*a*) For busbar installation having a rated capacity not exceeding 400 amperes in each phase of a 3-phase 4-wire system, the associated neutral busbars should have a cross-sectional area not less than the cross-sectional area of the phase busbar.

(*b*) For busbar installation having a rated capacity exceeding 400A in each phase of a 3-phase 4-wire system, the associated neutral busbar may have a cross-sectional area smaller than the cross sectional area of the phase busbar if overcurrent detection is provided for the neutral conductor, which is appropriate to the cross-sectional area of the conductor. This detection shall cause the disconnection of the phase conductors but not necessarily the neutral conductor.

(*c*) The joint part of the busbar, or contact part of the busbars in the case of plug-in busbar trunking systems, should be electroplated with tin or other equivalent materials.

(*d*) Drilling of all-insulated busbars for connection of cables are not acceptable.

(4) *Expansion unit*

Proper expansion unit should be provided where:

(*a*) both ends of the busbar trunking system are fixed, or

(*b*) the busbar trunking system is installed across a building expansion joint, or

(*c*) the run of busbar exceeds 30 metres or as recommended by the busbar manufacturer.

(5) *Feeder unit*

A proper feeder unit should be provided for each busbar trunking system for connection of incoming supply.

(6) *Tap-off unit*

(*a*) Proper tap-off unit should be used where a branch circuit is taken off from the busbars.

(*b*) Where protective devices are used separately for tapping-off, they should be provided adjacent to the tapping position for protection of the branch circuits.

(*c*) Where conductors are used for connection to the busbars, they should have a current rating not less than that of the tap-off units.

(*d*) Where plug-in tap-off units are used, mechanical interlocks should be provided such that the tap-off unit cannot be inserted or removed from the busbar trunking unless it is in the 'OFF' position.

(*e*) Where cutout fuses are used for tap-off supply from busbars, they should be fitted with an insulated carrier to avoid danger during replacement or withdrawal.

(7) *Busbar trunking accessories*

(*a*) Accessories such as bends, tees, feeder and tap-off units for busbar trunking system should be purpose-made.

(*b*) Bends, tees and intersection units should be designed and manufactured to suit the particular type of busbar system. The casing should have a cross-sectional area not less than that of the busbar casing.

26C **Electric Motor**

(1) *General*

(*a*) Every electrical motor having a rating exceeding 0.37 kW should be provided with control equipment incorporating means of protection against overload in the motor.

(*b*) This requirement does not apply to motors incorporated in an item of current using equipment complying as a whole with an appropriate recognised standard.

(2) *Rating of circuits supplying electric motors*

(*a*) All equipment, including cable of every electrical part of the circuit carrying the starting, accelerating and load currents of a motor should be suitable for a current at least equal to the full load current rating of the motor. Where the motor is intended for intermittent duty and for frequent stopping and starting, account should be taken of any cumulative effects of the starting or braking currents upon the temperature rise of the equipment of the circuit.

(*b*) The rating of the circuit supplying a slip ring or a commutator induction motor should be suitable for the starting and load conditions of the motor.

(3) *Starting facilities of electric motors*

(*a*) The starting facilities of induction motors of various sizes should restrict the starting current of the motors to maximum acceptable limits as required by the electricity supplier.

(i) Low voltage induction motors

(A) The choice of motor size and maximum acceptable starting current should be in accordance with the following table:

Supply Arrangement	Motor Size (M) in Kilowatts	No. of Phases	Maximum Starting Current (in Multiple of Full Load Current)
From Electricity Supplier's Overhead Line System	$M \leqslant 1.5$ $1.5 < M < 3.8$ $3.8 \leqslant M \leqslant 11$	1-phase 3-phase 3-phase	6 6 2.5
From Electricity Supplier's Non-overhead Line System	$M \leqslant 2.2$ $2.2 < M < 11$ $11 \leqslant M \leqslant 55$	1-phase 3-phase 3-phase	6 6 2.5

(B) Motors exceeding the limits stipulated in the table above must be approved in writing by the electricity supplier.

(ii) Synchronous motors and high voltage motors should only be installed by special arrangement with the electricity supplier.

(*b*) Except where failure to start after a brief interruption would be likely to cause greater danger, motors should be provided with means to prevent automatic restarting after the stoppage due to drop in voltage or failure of supply, where unexpected restarting of the motor might cause danger. These requirements do not preclude arrangements for starting a motor at intervals by an automatic control device, where other adequate precautions are taken against danger from unexpected restarting.

26D **Supply Connection to Transformers**

(*a*) Where an autotransformer is connected to a circuit having a neutral conductor, the common terminal of the winding should be connected to the neutral conductor.

(*b*) Where a step-up transformer is used, a linked switch should be provided for disconnecting the transformer from all live conductors (i.e. phase and neutral conductors) of the supply.

26E **Supply Connection to Welding Sets**

Welding sets having a current rating exceeding 30A single phase or half of the maximum demand of an installation in any one phase should be permanently connected to the mains on a 3-phase supply. Exposed conductive parts of welding sets must be effectively connected to earth.

26F **Installation of Fluorescent and Gaseous Discharge Lamps**

(*a*) Capacitors and chokes should normally be fitted inside the luminaire. Where they are fitted separately, they should be mounted in a metal box. Precautions should be taken to prevent the components from overheating, e.g. by the provision of adequate ventilation.

(*b*) The type and size of cables should be properly selected with due regard to the ambient temperature, the inrush current and high voltages generated during starting. The neutral conductor in every discharge lamp circuit should have a cross-sectional area not less than that of the phase conductor.

26G **Installation of Category 3 Circuits**

Electrical installation of Category 3 circuits should comply with the requirements of the relevant authority in respect to fire protection aspects.

26H **High Voltage Discharge Lighting Installation (Neon Signs)**

(1) *Requirements of circuits*

(*a*) High voltage discharge lighting installation should *not* be connected to the electricity supply through a plug and socket arrangement.

(*b*) Circuits should be capable of carrying the total steady load current of the lamps, any associated gear and also their harmonic currents.

(*c*) Where exact information on the associated gear is not available, the product of the rated wattage of the associated gear and a multiplying factor of not less than 1.8 shall be taken as the demand of the installation in volt-amperes.

(*d*) The cross-sectional area of the neutral conductor in every discharge lighting circuit should not be less than that of the phase conductor.

(*e*) Every switch for a discharge lighting circuit should be identified with a permanent label and should have a normal current rating not less than the product of the total steady current which it is required to carry and a multiplying factor of 1.8.

(2) *Means of isolation*

One or more of the following means should be provided inside the building for the isolation from all live conductors of the supply to self-contained luminaires or every circuit supplying high voltage luminaires, and such means should comply with requirements of Code 8B(2):

(*a*) an interlock on the self-contained luminaire, so arranged that before access can be made to live parts, the supply is automatically disconnected, such means being additional to the switch normally used for controlling the circuit, or

(*b*) a switch having a lock or removable handle, or a distribution board which can be locked, and with such arrangements to prevent the restoration of the supply by unauthorised persons. Where an installation comprises more than one such switch or distribution board, all keys and removable handles should be non-interchangeable.

(3) *Fireman's emergency switch*

A fireman's emergency switch complying with requirements of Code 8B(4), should be provided for every exterior or interior high voltage lighting installation which is operated unattended. Such firemen's emergency switch should:

(*a*) be arranged to isolate the installation from all live conductors of the supply, except that it need not isolate the neutral conductor of a 3-phase 4-wire supply;

(*b*) be fixed in a conspicuous position, reasonably accessible to firemen at not less than 2.7 metres and not more than 3.0 metres above the floor or the ground;

(*c*) be clearly marked to indicate the installation or part of the installation which they control, where more than one fireman's switch is installed in any one building;

(*d*) preferably be provided with a catch so designed as to prevent the switch being inadvertently or accidentally returned to the 'ON' position;

(*e*) for exterior installation, be outside the building and as near as possible vertically below the electrical discharge lamp(s). Alternatively a notice indicating the position of the switch shall be placed directly below the electrical discharge lamp(s) and a nameplate should be fixed near the switch so as to render it clearly distinguishable. An installation in a closed market or in an arcade is deemed to be an exterior installation and a temporary installation in a permanent building used for exhibitions is considered as an interior installation and not an exterior installation.

(*f*) for interior installations, be near the main entrance to the building or alternatively in a position to be agreed with the electricity supplier and the Fire Services Department.

(4) *Installation*

(*a*) The luminuous discharge tubes should be substantially supported at a sufficient distance from the sign face to ensure no arcing from the tube to any other portion of the sign could occur under normal condition, and be so installed as to be free from contact with inflammable material except that rubber glands are permitted where a weather proof construction is desirable.

(*b*) Tubes should not be unduly exposed to mechanical damage.

(*c*) Ancillary equipment for high voltage installations including inductors, capacitors, resistors and transformers should either be totally enclosed in a rigid and effectively earthed metal container (which may form part of the luminaires), or alternatively should be placed in a suitably ventilated enclosure of incombustible material or of fire resisting construction.

(*d*) High voltage cables and conductors should be supported at intervals not exceeding the appropriate values stated in the following table. Support for insulated-and-braided cables and for bare conductors should be of non-ignitable, non-hygroscopic insulating material, e.g. glass or glazed porcelain.

Type of Cable or Conductor	Spacing of Supports	
	Horizontal (mm)	Vertical (mm)
Bare conductor	500	500
Insulated-and-braided cables	500	800
Metal sheathed, non-armoured cables	800	1 250
Armoured cables	1 000	1 500

(*e*) Every inductor and high reactance transformer should be installed as near as practicable to its associated electric discharge tube.

(*f*) The transformer, discharge tube and other parts of high voltage circuits should be located out of reach.

(5) *Transformers*

(*a*) Every transformer should be double wound with windings insulated with material to a minimum quality of class E insulation and tropicalised.

(*b*) One point of the secondary winding of every transformer should be connected to an earthing terminal on the body of the container.

(*c*) The secondary voltage of every transformer should not exceed 5 kV r.m.s. to earth on open circuit.

(*d*) Every high voltage circuit supplied from a transformer having a rated input exceeding 500 watts should be provided with means for automatic disconnection of the supply at the supply end of the transformer in the event of a fault current exceeding 20 percent of the normal steady current in the circuit.

(*e*) The rating plate of every transformer should carry:

(i) the maker's name,
(ii) open-circuit secondary voltage,
(iii) rated secondary current,
(iv) rated primary voltage, and
(v) rated primary current.

(6) *Barrier for live parts*

(*a*) All live parts, including all conductors but excluding the tubes except in the neighbourhood of their terminals, should be provided with effective barriers of earthed metal or insulating materials, or mechanical strength adequate to withstand the conditions of normal service, or alternatively, for installations on the exterior of a building, such live parts may be so situated as to be accessible only to responsible persons.

(*b*) Barriers made of insulating material used for this purpose should be non-hygroscopic, anti-tracking and substantially non-ignitable. Glass barriers may be used only if so situated as to be accessible only to responsible persons.

(7) *Earthing*

Exposed conductive parts and metalwork inclusive of metal frames of high voltage discharge lighting signs, as well as sheaths of cables should be permanently connected to protective conductors and effectively earthed.

26I **Lightning Protection Installation**

Lightning protection installations should be installed to IEC 61024, BS 6651 or equivalent.

26J **Rising Mains Installation**

(*a*) Any building of more than four floors including the ground floor should be provided with 3-phase electrical rising mains with a 3-phase 4-wire tee-off at each floor unless otherwise agreed by the electricity supplier.

(*b*) The design of the rising mains installation should be agreed by the electricity supplier.

(*c*) Separate riser earthing conductors should be provided to earth all units therein. The minimum cross-sectional area of riser earthing conductor should be 70 mm^2 for copper and 150 mm^2 for aluminium.

(*d*) The consumer's main connection between the electricity supplier's meter and the consumer's main switch should be installed and maintained by the consumer and should be not less than 4 mm^2 stranded copper conductors.

(*e*) In multi-consumer premises a device capable of both isolating and switching the full load current of the whole installation should be provided for each consumer at a position immediately before the electricity supplier's meter. For a single phase installation this device should be of double-pole type interrupting all live conductors.

(*f*) In multi-consumer premises no part of the communal installation should pass through any individual consumer's unit within the building.

26K **Temporary Supply Installation**

(1) *Definition*

This type of installation should apply to temporary installation providing supplies during the execution of construction works, or for repair, and testing purposes and should not be used as permanent supply. Approval should be obtained from the electricity supplier.

(2) *General*

(*a*) Every temporary supply installation should comply with the requirement of the Wiring Regulations.

(*b*) Electrical apparatus and wiring installations in construction sites may be subjected to extreme abuse and the equipment to be used should withstand the particularly adverse conditions. Correct installation of overhead line or underground cable system, circuit protection, earthing arrangement will be essential as well as frequent inspection and testing to such installations.

(3) *Design consideration*

(*a*) *Operating voltage*

(i) *Mains voltage*

- Three phase—380 volts 4-wire is the standard three phase mains supply voltage for construction sites.
- Single phase—220 volts 2-wire is the standard single phase mains supply voltage.

(ii) *Lighting accessible to public*

Road work and site lighting which is connected to mains supply system and accessible to general public should be operated at 110 volts obtained by use of an isolating transformer having the centre tap of the secondary winding earthed so that the normal voltage of circuit to earth does not exceed 55 volts.

(*b*) *Selection and erection of installation*

(i) *Cable circuits*

- Where risk of mechanical damage is slight, the installation can be carried out in PVC insulated cable. However where damage is likely to occur armoured cables should be used.
- All cables that are likely to be frequently moved in normal use should be flexible cables.
- All cables shall be suitably supported and properly fixed.

(ii) *Overhead line circuits*

- Where carrier wire is used to support cable suspended between poles, Codes 16H and 16I should be complied with.

- Cables crossing carriage ways should be supported by steel poles of suitable construction to withstand wind of typhoon force. Wooden supports of adequate strength will be permitted in other locations.

(iii) Minimum clearance between ground and line should comply with Code 16E(2).

(iv) Where steel poles are used, installation methods shall comply with Codes 16B and 16I.

(v) Where wooden poles are used, all stay wires should be insulated to prevent danger from leakage. A stay insulator placed at a height not less than 3.1 m from ground should be installed.

(*c*) *Protection of circuits*

(i) Protection apparatus with adequate interrupting capability should be provided for all main and sub-circuits against overcurrent and earth faults.

(ii) Discrimination between protection devices of main and sub-circuits should be allowed where necessary.

(*d*) *Protection against earth leakage*

(i) Every temporary supply installation should be provided with a Residual Current Device (RCD) at main intake position to afford protection against earth leakage.

(ii) The operating current of the RCD to be used should be such that when its value in amperes is multiplied by the earth fault loop impedance in ohms, the product does not exceed 25 volts.

(iii) Every circuit supplying socket outlet should be protected by a RCD to IEC 61008 or equivalent having a rated residual operating current not exceeding 30 mA.

(iv) An earthing conductor should connect the consumer's main earthing terminal to an effective earth electrode. The size of the earthing conductor should be in accordance with Code 11H.

(v) In addition to the item (iv), the consumer should provide a bond between electricity supplier's metal sheath cable and consumer's main earthing terminal. The size of bonding conductor should be in accordance with Code 11G(*b*).

(*e*) *Precaution against danger*

(i) All equipment and cables exposed to weather, corrosive atmosphere or damp conditions should be of the weather proof type or contained in weather proof enclosures suitable for the conditions.

(ii) Socket outlets, plugs and cable couplers should comply with IEC 60309-2.

(iii) Lampholders should be of the all-insulated pattern and capable of withstanding rough usage. Handlamps must be made of insulated material with bulbs efficiently guarded against breakage.

(4) *Inspection, testing and maintenance*

An owner of the temporary installation should ensure that the electrical equipment and apparatus are maintained in a safe and proper working condition at all times.

A registered electrical worker should be appointed to be responsible for the safety and any alteration or extension of the installation. The name, designation and contact telephone number of such person should be permanently displayed close to the main switch of the installation.

A separate log book recording regular checks, maintenance, repair, extension and alteration should be provided for inspection by the Director and the electricity supplier.

26L **Hot Air Saunas Installation**

(1) *General*

The particular requirements of this Code should apply to locations in which hot air sauna heating equipment according to IEC 60335-2-53 (Household and Similar Electrical Appliances Part 2-53: Particular requirements—for sauna heating appliances) is installed.

(2) *Classification of temperature zones*

The assessment of the general characteristics of the location should take due consideration of the classification of the four temperature zones which are illustrated in Figure 26(2).

(3) *Protection against direct contact*

The following protective measures against direct contact should not be used:

(*a*) Protection by means of obstacles.

(*b*) Protection by placing out of reach.

(4) *Protection against indirect contact*

The following protective measures against indirect contact should not be used:

(*a*) Protection by non-conducting location.

(*b*) Protection by means of earth-free local equipotential bonding.

(5) *Selection and erection of equipment*

(*a*) All equipment should have at least the degree of protection of IP24 or equivalent.

(*b*) In temperature Zone A, only the sauna heater and equipment directly associated with it should be installed.

In temperature Zone B, there is no special requirement concerning heat resistance of equipment.

In temperature Zone C, equipment should be suitable for an ambient temperature of 125°C.

In temperature Zone D, only luminaires and their associated wiring, and control devices for the sauna heater and their associated wiring should be installed. The equipment should be suitable for an ambient temperature of 125°C.

(*c*) Only flexible cords complying with BS6004, BS6007, BS6500, BS7919 or equivalent having 150°C rubber insulation should be used and should be mechanically protected with material which complies with appropriate regulations in BS 7671 for the protection against indirect contact by the use of Class II equipment or by equivalent insulation.

(*d*) Switchgear not built into the sauna heater, other than a thermostat and a thermal cut-out should be installed outside the hot air sauna.

(*e*) Except as permitted in subparagraphs (*b*) and (*d*) above, accessories should not be installed within the hot air sauna.

(*f*) Luminaires should be so mounted as to prevent overheating.

26M **Swimming Pools and Fountains Installation**

(1) *General*

The particular requirements of this Code should apply to basins of swimming pools and paddling pools and their surrounding zones where the risk of electric shock is increased by a reduction in body resistance and contact of the body with earth potential.

Special requirements may be necessary for swimming pools for medical use.

(2) *Assessment of general characteristics*

Figures 26(3) and 26(4) illustrate the zone dimensions of swimming pools.

Zone A is the interior of the basin, chute or flume and includes the portions of essential apertures in its walls and floor which are accessible to persons in the basin.

Zone B is limited:

(*a*) by the vertical plane 2 m from the rim of the basin,

(*b*) by the floor or surface expected to be accessible to persons, and

(*c*) by the horizontal plan 2.5 m above that floor or surface except where the basin is above ground, when it should be 2.5 m above the level of the rim of the basin.

Where the building containing the swimming pool contains diving boards, spring boards, starting blocks or a chute, Zone B includes also the Zone limited by the vertical plane spaced 1.5 m from the periphery of diving boards, spring boards and starting blocks, and within that Zone, by the horizontal plane 2.5 m above the highest surface expected to be occupied by persons, or to the ceiling or roof, if they exist.

Zone C is limited:

(*a*) by the vertical plane circumscribing Zone B, and the parallel vertical plane 1.5 m external to Zone B, and

(*b*) by the floor or surface expected to be occupied by persons and the horizontal plane 2.5 m above that floor or surface.

(3) *Bonding*

Local supplementary equipotential bonding should be provided connecting all extraneous conductive parts in Zone A, B and C together, with the protective conductors of all exposed conductive parts situated in these Zones. This requirement is not to be applied to equipment supplied by SELV circuits. Where there is a metal grid in a solid floor, it should be connected to the local supplementary bonding.

(4) *Application of protective measures against electric shock*

In Zones A and B, only the protective measure against electric shock by SELV at a nominal voltage not exceeding 12V a.c. r.m.s. or 30V d.c. should be used, the safety source being installed outside Zones A, B and C, except that:

(*a*) where floodlights are installed, each floodlight should be supplied from its own transformer (or an individual secondary winding of a multi-secondary transformer), having an open circuit voltage not exceeding 18V.

(*b*) automatic disconnection of supply by means of a residual current device having the characteristics specified in Code 11J may be used to protect socket outlets installed in accordance with subparagraphs 5(*c*)(i) or 5(*c*)(ii) below.

(5) *Selection and erection of equipment*

(*a*) *Degree of protection of enclosures*

Equipment should have the following minimum degrees of protection or equivalent:

(i) in Zone A – IPX8

(ii) in Zone B – IPX5

– IPX4 for swimming pools where water jets are not likely to be used for cleaning purposes

(iii) in Zone C – IPX2 for indoor pools

– IPX4 for outdoor pools

– IPX5 for swimming pools where water jets are likely to be used for cleaning purposes.

(*b*) *Wiring systems*

(i) In Zones A and B, a surface wiring system should not employ metallic conduit or metallic trunking or an exposed metallic cable sheath or an exposed earthing or bonding conductor.

(ii) Zones A and B should contain only wiring necessary to supply equipment situated in those Zones.

(iii) Accessible metal junction boxes should not be installed in Zones A and B.

(*c*) *Switchgear, controlgear and accessories*

(i) In Zones A and B, switchgear, controlgear and accessories should not be installed except for swimming pools where it is not possible to locate socket outlet outside Zone B, when socket outlets complying with IEC 60309-2 or equivalent may be installed if they are more than 1.25 m outside the border of Zone A, and at least 0.3 m above the floor, and protected by either a residual current device complying with relevant recognised standards and having the characteristics specified in Code 11J, or electrical separation with the safety isolating transformer placed outside Zones A, B and C.

(ii) In Zone C, a socket outlet, switch or accessory is permitted only if it is:

- protected individually by electrical separation,
- protected by SELV,
- protected by a residual current device complying with the appropriate recognised standard and having the characteristics specified in Code 11J, or
- a shaver socket complying with BS EN 60742 or equivalent.

This requirement does not apply to the insulating cords of cord operated switches complying with BS EN 60669 or equivalent.

(*d*) *Other equipment*

(i) Socket outlets should comply with IEC 60309-2 or equivalent.

(ii) In Zones A and B, only current using equipment specifically intended for use in swimming pools should be installed.

(iii) In Zone C, equipment should be protected by one of the following:

- individually by electrical separation
- SELV
- a residual current device having the characteristics specified in Code 11J.

This requirement does not apply to instantaneous water heaters complying with the relevant section of IEC 60355 or equivalent.

(iv) An electric heating unit embedded in the floor in Zones B or C should incorporate a metallic sheath connected to the local supplementary equipotential bonding or shall be covered by the metallic grid required by paragraph (3) of this Code.

(6) *Fountains*

The basins of fountains that are intended to be occupied and their surroundings are treated as swimming pools. The requirements for basins of fountains that are not intended to be occupied are relaxed as follows:

(*a*) In Zones A and B protection by:

(i) automatic disconnection of supply using an RCD with a rated residual operating current not exceeding 30 mA; or

(ii) electrical separation, the separation source supplying only one item of equipment and installed outside the zones is allowed additionally to SELV.

(*b*) In Zone C, there are no requirements additional to the general rules.

26N **Installation in Restrictive Conductive Locations**

(1) *Scope*

The particular requirements of this Code should apply to installations within or intended to supply equipment or appliances to be used within a Restrictive Conductive Location. They do not apply to any location in which freedom of movement is not physically constrained.

(2) *Protection against direct and indirect contact*

Where protection by the use of SELV or functional extra low voltage (FELV) is used, the voltage should not exceed 25V a.c., r.m.s. or 60V ripple free d.c. and, regardless of the voltage, protection against direct contact should be provided by:

(*a*) a barrier or enclosure affording at least the degree of protection IP2X or IPXXB or equivalent, or

(*b*) insulation capable of withstanding a test voltage of 500V d.c. for 60 seconds.

(3) *Protection against direct contact*

Protection by obstacles or placing out of reach is not permitted.

(4) *Protection against indirect contact*

(*a*) Protection against indirect contact should be provided by one of the following:

(i) SELV,

(ii) automatic disconnection, a supplementary equipotential bonding conductor should be provided and be connected to the exposed conductive parts of the fixed equipment and the conductive parts of the location,

(iii) electrical separation, in which case only one socket or piece of equipment should be connected to each secondary winding of the isolating transformer, or

(iv) the use of Class II equipment adequately protected to an IP code (see IEC 60529) in which case the circuit should be further protected by a residual current device having the characteristics specified in Code 11J.

(*b*) A supply to or a socket intended to supply a hand lamp should be protected by SELV.

(*c*) If a functional earth is required for certain equipment, for example measurement or control apparatus, equipotential bonding should be provided between all exposed conductive parts, all extraneous conductive parts inside the restrictive conductive location, and the functional earth.

(*d*) A supply to or a socket intended to supply a handheld tool should be protected by SELV or electrical separation.

(*e*) A supply to fixed equipment should be protected by one of the methods listed in subparagraph (*a*) above.

(*f*) Every safety source and isolating source, other than an electrochemical source (e.g. a battery) or another source independent of a higher voltage circuit (e.g. an engine driven generator), should be situated outside the restrictive conductive location, unless it is part of a fixed installation which satisfies subparagraph (*a*) above within a permanent restrictive conductive location.

26O Installation of Equipment Having High Earth Leakage Currents

(*a*) The particular requirements of this Code should apply to every installation supplying equipment having a high earth leakage current (usually exceeding 3.5 mA), including information technology equipment to IEC 60950 and industrial control equipment where values of earth leakage current in normal service permitted by recognised standards necessitate special precautions being taken in the installation of the equipment.

(*b*) Where more than one item of stationary equipment having an earth leakage current exceeding 3.5 mA in normal service is to be supplied from an installation incorporating a residual current device, it should be verified that the total leakage current does not exceed 25% of the nominal tripping current of the residual current device.

Where compliance with this Code cannot be otherwise achieved, the items of equipment should be supplied through a double-wound transformer or equivalent device as described in paragraph (*f*)(vi) of this Code.

(*c*) An item of stationary equipment having an earth leakage current exceeding 3.5 mA but not exceeding 10 mA in normal service should either be permanently connected to the fixed wiring of the installation without the use of a plug and socket outlet or should be connected by means of a plug and socket outlet complying with IEC 60309-2 or equivalent.

(*d*) An item of stationary equipment having an earth leakage current exceeding 10 mA in normal service should preferably be permanently connected to the fixed wiring of the installation. Alternatively, one of the following precautions should be taken:

(i) the equipment may be connected by means of a plug and socket outlet complying with IEC 60309-2 provided that the protective conductor of the associated flexible cable is supplemented by a separate contact and a second protective conductor having a cross-sectional area not less than 4 mm^2 or the flexible cable complies with paragraph (*f*)(iii) of this Code with the second protective conductor connected via a separate contact within the plug. The permanent connection to the fixed wiring may be by means of a flexible cable, or

(ii) a monitoring system to BS4444 may be installed which, in the event of a discontinuity in the protective conductor, automatically disconnects the supply by a residual current device complying with relevant recognised standards and having the characteristic specified in Code 11J or an overcurrent protective device described in Code 9.

(*e*) For a final circuit supplying a number of socket outlets in a location intended to accommodate several items of equipment, where it is known or is reasonably to be expected that the total earth leakage current in normal service will exceed 10 mA, the circuit should be provided with a high integrity protective connection complying with one or more of the arrangements described in paragraph (*f*)(i) to (*f*)(vi) of this Code. Alternatively a ring circuit may be used to supply a number of single socket outlets. There should be no spur from the ring and the supply ends of the protective conductor ring should be separately connected at the distribution board. The minimum size of the ring protective earth conductor should be 1.5 mm^2.

(*f*) The fixed wiring of every final circuit intended to supply an item of stationary equipment having an earth leakage current exceeding 10 mA in normal service should be provided with a high integrity protective connection complying with one or more of the arrangements described below:

(i) a single protective conductor with a cross-sectional area of not less than 10 mm^2.

(ii) separate duplicated protective conductors, having independent connections complying with Code 25D, each having a cross-sectional area not less than 4 mm^2.

(iii) duplicate protective conductors incorporated in a multicore cable together with the live conductors of the circuit, provided that the total cross-sectional area of all the conductors of the cable is not less than 10 mm^2. One of the protective conductors may be formed by a metallic armour, sheath or braid incorporated in the construction of the cable and complying with Code 11C.

(iv) duplicate protective conductors formed by metal conduit, trunking or ducting complying with Code 11C, and by a conductor having a cross-sectional area not less than 2.5 mm^2 installed in the same enclosure and connected in parallel with it.

(v) an earth monitoring device which, in the event of a discontinuity in the protective conductor, automatically disconnects the supply of the equipment.

(vi) connection of the equipment to the supply by means of a double-wound transformer or other unit in which the input and output circuits are electrically separated, the circuit protective conductor is connected to the exposed conductive parts of the equipment and to a point of the secondary winding of the transformer or equivalent device. The protective conductor(s) between the equipment and the transformer should comply with one of the arrangements described in (i) to (iv) above.

Except where paragraph (*d*) of this Code applies, each protective conductor mentioned in (i) to (iv) above should comply with the requirements of Codes 11B, 11C and paragraph (*e*) of this Code.

(*g*) Where items of stationary equipment having an earth leakage current exceeding 3.5 mA in normal service are to be supplied from an installation forming part of a TT system, it should be verified that the product of the total earth leakage current (in amperes) and the resistance of the installation earth electrodes (in ohms) does not exceed 25 volts.

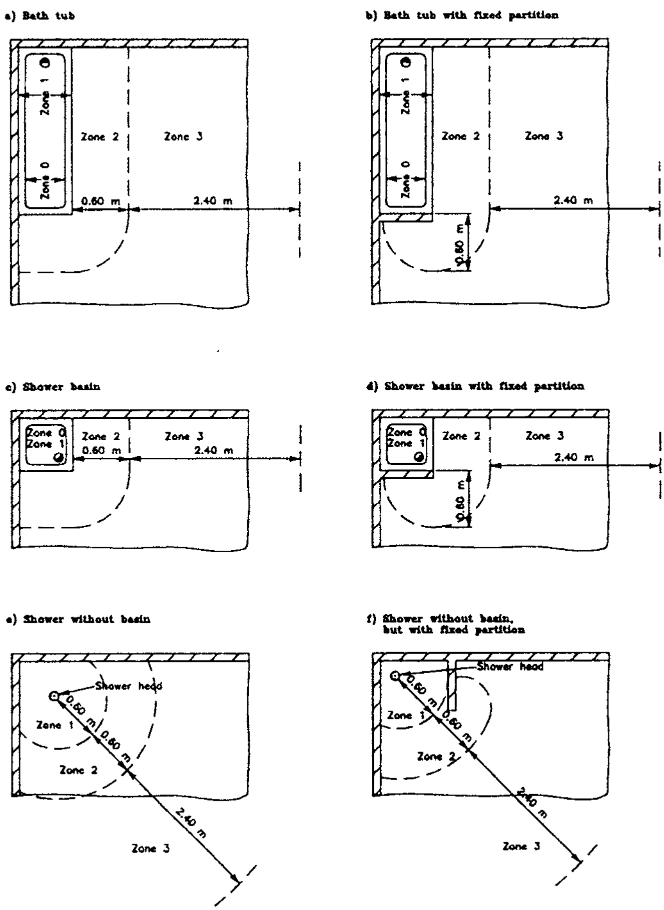
Where compliance with this requirement connot be otherwise achieved, the items of equipment should be supplied through a double-wound transformer or equivalent device as described in paragraph (*f*)(vi) of this Code.

Table 26(1)

Recommended Number of Socket Outlets in Dwellings

Location	Minimum No. of Socket Outlet	Recommended Maximum Floor Area sq. metre Served by a Socket Outlets
Kitchen	3	1.2
Living/Dining Room	4	2.5
Bedroom	2	3
Store	1	—
Utility Room	3	—

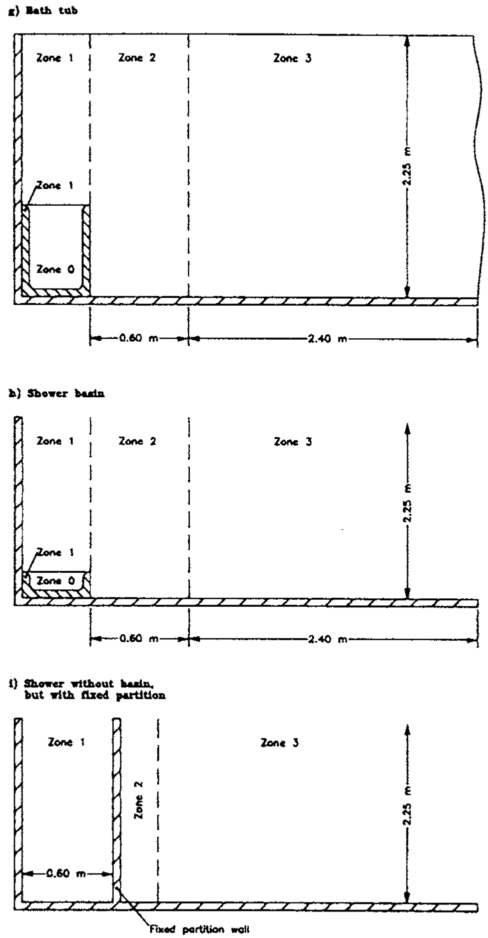
Note: A twin socket outlet is regarded as 2 outlets.



ZONE DIMENSIONS (PLAN)

(Note: The information above is extracted from IEC 364-7-701, please refer to the standard for details)

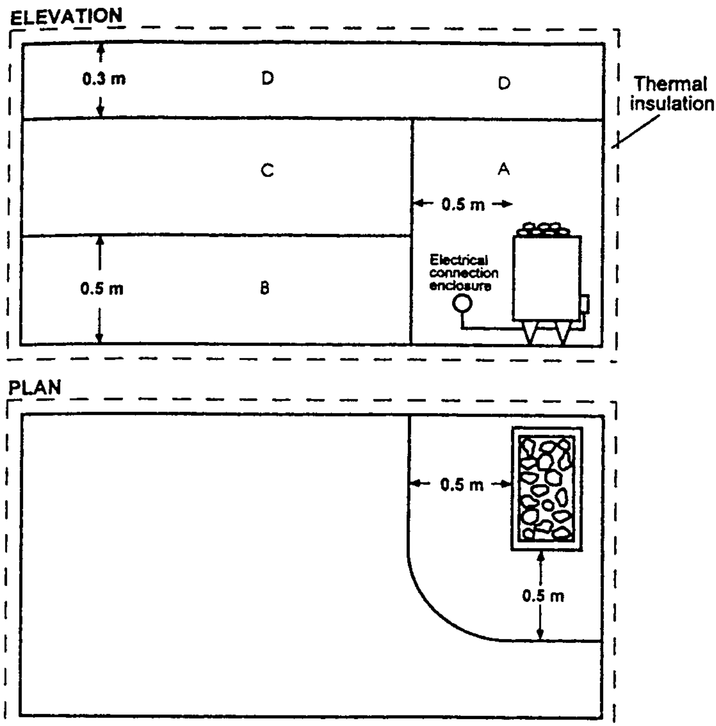
CODE No.	FIGURE No.	
26	26(1)(a)	



ZONE DIMENSIONS (ELEVATION)

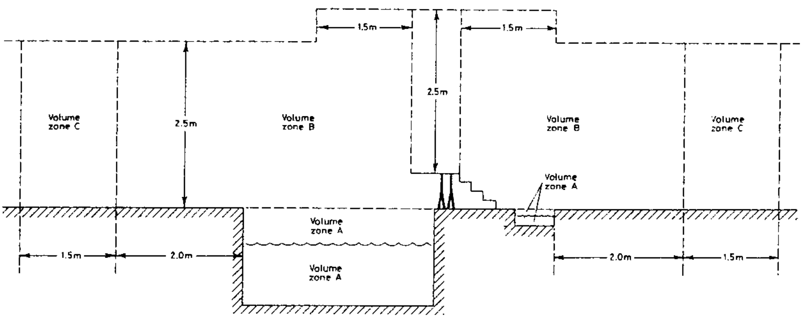
(Note: The information above is extracted from IEC 364-7-701, please refer to the standard for details)

CODE No.	FIGURE No.	
26	26(1)(b)	



CLASSIFICATION OF TEMPERATURE ZONES FOR LOCATIONS WITH HOT AIR SAUNA HEATING EQUIPMENT

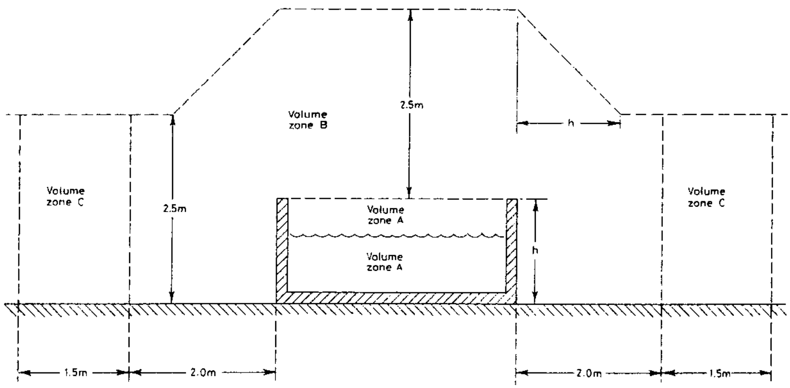
CODE No.	FIGURE No.	
26	26(2)	



Note: The dimensions are measured taking account of walls and fixed partitions

ZONE DIMENSIONS OF SWIMMING POOLS AND PADDLING POOLS

CODE No.	FIGURE No.	
26	26(3)	



Note: The dimensions are measured taking account of walls and fixed partitions

ZONE DIMENSIONS FOR BASIN ABOVE GROUND LEVEL

CODE No.	FIGURE No.	
26	26(4)	

APPENDICES

1. Prescribed Requirements for 3-pin (non-reversible) 5 ampere and 15 ampere Socket Outlets
2. Prescribed Requirements for 3-pin (non-reversible) 13 ampere Socket Outlets
3. Prescribed Requirements for Protected Type Non-reversible 5 ampere, 15 ampere and 30 ampere Socket Outlets
4. Prescribed Requirements for Industrial Type 16 ampere, 32 ampere, 63 ampere and 125 ampere Socket Outlets with Retaining Devices
5. Correction Factors for Sizing of Cable Conductors
6. Current Carrying Capacities and Voltage Drop Tables for PVC Insulated and XLPE Insulated Cables
7. Typical Methods of Installation of Cables
8. Graphical Symbols for Electrical Diagrams
9. Accredition bodies which have mutual recognition agreement/ arrangement with HOKLAS/HKAS
10. Degree of protection provided by enclosures (IP Code)
11. Forms of internal separations for switchgear assemblies
12. Worked Examples for Application of the CoP
13. Checklists
14. References
15. Sample of Permit-To-Work
16. Sample of H.V. Enclosure Log Book

Appendix 1

Prescribed Requirements for 3-pin (non-reversible) 5 ampere and 15 ampere Socket Outlets

(1) General

A 5A or 15A socket outlet to BS 546 is acceptable as complying with the prescribed requirements of this appendix.

(2) Materials for plate/cover, base and current carrying parts

(*a*) Parts made of ferrous metal should be rendered rust proof, special attention being given to springs and moving parts.

(*b*) (i) Insulating materials should be tough, non-ignitable and having a plastic yield not exceeding 6 mm when heated to a temperature of 100°C in accordance with the plastic yield test method 102A of BS2782 Part 1 or equivalent.

(ii) Current carrying parts, including earthing contact should be made of brass, copper, phosphor-bronze, and/or other suitable material.

(iii) A shutter if provided, the distortion of the material should not be such as to impede its action.

(iv) The enclosure of the socket outlet should be rigid and be capable of withstanding a minimum force of 4 kg applied over an area of 250 mm^2 anywhere on the surface without causing appreciable damage or reducing the protective clearance below the minimum values specified in paragraph (6).

(3) Construction of socket outlet

(*a*) (i) Socket outlets are to be constructed to accommodate the plug having physical dimensions as detailed in Figure A1(1).

(ii) In this appendix, where reference is made to a plug, it means a plug having a corresponding rating and dimensions as detailed in Figure A1(1).

(*b*) The configuration of the socket contacts should be as shown in Figure A1(2).

(*c*) There should be no projection on the minimum engagement surface of the socket outlet within a circle having the radius illustrated in Figure A1(2) and concentric with a circle through the centres of the contacts, such as would prevent the full insertion of a plug. Raised marking is permitted provided it does not project more than 0.5 mm from the engagement surface.

(*d*) The spacing of the socket contacts should correspond with that of the plug pins as shown in Figure A1(1).

(*e*) On insertion of pins into contacts, the travel from the first point of contact to the complete engagement, should not be less than the minimum, or more than the maximum, given in Table A1(1).

Table A1(1) Contact Travel

Current Rating (ampere)	Minimum (mm)	Maximum (mm)
5	4.17	6.25
15	4.75	6.83

(*f*) Socket contacts should be self-adjusting as to contact making and each socket contact should be such as to make and maintain, in normal use, effective electrical and mechanical contact with the corresponding plug pins. The means for producing the contact pressure should be associated with each socket contact independently such that individual line or neutral socket contact should be capable of retaining the withdrawal—pull of a gauge as detailed in Figure A1(3) for 30 sec. when the socket outlet is held horizontally with the gauge hanging vertically downwards. It should be checked that neither shutter nor the cover/moulding has any effect on the results.

(*g*) Where a shutter is provided, the construction of the socket outlet should be such that when a plug is withdrawn from it, the current carrying socket contacts are automatically screened by the shutter. The shutter should be operated by the insertion of the earthing pin.

(*h*) (i) Unless a shutter is provided, diameter of holes in the socket outlet plate or cover for the reception of the line and the neutral plug pins should not exceed 5.8 mm or 7.7 mm for 5A or 15A socket outlet respectively.

(ii) The holes for the line and the neutral plug pins in metal plates should have insulated material of at least 2 mm thick around them.

(*i*) The socket outlet should be constructed to prevent a current carrying pin of a plug from making contact with a current carrying contact of the socket while either or both of other pins are completely exposed. The provision of a shutter, or no part of hole intended for the reception of line or neutral pin should be less than 16.5 mm or 21 mm from the edge of a 5A or 15A socket outlet respectively, is acceptable for this purpose.

(*j*) Multiple socket outlets should be capable of simultaneous use of all socket outlets.

(*k*) Where a switch is incorporated:

(i) the actuating member of a switch should not remain at rest in the off position whilst the switch contacts remain closed; and

(ii) the actuating mechanism should be so constructed that when operated the switch can remain only in a position giving adequate contact or adequate separation of the contacts; and

(iii) switches should be so constructed that undue arcing cannot occur when the switch is operated slowly; and

(iv) the switch in any switched socket outlet should disconnect the supply to the line socket contact.

(*l*) Conductive component parts of the socket outlet should be so located and separated that, in normal use, they cannot be displaced so as to affect adversely the safety or proper operation of the socket outlet.

(*m*) (i) For the flush socket outlet intended to be used in enclosure, the size of the base shall be such that the clearance for the purpose of wiring between the base and the inside walls of the box or enclosure is not less than 6 mm.

(ii) There should be no live metal protruding from or flush with the socket outlet base. Any exposed live metal part should be recessed at least 2.5 mm from the base surface.

(iii) Where it is intended that the fixed wiring conductors pass through holes in the base of the socket outlet to the terminals, the minimum diameter of each hole should not be less than 7.9 mm or 9.5 mm for the 5A or 15A socket outlet respectively.

(4) Construction of terminals

(*a*) Terminals in the 5A socket outlet should permit the connection, without special preparation, of one or two 1.5 mm^2 solid or stranded conductors.

(*b*) Line and neutral terminals in the 15A socket outlet should permit the connection, without special preparation, of one or two 2.5 mm^2 solid or stranded conductors.

(*c*) Earthing terminals should permit the connection without special preparation of one or two 1.5 mm^2 or 2.5 mm^2 solid or stranded conductors.

(*d*) Where pillar terminals are used they should have clamping screws of sufficient length to extend to the far side of the conductor hole. The end of the screw should be slightly rounded so as to minimize damage to the conductors. The sizes of the conductor hole and the clamping screw should be such that the clearance between the sides of the major diameter of the clamping screw and the conductor hole does not exceed 0.6 mm.

The size of conductor hole should not be less than 3.5 mm or 4.3 mm for 5A or 15A socket outlet respectively.

(*e*) Terminal screws should have a nominal diameter of not less than 2.8 mm or 3 mm for 5A or 15A socket outlets.

(5) Screws and connections

(*a*) Screwed connections, electrical and otherwise should withstand the mechanical stresses occurring in normal use. Screws transmitting electrical contact pressure should screw into metal.

(*b*) Screws should not be of insulating material if their replacement by a metal screw would affect the safety or performance requirements of the accessory.

(*c*) Where current carrying parts are screwed together, the current path should not rely on the screw threads.

(6) Creepage distances, clearances and distances through insulation

(*a*) When the socket outlet is correctly assembled and wired with the appropriate cable, the minimum clearance through air and the minimum creepage distance shall be 2.5 mm:

(i) between live parts of opposite polarity;

(ii) between live parts and any other metal parts; and

(iii) between live parts and the accessible external surface of the accessory.

(*b*) The minimum clearance between switch contacts in the open position for socket outlet should be 1.2 mm.

(*c*) The socket outlet should have a minimum distance of 2 mm between insulated live parts and the accessible external surface.

(7) Provision of earthing

(*a*) The socket outlet should be so constructed that, when inserting the plug, the earth connection is made before the current carrying pins of the plug become live. When withdrawing the plug, the current carrying parts should separate before the earth contact is broken.

(*b*) All accessible metal parts of accessories should be in effective electrical contact with the earthing socket contact except the metal parts on, or screws in or through, non-conducting material, and separated by such material from current carrying parts in such a way that in normal use they cannot become live, need not be in effective electrical contact with the earthing socket contact.

(8) Marking

(*a*) The socket outlet should be legibly and durably marked with the following information, which should not be placed on screws, removable washers or other easily removable parts, or upon parts intended for separate sale:

(i) rated current;
(ii) rated voltage;
(iii) nature of supply.

(*b*) If symbols are used they should be as follows:

amperes	A
volts	V
alternating current	a.c.
earth	⏚ or E

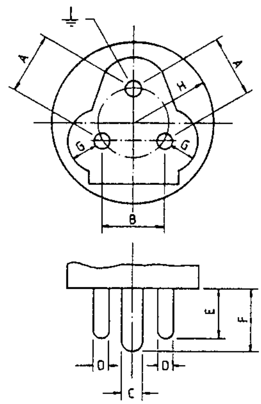
(*c*) The letters L and N should be used to indicate the terminals corresponding respectively to the line socket contact (L) and the neutral socket contact (N) and letter E or symbol ⏚ for the earthing socket contact (E). The letters and symbols should be as close as practicable to the corresponding terminals.

(9) Temperature rise

(*a*) The permitted temperature rise of the accessible external surface of the socket outlet after the test of subparagraph (*b*) should be 50°C.

(*b*) The following procedures of the test on the temperature rise of the accessible external surface of the socket outlet are acceptable:

(i) Temperature rise of socket outlets should be measured by fine wire thermocouples.
(ii) Surface mounted outlets should be mounted as in use with their accompanying mounting block or backplate fixed to a vertical plywood board 25 mm thick and having a flat surface extending at least 150 mm in each direction beyond the extremity of the socket outlet.
(iii) Flush mounted socket outlets should be mounted on socket outlet boxes with an internal depth of 35 mm. The flush mounted socket outlet box is placed in a block of wood, so that the front edges of the box are between 2.5 mm and 5 mm below the front surface of the block. The size of the block should be such that there is a minimum of 25 mm of wood surrounding the box on all four sides and the back.
(iv) Socket outlets under test should be subjected to its rated loading connected via a plug for a minimum continuous period of 4 hours or longer until stability is reached with a maximum duration of 8 hours, stability being taken as less than 1°C rise within 1 hour.



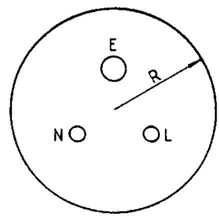
RATED CURRENT (AMPERE)	DIMENSIONS IN mm							
	A	B	C	D	E	F	G (NOTE 1)	H (NOTE 2)
5	22.22	19.05	7.04 TO 7.09	5.05 TO 5.1	14.73 TO 15.62	20.5 TO 21.39	7.94	27.2
15	28.58	25.4	8.69 TO 8.74	7.04 TO 7.09	18.49 TO 19.38	28.45 TO 29 34	9.52	32.3

NOTES :- (1) "G" IS THE MINIMUM DISTANCE BETWEEN THE PINS AND THE PERIPHERY OF THE PLUG.

(2) "H" IS THE RADIUS OF THE MAXIMUM PERMISSIBLE PLUG CONTOUR. THE RADIUS IS CONCENTRIC WITH THE PITCH CIRCLE RADIUS OF THE PINS.

3 PIN 5 AMPERE AND 15 AMPERE PLUGS

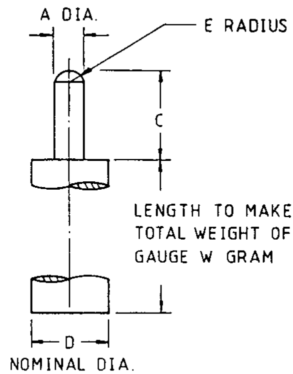
CODE No.	FIGURE No.	
A1	A1(1)	



	RATED CURRENT	
	5 A	15 A
RADIUS OF ENGAGEMENT SURFACE (R)	27.2 mm	32.3 mm

CONFIGURATION OF THE SOCKET CONTACTS AND ENGAGEMENT SURFACE OF 5 AMPERE AND 15 AMPERE SOCKET OUTLETS

CODE No.	FIGURE No.	
A1	A1(2)	



CURRENT RATING	CONTACTS	A	C	D	W	E
AMPERE		mm	mm	mm	GRAM	mm
5	CURRENT CARRYING	5.05	14.86	15.88	226.8	2.74
	EARTHING	7.04	20.63	19.05	226.8	4.01
15	CURRENT CARRYING	7.04	18.62	19.05	340.2	4.01
	EARTHING	8.69	28.56	22.23	340.2	5.05
TOLERANCE		- 0.008	±0.025		+ 1.8	±0.127

WITHDRAWAL-PULL GAUGES FOR 5 AMPERE AND 15 AMPERE SOCKET OUTLETS

CODE No.	FIGURE No.	
A1	A1(3)	

Appendix 2

Prescribed Requirements for 3-pin (non-reversible) 13 ampere Socket Outlets

(1) General

A 13A outlet to BS 1363 is acceptable subject to complying with the prescribed requirements of this appendix.

(2) Materials for plate/cover, base and current carrying parts

(*a*) Parts made of ferrous metal should be rendered rust proof, special attention being given to springs and moving parts.

(*b*) (i) Insulating materials should be tough, non-ignitable and not soften when heated to a temperature of 100°C

(ii) Current carrying parts, including earthing contact should be made of brass, copper, phosphor-bronze, and/or other suitable material.

(iii) The material of the shutter should not distort to an extent to impede its action.

(iv) The enclosure of the socket outlet should be rigid and be capable of withstanding a minimum force of 4 kg applied over an area of 250 mm^2 anywhere on the surface without causing appreciable damage or reducing the protective clearance below the minimum values specified in paragraph (6).

(3) Construction of socket outlet

(*a*) (i) Socket outlets are to be constructed to accommodate the plug having physical dimensions as detailed in Figure A2(1).

(ii) In this appendix, where reference is made to a plug, it means a plug having a current rating and dimensions of 13A as detailed in Figure A2(1).

(*b*) The configuration of the socket contacts should be as shown in Figure A2(2).

(*c*) There should be no projection on the minimum engagement surface of the socket outlet illustrated in Figure A2(2), such as would prevent the full insertion of a plug. Raised marking is permitted provided it does not project more than 0.5 mm from the engagement surface.

(*d*) The spacing of the socket contacts should correspond with that of the plug pins as shown in Figure A2(1).

(*e*) On insertion of pins into contacts, the travel of the end of either current carrying pin from the first face of the socket outlet to the first point of contact with appropriate socket contact, should not be less than the minimum of 9.5 mm, or more than the maximum of 12.7 mm.

(*f*) Socket contacts should be self-adjusting as to contact making and each socket contact should be such as to make and maintain, in normal use, effective electrical and mechanical contact with the corresponding plug pins. The means for producing the contact pressure should be associated with each socket contact independently such that individual line or neutral socket contact should be capable of retaining the gauge as detailed in Figure A2(3) for 30 sec. when the socket outlet is held horizontally with the gauge hanging vertically downwards. It should be checked that neither shutter nor the cover/moulding has any effect on the results.

(*g*) The construction of the socket outlet should be such that when a plug is withdrawn from it, the current carrying socket contacts are automatically screened by the shutter. The shutter should be operated by the insertion of the earthing pin.

(*h*) (i) Apertures of the socket outlet plate or cover for the reception of the line and the neutral plug pins should not exceed 7.2 mm × 4.8 mm and for the earthing plug pin 8.8 mm × 4.8 mm.

(ii) The holes for the line and the neutral plug pins in metal plates should have insulated material of at least 2 mm thick around them.

(i) No part of the aperture intended for the reception of the line or neutral pin should be less than 9.5 mm from the periphery of the engagement face of a socket outlet.

(*j*) Multiple socket outlets should be capable of simultaneous use of all socket outlets.

(*k*) Where a switch is incorporated:

(i) the actuating member of a switch should not remain at rest in the off position whilst the switch contacts remain closed; and

(ii) the actuating mechanism should be so constructed that when operated the switch can remain only in a position giving adequate contact or adequate separation of the contacts; and

(iii) switches should be so constructed that undue arcing cannot occur when the switch is operated slowly; and

(iv) the switch in any switched socket outlet should disconnect the supply to the line socket contact.

(*l*) Conductive component parts of the socket outlet should be so located and separated that, in normal use, they cannot be displaced so as to affect adversely the safety or proper operation of the socket outlet.

(*m*) (i) For the flush socket outlet intended to be used in enclosure, the size of the base shall be such that the clearance for the purpose of wiring between the base and the inside walls of the box or enclosure is not less than 6 mm.

(ii) There should be no live metal protruding from or flush with the socket outlet base. Any exposed live metal part should be recessed at least 2.5 mm from the base surface.

(iii) Where it is intended that the fixed wiring conductors pass through holes in the base of the socket outlet to the terminals, the minimum diameter of each hole should not be less than 9.5 mm.

(4) Construction of terminals

(*a*) Line and neutral terminals in the socket outlet should permit the connection, without special preparation, of one, two or three 2.5 mm^2 solid or stranded or of one or two 4 mm^2 stranded conductors.

(*b*) Earthing terminals should permit the connection without special preparation, of one, two or three 1.5 mm^2 or 2.5 mm^2 solid or stranded or of one or two 4 mm^2 stranded conductors.

(*c*) Where pillar terminals are used they should have clamping screws of sufficient length to extend to the far side of the conductor hole. The end of the screw should be slightly rounded so as to minimize damage to the conductors. The sizes of the conductor hole and the clamping screw should be such that the clearance between the sides of the major diameter of the clamping screw and the conductor hole does not exceed 0.6 mm. The size of conductor hole should not be less than 4.3 mm.

(*d*) Terminal screws should have a nominal diameter of not less than 3 mm.

(5) Screws and connections

(*a*) Screwed connections, electrical and otherwise should withstand the mechanical stresses occurring in normal use. Screws transmitting electrical contact pressure should screw into metal.

(*b*) Screws should not be of insulating material if their replacement by a metal screw would affect the safety or performance requirements of the accessory.

(*c*) Where current carrying parts are screwed together, the current path should not rely on the screw threads.

(6) Creepage distances, clearances and distances through insulation

(*a*) When the socket outlet is correctly assembled and wired with the appropriate cable, the minimum clearance through air and the minimum creepage distance shall be 2.5 mm:

(i) between live parts of opposite polarity;

(ii) between live parts and any other metal parts; and

(iii) between live parts and the accessible external surface of the accessory.

(*b*) The minimum clearance between switch contacts in the open position for socket outlet should be 1.2 mm.

(*c*) The socket outlet should have a minimum distance of 2 mm between insulated live parts and the accessible external surface.

(7) Accessibility of live parts

Socket outlets should be so designed that when mounted and wired as in normal use, live parts are not accessible as tested by a test pin shown in Figure A2(4).

(8) Provision of earthing

(*a*) The socket outlet should be so constructed that, when inserting the plug, the earth connection is made before the current carrying pins of the plug become live. When withdrawing the plug, the current carrying parts should separate before the earth contact is broken.

(*b*) All accessible metal parts of accessories should be in effective electrical contact with the earthing socket contact except the metal parts on, or screws in or through, non-conducting material, and separated by such material from current carrying parts in such a way that in normal use they cannot become live, need not be in effective electrical contact with the earthing socket contact.

(9) Marking

(*a*) The socket outlet should be legibly and durably marked with the following information, which should not be placed on screws, removable washers or other easily removable parts, or upon parts intended for separate sale:

(i) rated current;

(ii) rated voltage;

(iii) nature of supply.

(*b*) If symbols are used they should be as follows—

amperes	A
volts	V
alternating current	a.c.
earth	⏚ or E

(*c*) The letters L and N should be used to indicate the terminals corresponding respectively to the line socket contact (L) and the neutral socket contact (N) and letter E or symbol ⏚ for the earthing socket contact (E). The letters and symbols should be as close as practicable to the corresponding terminals.

(10) Temperature rise

(*a*) The permitted temperature rise of the accessible external surface of the socket outlet after the test of subparagraph (*b*) should be 50°C.

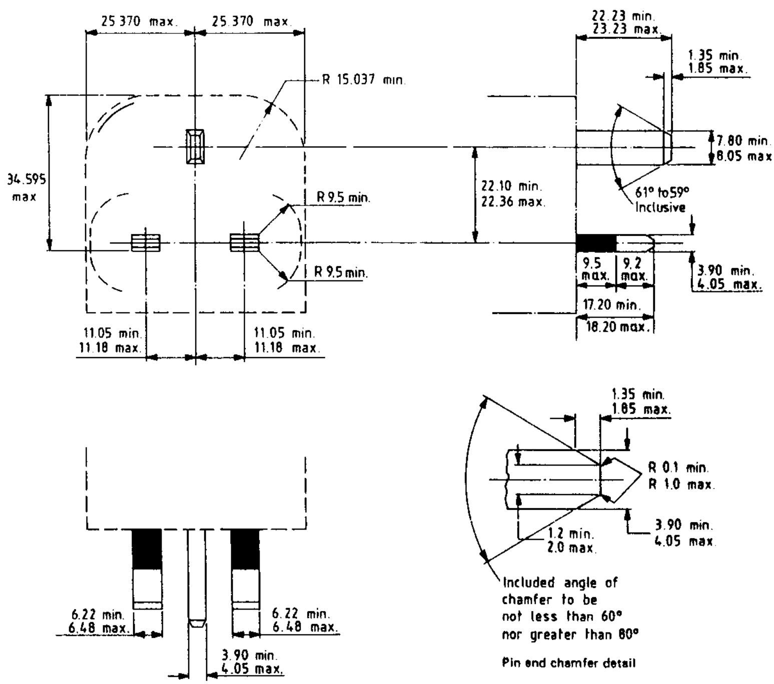
(*b*) The following procedures of the test on the temperature rise of the accessible external surface of the socket outlet are acceptable:

(i) Temperature rise of socket outlets should be measured by fine wire thermocouples.

(ii) Surface mounted socket outlets should be mounted as in use with their accompanying mounting block or backplate fixed to a vertical plywood board 25 mm thick and having a flat surface extending at least 150 mm in each direction beyond the extremity of the socket outlet.

(iii) Flush mounted socket outlets should be mounted on socket outlet boxes with an internal depth of 35 mm. The flush mounted socket outlet box is placed in a block of wood, so that the front edges of the box are between 2.5 mm and 5 mm below the front surface of the block. The size of the block should be such that there is a minimum of 25 mm of wood surrounding the box on all four sides and the back.

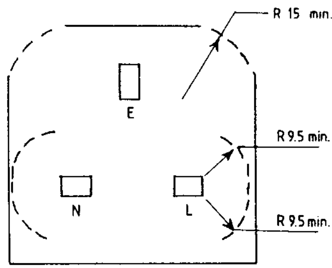
(iv) Socket outlets under test should be subjected to its rated loading connected via a plug for a minimum continuous period of 4 hours or longer until stability is reached with a maximum duration of 8 hours, stability being taken as less than 1°C rise within 1 hour.



(All dimensions are in mm)

13 AMPERE 3-PIN PLUG

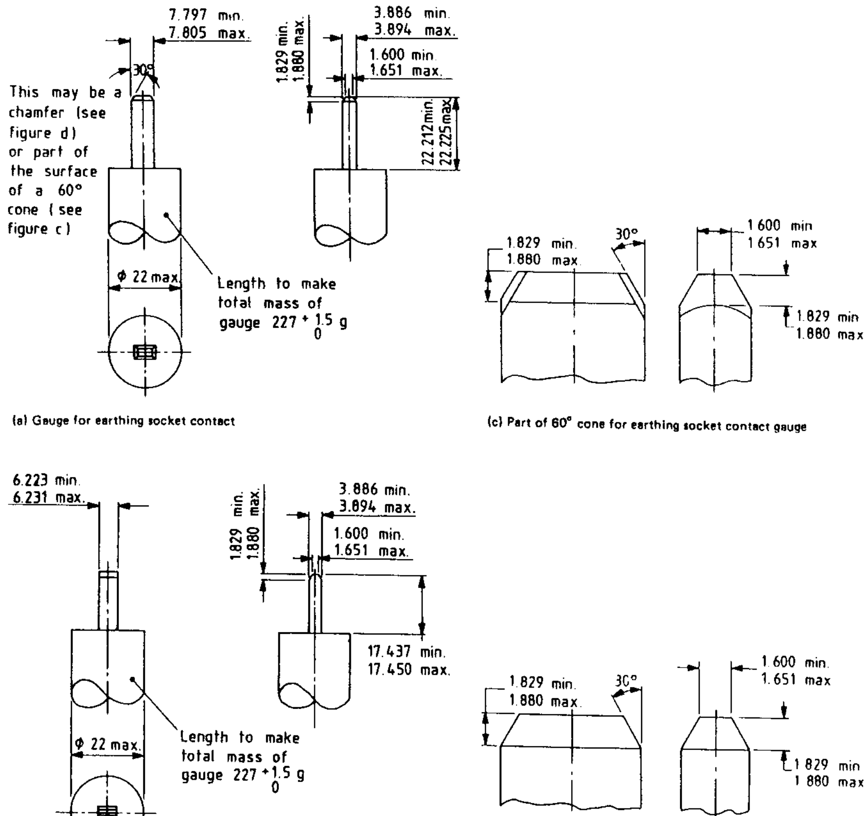
CODE No.	FIGURE No.	
A2	A2(1)	



(All dimensions are in mm)

CONFIGURATION OF THE SOCKET CONTACTS AND ENGAGEMENT SURFACE OF 13 AMPERE SOCKET OUTLETS

CODE No.	FIGURE No.	
A2	A2(2)	



(a) Gauge for earthing socket contact

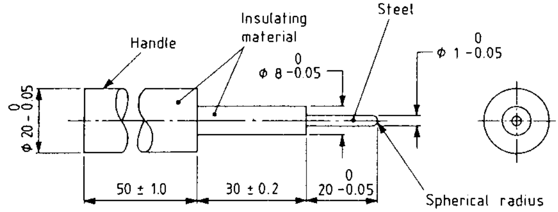
(c) Part of 60° cone for earthing socket contact gauge

(b) Gauge for line and neutral current carrying socket contacts
All dimensions are in millimetres

(d) Chamfer of earthing socket contact gauge
(Chamfer on long sides only for line and neutral socket contact gauges)

WITHDRAWAL - PULL GAUGES FOR 13 AMPERE SOCKET OUTLET

CODE No.	FIGURE No.	
A2	A2(3)	



All dimensions are in millimetres.

STANDARD TEST PIN FOR 13 AMPERE SOCKET OUTLET

CODE No.	FIGURE No.
A2	A2(4)

Appendix 3

Prescribed Requirements for Protected Type Non-reversible 5 ampere, 15 ampere and 30 ampere Socket Outlets

(1) General

A 5A or 15A or 30A socket outlet to BS 196 is acceptable as complying with the prescribed requirements of this appendix.

(2) Materials for plate/cover, base and current carrying parts

(*a*) Parts made of ferrous metal should be rendered rust proof, special attention being given to springs and moving parts.

(*b*) (i) Insulating materials should be tough, non-ignitable and not soften when heated to a temperature of 100°C.

(ii) Current carrying parts, including earthing contact should be made of brass, copper, phosphor-bronze, and/or other suitable material.

(iii) The enclosure of the socket outlet should be rigid and be capable of withstanding a minimum force of 4 kg applied over an area of 250 mm^2 anywhere on the surface without causing appreciable damage or reducing the protective clearance below the minimum values specified in paragraph (6).

(3) Construction of socket outlet

(*a*) (i) The socket outlet is to be constructed to accommodate the plug having physical dimensions as detailed in Figure A3(1).

(ii) In this appendix, where reference is made to a plug, it means a plug having a corresponding rating and dimensions as detailed in Figure A3(1).

(*b*) The configuration of the socket contacts should be as shown in Figure A3(2).

(*c*) The essential dimensions of the socket outlet fed exclusively by a radial final circuit is shown in Figure A3(2).

(*d*) Socket contacts should be self-adjusting as to contact making and each socket contact should such as to make and maintain, in normal use, effective electrical and mechanical contact with the corresponding plug pins. The means for producing the contact pressure should be associated with each socket contact independently.

(*e*) Conductive component parts of socket outlets should be so located and separated that, in normal use, they cannot be displaced so as to affect adversely the safety or proper operation of the socket outlet.

(*f*) Where the socket outlet is required to be weatherproof, it should be totally enclosed when fitted with screwed conduits, or PVC sheathed cables and without a plug in position. The socket outlets should be threaded with dimensions given in Figure A3(3) for use with the corresponding screwed ring fitted to plugs.

(*g*) For a ring or radial final circuit feeding a number of socket outlets and where:

(i) the circuit has one pole earthed, the socket outlet should be of the type that will accept only 2-pole-and-earth contact plugs with single-pole fusing on the live pole. Such socket outlets with raised socket keys are shown in Figure A3(4), and those with socket keyways recessed at position 'B' are shown in Figure A3(5).

(ii) the circuit has neither pole earthed (e.g. a circuit supplied from a double-wound transformer having the midpoint of its secondary winding earthed), the socket outlet should be of the type that will accept only 2-pole-and-earth contact plugs with double-pole fusing. Such socket outlet is those which have raised socket keys as shown in Figure A3(4), together with socket keyways recessed at position 'P' as shown in figure A3(5).

(4) Construction of terminals

(*a*) Connection should be made by means of screws, nuts or equally effective devices.

(*b*) When pillar type terminals are used, they should comply with the following requirements:

(i) the minimum dimensions are in accordance with Figure A3(2).

(ii) the cable clamping screws should be long enough to reach the opposite surface of the cable hole, and should have rounded ends, and

(iii) the surface of the cable hole against which the cable is clamped should be smooth and unbroken.

(*c*) Terminals should be effectively enclosed. Insulating barriers securely fixed to, or forming an integral part of the interiors, should be provided to separate internal metal at different potential including any bare flexible conductors, even if such conductors should become detached from their terminals.

(*d*) An earthing terminal should be provided and be so arranged that the earth wire of the cable, if any, is visible at least when the plug or appliance inlet is removed from the corresponding socket outlet or connector.

(5) Screws and connections

(*a*) Screwed connections, electrical and otherwise should withstand the mechanical stresses occurring in normal use. Screws transmitting electrical contact pressure should screw into metal.

(*b*) Screws should not be made of insulating material if their replacement by a metal screw would affect the safety or performance requirements of the accessory.

(*c*) Where current carrying parts are screwed together, the current path should not rely on the screw threads.

(6) Creepage distances, clearances and distances through insulation

(*a*) When the socket outlet is correctly assembled and wired with the appropriate cable, the minimum clearance through air and the minimum creepage distance shall be 2.5 mm:
   (i) between live parts of opposite polarity;
   (ii) between live parts and any other metal parts; and
   (iii) between live parts and the accessible external surface of the accessory.

(*b*) The socket outlet should have a minimum distance of 2 mm between insulated live parts and the accessible external surface.

(7) Accessibility of live parts

Socket outlets should be so designed that when mounted and wired as in normal use, live parts are not accessible as tested by a test finger shown in Figure A3(6).

(8) Provision of earthing

(*a*) Socket outlets should be so constructed with scraping earthing contact that, when inserting the plug, the earth connection is made before the current carrying pins of the plug become live. When withdrawing the plug, the current carrying parts should separate before the earth contact is broken.

(*b*) All accessible metal parts at accessories shall be in effective electrical contact with the scraping earthing contact except that metal parts on, or screws in or through, non-conducting material, and separated by such material from current carrying parts in such a way that in normal use they cannot become live, need not be in effective electrical contact with the scraping earthing contact.

(9) Marking

(*a*) The socket outlet should be legibly and durably marked with the following information, which should not be placed on screws, removable washers or other easily removable parts, or upon parts intended for separate sale:
- (i) rated current;
- (ii) rated voltage;
- (iii) nature of supply.

(*b*) If symbols are used they should be as follows:

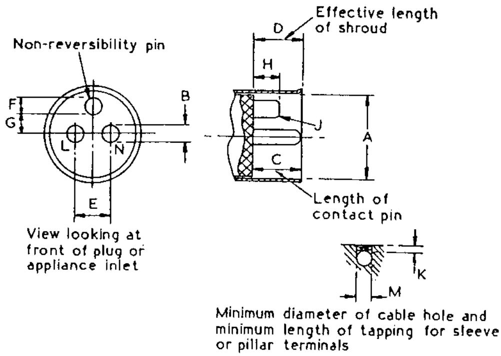
amperes	A
volts	V
alternating current	a.c.
earth	⏚ or E

(*c*) The letters L and N should be used to indicate the terminals corresponding respectively to the line socket contact (L) and the neutral socket contact (N) and letter E or symbol ⏚ for the earthing socket contact (E). The letters and symbols should be as close as practicable to the corresponding terminals.

(10) Temperature rise

(*a*) The permitted temperature rise of the accessible external surface of the socket outlet after the test of subparagraph (*b*) should be 50°C.

(*b*) The following procedures of the test on the temperature rise of the accessible external surface of the socket outlet are acceptable:
- (i) Temperature rise of socket outlets should be measured by fine wire thermocouples.
- (ii) Socket outlets under test should be subjected to its rated loading connected via a plug for a minimum continuous period of 1 hour.
- (iii) Sockets and plugs should be mounted and connected as in normal use.

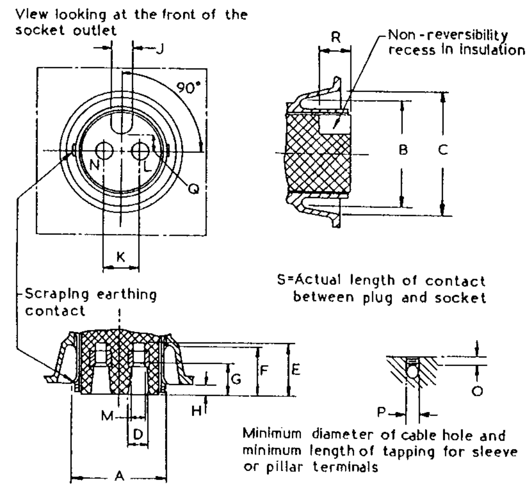


Current rating of plug	A dia.	B dia.	C	D	E	F dia.	G	H	J radius	K min.	M dia. min.
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
5	35·71	5·11	17·48	17·48	15·88	7·14	8·33	9·52	0·40	1·65	2·64
15	42·06	7·09	22·22	22·22	19·05	7·95	9·52	12·70	2·38	3·18	3·58
30	54·76	7·95	30·18	30·18	22.18	11·13	11·13	15·88	3·18	4·75	4·75
Tolerance	+0 −0·13	+0 −0·05	+0 . −0·25	+0·25 −0·25	— —	+0·13 −0·13	+0·25 −0·25	+0·25 −0·25	— —	— —	— —

DIMENSIONS OF 5 AMPERE, 15 AMPERE AND 30 AMPERE

PROTECTED TYPE NON-REVERSIBLE PLUGS

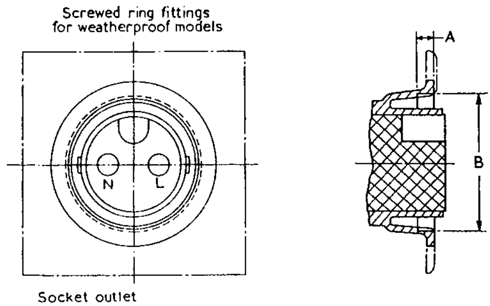
CODE No.	FIGURE No.	
A3	A3(1)	



Current rating of socket	A dia.	B dia. min.	C dia. max.	D dia. orifice max.	E min.	F	G	H	J	K	M dia. orifice max.	O min.	P dia. min.	Q	R min.	S min.
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
5	35·97	41·28	44·83	6·55	19·05	17·48	9·52	3·18	9·52	15·88	5·72	1·65	3·56	7·14	12·70	4·78
15	42·32	47·62	51·21	8·94	23·83	22·22	11·13	0·41	11·13	19·05	8·10	3·18	4·37	7·95	15·88	6·35
30	55·02	62·69	69·85	10·52	31·75	30·18	17·48	1·60	14·30	22·23	8·89	4·75	6·35	9·52	19·05	7·95
Tolerance	+0·12 −0	—	—	—	—	+0·13 −0·13	+0·25 −0·25	—	+0·50 −0·50	—	—	—	—	+0·50 −0·50	—	—

CONFIGURATION OF SOCKET CONTACTS AND DIMENSIONS OF 5 AMPERE, 15 AMPERE AND 30 AMPERE PROTECTED TYPE NON-REVERSIBLE SOCKET OUTLETS

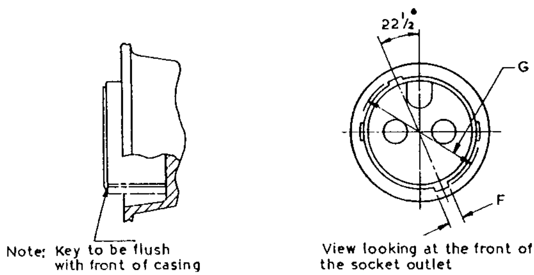
CODE No.	FIGURE No.
A3	A3(2)



SOCKET OUTLET DIMENSIONS		
Current rating of tubes	A	B major diameter
amperes	mm	mm
5	6·35	47·63
15	6·35	53·98
30	6·35	73·03

SCREWED RING FITTINGS FOR 5 AMPERE, 15 AMPERE AND 30 AMPERE PROTECTED TYPE NON-REVERSIBLE SOCKET OUTLET

CODE No.	FIGURE No.	
A3	A3(3)	

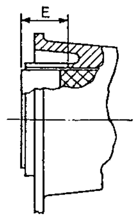


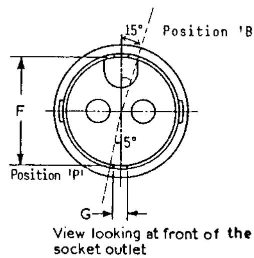
SOCKET OUTLET DIMENSIONS			
Current rating of socket	F	G	Minimum shearing load on each key
Amperes	mm	mm	kg
5	3·96	36·91	45·4
15	3·96	43·26	45·4
30	3·96	55·96	45·4
Tolerance	—	+0	—
	—	−0·13	—

SOCKET KEY OF 5 AMPERE, 15 AMPERE AND 30 AMPERE

PROTECTED TYPE NON-REVERSIBLE SOCKET OUTLETS FOR FUSED PLUGS

CODE No.	FIGURE No.		
A3	A3(4)		

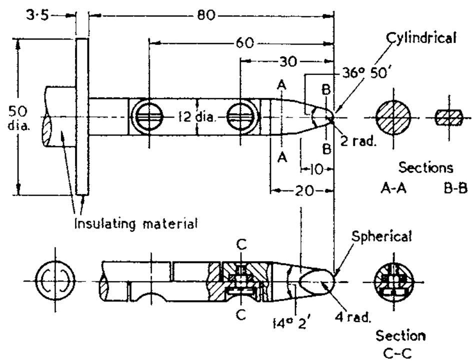




SOCKET OUTLET DIMENSIONS			
Current rating of socket	E	F	G
Amperes	mm	mm	mm
5	11·91	32·05	4·78
15	13·49	37·54	4·78
30	22·22	49·05	4·78
Tolerance	— —	+0·13 −0	— —

SOCKET KEYWAYS OF 5 AMPERE, 15 AMPERE AND 30 AMPERE PROTECTED TYPE NON-REVERSIBLE SOCKET OUTLETS FOR FUSED PLUGS

CODE No.	FIGURE No.	
A3	A3(5)	



Tolerances on angles ±5', on linear dimensions:
less than 25 mm ±0·05 over 25 mm ±0·2.

All dimensions are in mm.

TEST FINGER FOR INDUSTRIAL SOCKET OUTLETS

CODE No.	FIGURE No.	
A3	A3(6)	

Appendix 4

Prescribed Requirements for Industrial Type 16 ampere, 32 ampere, 63 ampere and 125 ampere Socket Outlets with Retaining Devices

(1) General

A 16A or 32A or 63A or 125A socket outlet to IEC 60309 is acceptable as complying with the prescribed requirements of this appendix.

(2) Materials for plate/cover, base and current carrying parts

(*a*) Parts made of ferrous metal should be rendered rust proof, special attention being given to springs and moving parts.

(*b*) (i) Insulating materials should be tough, non-ignitable and not soften when heated to a temperature of 100°C.

(ii) Current carrying parts, including earthing contact should be made of brass, copper, phosphor-bronze, and/or other suitable material.

(iii) The enclosure of the socket outlet should be rigid and be capable of withstanding a minimum force of 4 kg applied over an area of 250 mm^2 anywhere on the surface without causing appreciable damage or reducing the protective clearance below the minimum values specified in paragraph (6).

(3) Construction of socket outlet

(*a*) (i) The socket outlet is to be constructed to accommodate the plug having physical dimensions as detailed in Figure A4(1) and A4(2).

(ii) In this appendix, where reference is made to a plug, it means a plug having a corresponding rating and dimensions as detailed in Figure A4(1) and A4(2).

(*b*) The configuration of the socket contacts should be as shown in Figure A4(3) and A4(4).

(*c*) The essential dimensions of the socket outlets are shown in Figure A4(3) and A4(4).

(*d*) Socket contacts should be self-adjusting as to contact making and each socket contact should such as to make and maintain, in normal use, effective electrical and mechanical contact with the corresponding plug pins. The means for producing the contact pressure should be associated with each socket contact independently.

(*e*) Conductive component parts of the socket outlet should be so located and separated that, in normal use, they cannot be displaced so as to affect adversely the safety or proper operation of the socket outlet.

(*f*) (i) Socket outlets having a rated current exceeding 32A should be splash proof or watertight.

(ii) Sockets outlets having a rated current exceeding 63A should be watertight.

(*g*) Splash proof socket outlets should be totally enclosed when fitted with screwed conduits, or lead sheathed or armoured cables and without a plug in position.

(*h*) The construction of splash proof or watertight socket outlets to Figure A4(5) or Figure A4(6) are acceptable.

(i) 63A and 125A socket outlets should have provision for an electrical interlock in the form of a pilot contact shown on Figure A4(4).

(*j*) Socket outlets should be provided with a retaining device as indicated in Table A4(1).

Table A4(1)—Retaining devices

Rated Current of the Socket Outlet Amperes	Classification According to Degree of Protection against Moisture	Retaining Means	Figures Referred to
16 and 32	ordinary	lever or lid	A4(7)
	splash proof	lid	A4(7)
	watertight	two-ramp system	A4(8)
63	splash proof	lid and two-ramp system	A4(5)
	watertight	two-ramp system	A4(6)
125	watertight	two-ramp system	A4(6)

(4) Construction of terminals

(*a*) Connection should be made by means of screws, nuts or equally effective devices.

(*b*) Dimensions of terminals should comply with Figure A4(9) for pillar terminals, Figure A4(10) for screw terminals and stud terminals, Figure A4(11) for saddle terminals and Figure A4(12) for lug terminals.

(*c*) Terminals should be effectively enclosed. Insulating barriers securely fixed to, or forming an integral part of the interiors, should be provided to separate internal metal at different potential including any bare flexible conductors, ever if such conductors should become detached from their terminals.

(5) Screws and connections

(*a*) Screwed connections, electrical and otherwise should withstand the mechanical stresses occurring in normal use. Screws transmitting electrical contact pressure should screw into metal.

(*b*) Screws should not be of insulating material if their replacement by a metal screw would affect the safety or performance requirements of the accessory.

(*c*) Where current carrying parts are screwed together, the current path should not rely on the screw threads.

(*d*) Screws and nuts for clamping the conductors should not serve to fix any other component.

(6) Creepage distances, clearances and distances through insulation

(*a*) When the socket outlet is correctly assembled and wired with the appropriate cable, the minimum clearance through air and the minimum creepage distance should be 4 mm:

(i) between live parts of opposite polarity;

(ii) between live parts and any other metal parts; and

(iii) between live parts and the accessible external surface of the accessory.

(*b*) The socket outlet should have a minimum distance of 2 mm between insulated live parts and the accessible external surface.

(7) Accessibility of live parts

Socket outlets should be so designed that when mounted and wired as in normal use, live parts are not accessible as tested by a test finger shown in Figure A3(6).

(8) Provision for earthing

(*a*) The socket outlet should be so constructed with earthing contacts which should be directly connected to an internal earthing terminal.

(*b*) Metalclad socket outlets should be provided with an earthing terminal intended for connection of an external earthing conductor, except for flush type socket outlets, this earthing terminal should be so arranged that the protective conductor of the cable, if any, is visible at least when the plug or appliance inlet is removed from the corresponding socket outlet.

(*c*) All accessible metal parts of the socket outlet should be in effective electrical contact with the earthing contact except that metal parts on, or screws in or through, non-conducting material, and separated by such material from current carrying parts in such a way that in normal use they cannot become live, need not be in effective electrical contact with the scraping earthing contact.

(9) Marking

(*a*) The socket outlet should be legibly and durably marked with the following information, which should not be placed on screws, removable washers or other easily removable parts, or upon parts intended for separate sale:

(i) rated current;
(ii) rated voltage;
(iii) nature of supply.

(*b*) If symbols are used they should be as follows:

amperes	A
volts	V
alternating current	a.c.
earth	⏚ or E
splash proof construction	
watertight construction	

(*c*) The letters R1, S2, T3 and N should be used to indicate the terminals corresponding respectively to the phase socket contacts and the neutral socket contact (N), and a symbol ⏚ for the earth contact. The letters and symbols should be as close as practicable to the corresponding terminals.

(10) Temperature rise

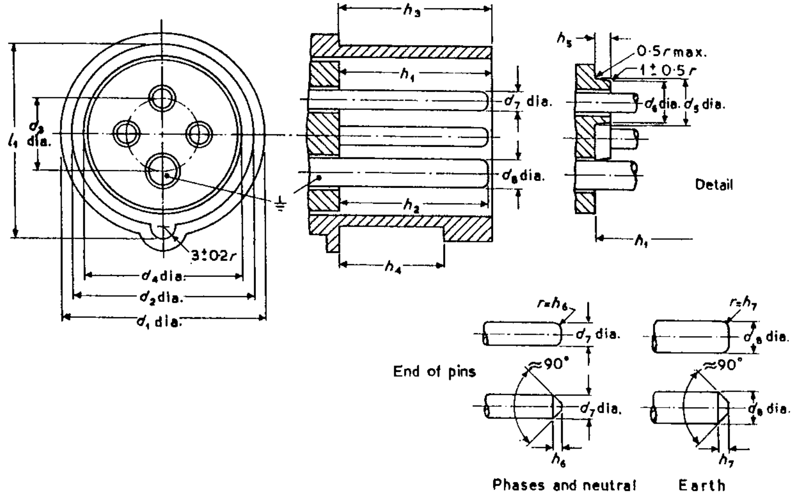
(*a*) The permitted temperature rise of the accessible external surface of the socket outlet after the test of subparagraph (*b*) should be 50°C.

(*b*) The following procedures of the test on the temperature rise of the accessible external surface of the socket outlet are acceptable:

(i) Temperature rise of socket outlets should be measured by fine wire thermocouples.
(ii) The socket outlets under test should be subjected to its rated loading connected via a plug. The duration of the test is 1 hour for socket outlets having a rated current not exceeding 32A; and 2 hours for socket outlets having a rated current exceeding 32A.

(*c*) Socket outlets and plugs should be mounted and connected as in normal use.

All dimensions are in mm.
The sketches are not intended to govern design except as regards the dimensions shown.



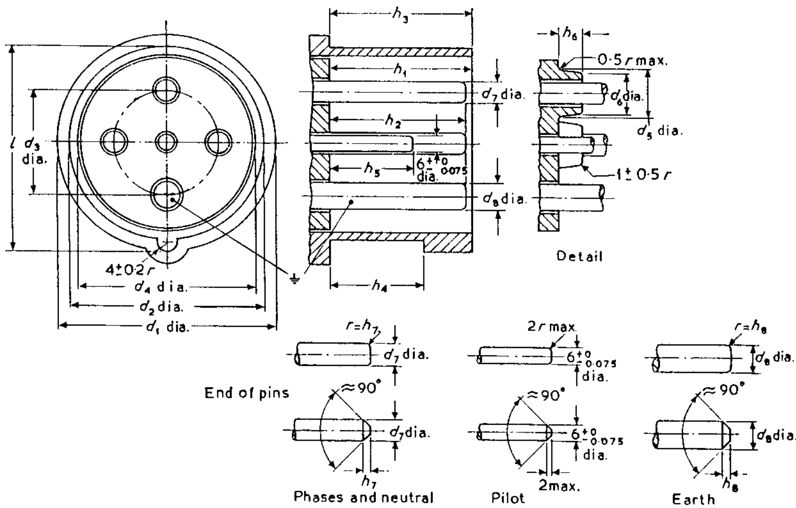
Rated current	Dimension	d_1	d_2(6)		d_3	d_4	d_5(6)	d_6(6)	d_7	d_8	h_1	h_2	h_3	h_4	h_5(3)	h_6	h_7	l_1(6)		
	Tolerance	min.		Tol.	±0·5	min.	max.	max.	+0 −0·075	+0 −0·09	+0 −1	+0 −1	+0 −1	+1 −0	max.	max.	max.	(4)	(5)	Tol.
A																				
16	2 P + ⏚	47·5	43·5	+0 −0·6	17·5	37·9	11	10	5	7	37	36	37	24·0(1) 27·5(2)	3·5	1·7	2·2	46·5	47·0	+0 −0·4
	3 P + ⏚	53·5	49·5		21·5	42·8												52·9	53·6	+0 −0·5
	3 P + N + ⏚	60·5	56·1		26·5	48·8												60·1	61·0	+0 −0·6
32	2 P + ⏚ / 3 P + ⏚	61·5	57·3	+0 −0·8	25·0	49·7	13	12	6	8	46	45	46	32·0(1) 35·5(2)	5·0	2·0	2·5	63·2	63·2	+0 −0·6
	3 P + N + ⏚	67·5	63·4		30·3	55·6												69·9	69·9	+0 −0·7

(1) Applicable only to ordinary or splash proof accessories.
(2) Applicable only to watertight accessories.
(3) Spats as shown in detail required for accessories having rated voltages exceeding 500 V, optional for other accessories.
(4) For metal enclosures.
(5) For enclosures of insulating material.
(6) These dimensions shall be within the prescribed limits over the specified length.

DIMENSIONS OF 16 AMPERE AND 32 AMPERE PLUGS WITH RETAINING DEVICES

CODE No.	FIGURE No.
A4	A4(1)

All dimensions are in mm.
The sketches are not intended to govern design except as regards the dimensions shown.

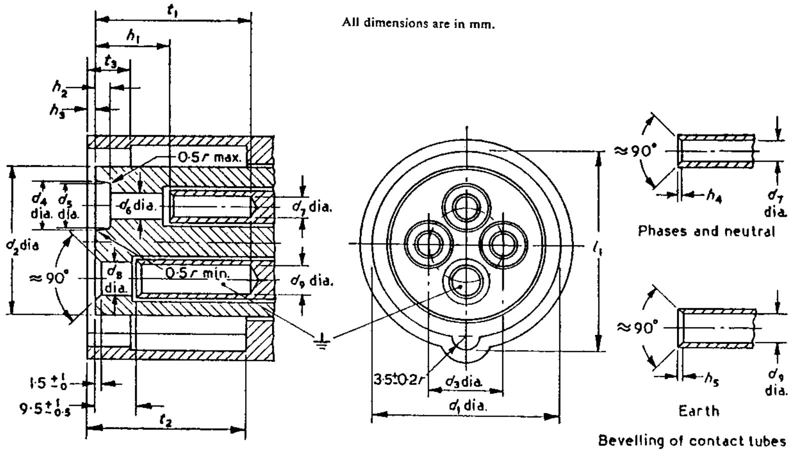


Rated current	Dimension / Tolerance	d_1	d_2	d_3	d_4	d_5(1)	d_6(1)	d_7	d_8	h_1	h_2	h_3	h_4	h_5	h_6(1)	h_7	h_8	l
		min.	$^{+0}_{-0{\cdot}8}$	$\pm 0{\cdot}5$	min.	max.	max.	$^{+0}_{-0{\cdot}09}$	$^{+0}_{-0{\cdot}11}$	$^{+0}_{-1}$	$^{+0}_{-1}$	$^{+0}_{-1}$	$^{+2}_{-0}$	$^{+0}_{-1}$	max.	max.	max.	$^{+0}_{-0{\cdot}6}$
A 63	2 P + p + ⏚ 3 P + p + ⏚	75·5	69·5	36·5	61·5	15·8	14·3	8	10	67·0	66·0	67·0	50	29·0	8	2·5	3	75·5
125	3 P + p + N + ⏚	87·5	81·5	42·5	72·5	20·2	18·2	10	12	74·5	69·5	75·5	58	31·5	10	3·0	4	87·5

(1) Spats as shown in detail required only for accessories having rated voltages exceeding 500 V, optional for other accessories.

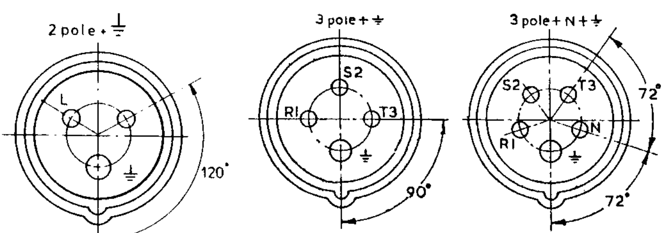
DIMENSIONS OF 63 AMPERE AND 125 AMPERE PLUGS WITH RETAINING DEVICES

CODE No.	FIGURE No.
A4	A4(2)



Rated Current	Dimension	d_1(2)		d_2(1)	d_3	d_4	d_5	d_6	d_7(4)	d_8	d_9(4)	h_1(3)	h_2	h_3	h_4	h_5	l_1(2)	t_1	t_2	t_3
	Tolerance		Tol.	+0 −1·5	±0·5	+1 −0	min.	+0·6 −0		+0·6 −0		+1 −0·5	+3 −0	+0 −1	max.	max.	+0·5 −0	min.	min.	min.
A	2 P + ⏚	44·3	+0·4 −0	36	17·5												47·5			
16	3 P + ⏚	50·4	+0·5 −0	40·8	21·5	11·6	11	6	5	8·0	7	19·5	3·8	2	0·8	1·2	54·0	37	38	10
	3 P + N + ⏚	57·3	+0·6 −0	46·4	26·5												61·3			
	2 P + ⏚																			
32	3 P + ⏚	58·6	+0·6 −0	47	25·0	13·6	13	7	6	9·1	8	21·5	5·3	3	1·0	1·5	64·6	45	48	15
	3 P + N + ⏚	64·7	+0·6 −0	52·9	30·3												71·2			

(1) The dimension d_2 shall be within the prescribed limits over the distance t_3.
(2) The dimensions d_1 and l_1 shall be within the prescribed limits over the distance t_3. Beyond this, they may be larger but not smaller.
(3) For type 3 P + N + ⏚ the dimension h_1 is 16·0 mm for the neutral.
(4) The contact tubes should be suitable for pins of the specified diameters.

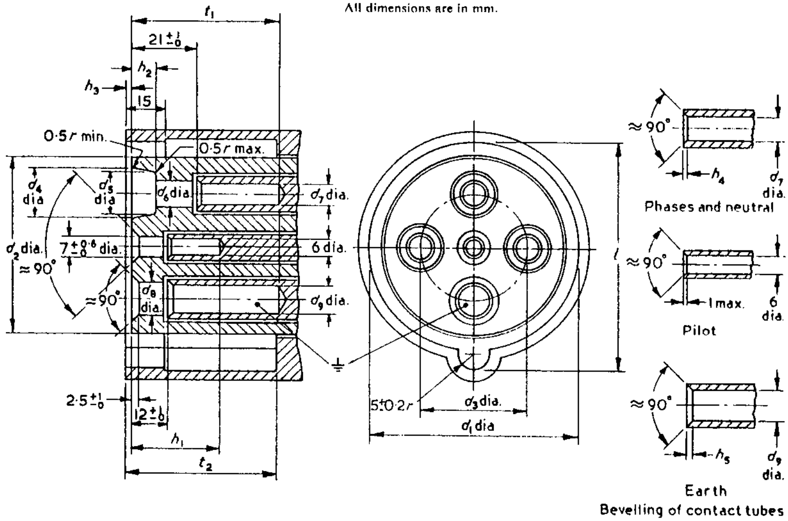


Arrangement of contact tubes and marking of terminals.
Front view of contact tubes of socket-outlet or connector

CONFIGURATION OF SOCKET CONTACTS AND DIMENSIONS OF
16 AMPERE AND 32 AMPERE SOCKET OUTLET WITH RETAINING DEVICES

CODE No.	FIGURE No.	
A4	A4(3)	

All dimensions are in mm.

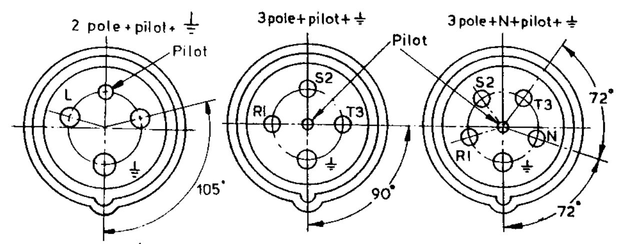


Rated current	Dimension	d_1(3)	d_2(1)	d_3	d_4	d_5	d_6	d_7	d_8	d_9	h_1	h_2	h_3	h_4	h_5	l(2)	t_1	t_2
	Tolerance	$^{+0.8}_{-0}$	$^{+0}_{-1.5}$	±0·5	$^{+1}_{-0}$	min.	$^{+0.6}_{-0}$		$^{+0.6}_{-0}$		min.	$^{+3}_{-0}$	$^{+0}_{-1}$	max.	max.	$^{+0.6}_{-0}$	min.	min.
A 63	2 P + p + ⏚ 3 P + p + ⏚	71	60	36·5	16·6	15·1	9·0	8	11·5	10	30	8	2·5	1·5	2·0	77·5	67	69
125	3P + p + N + ⏚	83	71	42·5	21·0	19·0	11·5	10	14·0	12	32	10	4·0	2·0	2·5	89·5	71	76

(1) The dimension d_2 shall be within the prescribed limits over the distance t_1.

(2) The dimensions d_1 and l shall be within the prescribed limits over a distance of 15 mm. Beyond this, they may be larger but not smaller.

(3) The contact tubes shall be suitable for pins of the specified diameters.



Arrangement of contact tubes and marking of terminals.

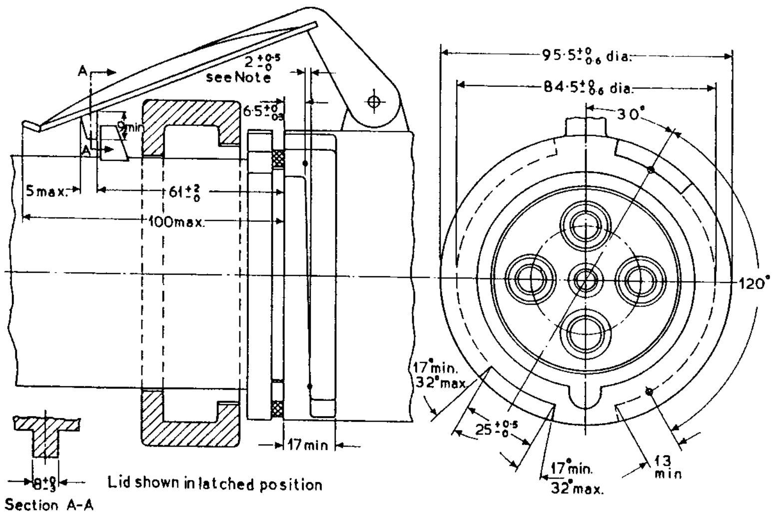
Front view of contact tubes of socket-outlet or connectors.

CONFIGURATION OF SOCKET CONTACTS AND DIMENSIONS OF

63 AMPERE AND 125 AMPERE SOCKET OUTLETS WITH RETAINING DEVICES

CODE No.	FIGURE No.	
A4	A4(4)	

All dimensions are in mm

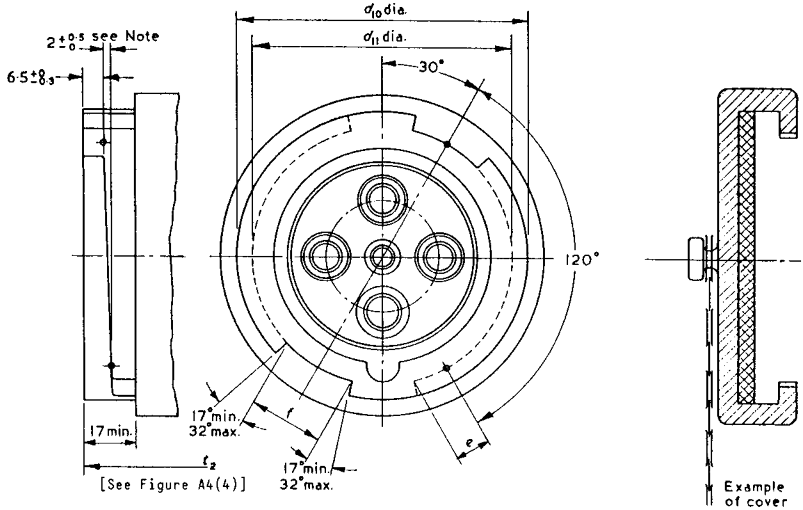


Note : The inclination of the ramp shall be such that this dimension refers to the angle of 120° shown.

CONSTRUCTION OF 63 AMPERE SPLASH PROOF SOCKET OUTLET WITH RETAINING DEVICE

CODE No.	FIGURE No.	
A4	A4(5)	

All dimensions are in mm

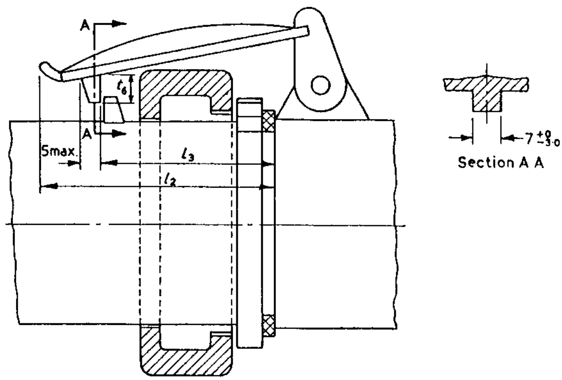


Rated current	Dimension	d_{10}	d_{11}	e	f
	Tolerance	+0 −0·6	+0 −0·6	min.	+0·5 −0
A 63	2 P + p + ⏚	95·5	84·5	13	25
125	3 P + p + ⏚ 3 P + p + N + ⏚	108·5	97·5	16	30

Note : The inclination of the ramps shall be such that this dimension refers to the angle of 120° shown.

CONSTRUCTION OF 63 AMPERE AND 125 AMPERE WATERTIGHT SOCKET OUTLETS WITH RETAINING DEVICES

CODE No.	FIGURE No.	
A4	A4(6)	



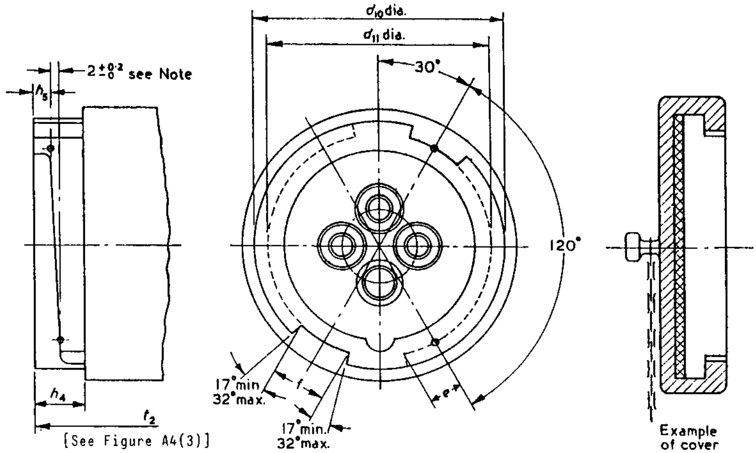
Rated current	Dimension / Tolerance	l_2 max.	l_3	l_3 Tol.	t_6 min.
A					
16	2 P + ⏚	70	41·5	+1·5 −0	5
	3 P + ⏚	75	47·5		5
	3 P + *N* + ⏚	85	53·5		6
32	2 P + ⏚	85	54·5	+1·5 −0	6
	3 P + ⏚				
	3 P + *N* + ⏚	100	60·5	+2 −0	7

All dimensions are in mm

LEVEL OR LID FOR 16 AMPERE AND 32 AMPERE SOCKET OUTLETS WITH RETAINING DEVICES

CODE No.	FIGURE No.
A4	A4(7)

All dimensions are in mm



Rated current	Dimension	d_{10}	d_{11}	e	f	h_4	h_5
	Tolerance	$^{+0}_{-0.5}$	$^{+0}_{-0.5}$	min.	$^{+0.5}_{-0}$	min.	$^{+0}_{-0.2}$
A							
16	2 P + ⏚	60	53	8	13	12	4·2
	3 P + ⏚	68	60	10	17		
	3 P + N + ⏚	76	68	12	20		
32	2 P + ⏚	82	72	12	20	14	6·2
	3 P + ⏚						
	3 P + N + ⏚	89	79	15	23		

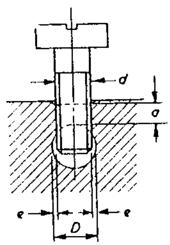
Note: The inclination of the ramps shall be such that this dimension refers to the angle of 120° shown.

TWO-RAMP SYSTEM FOR 16 AMPERE AND 32 AMPERE

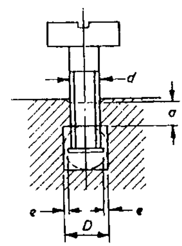
SOCKET OUTLETS WITH RETAINING DEVICES

CODE No.	FIGURE No.	
A4	A4(8)	

All dimensions are in mm.



Terminal without pressure plate



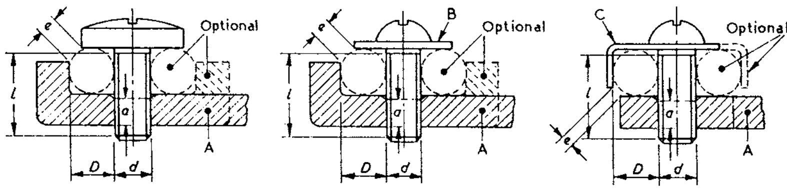
Terminal with pressure plate

Terminal size	Minimum diameter of conductor space	Minimum nominal thread diameter *d*		Maximum gap between conductor restraining parts	Minimum length of thread in terminal *a*		Minimum distance between clamping screw and end of conductor when fully inserted	
	D	One screw	Two screws	*e*	One screw	Two screws	One screw	Two screws
2	3·0	3·0[1]	2·5	0·5	2·0	1·8	1·5	1·5
3	3·6	3·5	2·5[1]	0·5	2·5	1·8	1·8	1·5
4	4·0	3·5	3·0[1]	0·6	2·5	2·0	1·8	1·5
5	4·5	4·0	3·0[1]	1·0	3·0	2·0	2·0	1·5
6	5·5	5·0	4·0	1·3	4·0	3·0	2·5	2·0
7	7·0	6·0	4·0	1·5	4·0	3·0	3·0	2·0
8	8·0	—	6·0	—	—	4·5	—	3·0
9	12	—	10	—	—	7·5	—	—
10	16	—	—	—	—	—	—	—

DIMENSIONS OF PILLAR TERMINALS FOR SOCKET OUTLET WITH RETAINING DEVICE

CODE No.	FIGURE No.	
A4	A4(9)	

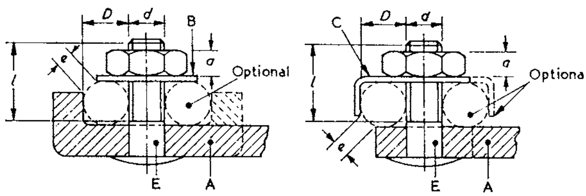
All dimensions are in mm.



Screw not requiring washer or clamping plate

Screw requiring washer or clamping plate

Screw terminals



Stud terminals

A Fixed part.
B Washer or clamping plate.

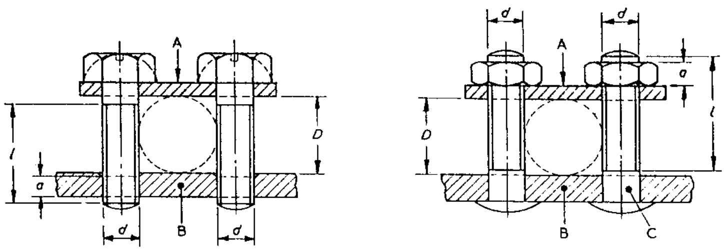
C Anti-spread device.
E Stud.

Terminal size	Minimum diameter of conductor space	Minimum nominal thread diameter		Maximum gap between conductor restraining parts	Minimum length of thread in fixed part or nut		Minimum length of thread on screw or stud
	D	One screw	Two screws	e	One screw	Two screws	l
		d			a		
2	2·0	3·5	—	1·5	1·5	—	4·0
3	2·7	4·0	3·0[1]	1·5	2·5	1·5	5·5
4	3·6	5·0	4·0	1·5	3·0	2·5	6·5
5	4·3	5·0	4·0	2·0	3·0	2·5	7·5
6	5·5	5·0	4·0	2·0	3·5	2·5	9·0
7	7·0	6·0	5·0	2·0	3·5	3·0	10·5
8	8·0	6·0	5·0	2·0	4·0	3·0	12·0
9	—	8·0	—	—	5·5	—	14·0
10	—	10·0	—	—	7·0	—	16·0

DIMENSIONS OF SCREW TERMINALS AND STUD TERMINALS FOR SOCKET OUTLET WITH RETAINING DEVICE

CODE No.	FIGURE No.	
A4	A4(10)	

All dimensions are in mm.



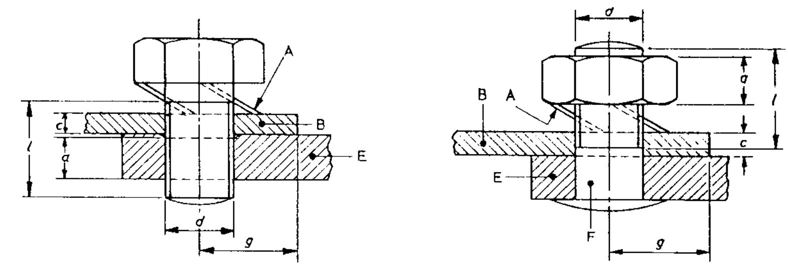
A Saddle.
B Fixed part.
C Stud.

Terminal size	Minimum diameter of conductor space D	Minimum nominal thread d	Minimum length of thread in fixed part or nut a	Minimum length of thread on screws or studs l
3	3·0	3·0[1]	1·5	5·0
4	4·0	3·5	1·5	6·0
5	4·5	4·0	2·5	7·0
6	5·5	4·0	2·5	8·0
7	7·0	5·0	3·0	10·0

DIMENSIONS OF SADDLE TERMINALS FOR SOCKET OUTLET WITH RETAINING DEVICE

CODE No.	FIGURE No.	
A4	A4(11)	

All dimensions are in mm.



A Locking means.
B Cable lug or bar.

E Fixed part.
F Stud.

Terminal size	Minimum nominal thread diameter *d*	Minimum length of thread on fixed part or nut *a*	Minimum length of thread on screw or stud *l*	Maximum thickness of lug or bar to be accommodated *c*	Minimum distance from centre of screw or hole to side of rectangular clamping area *g*
6	5·0	3·0	10	6·0	10
7	6·0	3·5	12	8·0	12

DIMENSIONS OF LUG TERMINALS FOR SOCKET OUTLET WITH RETAINING DEVICE

CODE No.	FIGURE No.	
A4	A4(12)	

Appendix 5

Correction Factors for Sizing of Cable Conductors

(1) Correction factors for ambient temperature

Table A5(1)

Correction factors for ambient temperature

Note: This table applies where the associated overcurrent protective device is intended to provide short circuit protection only. Except where the device is a semi-enclosed fuse to BS3036 the table also applies where the device is intended to provide overload protection.

Type of insulation	Operating temperature	Ambient Temperature °C														
		25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
Rubber (flexible cables only)	60°C	1.04	1.0	0.91	0.82	0.71	0.58	0.41	—	—	—	—	—	—	—	—
General purpose PVC	70°C	1.03	1.0	0.94	0.87	0.79	0.71	0.61	0.50	0.35	—	—	—	—	—	—
Paper	80°C	1.02	1.0	0.95	0.89	0.84	0.77	0.71	0.63	0.55	0.45	0.32	—	—	—	—
Rubber	85°C	1.02	1.0	0.95	0.90	0.85	0.80	0.74	0.67	0.60	0.52	0.43	0.30	—	—	—
Heat resisting PVC*	85°C/90°C	1.03	1.0	0.97	0.94	0.91	0.87	0.84	0.79/ 0.80	0.71/ 0.76	0.61/ 0.71	0.50/ 0.61	0.35/ 0.50	0.35	—	—
Thermosetting (XLPE)	90°C	1.02	1.0	0.96	0.91	0.87	0.82	0.76	0.71	0.65	0.58	0.50	0.41	0.29	—	—
Mineral:	70°C sheath	1.03	1.0	0.93	0.85	0.77	0.67	0.57	0.45	0.31	—	—	—	—	—	—
	105°C sheath	1.02	1.0	0.96	0.92	0.88	0.84	0.80	0.75	0.70	0.65	0.60	0.54	0.47	0.40	0.32

Note: Correction factors for flexible cords and for 85°C or 150°C rubber insulated flexible cables are given in the relevant table of current carrying capacity in BS 7671.

* These factors are applicable only to ratings in columns 2 to 5 of Table A6(1).

Table A5(2)

Correction factors for ambient temperature where the overload protective device is a semi-enclosed fuse to BS3036

Type of insulation	Operating temperature	Ambient Temperature °C														
		25	30	35	40	45	50	55	60	65	70	75	80	85	90	95
Rubber (flexible cables only)	60°C	1.04	1.0	0.96	0.91	0.87	0.79	0.56	—	—	—	—	—	—	—	—
General purpose PVC	70°C	1.03	1.0	0.97	0.94	0.91	0.87	0.84	0.69	0.48	—	—	—	—	—	—
Paper	80°C	1.02	1.0	0.97	0.95	0.92	0.90	0.87	0.84	0.76	0.62	0.43	—	—	—	—
Rubber	85°C	1.02	1.0	0.97	0.95	0.93	0.91	0.88	0.86	0.83	0.71	0.58	0.41	—	—	—
Heat resisting PVC*	85°C/90°C	1.03	1.0	0.97	0.94	0.91	0.87	0.84	0.80	0.76	0.72	0.68	0.49/ 0.63	0.49	—	—
Thermosetting (XLPE)	90°C	1.02	1.0	0.98	0.95	0.93	0.91	0.89	0.87	0.85	0.79	0.69	0.56	0.39	—	—
Mineral: Bare and exposed to touch or PVC covered	70°C sheath	1.03	1.0	0.96	0.93	0.89	0.86	0.79	0.62	0.42	—	—	—	—	—	—
Bare and not exposed to touch	105°C sheath	1.02	1.0	0.98	0.96	0.93	0.91	0.89	0.86	0.84	0.82	0.79	0.77	0.64	0.55	0.43

Note: Correction factors for flexible cords and for 85°C or 150°C rubber insulated flexible cables are given in the relevant table of current carrying capacity in BS 7671.

* These factors are applicable only to ratings in columns 2 to 5 of Table A6(1).

(2) Correction factors for groups of cables

Table A5(3)

Correction factors for groups of more than one circuit of single-core cables, or more than one multicore cable

Reference Method of Installation (See Appendix 7)		Correction Factor													
		Number of Circuits or Multicore Cables													
		2	3	4	5	6	7	8	9	10	12	14	16	18	20
Enclosed (Method 3 or 4) or bunched and clipped direct to a non-metallic surface (Method 1)		0.80	0.70	0.65	0.60	0.57	0.54	0.52	0.50	0.48	0.45	0.43	0.41	0.39	0.38
Single layer clipped to a non-metallic surface (Method 1)	Touching	0.85	0.79	0.75	0.73	0.72	0.72	0.71	0.70	—	—	—	—	—	—
	Spaced*	0.94	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Single layer multicore on a perforated metal cable tray, vertical or horizontal (Method 11)	Touching	0.86	0.81	0.77	0.75	0.74	0.73	0.73	0.72	0.71	0.70	—	—	—	—
	Spaced* #	0.91	0.89	0.88	0.87	0.87	—	—	—	—	—	—	—	—	—
Single layer single-core on a perforated metal cable tray, touching (Method 11)	Horizontal	0.90	0.85	—	—	—	—	—	—	—	—	—	—	—	—
	Vertical	0.85	—	—	—	—	—	—	—	—	—	—	—	—	—
Single layer multicore touching on ladder supports (Method 13)		0.86	0.82	0.80	0.79	0.78	0.78	0.78	0.77	—	—	—	—	—	—

* 'Spaced' means a clearance between adjacent surfaces of at least one cable diameter (De). Where the horizontal clearances between adjacent cables exceeds 2De, no correction factor need be applied.

\# Not applicable to Mineral Insulated Cables. Please refer to Table 4B2 of BS 7671 for the required correction factors.

Notes to Tables A5(3)

1. The factors in the table are applicable to groups of cables of one size only. The value of current derived from application of the appropriate factors is the maximum continuous current to be carried by any of the cables in the group.
2. If, due to known operating conditions, a cable is expected to carry not more than 30% of its grouped rating, it may be ignored for the purpose of obtaining the rating factor for the rest of the group.
3. When cables having different conductor operating temperatures are grouped together, the current rating should be based upon the lowest operating temperature of any cable in the group.

(3) Correction factors for cables enclosed in thermal insulating material

For a cable installed in a thermally insulated wall or above a thermally insulated ceiling, the cable being in contact with a thermally conductive surface on one side, current carrying capacities are tabulated in Appendix 6, Method 4 of Appendix 7 being the appropriate Reference Method.

For a single cable likely to be totally surrounded by thermally insulating material over a length of more than 0.5m, the current carrying capacity shall be taken, in the absence of more precise information, as 0.5 times the current carrying capacity for that cable clipped direct to a surface and open (Reference Method 1 of Appendix 7).

Where a cable is to be totally surrounded by thermal insulation for less than 0.5 m the current carrying capacity of the cable shall be reduced appropriately depending on the size of cable, length in insulation and thermal properties of the insulation. The derating factors in Table A5(4) are appropriate to conductor size up to 10 mm^2 in thermal insulation having a thermal conductivity greater than 0.0625 W/K.m.

Table A5(4)

Cable surrounded by thermal insulation

length in insulation mm	derating factor
50	0.89
100	0.81
200	0.68
400	0.55

(4) Correction factors for the type of protective devices protecting the cable

Table A5(5)

Correction Factors for Type of Protective Devices

Type of Protective Device	Correction Factor
Semi-enclosed fuse to BS 3036	0.725
Others	1.0

5. Correction factors for cables installed in enclosed trenches

Table A5(6)

*Correction factors for cable installed in enclosed trenches (Installation Methods 18, 19 and 20 of Appendix 7)**

The correction factors tabulated below relate to the disposition of cables illustrated in items 18 to 20 of Appendix 7 and are applicable to the current carrying capacities for installation methods 12 or 13 of Appendix 7 as given in the tables of Appendix 6:

Correction Factors

	Installation Method 18				Installation Method 19			Installation Method 20		
Conductor cross-sectional area	2 single-core cables, or 1 three- or four-core cable	3 single-core cables, or 2 two-core cables	4 single-core cables, or 2 three- or four-core cables	6 single-core cables, 4 two-core cables, or 3 three- or four-core cables	6 single-core cables, 4 two-core cables, or 3 three- or four-core cables	8 single-core cables, or 4 three- or four-core cables	12 single-core cables, 8 two-core cables, or 6 three- or four-core cables	12 single-core cables, 8 two-core cables, or 6 three- or four-core cables	18 single-core cables, 12 two-core cables, or 9 three- or four-core cables	24 single-core cables, 16 two-core cables, or 12 three- or four-core cables
mm^2										
4	0.93	0.90	0.87	0.82	0.86	0.83	0.76	0.81	0.74	0.69
6	0.92	0.89	0.86	0.81	0.86	0.82	0.75	0.80	0.73	0.68
10	0.91	0.88	0.85	0.80	0.85	0.80	0.74	0.78	0.72	0.66
16	0.91	0.87	0.84	0.78	0.83	0.78	0.71	0.76	0.70	0.64
25	0.90	0.86	0.82	0.76	0.81	0.76	0.69	0.74	0.67	0.62
35	0.89	0.85	0.81	0.75	0.80	0.74	0.68	0.72	0.66	0.60
50	0.88	0.84	0.79	0.74	0.78	0.73	0.66	0.71	0.64	0.59
70	0.87	0.82	0.78	0.72	0.77	0.72	0.64	0.70	0.62	0.57
95	0.86	0.81	0.76	0.70	0.75	0.70	0.63	0.68	0.60	0.55
120	0.85	0.80	0.75	0.69	0.73	0.68	0.61	0.66	0.58	0.53
150	0.84	0.78	0.74	0.67	0.72	0.67	0.59	0.64	0.57	0.51
185	0.83	0.77	0.73	0.65	0.70	0.65	0.58	0.63	0.55	0.49
240	0.82	0.76	0.71	0.63	0.69	0.63	0.56	0.61	0.53	0.48
300	0.81	0.74	0.69	0.62	0.68	0.62	0.54	0.59	0.52	0.46
400	0.80	0.73	0.67	0.59	0.66	0.60	0.52	0.57	0.50	0.44
500	0.78	0.72	0.66	0.58	0.64	0.58	0.51	0.56	0.48	0.43
630	0.77	0.71	0.65	0.56	0.63	0.57	0.49	0.54	0.47	0.41

* When cables having different conductor operating temperatures are grouped together the current rating should be based on the lowest operating temperature of any cable in the group.

Appendix 6

Current Carrying Capacities and Voltage Drop Tables for PVC Insulated and XLPE Insulated Cables

(*Note:* For cable types other than PVC insulated or XLPE insulated cables, tables of current carrying capacities and voltage drop can be obtained in BS 7671.)

1. Tables of current carrying capacities

(*a*) The tabulated current carrying capacities relate to continuous loading of cables in single circuit with the installation methods shown in Appendix 7. The values correspond to the conductor operating temperatures indicated in the headings of the tables and for a.c. operation apply only to frequencies in the range 49 to 61 Hz.

(*b*) The values of current tabulated represent current carrying capacities where no correction factor is applied. Under individual installation conditions, appropriate correction factors (see Appendix 5) for ambient temperature, grouping and thermal insulation etc. should be applied as multipliers to the tabulated values.

2. Tables of voltage drop

(*a*) In the Tables, values of voltage drop are given for a current of one ampere for a metre run and represent the result of the voltage drops in all the circuit conductors. The values of voltage drop assume that the conductors are at their maximum permitted normal operating temperatures. For a.c. operation, the tabulated values apply only to frequencies in the range 49 to 61 Hz and for armoured cables, the values apply where the armour is bonded.

(*b*) For cables having conductors cross-sectional area of 16 mm^2 or less, inductance can be ignored and only the resistive component (mV/A/m), values are tabulated. For cables having conductors cross-sectional area greater than 16 mm^2, the impedance values are given as $(mV/A/m)_z$, together with the resistive component $(mV/A/m)_r$ and the reactive component $(mV/A/m)_x$.

TABLE A6(1)

Single-core PVC insulated cables, non-armoured, with or without sheath

(COPPER CONDUCTORS)

BS 6004
BS 6231
BS 6346

CURRENT CARRYING CAPACITY (Amperes):

Ambient temperature: 30°C
Conductor operating temperature: 70°C

Conductor cross-sectional area	Reference Method 4 (enclosed in conduit in thermally insulating wall etc.)		Reference Method 3 (enclosed in conduit on a wall or in trunking etc.)		Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray horizontal or vertical)		Reference Method 12 (free air) Horizontal flat spaced	Reference Method 12 (free air) Vertical flat spaced	Reference Method 12 (free air) Trefoil
	2 cables, single-phase a.c. or d.c.	3 or 4 cables three-phase a.c.	2 cables, single-phase a.c. or d.c.	3 or 4 cables three-phase a.c.	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables three-phase a.c. flat and touching or trefoil	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables three-phase a.c. flat and touching or trefoil	2 cables, single-phase a.c. or d.c. or 3 cables three-phase a.c.	2 cables, single-phase a.c. or d.c. or 3 cables three-phase a.c.	3 cables trefoil three phase a.c.
1	2	3	4	5	6	7	8	9	10	11	12
mm²	A	A	A	A	A	A	A	A	A	A	A
1	11	10.5	13.5	12	15.5	14	—	—	—	—	—
1.5	14.5	13.5	17.5	15.5	20	18	—	—	—	—	—
2.5	19.5	18	24	21	27	25	—	—	—	—	—
4	26	24	32	28	37	33	—	—	—	—	—
6	34	31	41	36	47	43	—	—	—	—	—
10	46	42	57	50	65	59	—	—	—	—	—
16	61	56	76	68	87	79	—	—	—	—	—
25	80	73	101	89	114	104	126	112	146	130	110
35	99	89	125	110	141	129	156	141	181	162	137
50	119	108	151	134	182	167	191	172	219	197	167
70	151	136	192	171	234	214	246	223	281	254	216
95	182	164	232	207	284	261	300	273	341	311	264
120	210	188	269	239	330	303	349	318	396	362	308
150	240	216	300	262	381	349	404	369	456	419	356
185	273	245	341	296	436	400	463	424	521	480	409
240	320	286	400	346	515	472	549	504	615	569	485
300	367	328	458	394	594	545	635	584	709	659	561
400	—	—	546	467	694	634	732	679	852	795	656
500	—	—	626	533	792	723	835	778	982	920	749
630	—	—	720	611	904	826	953	892	1 138	1 070	855
800	—	—	—	—	1 030	943	1 086	1 020	1 265	1 188	971
1000	—	—	—	—	1 154	1 058	1 216	1 149	1 420	1 337	1 079

NOTE: 1. Where the conductor is to be protected by a semi-enclosed fuse to BS 3036, see appendix 5(4).
2. The current carrying capacities in columns 2 to 5 are also applicable to flexible cables to BS 6004 Table 1(*c*) and to 85°C/90°C heat resisting PVC cables to BS 6231 tables 8 and 9 where the cables are used in fixed installations.

TABLE A6(1) *(Cont.)*

VOLTAGE DROP (per ampere per metre): Conductor operating temperature: 70°C

Conductor cross-sectional area	2 cables d.c.	2 cables—single-phase a.c.									3 or 4 cables—three-phase a.c.											
		Reference Methods 3 & 4 (Enclosed in conduit etc. in or on a wall)			Reference Methods 1 & 11 (Clipped direct or on trays, touching)			Reference Method 12 (Spaced*)			Reference Methods 3 & 4 (Enclosed in conduit etc. in or on a wall)			Reference Methods 1, 11 & 12 (In trefoil)			Reference Methods 1 & 11 (Flat and touching)			Reference Method 12 (Flat spaced*)		
1	2	3			4			5			6			7			8			9		
mm²	mV		mV			mV			mV			mV			mV			mV			mV	
1	44		44			44			44			38			38			38			38	
1.5	29		29			29			29			25			25			25			25	
2.5	18		18			18			18			15			15			15			15	
4	11		11			11			11			9.5			9.5			9.5			9.5	
6	7.3		7.3			7.3			7.3			6.4			6.4			6.4			6.4	
10	4.4		4.4			4.4			4.4			3.8			3.8			3.8			3.8	
16	2.8		2.8			2.8			2.8			2.4			2.4			2.4			2.4	
		r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z
25	1.75	1.80	0.33	1.80	1.75	0.20	1.75	1.75	0.29	1.80	1.50	0.29	1.55	1.50	0.175	1.50	1.50	0.25	1.55	1.50	0.32	1.55
35	1.25	1.30	0.31	1.30	1.25	0.195	1.25	1.25	0.28	1.30	1.10	0.27	1.10	1.10	0.170	1.10	1.10	0.24	1.10	1.10	0.32	1.15
50	0.93	0.95	0.30	1.00	0.93	0.190	0.95	0.93	0.28	0.97	0.81	0.26	0.85	0.80	0.165	0.82	0.80	0.24	0.84	0.80	0.32	0.86
70	0.63	0.65	0.29	0.72	0.63	0.185	0.66	0.63	0.27	0.69	0.56	0.25	0.61	0.55	0.160	0.57	0.55	0.24	0.60	0.55	0.31	0.63
95	0.46	0.49	0.28	0.56	0.47	0.180	0.50	0.47	0.27	0.54	0.42	0.24	0.48	0.41	0.155	0.43	0.41	0.23	0.47	0.40	0.31	0.51
120	0.36	0.39	0.27	0.47	0.37	0.175	0.41	0.37	0.26	0.45	0.33	0.23	0.41	0.32	0.150	0.36	0.32	0.23	0.40	0.32	0.30	0.44
150	0.29	0.31	0.27	0.41	0.30	0.175	0.34	0.29	0.26	0.39	0.27	0.23	0.36	0.26	0.150	0.30	0.26	0.23	0.34	0.26	0.30	0.40
185	0.23	0.25	0.27	0.37	0.24	0.170	0.29	0.24	0.26	0.35	0.22	0.23	0.32	0.21	0.145	0.26	0.21	0.22	0.31	0.21	0.30	0.36
240	0.180	0.195	0.26	0.33	0.185	0.165	0.25	0.185	0.25	0.31	0.17	0.23	0.29	0.160	0.145	0.22	0.160	0.22	0.27	0.160	0.29	0.34
300	0.145	0.160	0.26	0.31	0.150	0.165	0.22	0.150	0.25	0.29	0.14	0.23	0.27	0.130	0.140	0.190	0.130	0.22	0.25	0.130	0.29	0.32
400	0.105	0.130	0.26	0.29	0.120	0.160	0.20	0.115	0.25	0.27	0.12	0.22	0.25	0.105	0.140	0.175	0.105	0.21	0.24	0.100	0.29	0.31
500	0.086	0.110	0.26	0.28	0.098	0.155	0.185	0.093	0.24	0.26	0.10	0.22	0.25	0.086	0.135	0.160	0.086	0.21	0.23	0.081	0.29	0.30
630	0.068	0.094	0.25	0.27	0.081	0.155	0.175	0.076	0.24	0.25	0.08	0.22	0.24	0.072	0.135	0.150	0.072	0.21	0.22	0.066	0.28	0.29
800	0.053		—		0.068	0.150	0.165	0.061	0.24	0.25		—		0.060	0.130	0.145	0.060	0.21	0.22	0.053	0.28	0.29
1 000	0.042		—		0.059	0.150	0.160	0.050	0.24	0.24		—		0.052	0.130	0.140	0.052	0.20	0.21	0.044	0.28	0.28

NOTE: *Spacings larger than those specified in Method 12 (See Appendix 7) will result in larger voltage drop.

TABLE A6(2)

Multicore PVC insulated cables, non-armoured
(COPPER CONDUCTORS)

BS 6004
BS 6346
BS 7629

CURRENT CARRYING CAPACITY (Amperes):

Ambient temperature: 30°C
Conductor operating temperature: 70°C

Conductor cross-sectional area	Reference Method 4 (enclosed in an insulated wall, etc.)		Reference Method 3 (enclosed in conduit on a wall or ceiling, or in trunking)		Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray), or Reference method 13 (free air)	
	1 two-core cable*, single-phase a.c. or d.c.	1 three-core cable*, or 1 four-core cable, three-phase a.c.	1 two-core cable*, single-phase a.c. or d.c.	1 three-core cable*, or 1 four-core cable, three-phase a.c.	1 two-core cable*, single-phase a.c. or d.c.	1 three-core cable*, or 1 four-core cable, three-phase a.c.	1 two-core cable*, single-phase a.c. or d.c.	1 three-core cable*, or 1 four-core cable, three-phase a.c.
1	2	3	4	5	6	7	8	9
mm^2	A	A	A	A	A	A	A	A
1	11	10	13	11.5	15	13.5	17	14.5
1.5	14	13	16.5	15	19.5	17.5	22	18.5
2.5	18.5	17.5	23	20	27	24	30	25
4	25	23	30	27	36	32	40	34
6	32	29	38	34	46	41	51	43
10	43	39	52	46	63	57	70	60
16	57	52	69	62	85	76	94	80
25	75	68	90	80	112	96	119	101
35	92	83	111	99	138	119	148	126
50	110	99	133	118	168	144	180	153
70	139	125	168	149	213	184	232	196
95	167	150	201	179	258	223	282	238
120	192	172	232	206	299	259	328	276
150	219	196	258	225	344	299	379	319
185	248	223	294	255	392	341	434	364
240	291	261	344	297	461	403	514	430
300	334	298	394	339	530	464	593	497
400	—	—	470	402	634	557	715	597

NOTE:
1. Where the conductor is to be protected by a semi-enclosed fuse to BS 3036, see Appendix 5(4).
*2. With or without protective conductor.
3. Circular conductors are assumed for sizes up to and including 16 mm^2. Values for larger sizes relate to shaped conductors and may safely be applied to circular conductors.
4. Cables to BS 7629 are rated for a conductor operating temperature of 70°C and are therefore included in this table, although the material used for the cable insulation is not PVC.

TABLE A6(2) *(Cont.)*

VOLTAGE DROP (per ampere per metre): Conductor operating temperature: 70°C

Conductor cross-sectional area 1	Two-core cable d.c. 2	Two-core cable single phase a.c. 3			Three-or four-core cable three phase a.c. 4		
mm^2	mV		mV			mV	
1	44		44			38	
1.5	29		29			25	
2.5	18		18			15	
4	11		11			9.5	
6	7.3		7.3			6.4	
10	4.4		4.4			3.8	
16	2.8		2.8			2.4	
		r	x	z	r	x	z
25	1.75	1.75	0.170	1.75	1.50	0.145	1.50
35	1.25	1.25	0.165	1.25	1.10	0.145	1.10
50	0.93	0.93	0.165	0.94	0.80	0.140	0.81
70	0.63	0.63	0.160	0.65	0.55	0.140	0.57
95	0.46	0.47	0.155	0.50	0.41	0.135	0.43
120	0.36	0.38	0.155	0.41	0.33	0.135	0.35
150	0.29	0.30	0.155	0.34	0.26	0.130	0.29
185	0.23	0.25	0.150	0.29	0.21	0.130	0.25
240	0.180	0.190	0.150	0.24	0.165	0.130	0.21
300	0.145	0.155	0.145	0.21	0.135	0.130	0.185
400	0.105	0.115	0.145	0.185	0.100	0.125	0.160

TABLE A6(3)

Single-core armoured PVC insulated cables
(non-magnetic armour)
(COPPER CONDUCTORS)

BS 6346

Ambient temperature: 30°C
Conductor operating temperature: 70°C

CURRENT CARRYING CAPACITY (Amperes):

	Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray)		Reference Method 12 (free air)						
					2 cables single phase a.c.		2 cables d.c.		3 or 4 cables, three-phase a.c.		
Conductor cross-sectional area	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables, three-phase a.c. flat and touching	2 cables, single-phase a.c. flat & touching	3 or 4 cables three-phase a.c. flat & touching	Horizontal flat spaced	Vertical flat spaced	Horizontal, spaced	Vertical, spaced	Horizontal flat spaced	Vertical flat spaced	3 cables trefoil
1	2	3	4	5	6	7	8	9	10	11	12
mm²	A	A	A	A	A	A	A	A	A	A	A
50	193	179	205	189	229	217	229	216	230	212	181
70	245	225	259	238	287	272	294	279	286	263	231
95	296	269	313	285	349	332	357	340	338	313	280
120	342	309	360	327	401	383	415	396	385	357	324
150	393	352	413	373	452	431	479	458	436	405	373
185	447	399	469	422	511	489	548	525	490	456	425
240	525	465	550	492	593	568	648	622	566	528	501
300	594	515	624	547	668	640	748	719	616	578	567
400	687	575	723	618	737	707	885	851	674	632	657
500	763	622	805	673	810	777	1 035	997	721	676	731
630	843	669	891	728	893	856	1 218	1 174	771	723	809
800	919	710	976	777	943	905	1 441	1 390	824	772	886
1 000	975	737	1 041	808	1 008	967	1 685	1 627	872	816	945

NOTE: Where the conductor is to be protected by a semi-enclosed fuse to BS 3036, see Appendix 5(4).

TABLE A6(3) *(Cont.)*

VOLTAGE DROP (per ampere per metre): Conductor operating temperature: 70°C

Conductor cross-sectional area 1	2 cables d.c. 2	2 cables—single phase a.c. Reference Methods 1 & 11 (Touching) 3			2 cables—single phase a.c. Reference Method 12 (Spaced*) 4			3 or 4 cables—three phase a.c. Reference Methods 1, 11 and 12 (in trefoil touching) 5			3 or 4 cables—three phase a.c. Reference Methods 1 & 11 (Flat and touching) 6			3 or 4 cables—three phase a.c. Reference method 12 (Flat spaced*) 7		
mm^2	mV	mV			mV			mV			mV			mV		
		r	x	z	r	x	z	r	x	z	r	x	z	r	x	z
50	0.93	0.93	0.22	0.95	0.92	0.30	0.97	0.80	0.190	0.82	0.79	0.26	0.84	0.79	0.34	0.86
70	0.63	0.64	0.21	0.68	0.66	0.29	0.72	0.56	0.180	0.58	0.57	0.25	0.62	0.59	0.32	0.68
95	0.46	0.48	0.20	0.52	0.51	0.28	0.58	0.42	0.175	0.45	0.44	0.25	0.50	0.47	0.31	0.57
120	0.36	0.39	0.195	0.43	0.42	0.28	0.50	0.33	0.170	0.37	0.36	0.24	0.43	0.40	0.30	0.50
150	0.29	0.31	0.190	0.37	0.34	0.27	0.44	0.27	0.165	0.32	0.30	0.24	0.38	0.34	0.30	0.45
185	0.23	0.26	0.190	0.32	0.29	0.27	0.39	0.22	0.160	0.27	0.25	0.23	0.34	0.29	0.29	0.41
240	0.180	0.20	0.180	0.27	0.23	0.26	0.35	0.175	0.160	0.23	0.20	0.23	0.30	0.24	0.28	0.37
300	0.145	0.160	0.180	0.24	0.190	0.26	0.32	0.140	0.155	0.21	0.165	0.22	0.28	0.20	0.28	0.34
400	0.105	0.140	0.175	0.22	0.180	0.24	0.30	0.120	0.150	0.195	0.160	0.21	0.26	0.21	0.25	0.32
500	0.086	0.120	0.170	0.21	0.165	0.23	0.29	0.105	0.145	0.180	0.145	0.20	0.25	0.190	0.24	0.30
630	0.068	0.105	0.165	0.195	0.150	0.22	0.27	0.091	0.145	0.170	0.135	0.195	0.23	0.175	0.22	0.28
800	0.053	0.095	0.160	0.185	0.145	0.21	0.25	0.082	0.140	0.160	0.125	0.180	0.22	0.170	0.195	0.26
1 000	0.042	0.091	0.155	0.180	0.140	0.19	0.24	0.079	0.135	0.155	0.125	0.165	0.21	0.165	0.170	0.24

NOTE: *Spacings larger than those specified in Method 12 (See Appendix 7) will result in larger voltage drop.

TABLE A6(4)

Multicore armoured PVC insulated cables
(COPPER CONDUCTORS)

BS 6346

Ambient temperature: 30°C
Conductor operating temperature: 70°C

CURRENT CARRYING CAPACITY (Amperes):

Conductor cross-sectional area	Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated horizontal or vertical cable tray), or Reference Method 13 (free air)	
	1 two-core cable, single-phase a.c. or d.c.	1 three- or four-core cable, three-phase a.c.	1 two-core cable, single-phase a.c. or d.c.	1 three- or four-core cable, three-phase a.c.
1	2	3	4	5
mm^2	A	A	A	A
1.5	21	18	22	19
2.5	28	25	31	26
4	38	33	41	35
6	49	42	53	45
10	67	58	72	62
16	89	77	97	83
25	118	102	128	110
35	145	125	157	135
50	175	151	190	163
70	222	192	241	207
95	269	231	291	251
120	310	267	336	290
150	356	306	386	332
185	405	348	439	378
240	476	409	516	445
300	547	469	592	510
400	621	540	683	590

NOTE: Where the conductor is to be protected by a semi-enclosed fuse to BS 3036, see Appendix 5(4).

TABLE A6(4) *(Cont.)*

VOLTAGE DROP (per ampere per metre): Conductor operating temperature: 70°C

Conductor cross-sectional area	Two-core cable d.c.	Two-core cable single phase a.c.			Three- or four-core cable three phase a.c.		
1	2	3			4		
mm^2	mV	mV			mV		
1.5	29	29			25		
2.5	18	18			15		
4	11	11			9.5		
6	7.3	7.3			6.4		
10	4.4	4.4			3.8		
16	2.8	2.8			2.4		
		r	x	z	r	x	z
25	1.75	1.75	0.170	1.75	1.50	0.145	1.50
35	1.25	1.25	0.165	1.25	1.10	0.145	1.10
50	0.93	0.93	0.165	0.94	0.80	0.140	0.81
70	0.63	0.63	0.160	0.65	0.55	0.140	0.57
95	0.46	0.47	0.155	0.50	0.41	0.135	0.43
120	0.36	0.38	0.155	0.41	0.33	0.135	0.35
150	0.29	0.30	0.155	0.34	0.26	0.130	0.29
185	0.23	0.25	0.150	0.29	0.21	0.130	0.25
240	0.180	0.190	0.150	0.24	0.165	0.130	0.21
300	0.145	0.155	0.145	0.21	0.135	0.130	0.185
400	0.105	0.115	0.145	0.185	0.100	0.125	0.160

TABLE A6(5)

Single core XLPE insulated cables, non-armoured, with or without sheath (COPPER CONDUCTORS)

BS 5467 Ambient temperature: 30°C

CURRENT CARRYING CAPACITY (Amperes): BS 7211 Conductor operating temperature: 90°C

Conductor cross-sectional area	Reference Method 4 (enclosed in conduit in thermally insulating wall etc.)		Reference Method 3 (enclosed in conduit on a wall or in trunking etc.)		Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray horizontal or vertical)		Reference Method 12 (Free air)		
									Horizontal flat spaced	Vertical flat spaced	Trefoil
	2 cables, single-phase a.c. or d.c.	3 or 4 cables three-phase a.c.	2 cables, single-phase a.c. or d.c.	3 or 4 cables three-phase a.c.	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables three-phase a.c. flat and touching or trefoil	2 cables, single-phase a.c. or d.c. flat and touching	3 or 4 cables three-phase a.c. flat and touching or trefoil	2 cables, single-phase a.c. or d.c. or 3 cables three-phase	2 cables, single-phase a.c. or d.c. or 3 cables three-phase	3 cables, trefoil three-phase a.c.
1	2	3	4	5	6	7	8	9	10	11	12
mm^2	A	A	A	A	A	A	A	A	A	A	A
1	14	13	17	15	19	17.5	—	—	—	—	—
1.5	18	17	22	19	25	23	—	—	—	—	—
2.5	24	23	30	26	34	31	—	—	—	—	—
4	33	30	40	35	46	41	—	—	—	—	—
6	43	39	51	45	59	54	—	—	—	—	—
10	58	53	71	63	81	74	—	—	—	—	—
16	76	70	95	85	109	99	—	—	—	—	—
25	100	91	126	111	143	130	158	140	183	163	138
35	124	111	156	138	176	161	195	176	226	203	171
50	149	135	189	168	228	209	293	215	274	246	209
70	189	170	240	214	293	268	308	279	351	318	270
95	228	205	290	259	355	326	375	341	426	389	330
120	263	235	336	299	413	379	436	398	495	453	385
150	300	270	375	328	476	436	505	461	570	524	445
185	341	306	426	370	545	500	579	530	651	600	511
240	400	358	500	433	644	590	686	630	769	711	606
300	459	410	513	493	743	681	794	730	886	824	701
400	—	—	683	584	868	793	915	849	1065	984	820
500	—	—	783	666	990	904	1044	973	1228	1150	936
630	—	—	900	764	1130	1033	1191	1115	1423	1338	1069
800	—	—	—	—	1288	1179	1358	1275	1581	1485	1214
1000	—	—	—	—	1443	1323	1520	1436	1775	1671	1349

NOTE:
1. Where the conductor is to be protected by a semi-enclosed fuse to BS 3036, see Appendix 5(4).

*2. Where a conductor operates at a temperature exceeding 70°C it shall be ascertained that the equipment connected to the conductor is suitable for the conductor operating temperature.

3. Where cables in this table are connected to equipment or accessories designed to operate at a temperature not exceeding 70°C, the current ratings given in the equivalent table for 70°C PVC insulated cables (BS 6004, BS 6346) shall be used.
4. The current carrying capacity in columns 2 to 5 are also applicable to flexible cables to BS 7211 Table 3(*b*) where the cables are used in fixed installations.
5. For cable in rigid PVC conduit, the values stated in Table A6(1) are applicable.

TABLE A6(5) *(Cont.)*

VOLTAGE DROP (per ampere per metre): Conductor operating temperature: 90°C

Conductor cross-sectional area	2 cables d.c.	2 cables—single phase a.c.									3 or 4 cables—three-phase a.c.											
		Reference Methods 3 & 4 (Enclosed in conduit etc. in or on a wall)			Reference Methods 1 & 11 (Clipped direct or on trays, touching)			Reference Method 12 (Spaced*)			Reference Methods 3 & 4 (Enclosed in conduit etc. in or on a wall)			Reference Methods 1, 11 & 12 (In trefoil)			Reference Methods 1 & 11 (Flat touching)			Reference Method 12 (Flat spaced*)		
1	2		3			4			5			6			7			8			9	
mm^2	mV		mV			mV			mV			mV			mV			mV			mV	
1	46		46			46			46			40			40			40			40	
1.5	31		31			31			31			27			27			27			27	
2.5	19		19			19			19			16			16			16			16	
4	12		12			12			12			10			10			10			10	
6	7.9		7.9			7.9			7.9			6.8			6.8			6.8			6.8	
10	4.7		4.7			4.7			4.7			4.0			4.0			4.0			4.0	
16	2.9		2.9			2.9			2.9			2.5			2.5			2.5			2.5	
		r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z	r	x	z
25	1.85	1.85	0.31	1.90	1.85	0.190	1.85	1.85	0.28	1.85	1.60	0.27	1.65	1.60	0.165	1.60	1.60	0.190	1.60	1.60	0.27	1.65
35	1.35	1.35	0.29	1.35	1.35	0.180	1.35	1.35	0.27	1.35	1.15	0.25	1.15	1.15	0.155	1.15	1.15	0.180	1.15	1.15	0.26	1.20
50	0.99	1.00	0.29	1.05	0.99	0.180	1.00	0.99	0.27	1.00	0.87	0.25	0.90	0.86	0.155	0.87	0.86	0.180	0.87	0.86	0.26	0.89
70	0.68	0.70	0.28	0.75	0.68	0.175	0.71	0.68	0.26	0.73	0.60	0.24	0.65	0.59	0.150	0.61	0.59	0.175	0.62	0.59	0.25	0.65
95	0.49	0.51	0.27	0.58	0.49	0.170	0.52	0.49	0.26	0.56	0.44	0.23	0.50	0.43	0.145	0.45	0.43	0.170	0.46	0.43	0.25	0.49
120	0.39	0.41	0.26	0.48	0.39	0.165	0.43	0.39	0.25	0.47	0.35	0.23	0.42	0.34	0.140	0.37	0.34	0.165	0.38	0.34	0.24	0.42
150	0.32	0.33	0.26	0.43	0.32	0.165	0.36	0.32	0.25	0.41	0.29	0.23	0.37	0.28	0.140	0.31	0.28	0.165	0.32	0.28	0.24	0.37
185	0.25	0.27	0.26	0.37	0.26	0.165	0.30	0.25	0.25	0.36	0.23	0.23	0.32	0.22	0.140	0.26	0.22	0.165	0.28	0.22	0.24	0.33
240	0.190	0.21	0.26	0.33	0.20	0.160	0.25	0.195	0.25	0.31	0.185	0.22	0.29	0.170	0.140	0.22	0.170	0.165	0.24	0.170	0.24	0.29
300	0.155	0.175	0.25	0.31	0.160	0.160	0.22	0.155	0.25	0.29	0.150	0.22	0.27	0.140	0.140	0.195	0.135	0.160	0.21	0.135	0.24	0.27
400	0.120	0.140	0.25	0.29	0.130	0.155	0.20	0.125	0.24	0.27	0.125	0.22	0.25	0.110	0.135	0.175	0.110	0.160	0.195	0.110	0.24	0.26
500	0.093	0.120	0.25	0.28	0.105	0.155	0.185	0.098	0.24	0.26	0.100	0.22	0.24	0.090	0.135	0.160	0.088	0.160	0.180	0.085	0.24	0.25
630	0.072	0.100	0.25	0.27	0.086	0.155	0.175	0.078	0.24	0.25	0.088	0.21	0.23	0.074	0.135	0.150	0.071	0.160	0.170	0.068	0.23	0.24
800	0.056		—		0.072	0.150	0.170	0.064	0.24	0.25		—		0.062	0.130	0.145	0.059	0.155	0.165	0.055	0.23	0.24
1000	0.045		—		0.063	0.150	0.165	0.054	0.24	0.24		—		0.055	0.130	0.140	0.050	0.155	0.165	0.047	0.23	0.24

NOTE: *Spacings larger than those specified in Method 12 (See Appendix 7) will result in larger voltage drop.

TABLE A6(6)

Multicore XLPE insulated cables, non-armoured
(COPPER CONDUCTORS)

BS 5467 | Ambient temperature: 30°C
CURRENT CARRYING CAPACITY (Amperes): BS 7211 | Conductor operating temperature: 90°C

Conductor cross-sectional area	Reference Method 4 (enclosed in an insulated wall, etc.)		Reference Method 3 (enclosed in conduit on a wall or ceiling, or in trunking)		Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray), or Reference method 13 (free air)	
	1 two-core cable*, single-phase a.c. or d.c.	1 three-core cable*, or 1 four-core cable, three-phase a.c.	1 two-core cable*, single-phase a.c. or d.c.	1 three-core cable*, or 1 four-core cable, three-phase a.c.	1 two-core cable*, single-phase a.c. or d.c.	1 three-core cable* or 1 four-core cable, three-phase a.c.	1 two-core cable*, single-phase a.c. or d.c.	1 three-core cable*, or 1 four-core cable, three-phase a.c.
1	2	3	4	5	6	7	8	9
mm^2	A	A	A	A	A	A	A	A
1	14.5	13	17	15	19	17	21	18
1.5	18.5	16.5	22	19.5	24	22	26	23
2.5	25	22	30	26	33	30	36	32
4	33	30	40	35	45	40	49	42
6	42	38	51	44	58	52	63	54
10	57	51	69	60	80	71	86	75
16	76	68	91	80	107	96	115	100
25	99	89	119	105	138	119	149	127
35	121	109	146	128	171	147	185	158
50	145	130	175	154	209	179	225	192
70	183	164	221	194	269	229	289	246
95	220	197	265	233	328	278	352	298
120	253	227	305	268	382	322	410	346
150	290	259	334	300	441	371	473	399
185	329	295	384	340	506	424	542	456
240	386	346	459	398	599	500	641	538
300	442	396	532	455	693	576	741	621
400	—	—	625	536	803	667	865	741

NOTE:
1. Refer notes 1, 2 and 3 of table A6(5)
*2. With or without protective conductor.
3. For cables in rigid PVC conduit, the values stated in A6(2) are applicable.
4. Circular conductors are assumed for sizes up to and including $16mm^2$. Values for larger sizes related to shaped conductors and may safely be applied to circular conductors.

TABLE A6(6) *(Cont.)*

VOLTAGE DROP (per ampere per metre): Conductor operating temperature: 90°C

Conductor cross-sectional area 1	Two-core cable d.c. 2	Two-core cable single phase a.c. 3			Three-or four-core cable three phase a.c. 4		
mm^2	mV	mV			mV		
1	46	46			40		
1.5	31	31			27		
2.5	19	19			16		
4	12	12			10		
6	7.9	7.9			6.8		
10	4.7	4.7			4.0		
16	2.9	2.9			2.5		
		r	x	z	r	x	z
25	1.85	1.85	0.160	1.90	1.60	0.140	1.65
35	1.35	1.35	0.155	1.35	1.15	0.135	1.15
50	0.98	0.99	0.155	1.00	0.86	0.135	0.87
70	0.67	0.67	0.150	0.69	0.59	0.130	0.60
95	0.49	0.50	0.150	0.52	0.43	0.130	0.45
120	0.39	0.40	0.145	0.42	0.34	0.130	0.37
150	0.31	0.32	0.145	0.35	0.28	0.125	0.30
185	0.25	0.26	0.145	0.29	0.22	0.125	0.26
240	0.195	0.20	0.140	0.24	0.175	0.125	0.21
300	0.155	0.16	0.140	0.21	0.140	0.120	0.185
400	0.120	0.13	0.145	0.195	0.115	0.125	0.170

TABLE A6(7)

Single-core XLPE insulated cables
(non-magnetic armour)
(COPPER CONDUCTORS)

BS 5467
BS 6724

CURRENT CARRYING CAPACITY (Amperes):

Ambient temperature: 30°C
Conductor operating temperature: 90°C

	Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated cable tray)		Reference Method 12 (free air)						
					2 cables single phase a.c.		2 cables d.c.		3 or 4 cables, three-phase a.c.		
Conductor cross-sectional area 1	2 cables, single-phase a.c. or d.c. flat and touching 2	3 or 4 cables, three-phase a.c. flat and touching 3	2 cables, single-phase a.c. flat & touching 4	3 or 4 cables three-phase a.c. flat & touching 5	Horizontal flat spaced 6	Vertical flat spaced 7	Horizontal spaced 8	Vertical spaced 9	Horizontal flat spaced 10	Vertical flat spaced 11	3 cables trefoil 12
mm^2	A	A	A	A	A	A	A	A	A	A	A
50	237	220	253	232	282	266	284	270	288	266	222
70	303	277	322	293	357	337	356	349	358	331	285
95	367	333	389	352	436	412	446	426	425	393	346
120	425	383	449	405	504	477	519	497	485	449	402
150	488	437	516	462	566	539	600	575	549	510	463
185	557	496	587	524	643	614	688	660	618	574	529
240	656	579	689	612	749	714	815	782	715	666	625
300	755	662	792	700	842	805	943	906	810	755	720
400	853	717	899	767	929	889	1137	1094	848	797	815
500	962	791	1016	851	1032	989	1314	1266	923	871	918
630	1082	861	1146	935	1139	1092	1528	1474	992	940	1027
800	1170	904	1246	987	1204	1155	1809	1744	1042	978	1119
1000	1261	961	1345	1055	1289	1238	2100	2026	1110	1041	1214

NOTE: Refer Notes 1, 2 and 3 of table A6(5).

TABLE A6(7) *(Cont.)*

VOLTAGE DROP (per ampere per metre): Conductor operating temperature: 90°C

Conductor cross-sectional area 1	2 cables d.c. 2	2 cables—single phase a.c.						3 or 4 cables—three phase a.c.								
		Reference Methods 1 & 11 (Touching) 3			Reference Method 12 (Spaced*) 4			Reference Methods 1, 11 and 12 (in trefoil touching) 5			Reference Methods 1 & 11 (Flat and touching) 6			Reference method 12 (Flat spaced*) 7		
mm²	mV	mV			mV			mV			mV			mV		
		r	x	z	r	x	z	r	x	z	r	x	z	r	x	z
50	0.98	0.99	0.21	1.00	0.98	0.29	1.00	0.86	0.18	0.87	0.84	0.25	0.88	0.84	0.33	0.90
70	0.67	0.68	0.20	0.71	0.69	0.29	0.75	0.59	0.17	0.62	0.60	0.25	0.65	0.62	0.32	0.70
95	0.49	0.51	0.195	0.55	0.53	0.28	0.60	0.44	0.17	0.47	0.46	0.24	0.52	0.49	0.31	0.58
120	0.39	0.41	0.190	0.45	0.43	0.27	0.51	0.35	0.165	0.39	0.38	0.24	0.44	0.41	0.30	0.51
150	0.31	0.33	0.185	0.38	0.36	0.27	0.45	0.29	0.160	0.33	0.31	0.23	0.39	0.34	0.29	0.45
185	0.25	0.27	0.185	0.33	0.30	0.26	0.40	0.23	0.160	0.28	0.26	0.23	0.34	0.29	0.29	0.41
240	0.195	0.21	0.180	0.28	0.24	0.26	0.35	0.18	0.155	0.24	0.21	0.22	0.30	0.24	0.28	0.37
300	0.155	0.17	0.175	0.25	0.195	0.25	0.32	0.145	0.150	0.21	0.17	0.22	0.28	0.20	0.27	0.34
400	0.115	0.145	0.170	0.22	0.180	0.24	0.30	0.125	0.150	0.195	0.16	0.21	0.27	0.20	0.27	0.33
500	0.093	0.125	0.170	0.21	0.165	0.24	0.29	0.105	0.145	0.180	0.145	0.20	0.25	0.19	0.24	0.31
630	0.073	0.105	0.165	0.195	0.150	0.23	0.27	0.092	0.145	0.170	0.135	0.195	0.24	0.175	0.23	0.29
800	0.056	0.090	0.160	0.190	0.145	0.23	0.27	0.086	0.140	0.165	0.130	0.180	0.23	0.175	0.195	0.26
1000	0.045	0.092	0.155	0.180	0.140	0.21	0.25	0.080	0.135	0.155	0.125	0.170	0.21	0.165	0.180	0.24

NOTE: *Spacings larger than those specified in Method 12 (See Appendix 7) will result in larger voltage drop.

TABLE A6(8)

Multicore armoured XLPE insulated cables (COPPER CONDUCTORS)

BS 5467
BS 6724

CURRENT CARRYING CAPACITY (Amperes):

Ambient temperature: 30°C
Conductor operating temperature: 90°C

Conductor cross-sectional area	Reference Method 1 (clipped direct)		Reference Method 11 (on a perforated horizontal or vertical cable tray), or Reference Method 13 (free air)	
	1 two-core cable, single-phase a.c. or d.c.	1 three or four-core cable, three-phase a.c.	1 two-core cable, single-phase a.c. or d.c.	1 three- or four-core cable, three-phase a.c.
1	2	3	4	5
mm^2	A	A	A	A
1.5	27	23	29	25
2.5	36	31	39	33
4	49	42	52	44
6	62	53	66	56
10	85	73	90	78
16	110	94	115	99
25	146	124	152	131
35	180	154	188	162
50	219	187	228	197
70	279	238	291	251
95	338	289	354	304
120	392	335	410	353
150	451	386	472	406
185	515	441	539	463
240	607	520	636	546
300	698	599	732	628
400	787	673	847	728

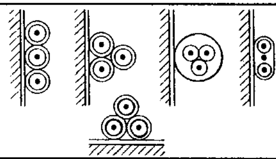
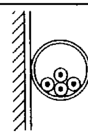
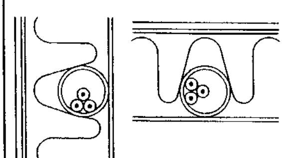
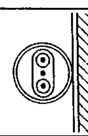
NOTE: Refer Notes 1, 2 and 3 of table A6(5).

TABLE A6(8) *(Cont.)*

VOLTAGE DROP (per ampere per metre): Conductor operating temperature: 90°C

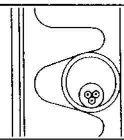
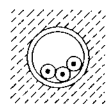
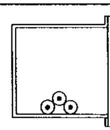
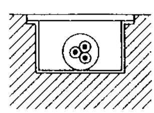
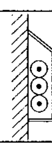
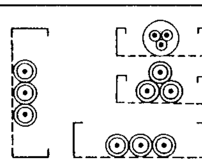
Conductor cross-sectional area 1	Two-core cable d.c. 2	Two-core cable single phase a.c. 3			Three-or four-core cable three phase a.c. 4		
mm^2	mV	mV			mV		
1.5	31	31			27		
2.5	19	19			16		
4	12	12			10		
6	7.9	7.9			6.8		
10	4.7	4.7			4.0		
16	2.9	2.9			2.5		
		r	x	z	r	x	z
25	1.85	1.85	0.160	1.90	1.60	0.140	1.65
35	1.35	1.35	0.155	1.35	1.15	0.135	1.15
50	0.98	0.99	0.155	1.00	0.86	0.135	0.87
70	0.67	0.67	0.150	0.69	0.59	0.130	0.60
95	0.49	0.50	0.150	0.52	0.43	0.130	0.45
120	0.39	0.40	0.145	0.42	0.34	0.130	0.37
150	0.31	0.32	0.145	0.35	0.28	0.125	0.30
185	0.25	0.26	0.145	0.29	0.22	0.125	0.26
240	0.195	0.20	0.140	0.24	0.175	0.125	0.21
300	0.155	0.16	0.140	0.21	0.140	0.120	0.185
400	0.120	0.13	0.140	0.19	0.115	0.120	0.165

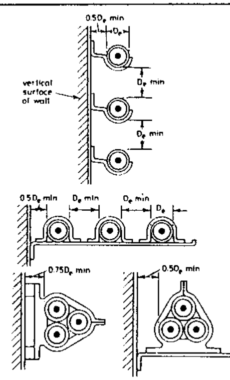
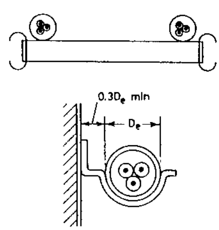
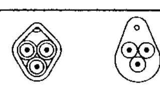
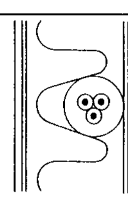
APPENDIX 7 - TYPICAL METHODS OF INSTALLATION OF CABLES

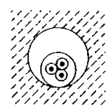
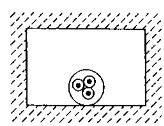
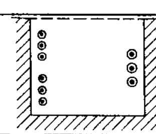
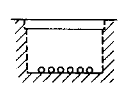
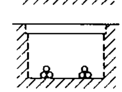
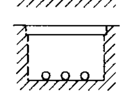
Installation method		Examples	Appropriate Reference Method for determining current carrying capacity
Number	Description		
1	2	3	4
Open and clipped direct:			
1	**Sheathed cables clipped direct to or lying on a non-metallic surface.**		**Method 1**
In conduit:			
3	**Single-core non-sheathed cables in metallic or non-metallic conduit on a wall or ceiling**		**Method 3**
4	**Single-core non-sheathed cables in metallic or non-metallic conduit in a thermally insulating wall or above a thermally insulating ceiling, the conduit being in contact with a thermally conductive surface on one side.†**		**Method 4**
5	**Multicore cables having non-metallic sheath, in metallic or non-metallic conduit on a wall or ceiling**		**Method 3**

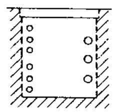
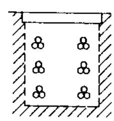
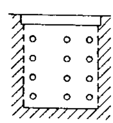
† The wall is assumed to consist of an outer weatherproof skin, thermal insulation and an inner skin of plasterboard or wood-like material having a coefficient of heat transfer not less than 10 W/m^2K. The conduit is fixed so as to be close to, but not necessarily touching, the inner skin. Heat from the cables is assumed to escape through the inner skin only.

APPENDIX 7 - **TYPICAL METHODS OF INSTALLATION OF CABLES** (Continued)

Installation method		Examples	Appropriate Reference Method for determining current carrying capacity
Number	Description		
1	2	3	4
6	Sheathed cables in conduit in a thermally insulating wall etc (otherwise as Ref Method 4)		Method 4
7	Cables in conduit embedded in masonry, brickwork, concrete, plaster or the like (other than thermally insulating materials)		Method 3
In trunking:			
8	Cables in trunking on a wall or suspended in the air		Method 3
9	Cables in flush floor trunking		Method 3
10	Single-core cables in skirting trunking		Method 3
On trays :			
11	**Sheathed cables on a perforated cable tray, bunched and unenclosed. A perforated cable tray is considered as a tray in which the holes occupy at least 30% of the surface area**		**Method 11**

Installation method		Examples	Appropriate Reference Method for determining current carrying capacity
Number	Description		
1	2	3	4
In free air, on cleats, brackets or a ladder			
12	**Sheathed single-core cables in free air (any supporting metal work under the cables occuping less than 10% of the plan area):** **Two or three cables vertically one above the other, minimum distance between cable surfaces equal to the overall cable diameter (D_e); distance from the wall not less than $0.5D_e$** **Two or three cables horizontally, with spacings as above** **Three cables in trefoil, distance between wall and surface of nearest cable $0.5D_e$ or nearest cables $0.75D_e$**		**Method 12**
13	**Sheathed multicore cables on ladder or brackets, separation greater than $2D_e$.** **Sheathed multicore cables in free air distance between wall and cable surface not less than $0.3D_e$** **Any supporting metalwork under the cables occupying less than 10% of the plan area**		**Method 13**
14	Cables suspended from or incorporating a catenary wire		Method 12 or 13 as appropiate
Cables in building voids:			
15	Sheathed cables installed directly in a thermally insulating wall or above a thermally insulating ceiling, the cable being in contact with a thermally conductive surface on one side (otherwise as Ref Method No 4)		Method 4

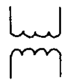
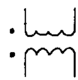
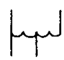
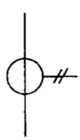
Installation method		Examples	Appropriate Reference Method for determining current carrying capacity
Number	Description		
1	2	3	4
16	Sheathed cables in ducts or voids formed by the building structure, other than thermally insulating materials	 	Method 4 Where the cable has a diameter D_e and the duct has a diameter not greater than $5D_e$ or a perimeter not greater than $20D_e$ Method 3 Where the duct has either a diameter greater than $5D_e$ or a perimeter greater than $20D_e$ NOTE 1- Where the perimeter is greater than $60D_e$, installation Methods 18 to 20, as appropriate, should be used. NOTE 2 - D_e is the overall cable diameter. For groups of cables D_e is the sum of the cable diameters.
Cable in trenches:			
17	Cables supported on the wall of an open or ventilated trench, with spacings as indicated for Ref Method 12 or 13 as appropriate		Method 12 or 13, as appropriate
18	**Cables in enclosed trench 450 mm wide by 300 mm deep (minimum dimensions) including 100 mm cover**	Two single-core cables with surfaces seperated by a minimum of one cable diameter; three single-core cables in trefoil and touching throughout. Multicore cables or groups of single-core cables with surfaces separated by a minimum of 50 mm   	**Method 18** **Use rating factors in Table** A5(6) of Appendix 5

Installation method		Examples	Appropriate Reference Method for determinging current carrying capacity
Number	Description		
1	2	3	4
19	**Cables in enclosed trench 450 mm wide by 600 mm deep (minimum dimensions) including 100 mm cover**	Single-core cables arranged in flat groups of two or three on the vertical trench wall with surfaces separated by one diameter with a minimum distance of 50 mm between groups. Multicore cables installed with surfaces separated by a minimum* of 75 mm. All cables spaced at least 25 mm from the trench wall 	**Method 19** **Use rating factors in Table** A5(6) of Appendix 5
20	**Cables in enclosed trench 600 mm wide by 760 mm deep (minimum dimensions) including 100 mm cover**	Single-core cables arranged in groups of two or three in flat formation with the surfaces separated by one diameter or in trefoil formation with cables touching. Groups separated by a minimum* of 50 mm either horizontally or vertically. Multicore cables installed with surfaces separated by a minimum* of 75 mm either horizontally or vertically. All cables spaced at least 25 mm from the trench wall  	**Method 20** **Use rating factors in Table** A5(6) of Appendix 5

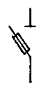
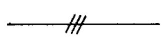
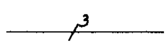
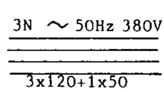
* Larger spacing to be used where practicable

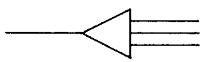
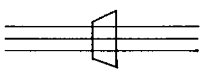
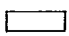
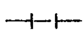
Appendix 8

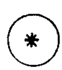
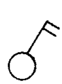
Graphical Symbols for Electrical Diagrams

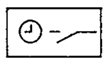
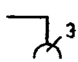
No.	Symbol		Description
	Form 1	Form 2	
1.			Transformer with two windings **Note** – The instantaneous voltage polarities may be indicated in form 2 of the symbol.
2.			Example : – Transformer with two windings shown with instantaneous voltage polarity indicators. Instantaneous currents entering the marked ends of the windings produce aiding fluxes.
3.			Auto-transformer
4.			Current transformer

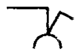
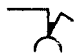
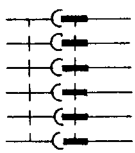
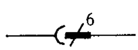
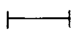
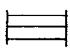
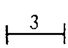
No.	Symbol	Description
5.	Form 1 	Switch (Mechanical)
6.	Form 2 	
7.		Contactor Main make contact of a contactor (contact open in the unoperated position
8.		Contactor with automatic tripping initiated by a built-in measuring relay or release
9.		Contactor Main break contact of a contactor (contact closed in the unoperated position)
10.		Circuit breaker
11.		Disconnector (isolator)
12.		Two-way disconnector (isolator) with off-position in the centre
13.		Switch-disconnector (on-load isolating switch)
14.		Switch-disconnector with automatic tripping initiated by a built-in measuring relay or release
15.		Fuse, general symbol

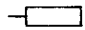
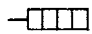
No.	Symbol	Description
16.		Fuse switch
17.		Fuse-disconnector (Fuse isolator)
18.		Fuse switch-disconnector (on-load isolating fuse switch)
19.		Conductor Group of conductors Line Cable Circuit **Notes** 1. Single-line representation of conductors When a single line represents a group of conductors, their number may be indicated either by adding small strokes or one stroke and a figure Examples:
20.	Form 1 	Three conductors
21.	Form 2 	2. Additional information may be indicated as follows: Above the line: kind of current, system of distribution frequency and voltage Below the line: the number of conductors of the circuit followed by a multiplication sign and the cross-sectional area of each conductor. If different sizes of conductors are used, their particulars should be separated by a plus sign. The conductor material may be indicated by its chemical symbol
22.		Three-phases circuit, 50Hz, 380V, three conductors of $120mm^2$ with neutral of $50mm^2$
23.		Conductors in a cable, three conductors shown

No.	Symbol	Description
24.	•	Junction, connection point
25.	○	Terminal
26.	11 12 13 14 15 16	Terminal strip, example shown with terminal markings
27.	Form 1 	Junction of conductors
28.	Form 2 	
29.		Cable sealing end, shown with one three-core cable
30.		Cable sealing end, shown with three one-core cables
31.		Link boxes, distribution board General symbol
32.	Form 1	Connecting link, closed
33.	Form 2 	
34.		Connecting link, open

No.	Symbol	Description
35.		Motor starter, general symbol Note - Qualifying symbols may be shown inside the general symbol to indicate particular types of starters
36.		Starter operated in steps Note - The number of steps may be indicated
37.		Star-delta starter
38.		Auto-transformer starter
39.		Direct-on-line starter with contactor for reversing the rotation of a motor
40.		Starter-regulator with thyristors
41.		Machine, general symbol The asterisk* shall be replaced by a letter designation as follows: C Synchronous converter G Generator GS Synchronous generator M Motor MG Machine capable of use as a generator or motor MS Synchronous motor
42.		Switch, general symbol
43.		Switch with pilot light
44.		Switch, two pole

No.	Symbol	Description
45.		Pull-cord switch, single pole
46.		Two-way switch
47.		Intermediate switch
48.		Time switch
49.		Period limiting switch, single pole
50.		Dimmer
51.		Push-button
52.		Socket outlet (power), general symbol Receptacle outlet (power), general symbol
53.	Form 1 	Multiple socket outlet (power) The symbol is shown with three outlets.
54.	Form 2 	
55.		Socket outlet (power) with protective contact

No.	Symbol	Description
56.		Socket outlet (power) with shutter
57.		Socket outlet (power) with single-pole switch
58.		Socket outlet (power) with interlocked switch
59.		Socket outlet (power) with isolating transformer, for exampl: shaver outlet
60.		Multipole plug and socket, shown with six poles: multi-line representation
61.		Single-line representation
62.		Luminaire, fluorescent lamp, general symbol
63.		Example: Luminaire with three fluorescent tubes
64.		Luminaire with three fluorescent tubes, simplified representation
65.		Auxilliary apparatus for discharge lamp Note - Use only when the auxilliary apparatus is not incorporated in the luminaire
66.		Self-contained emergency luminaire
67.		Signal lamp

No.	Symbol	Description
68.		Electrical appliance: general symbol Note - If necessary use designations to specify type
69.		Fan, shown with wiring
70.		Heater Type to be specified
71.		Bell
72.		Clock
73.		Earth, general symbol Ground, general symbol
74.		Fault (indication of assumed fault location)
75.		Flashover Break-through

Appendix 9

Accreditation Bodies which have Mutual Recognition Agreement / Arrangement with HOKLAS/ HKAS

The up-to-date list of accreditation bodies which have mutual recognition arrangements with HKAS or HOKLAS can be found at Innovation and Technology Commission website: www.info.gov.hk/itc/hkas (tel. no.: 2829 4840, fax no.: 2824 1302). The mutual recognition arrangement partners of HKAS up to May 2003 are listed below:

(1) National Association of Testing Authorities, Australia (NATA) [Australia],

(2) Bundesministerium für Wirtschaft und Arbeit (BMWA) [Austria],

(3) Belgian Organisation for Accreditation and Conformity Assessment (BELTEST) and Belgian Calibration Organisation/Belgische Kalibratie Organisatie (BKO/OBE) [Belgium],

(4) National Institute of Metrology, Standardization and Industrial Quality/ Instituto Nacional de Metrologia, Normalização e Qualidade Industrial (INMETRO) [Brazil],

(5) Standards Council of Canada/Conseil canadien des normes (SCC) [Canada],

(6) China National Accreditation Board for Laboratories (CNAL) [People's Republic of China],

(7) Chinese National Laboratory Accreditation (CNLA) [Taiwan, China],

(8) Czech Accreditation Institute, o.p.s (CAI) [Czech Republic],

(9) Danish Accreditation (DANAK) [Denmark],

(10) Finnish Accreditation Service (FINAS) [Finland],

(11) Comité Français d'Accréditation (COFRAC) [France],

(12) Deutsche Akkreditierungsstelle Chemie GmbH (DACH) [Germany],

(13) Deutsches Akkreditierungssystem Prüfwesen GmbH (DAP) [Germany],

(14) Deutsche Akkreditierungsstelle Mineralöl GmbH (DASMIN) [Germany],

(15) Deutsche Akkreditierungsstelle für Technik e.V. (DATech) [Germany],

(16) Deutscher Kalibrierdienst (DKD) [Germany],

(17) National Accreditation Board for Testing and Calibration Laboratories (NABL) [India],

(18) The National Accreditation Body of Indonesia/Komite Akreditasi Nasional (KAN) [Indonesia],

(19) The Irish National Accreditation Board (NAB) [Ireland],

(20) Israel Laboratory Accreditation Authority (ISRAC) [Israel],

(21) Sistema Nazionale per l'Accreditamento di Laboratori (SINAL) [Italy],

(22) Servizio di Taratura n Italia (SIT) [Italy],

(23) International Accreditation Japan (IAJapan) [Japan],

(24) Japan Accreditation Board for Conformity Assessment (JAB) [Japan],

(25) Korea Laboratory Accreditation Scheme (KOLAS) [Republic of Korea],

(26) Latvian National Accreditation Bureau (LATAK) [Latvia],

(27) Lithuanian National Accreditation Bureau (LA) [Republic of Lithuania],

(28) Department of Standards Malaysia (DSM) [Malaysia],

(29) Dutch Accreditation Council/Raad voor Accreditatie (RvA) [The Netherlands],

(30) International Accreditation New Zealand (IANZ) [New Zealand],

(31) Norwegian Accreditation (NA) [Norway],

(32) Instituto Português da Qualidade (IPQ) [Portugal],

(33) Singapore Accreditation Council (SAC-SINGLAS) [Singapore],

(34) Slovak National Accreditation Service (SNAS) [Slovakia],

(35) South African National Accreditation System (SANAS) [South Africa],

(36) Entidad Nacional de Acreditación (ENAC) [Spain],

(37) Swedish Board for Accreditation and Conformity Assessment (SWEDAC) [Sweden],

(38) Swiss Accreditation Service (SAS) [Switzerland],

(39) Department of Medical Sciences, Ministry of Public health (DMSc) [Thailand],

(40) Thai Laboratory Accreditation Scheme (TLAS) [Thailand],

(41) United Kingdom Accreditation Service (UKAS) [United Kingdom],

(42) American Association for Laboratory Accreditation (A2LA) [United States of America],

(43) International Accreditation Service Inc. (IAS) [United States of America],

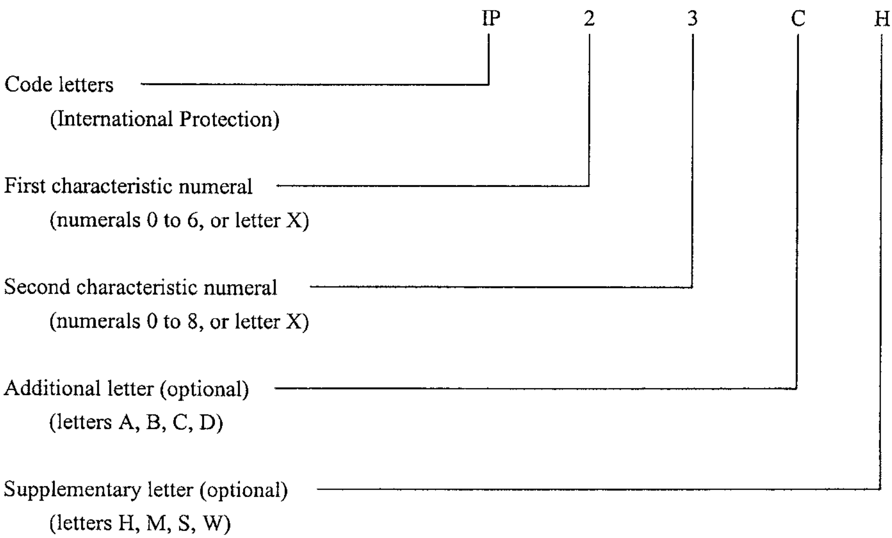
(44) National Voluntary Laboratory Accreditation Program (NVLAP) [United States of America], and

(45) Vietnam Laboratory Accreditation Scheme (VILAS-STAMEQ) [Vietnam].

Appendix 10

Degree of Protection Provided by Enclosures (IP Code)

(A) Arrangement of the IP Code



Where a characteristic numeral is not required to be specified, it shall be replaced by the letter "X" ("XX" if both numerals are omitted).

(B) Elements of the IP Code and their meanings

A brief description of the IP Code elements is given in the following chart.

Element	Numerals or letters	Meaning for the protection of equipment	Meaning for the protection of persons
Code letters	IP	-	-
First characteristic numeral		Against ingress of solid foreign objects	Against access to hazardous parts with
	0	(non-protected)	(non-protected)
	1	≥ 50 mm diameter	back of hand
	2	≥ 12.5 mm diameter	finger
	3	≥ 2.5 mm diameter	tool
	4	≥ 1.0 mm diameter	wire
	5	dust- protected	wire
	6	dust-tight	wire
Second characteristic numeral		Against ingress of water with harmful effects	-
	0	(non-protected)	
	1	vertically dripping	
	2	dripping (15° tilted)	
	3	spraying	
	4	splashing	
	5	jetting	
	6	powerful jetting	
	7	temporary immersion	
	8	continuous immersion	
Additional letter (optional)		-	Against access to hazardous parts with:
	A		back of hand
	B		finger
	C		tool
	D		wire
Supplementary letter (optional)		Supplementary information specific to:	-
	H	High voltage apparatus	
	M	Motion during water test	
	S	Stationary during water test	
	W	Weather conditions	

(Note: The information above is extracted from IEC 60529, please refer to the standard for details.)

Appendix 11

Forms of Internal Separations for Switchgear Assemblies

Symbols

Busbars, including distribution busbars

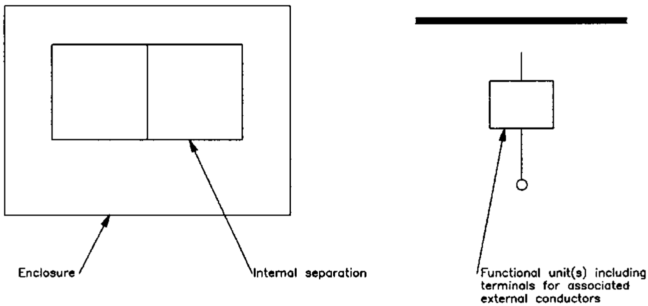
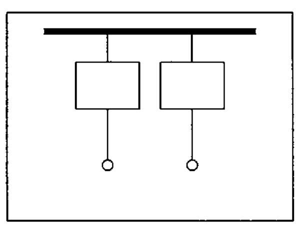


Figure A11(1) – Symbols used

Form 1

No internal separation



Form 2

Separation of busbars from the functional units

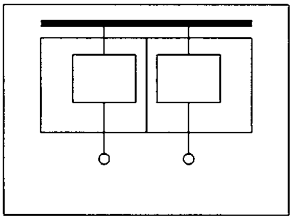
Form 2a:
Terminals not separated from busbars

Form 2b:
Terminals separated from busbars

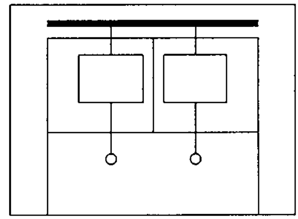
Figure A11(2) – Forms 1 and 2

Form 3

Separation of busbars from the functional units
+
Separation of functional units from one another
+
Separation of terminals from functional units



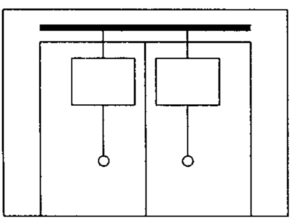
Form 3a:
Terminals not separated from busbars



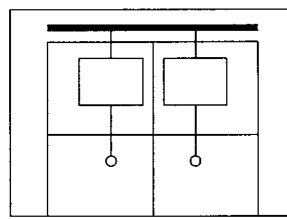
Form 3b:
Terminals separated from busbars

Form 4

Separation of busbars from the functional units
+
Separation of functional units from one another
+
Separation of terminals from functional units



Form 4a:
Terminals in same compartment
as associated functional unit



Form 4b:
Terminals separated from busbars
as associated functional unit

Figure A11(3) – Forms 3 and 4

(Note : The information above is extracted from IEC 60439, please refer to the standard for details)

Appendix 12

Worked Examples for Application of the CoP

(A) General application of the CoP in the design of wiring installation of a typical dwelling

1. *Objective*

This worked example shows the general application of the CoP in the design of the wiring installation for an individual dwelling.

2. *Assumed data of the dwelling*

(i) Number of bedrooms = 2
(ii) Size of each bedroom = 7 m^2
(iii) Size of living room = 16 m^2
(iv) Size of kitchen = 4.5 m^2
(v) Steel conduit wiring system to be used

3. *Final circuits for the dwelling*

(*a*) The following socket outlets are required (Table 26(1))—
(i) 3 socket outlets for each bedroom;
(ii) 7 socket outlets for the living room; and
(iii) 4 socket outlets for the kitchen.

(*b*) Other outlets required—
(i) Three connector units controlled by 20A double-pole switches, one for an air-conditioner installed in the living room, two for air-conditioners in the bedrooms.
(ii) 6 fixed lighting points (1 for each bedroom, 2 for the living room, 1 for the kitchen and 1 for the bathroom).

(*c*) Final circuits required for subparagraphs (*a*) and (*b*) are shown below—
(i) A 30A ring final circuit using 13A socket outlets serving the living room and the bedrooms.
(ii) A 30A ring final circuit using 13A socket outlets serving the kitchen.
(iii) A 20A exclusive radial final circuit for an air-conditioner in the living room (Code 26A(4)).
(iv) A 15A exclusive radial final circuit for an air-conditioner in each bedroom (Code 26A(4)).
(v) Two 5A radial final circuits for lighting points (one of them is also for door bell).

(*d*) Size of PVC insulated copper cables are determined as follows—
  (i) 1.5 mm^2 for lighting circuit (Table 13(1));
  (ii) 2.5 mm^2 for radial final circuits to the air-conditioners (Table 13(1));
  (iii) 2.5 mm^2 for ring final circuits using 13A socket outlets (Table 6(1)).

(*e*) For prevention of dangerous earth leakage current, the ring final circuits using socket outlets are connected to a residual current device (RCD) having a rated operating current not exceeding 30 mA. (Code 11J(2)(*b*)).

(*f*) The current demand on the RCD is 42A (Table 7(1), item 12) including—
  (i) one 30A ring final circuit using 13A socket outlets;
  (ii) 0.4 of the other 30A ring final circuit using 13A socket outlets.

(*g*) to meet the current demand of (*f*) a 60A RCD is to be used.

4. *Current demand and the size of main switch and cable of the dwelling*

(*a*) The current demand of the dwelling is calculated as follows (Table 7(1))—

	Final Circuit	*Demeand (A)*
(i)	Lighting: 0.66 × 0.45A (Code 7B(3)(b)(ii)) × 6	= 1.78
(ii)	Air-conditioners: 12A (f.l. of a/c in living room) + 2 × 0.4 × 5A (f.l. of a/c in bedrooms)	= 16
(iii)	Final circuits for socket outlets (subparagraph (3)(*f*))	= 42

(*b*) The minimum size of main switch for the dwelling to meet the maximum demand of 59.78A is 60A.

(*c*) the size of the main cable is 16 mm^2 (Table 13(1)).

5. *MCB Board*

A 8 way single pole and neutral MCB board with split busbars incorporating a RCD is used to connect these final circuits.

6. *Size of protective conductors for each dwelling*

(*a*) Steel conduits are used as circuit protective conductors for the dwelling.

(*b*) 6 mm^2 PVC insulated copper cables as main equipotential bonding conductors are used to bond the main gas pipe and the main water pipe to the main earthing terminal of the MCB board (Code 11E(*d*)).

(*c*) 4 mm² PVC insulated copper cables as supplementary bonding are used to bond the window frames intended to support air-conditioners.

(B) Example in steps of sizing cable conductors as described in Code 13A(3)

1. *Assumed data*

An immersion electric water heater rated at 220V, 2 kW is to be installed using a 2-core-and-earth PVC-insulated and sheathed, non-armoured cable. The supply will be taken from an existing 15A spare way in a consumer's unit containing semi-enclosed (rewirable) fuses to BS3036. The supply cable will run for much of its 14 m length in a roof space which is thermally insulated with glass fibre. The roof space ambient temperature is expected to be 35°C in summer and, where leaving the consumer's unit, the cable will be bunched with seven other 2 core-and-earth cables.

2. *Steps in sizing cable conductors*

(*a*) Design current of the circuit

$$= \frac{\text{Rated power of the heater}}{\text{Supply voltage}} = \frac{2000}{220} = 9.1\text{A}$$

(*b*) A 15A semi-enclosed (rewirable) fuse to BS3036 is chosen as the overcurrent protective device.

(*c*) Current carrying capacity of the conductors is determined by applying the following correction factors to the current rating of the overcurrent protective device (i.e. 15A):

(i) Ambient temperature factor = 0.97

(From Table A5(2) of Appendix 5, using conditions:

Ambient temperature = 35°C

Type of insulation = General purpose PVC)

(ii) Grouping factor = 0.52

(From Table A5(3) of Appendix 5, using conditions:

Number of multicore cable = 8

Reference Method of installation = Bunched and clipped direct to a non-metallic surface (Method 1), from Appendix 7)

(iii) Thermal insulation factor = 0.5

(From Appendix 5(3) and the cable is totally surrounded by thermally insulating material)

(iv) Factor for type of protective devices = 0.725

(From Table A5(5) of Appendix 5 and the type of protective device is semi-enclosed fuse to BS3036)

Current carrying capacity of the conductors required $= \dfrac{15}{0.97 \times 0.52 \times 0.5 \times 0.725}$ A

$= 82$A

(*d*) From Table A6(2) of Appendix 6, size of conductor is chosen to be 16 mm^2 (using Reference Method 1).

(*e*) Voltage drop calculation:

Maximum permissible voltage drop = 4% × 220V
(by Code 13A(3)(*a*)(v)) = 8.8V

The cable is carrying 9.1A and is 14 m long. From Table A6(2) of Appendix 6, the voltage drop figure for the 16 mm^2 cable is 2.8 mV/A/m and so the voltage drop is:

$$\frac{2.8 \times 9.1 \times 14}{1\,000} = 0.36\text{V}$$

The calculated figure is within the acceptable figure of 8.8V if the voltage drop between the origin of the installation and the 15A fuse does not exceed 8.44V (i.e. 8.8V–0.36V).

3. *Conclusion*

The cable chosen for this example should be a 16 mm^2 2-core-and-earth, PVC insulated, PVC sheathed, non-armoured cable.

(C) Determination of Extraneous Conductive Parts

An extraneous conductive part means a conductive part liable to introduce a potential, generally an earth potential, that does not form part of an electrical installation. Typical examples of extraneous conductive parts are metallic water mains and gas pipes. To determine whether conductive parts such as metallic bathroom accessories, metallic windows or metallic door handles are extraneous conductive part, a measurement should be carried out to measure the insulation resistance between the conductive part and the main earthing terminal. If the measured resistance could be maintained at not less than 21,000 Ohm even under the worst conditions (e.g. high moisture), the metallic part could be considered as a non-extraneous conductive part.

Appendix 13

Checklists

(*Note:* For the use of the following five checklists, please refer to Code 22)

Checklist No. 1—Items For New L.V. Installation or Items For Periodic Testing of L.V. Installations connected before 1.1.85

Installation Address: ______________________________

	Tested by/Date (N/A if not applicable)
(*a*) *Switchboards, circuit breakers and main switches*	
(i) No visible damage to impair safety.	______________
(ii) Safe access provided.	______________
(iii) Every circuit breaker, main switch and fuse holder(s) provided with up-to-date, legible and durable rating labels giving their ratings.	______________
(iv) Every circuit breaker and main switch provided with a legible and durable identification lablel.	______________
(v) An up-to-date schematic diagram displayed to show the main distribution system.	______________
(vi) Link of adequate size installed in neutral circuit.	______________
(vii) All accessible live parts screened with insulating plate or earthed metal.	______________
(viii) The overload and fault current protection characteristics of all circuit breakers verified with secondary injection test instruments where appropriate.	______________
(ix) Lowest insulation resistance being ______ Mohms (not less than 0.5 Mohm) measured between phases/neutral/earth.	______________
(x) All exposed conductive parts effectively earthed with a maximum earth fault loop impedance being ______ ohms.	______________
(*b*) *Busbar trunking system including rising mains*	
(i) No visible damage to impair safety.	______________
(ii) Phase identification marked on both ends of main cable/conductor, and at teminations.	______________

Tested by/Date
(N/A if not applicable)

(iii) All joints of metal conduit or trunking to be mechanically sound, electrically continuous and protected against corrosion. ____________________

(iv) All accessible live parts screened with an insulating plate or earthed metal. ____________________

(v) Lowest insulation resistance being ______ Mohms (not less than 0.5 Mohm) measured between phases/neutral/earth. ____________________

(vi) All metal conduit or trunking effectively earthed with a maximum earth fault loop impedance being ______ ohms. ____________________

(*c*) *Meter board/box*

(i) No visible damage to impair safety ____________________

(ii) Safe access provided. ____________________

(iii) All exposed metal parts effectively earthed with a maximum earth fault loop impedance being ______ ohms. ____________________

(*d*) *Overhead lines*

(i) No visible damage to impair safety ____________________

(ii) A minimum height of ______ metres from ground (not less than 5.8 metres for lines acrossing any place accessible to vehicular traffic, 5.2 metres in other places or not less than the tallest height restriction of ______ metres). ____________________

(iii) Lowest insulation resistance being ______ Mohms (not less than 0.5 Mohm) measured between phases/neutral/earth. ____________________

(iv) All metal work associated with every steel pole effectively earthed. ____________________

(*e*) *Main cables*

(i) No visible damage to impair safety. ____________________

(ii) Cables protected against mechanical damage. ____________________

(iii) Correct phase identification provided at both ends of the cable. ____________________

(iv) Lowest insulation resistance being ______ Mohms (not less than 0.5 Mohm) measured between cores and cores to earth. ____________________

Tested by/Date
(N/A if not applicable)

(v) All exposed metal parts including the cable armour effectively earthed with a maximum earth fault loop impedance being ______ ohms. ______________

(*f*) *Distribution board*

(i) No visible damage to impair safety. ______________

(ii) No fuse installed in the neutral circuit. ______________

(iii) All live parts screened with an insulating plate or earthed metal. ______________

(iv) Phase identification provided on the distribution board. ______________

(v) Insulation resistance of not less than 0.5 Mohm measured between phases/neutral/earth. ______________

(vi) All exposed metal parts effectively earthed. ______________

(*g*) *Final circuits*

(i) No visible damage to impair safety. ______________

(ii) All non-armoured cables susceptible to damage protected with steel conduit/trunking. Bushing and rubber grommet, where necessary, provided. ______________

(iii) Conductor sized to suit the rating of the fuse/MCB protecting the circuit. ______________

(iv) No cable joint in final circuit. ______________

(v) All joints of metal conduits or trunking to be mechanically sound, electrically continuous and protected against corrosion. ______________

(vi) For temporary installation, cables lying on the ground or attached to scaffoldings secured on suitable supports. ______________

(vii) Insulation resistance of not less than 0.5 Mohm measured between phases/neutral/earth. ______________

(viii) All metal conduits, trunking, switch boxes and exposed metal parts effectively earthed. ______________

(ix) Residual current devices function properly. ______________

Tested by/Date
(N/A if not applicable)

(x) Earth fault loop impedance and polarities of every outlet checked. ____________________

(*h*) *Motors*

(i) No visible damage to impair safety. ____________________

(ii) Insulation resistance of not less than 0.5 Mohm measured between phases/neutral/earth. ____________________

(iii) All exposed conductive parts effectively earthed. ____________________

(i) *Earthing*

(i) No visible damage to impair safety. ____________________

(ii) All exposed conductive parts of the wiring installation connected to the earthing terminal with appropriate protective conductors. ____________________

(iii) Bonding/earthing connection to water pipe/gas pipe/duct effectively connected. ____________________

(*j*) *Neon signs*

(i) No visible damage to impair safety. ____________________

(ii) The fireman's switch clearly labelled. ____________________

(iii) All high voltage equipment enclosed in an earthed metal box fitted with a 'DANGER' and '危險' warning notice. ____________________

(iv) All live parts screened with an insulation plate or earthed metal. ____________________

(v) High voltage cables securely supported with glass or glazed porcelain. ____________________

(vi) Insulation resistance of the L.V. circuit being ______ Mohms (not less than 0.5 Mohm) between phases/neutral/earth. ____________________

(vii) All exposed metalwork permanently and effectively bonded and earthed with a maximum earth fault loop impedance of ______ ohms measured at L.V. side. ____________________

Checklist No. 2—Additional Items For New L.V. Installation or Items For Periodic Testing of L.V. Installations connected on or after 1.1.85 but before 1.6.92

Installation Address: ____

Tested by/Date
(N/A if not applicable)

(*a*) *Earth*

(i) A warning notice 'SAFETY ELECTRICAL CONNECTION—DO NOT REMOVE and '安全接地終端——切勿移去' provided at all main earthing and bonding connections. ____________________

(ii) Main equipotential bonding conductors effectively connected to main water pipes, main gas pipes, other services pipes/ducting and exposed metallic parts of structural framework. ____________________

(iii) Supplementary equipotential bonding effectively provided between exposed conductive parts and extraneous conductive parts. ____________________

(iv) Exposed conductive parts of fixed equipment installed outside equipotential zone effectively earthed for 0.4 sec. disconnection. ____________________

(v) Exposed conductive parts of fixed equipment other than item (iv) effectively earthed for 5 sec. disconnection. ____________________

(vi) Effectiveness of the main equipotential bonding connection to the main earthing terminal and lightning protection system. ____________________

Checklist No. 3—Additional Items For New L.V. Installation or Items For Periodic Testing of L.V. Installations connected on or after 1.6.92

Installation Address: ______________________________

	Tested by/Date (N/A if not applicable)
(*a*) *Substations*	
(i) A warning notice 'DANGER—SUB-STATION, UNAUTHORISED ENTRY PROHIBITED' and '危險——電力分站，未經授權不得內進' provided at every entrance of substations.	____________
(ii) Suitable locking facilities provided for H.V. substations.	____________
(iii) Suitable lighting provided.	____________
(iv) Suitable ventilation provided.	____________
(v) Entrance/exit free of obstruction.	____________
(*b*) *Switchrooms*	
(i) A warning notice 'DANGER—ELECTRICITY, UNAUTHORISED ENTRY PROHIBITED' and '危險——有電，未經授權不得內進' provided at every entrance of switchrooms.	____________
(ii) Suitable locking facilities provided for H.V. switchrooms.	____________
(iii) Suitable lighting provided.	____________
(iv) Suitable ventilation provided.	____________
(v) Entrance/exit free of obstruction.	____________
(*c*) *Switchboards, circuit breakers and main switch*	
An up-to-date notice of periodic inspection and testing provided at point of supply (i.e. a switchboard, a circuit breaker or a distribution board) of the installation.	____________
(*d*) *Distribution boards*	
(i) A warning notice 'DANGER' and '危險' provided on the front panel of every distribution board.	____________
(ii) A notice of periodic testing provided at or near the main distribution board incorporating a residual current device.	____________

Checklist No. 4—Additional Items For New L.V. Installation

Installation Address: ____

	Tested by/Date (N/A if not applicable)
(*a*) *Switchboards, circuit breakers and main switches*	
(i) Safe access and adequate clearance space provided.	____________________
(ii) Number of source of supply: ______ and the rating of each of them: ______________ ______________________________________	____________________
(iii) Maximum loading approved by the electricity supplier: ____________________	____________________
(iv) Suitable interlock scheme provided to prevent parallel operation of two or more sources of supply and 4-pole incoming and interconnecting circuit breakers provided for supply to be taken from more than one source and is interconnected.	____________________
(v) Electrically and mechanically interlocked 4-pole changeover device(s) where standby generator set(s) is installed.	____________________
(vi) The breaking capacity of the main switch is ______ kA and all circuit breakers/interconnection devices are able to withstand the prospective fault current.	____________________
(vii) Protective relays have been correctly set and overcurrent protective devices suitably set for all circuits.	____________________
(viii) Protective type C.T. are used for protective relays.	____________________
(ix) A means of isolation provided for every circuit.	____________________
(x) Operation of circuit breakers and main switches checked.	____________________
(xi) Control, indication and alarm functions checked.	____________________
(xii) No undersized conductor used between the main busbar and fuse/MCB's.	____________________
(xiii) Fuses/MCB's matching the lowest rated conductor in the circuit.	____________________

Tested by/Date
(N/A if not applicable)

(xiv) Suitable cable terminations provided. ____________________

(xv) Cable conductors of correct phases connected. ____________________

(xvi) Single-pole devices for protection or switching connected in phase conductors only. ____________________

(*b*) *Busbar trunking system including rising mains*

(i) The current rating of the rising mains is ______ amperes. ____________________

(ii) The rising mains, lateral mains and meter boards positioned at places accessible from public area. ____________________

(iii) Fire barriers provided where the busbar trunking system passes through floor slabs or walls designated as fire barriers. ____________________

(iv) Cables passing through smoke lobby protected by enclosures of adequate fire rating. ____________________

(v) Non-sheathed cables protected by conduit, trunking or ducting. ____________________

(vi) Busbar trunking systems, cables and ductings adequately supported. ____________________

(vii) Armoured cables properly terminated to metal casing or trunking by proper cable glands. ____________________

(viii) Suitable cable lugs used for terminating cables. ____________________

(ix) Precaution against corrosion taking on aluminium conductor joined to copper conductor. ____________________

(x) Cutout fuses for tapping off supply fitted with insulated carriers. ____________________

(*c*) *Overhead lines*

(i) A steel carrier wire provided between poles to prevent strain on conductor. ____________________

(ii) substantial steel poles used to suspend cables crossing vehicular passes. ____________________

(iii) Overhead cables supported on suitable insulators. ____________________

	Tested by/Date (N/A if not applicable)
(iv) Suitable stay wires installed on the terminal poles and on each pole at which the line changes its direction.	____________
(v) Minimum clearance of overhead lines to ground, roads and obstacles maintained.	____________
(*d*) *Main cables*	
(i) The cross-sectional area or each core of the main supply cable is ______ mm^2. Number of cables in parallel, if connected is _____.	____________
(ii) Armoured cables properly terminated to metal casing or trunking by proper cable glands.	____________
(iii) Cables passing through smoke lobby protected by enclosures of adequate fire rating.	____________
(iv) Non-sheathed cables protected by conduit, trunking or ducting.	____________
(v) Cables and ductings adequately supported.	____________
(vi) Cables at distribution board or busbar terminated with cable lugs.	____________
(vii) Main cables connected up with correct polarity.	____________
(*e*) *Distribution board*	
(i) Safe access and adequate clearance space provided.	____________
(ii) Distribution boards securely mounted on suitable supports.	____________
(iii) A suitable switch provided to control each distribution board.	____________
(iv) Phase barriers for 3-phase distribution board provided.	____________
(v) The breaking capacity of MCB is ______ kA to Code 9.	____________
(vi) Suitable tools for withdrawal of fuses at a fuse board provided, where necessary.	____________
(vii) Circuits connected to MCB or fuse in accordance with the schematic diagram.	____________

	Tested by/Date (N/A if not applicable)
(*f*) *Final circuits*	
(i) All fuses and single pole switches connected to the phase conductors only with correct polarity.	______
(ii) Wiring for emergency lightings and fire services installation segregated from other wirings.	______
(iii) Low voltage circuits segregated from extra low voltage circuits.	______
(iv) Cables of all phases and neutral of the circuit bunched and contained in the same conduit.	______
(v) Exposed insulated non-sheathed cables protected.	______
(vi) Wiring inside false ceiling protected by conduit/trunking or metallic sheath.	______
(vii) Socket outlets installed below 1.5 m from floor being shuttered type complying to the prescribed requirements.	______
(viii) No socket outlet installed close to water tap, gas tap or cooker so as to avoid danger.	______
(ix) Floor socket outlets protected with suitable cover.	______
(x) No 2-pin sockets installed. All socket outlets connected with protective conductors and live conductors terminated at correct terminals.	______
(xi) Radial final circuits using 5A/15A socket outlets in compliance with Code 6D.	______
(xii) Final circuits using 13A socket outlets in compliance with Code 6E.	______
(xiii) Final circuits using industrial socket outlets in compliance with Code 6F or 6G or 6H.	______
(xiv) Circuit protective conductor is formed by the enclosure and a separate protective conductor between the earthing terminal of socket outlet and its associated metal box provided.	______

	Tested by/Date (N/A if not applicable)
(xv) Circuit protective conductor is not formed by the enclosure and a separate protective conductor to the earthing terminal of socket outlet provided.	____________________
(xvi) Residual current device of 30 mA rated residual operating current provided for all socket outlets.	____________________
(xvii) Means of isolation provided for every fixed appliance.	____________________
(xviii) All chokes, starters and capacitors of discharge lamps enclosed in earthed metal box(es) and suitably ventilated.	____________________
(xix) Phase conductors connected to the centre contact of the Edison-type screw lamp holders.	____________________
(xx) No switches other than a switch fed from a safety source or operated by an insulation cord or rod or a push-button type of switch having an insulated button of a large surface area provided in bathrooms.	____________________
(xxi) Shaver supply unit complying with BSEN 60742 or equivalent.	____________________
(xxii) Socket outlet in bathroom installed in zone 3 (i.e. 0.6m away from shower basin or bathtub); and protected by a 30mA residual current device or protected by an isolating transformer to BSEN 60742.	____________________
(xxiii) No fixed luminaire nor fixed heater having unguarded heating elements installed within reach of a person using the bath or shower.	____________________
(xxiv) Appliances exposed to weather being splashproof type.	____________________
(xxv) Luminaires, switches, sockets and plugs, cable couplers installed outdoor, being splashproof type.	____________________
(xxvi) General/site lighting readily accessible to the public supplied from a safety source.	____________________

Tested by/Date
(N/A if not applicable)

(xxvii) General/site lighting not readily accessible to the public and not supplied from a safety source, protected by RCD having a rated residual operating current not exceeding 30 mA. ____________________

(*g*) *Motors*

(i) A local switch provided to control every motor. ____________________

(ii) Means provided to prevent unexpected restarting of motors where such restarting might cause danger. ____________________

(iii) Flexible conduits terminated with suitable brass bushes. ____________________

(iv) Separate supply to motor heaters having its terminals screened, with warning notice provided. ____________________

(*h*) *Earthing*

(i) Rod electrode(s) having a minimum diameter 12.5 mm copper or 16 mm galvanised or stainless steel used. ____________________

(ii) Copper tape electrode having a cross-section of not less than 25 mm × 3 mm. ____________________

(iii) Copper plate electrode not less than 3 mm in thickness and having a maximum dimension of 1 200 mm × 1 200 mm. ____________________

(iv) No gas/water pipe used as earth electrodes. ____________________

(v) A test link provided at the main earthing terminal. ____________________

(vi) Minimum size of protective conductor used in compliance with Table 11(1). ____________________

(vii) Protective conductor up to and including 6 mm^2 with green and yellow insulation sheath used throughout its length. ____________________

(viii) Bonding conductors of ______ mm^2 (not less than 150 mm^2 copper equivalent) used for connection to the earthing terminal of the electricity supplier's transformer(s). ____________________

	Tested by/Date (N/A if not applicable)
(ix) Bonding conductors of ______ mm^2 (not less than 150 mm^2 copper equivalent) used for connection to the exposed conductive parts of the electricity supplier's underground cable(s).	______
(x) Copper links provided at joints of metallic trunking which forms part of a protective conductor.	______
(xi) Separate protective conductors provided for all flexible conduits.	______
(*i*) *Lightning Protection*	
(i) Air termination network/down conductor/ earth termination network having good continuity.	______
(ii) Joints and connections are mechanically and electrically sound.	______
(iii) Connection link to the main earthing terminal provided.	______
(iv) Test joint provided	______
(v) Rod electrode(s) having a minimum diameter 12.5 mm copper or 16 mm galvanised or stainless steel used.	______
(vi) Copper tape electrode having a cross-section of not less than 25 mm × 3 mm.	______
(vii) Copper plate electrode not less than 3 mm in thickness and having a maximum dimension of 1 200 mm × 1 200 mm.	______
(viii) No gas/water pipe used as earth electrodes.	______
(ix) Measured earth termination network resistance to earth not more than 10 Ohm when the connection to main earthing terminal disconnected.	______
(x) No evidence of corrosion likely to lead deterioration of the lightning protection system.	______
(*j*) *High voltage discharge lighting (Neon signs)*	
(i) ______ ampere control switch fitted with a removable handle or locking facilities.	______
(ii) Fireman's switch provided with the 'OFF' position at the top.	______

Tested by/Date
(N/A if not applicable)

(iii) High voltage cables exceeding 1 metre in length for connection between lamps and transformers, being metal sheathed or armoured. ________________

(iv) Bare or lightly insulated conductors for high voltage connection protected with glass tubing. ________________

(*k*) *Warning notices and labels*

(i) Warning notices for substations and switchrooms provided in compliance with Code 17. ________________

(ii) Warning notices for earthing and main bonding connections provided in compliance with Code 17. ________________

(iii) All switchgears, distribution boards and electrical equipment properly labelled. ________________

Checklist No. 5—Items for H.V. Installation

(Note: For L.V. Installation/Equipment, please refer to other checklists in this appendix)

Installation Address: ____________________

Tested by/Date
(N/A if not applicable)

(*a*) *Switchboard, circuit breakers*

(i)	No visible damage to impair safety.	________
(ii)	Safe access and adequate clearance space provided.	________
(iii)	Work done properly recorded in log book.	________
(iv)	Every circuit breaker provided with a legible and durable identification label.	________
(v)	An up-to-date schematic diagram displayed.	________
(vi)	All accessible live parts screened with insulating plate or earthed metal.	________
(vii)	All exposed conductive parts effectively earthed.	________
(viii)	Earthing system effectively connected.	________
(ix)	Warning notice displayed at main bonding connections.	________
(x)	All protective devices are functioned properly and correctly set.	________
(xi)	Padlock facilities for shutters provided.	________
(xii)	Maintenance test carried out according to relevant recognised standards and manufacturers' recommendation, where appropriate, with test reports. (insulation resistance test, pressure test, ductor test, oil dielectric strength test etc.)	________

(*b*) *Main Cables*

(i)	No visible damage to impair safety.	________
(ii)	Cables protected against mechanical damage and suitably supported.	________
(iii)	All exposed metal parts including the armour effectively earthed.	________

Tested by/Date
(N/A if not applicable)

(iv) Maintenance test carried out according to relevant recognised standards and manufacturers' recommendation, where appropriate, with test reports. (insulation resistance test, pressure test etc.) ____________________

(*c*) *Transformers/Motors*

(i) No visible damage to impair safety. ____________________

(ii) All accessible live parts screened with insulating plate or earthed metal. ____________________

(iii) Proper ventilation provided to avoid excessive temperature rise. ____________________

(iv) Maintenance test carried out according to relevant recognised standards and manufacturers' recommendation, where appropriate, with test reports. (insulation resistance test, pressure test, oil dielectric strength test etc.) ____________________

(*d*) *Earth*

(i) A warning notice 'SAFETY ELECTRICAL CONNECTION—DO NOT REMOVE' and '安全接地終端——切勿移去' provided at all main earthing and bonding connections. ____________________

(ii) Earthing conductors of adequate size. ____________________

(*e*) *D.C. Battery System*

(i) Condition of battery system ____________________

(ii) Voltage of each battery cell measured ____________________

(*f*) *Operation and Testing tools and equipment*

(i) Proper operation tools and equipment provided for switching and isolation use. ____________________

(ii) Suitable self-test high voltage tester provided for verifying equipment dead. ____________________

Appendix 14

References

References may be made to the following publications for better applying and understanding of the requirements of the CoP.

IEC 60079	Electrical apparatus for explosive gas atmospheres.
IEC 60127	Miniature fuses
IEC 60189	Low-frequency cables and wires with PVC insulation and PVC sheath
IEC 60227	Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V
IEC 60228	Conductors for insulated cables
IEC 60238	Edison screw lampholders
IEC 60245	Rubber insulated cables of rated voltages up to and including 450/750 V
IEC 60269	Low-voltage fuse
IEC 60309	Plugs, socket-outlets and couplers for industrial purposes
IEC 60335	Household and similar electrical appliances
IEC 60364	Electrical installations of buildings
IEC 60423	Conduits for electrical purposes - Outside diameters of conduits for electrical installations and threads for conduits and fittings
IEC 60439	Low-voltage switchgear and controlgear assemblies
IEC 60529	Degree of protection provided by enclosures (IP Code)
IEC 60614	Specification for conduits for electrical installations
IEC 60617	Graphical symbols for diagrams
IEC 60669	Switches for household and similar fixed electrical installations
IEC 60702	Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V
IEC 60742	Isolating transformers and safety isolating transformers requirements
IEC 60898	Circuit breakers for overcurrent protection for household and similar installations

IEC 60947	Low-voltage switchgear and controlgear
IEC 61008	Residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)
IEC 61009	Residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
IEC 61024	Protection of structures against lightning
IEC 61035	Specification for conduit fittings for electrical installations
IEC 61084	Cable trunking and ducting systems for electrical installations
IEC 61312	Protection against lightning electromagnetic impulse
IEC 61558	Safety of power transformers, power supply units and similar
IEC 61643	Surge protective devices connected to low-voltage power distribution systems
IEEE 519	IEEE recommended practices and requirements for harmonic control in electrical power systems
BS EN 50014	Electrical apparatus for potentially explosive atmospheres
BS EN 50085	Cable trunking and cable ducting systems for electrical installations
BS EN 50086	Specification for conduit systems for cable management
BS EN 60079	Electrical apparatus for explosive gas atmospheres
BS EN 60127	Miniature fuses
BS EN 60238	Edison screw lampholders
BS EN 60309	Plugs, socket outlets and couplers for industrial purposes
BS EN 60335	Specification for safety of household and similar electrical appliances
BS EN 60423	Conduits for electrical purposes
BS EN 60439	Specification for low-voltage switchgear and controlgear assemblies
BS EN 60529	Specification for degrees of protection provided by enclosures (IP code)

BS EN 60617	Graphical symbols for diagrams
BS EN 60669	Switches for household and similar fixed electrical installations
BS EN 60742	Isolating transformers and safety isolating transformers
BS EN 60898	Specification for circuit-breakers for overcurrent protection for household and similar installations
BS EN 60947-1	Specification for low-voltage switchgear and controlgear- General rules
BS EN 60947-2	Specification for low-voltage switchgear and controlgear -Circuit-breakers
BS EN 60947-3	Specification for low-voltage switchgear and controlgear - Switches, disconnectors, switch-disconnectors and fuse-combination units
BS EN 60947-4	Specification for low-voltage switchgear and controlgear - Contactors and motor-starters.
BS EN 60950	Specification for safety of information technology equipment, including electrical business equipment
BS EN 61008	Specification for residual current operated circuit-breakers without integral overcurrent protection for household and similar uses (RCCBs)
BS EN 61009	Specification for residual current operated circuit-breakers with integral overcurrent protection for household and similar uses (RCBOs)
BS31	Specification-Steel conduit and fittings for electrical wiring
BS88	Cartridge fuses for voltages up to and including 1000V a.c. and 1500V d.c.
BS88 Part 2 and Part 6	Specification for fuses for use by authorized persons (mainly for industrial application). Specification for supplementary requirements for fuses of compact dimensions for use in 240/415V a.c. industrial and commercial electrical installations
BS196	Specification for protected-type non-reversible plugs, socket-outlets, cable-couplers and appliance-couplers with earthing contacts for single-phase a.c. circuits up to 250 volts
BS546	Specification-Two-pole and earthing-pin plugs, socket-outlets and socket-outlet adaptors

BS731 Part 1	Flexible steel conduit and adaptors for the protection of electric cable
BS1361	Specification for cartridge fuses for a.c. circuits in domestic and similar premises
BS1363	13 A plugs, socket-outlets and adaptors
BS2757	Method for determining the thermal classification of electrical insulation
BS2782 Part 1	Methods of testing plastics-Thermal properties
BS3036	Specification-Semi-enclosed electric fuses (ratings up to 100 amperes and 240 volts to earth)
BS3456	Specification for safety of household and similar electrical appliances
BS3676	Switches for household and similar fixed electrical installations
BS4444	Guide to electrical earth monitoring and protective conductor proving
BS4568	Specification for steel conduit and fittings with metric threads of ISO form for electrical installations
BS4607	Non-metallic conduits and fittings for electrical installations
BS4662	Specification for boxes for the enclosure of electrical accessories
BS4678	Cable trunking
BS5266	Emergency lighting
BS 5467	Specification for 600/1000 V and 1900/3300 V armoured electric cables having thermosetting insulation
BS5501	Electrical apparatus for potentially explosive atmospheres
BS5839	Fire detection and alarm systems for buildings
BS6004	Electric cables. PVC insulated, non-armoured cables for voltages up to and including 450/750 V, for electric power, lighting and internal wiring
BS6007	Electric cables. Single core unsheathed heat resisting cables for voltages up to and including 450/750 V, for internal wiring
BS6231	Specification for PVC-insulated cables for switchgear and controlgear wiring

BS6346	Specification for 600/1000 V and 1900/3300 V armoured electric cables having PVC insulation
BS6387	Specification for performance requirements for cables required to maintain circuit integrity under fire conditions
BS 6500	Electric cables. Flexible cords rated up to 300/500 V, for use with appliances and equipment intended for domestic, office and similar environments
BS6651	Code of practice for protection of structures against lightning
BS6701	Code of practice for installation of apparatus intended for connection to certain telecommunication systems
BS6724	Specification for 600/1000 V and 1900/3300 V armoured electric cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire
BS7211	Specification for thermosetting insulated cables (non armoured) for electric power and lighting with low emission of smoke and corrosive gases when affected by fire
BS7629	Specification for 300/500 V fire resistant electric cables having low emission of smoke and corrosive gases when affected by fire
BS7671	Requirements for Electrical Installations (IEE Wiring Regulations-Sixteenth Edition)
BS 7919	Electric cables. Flexible cables rated up to 450/750V, for use with appliances and equipment intended for industrial and similar environments

APPENDIX 15
(SAMPLE)

工程許可證
PERMIT-TO-WORK

	組／處	許可證號碼
....	SECTION/OFFICE	Permit No. ....
	部門	地點
....	DEPARTMENT	Location..

第 1 部
PART 1.

本人謹此聲明，下述電力器具已經根據電力(線路)規例工作守則第 4 條有關對高壓和低壓電力裝置施工的安全規定，截斷電源、隔離和接地，可以安全進行工程。本人已提醒負責工程主管注意該份安全規定。

I hereby declare that it is safe to work on the following electrical equipment, which has been isolated, made dead, and earthed in accordance with the safety precautions for work on high voltage and low voltage electrical apparatus in Code 4 of the Code of Practice. I have drawn the attention of the person in charge of the work to these precautions.

本人已經向負責工程主管，直接指出該電力器具、說明工程範圍以及講解安全措施。

I have physically identified the electrical equipment, explained the extent of the work and demonstrated the safety arrangements to the Person who is to be in charge of the work.

進行工程的電力器具
ELECTRICAL EQUIPMENT TO BE WORKED ON ....

電力器具的地點
LOCATION OF ELECTRICAL EQUIPMENT ....

要進行的工程詳情
DETAILS OF WORK TO BE DONE ....

電力器具被隔離的確實位置
EXACT POINTS WHERE ELECTRICAL EQUIPMENT IS ISOLATED ....

電力器具接地的確實位置
EXACT POINTS WHERE ELECTRICAL EQUIPMENT IS EARTHED ....

已鎖上安全鎖的位置
SAFETY LOCKS APPLIED AT ....

警告告示和危險告示豎立位置
CAUTION NOTICES AND DANGER NOTICES HAVE BEEN POSTED AT ....

特別指示或安全措施
SPECIAL INSTRUCTIONS, OR SAFETY MEASURES ....

簽署 (負責人員)
Signed .... (Responsible Person)

姓名 聯絡電話號碼
Name... Contact Tel. No. ....

時間 (上午／下午 *) 時 分 日期
Time (a.m./p.m.*) .... hours .... minutes Date ....

第 2 部
PART 2.

本人確認收到工程許可證和裝備安全鎖匙箱的鎖匙。本人已閱讀過此工程許可證的內容，並證實該電力器具已按需要在上述地點切斷電源及隔離。有關的安全設備和接地線均不會移走，直至此許可證被撤銷並得到負責人員的准許為止。

I acknowledge receipt of this permit-to-work and of the key for the equipment safety key box. I have read the content of this permit-to-work and I certified that where applicable the electrical equipment is switched out and isolated on these premises. Safety devices and earths will not be removed until this permit-to-work has been cancelled and permission has been obtained from the Responsible Person.

本人謹此聲明，本人接納此工程許可證上所述在該電力器具進行工程的責任，而本人及本人轄下人員，均不會在其他電力器具進行工程。

I declare that I accept the responsibility for carrying out work on the electrical equipment described on this permit-to-work and that no attempt will be made by me or by the persons under my control to carry out work on other electrical equipment.

在第 1 部所述的工程進行期間，本人會保留此工程許可證，並會在工程完成或停止後，將許可證交還負責人員。

I will retain this permit-to-work while the work described in Part 1 is in progress and will return it to the Responsible Person when the work is completed or stopped.

簽署 (工程主管)
Signed .... (Person in-charge)

姓名 聯絡電話號碼
Name... Contact Tel. No. ....

時間 (上午／下午 *) 時 分 日期
Time (a.m./p.m.*) .... hours .... minutes Date ....

受僱於
In the employ of ....

此許可證在第 1 及第 2 部簽署後才生效
THIS PERMIT IS NOT VALID UNTIL PARTS 1 AND 2 HAVE BEEN SIGNED

第 3 部
PART 3.

本人謹此聲明，此工程許可證第 1 部所述工程已圓滿完成／停止 * ，本人轄下所有人員已經撤離，並受到警告：在上述電力器具進行工程已不安全。所有工具及臨時接線均已撤走。

I hereby declare that Work described in Part 1 of this permit-to-work has been satisfactorily completed/stopped*, and all persons under my charge have been withdrawn and warned that the above electrical equipment is no longer safe to work on. All tools and temporary connections have been removed.

簽署 (工程主管)
Signed .... (Person in-charge)

時間 (上午／下午 *) 時 分 日期
Time (a.m./p.m.*) .... hours .... minutes Date ....

第 4 部
PART 4.

本人謹此聲明，此工程許可證第 1 部所述工程已圓滿完成／停止 * ，此工程許可證現予以撤銷。工程許可證正本已交還本人並已銷毀。

I hereby declare that the work described in Part 1 of this permit-to-work has been satisfactorily completed/stopped* and that this permit-to-work is cancelled. The original permit-to-work has been returned to me and destroyed.

簽署
Signed ....
負責人員 Responsible person

時間 (上午／下午 *) 時 分 日期
Time (a.m./p.m.*) .... hours .... minutes Date ....

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* 將不適用的刪除 Delete as appropriate.

APPENDIX 16
(SAMPLE)

高壓範圍出入記錄簿
H.V. ENCLOSURE LOG BOOK

高壓範圍地點 ____________________
LOCATION ____________________

日期 Date	姓名 Name	註冊電業工程人員編號 R.E.W. No.	工程許可證號碼 Permit-To-Work No.	工作 Activity	進入時間 Time In	簽署 Sign	離開時間 Time Out	簽署 Sign

註：這本記錄簿必須長期存放在裝備安全鎖匙的箱內。
Note: This set of log book must be kept inside the equipment safety key box at all times.

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