Tonga

ELECTRICAL WIRING BY-LAWS

Chapter 32.12.3

2016 Revised Edition

ELECTRICAL WIRING BY-LAWS

Arrangement of Sections

Section

Tonga

ELECTRICAL WIRING BY-LAWS

Made by the Tonga Electric Power Board under section 63 of the Tonga Electric Power Board Act and continued in force under section 2(2) of Act 12 of 2007 [1]

Commencement [30th April, 1985]

1 Short title

These by-laws may be cited as the Electrical Wiring By-Laws.

PART I - GENERAL PROVISIONS

2 Interpretation

(1) In these by-laws, unless the context otherwise requires —

"**Accessible**" means not permanently closed in by the structure or finish of the building;

"**Accessory**" means any device, other than a lighting fitting associated with the wiring and current using appliances of an installation; and includes a switch, a fuse, a plug, a socket, a lampholder, and a ceiling rose;

"**Adaptor**" means a lampholder adaptor as defined in this subsection;

"**Aerial conductor**" means any conductor which is supported above the ground and which, or the covering of which, is directly exposed to the open air;

"**All-insulated**", in relation to any accessory, appliance, fitting, or other device, means covered with a non-conducting material in such manner that it is impossible when the device is in use for any person to make accidental or unintentional contact with any metal liable to become alive;

"**Appliance**" means any device which utilises electricity for a particular purpose;

"**Authorised Inspector**" means in respect of any electrical installation, a person authorised under the Electric Power Boards Act, Regulation or By-laws as an Inspector of electrical wiring and authorised by the Board to inspect the installation;

"**Board**" means the Tonga Electric Power Board;

"**Cable**" means a length of insulated single conductor (solid or stranded), or two or more such conductors, each provided with its own insulation which are laid up together, which insulated conductor or conductors may or may not be provided with an overall mechanical protective covering;

"**Caravan**" means any structure designed or adapted for human habitation which is designed to be moved from one place to another (whether by being towed or being transported on a motor vehicle or trailer) and any other vehicle designed or adapted for human habitation; but does not include a tent;

"**Circuit**" means an arrangement of conductors for the purpose of carrying current;

"**Circuit breaker**" means a mechanical device for making and breaking a circuit, both under normal conditions and abnormal conditions, the breaking of the circuit being by automatic operation;

"**Conductor**" means any wire, cable, bar or tube used for conducting electricity;

"**Consumer**" means any body or person supplied, or entitled to be supplied with electricity by the Tonga Electric Power Board; and includes any person who, being under no disability and being competent to receive a supply, is willing to enter into a contract with the Board for electricity to be supplied to him at a point within the Board's area of supply on the terms and subject to the conditions generally prevailing for those contracts within the Board's area of supply;

"**Damp situation**" means a situation in which moisture is either permanently present, or intermittently present to such an extent as to be likely to impair the effectiveness or safety of an installation conforming to the requirements for ordinary situations;

"**Distribution board**" means an assembly of parts, including one or more fuses or other excess-current protective devices, arranged for the distribution of electricity to subcircuits or to other distribution board or both;

"**Distribution line**" means an electric line from which electricity can be supplied to the service lines of consumers;

"**Double insulation**" means —

(a) in the case of a conductor, that insulating material intervenes not only between the conductor and its surrounding envelope (if a cable) or immediate support (if bare), but also between the envelope or support and earth;

(b) in the case of a portable appliance having accessible metal parts, that protective insulation is provided in addition to the normal functional insulation in order to protect against electric shock in case of a breakdown of the functional insulation;

"**Earthed**" means effectually connected to the general mass of the earth;

"**Earth-continuity conductor**" means the conductor, including any clamp, connecting to the earthing lead or to each other those parts of an installation which are required to be earthed, which conductor may be in whole or in part the metal conduit or the metal sheath of the cables, or the special continuity conductor of a cable or flexible cord incorporating the conductor;

"**Earth electrode**" means a metal rod or rods, or a system of underground metal water pipes or other conducting object, providing an effectual connection with the general mass of earth;

"**Earthed metal**" means metal that is directly or indirectly in electrical contact with earth;

"**Earthing lead**" means the final conductor by which the connection to the earth electrode is made;

"**Electric-discharge lamp**" means an electric lamp comprising a hermetically sealed bulb or tube containing gas or metal or both intended to be vapourised during operation and fitted with electrodes between which a discharge of electricity takes place, the useful light being emitted from or excited by the discharge through the gas or vapour on being so emitted and excited;

"**Electric line**" means any conductor or conductors used for conveying, transmitting, or distributing electricity;

"**Electrical hazard**" means danger from electricity to life or property or both;

"**Electrode boiler**" or "**electrode water heater**" means apparatus for the electrical heating of water or other liquid by the passage of electric current between electrode immersed therein or through a resistor which owing to its being in electrical contact with the water or other liquid is in this respect indistinguishable from an electrode;

"**Extra-high voltage**" means any voltage exceeding 6,600 volts;

"**Extra-low voltage**" means any voltage normally not exceeding 32 volts alternating current or 50 volts direct current;

"**Fixed wiring**" means all conductors forming part of the electrical installation between the point of entry and any point;

"**Flameproof enclosure**" means an enclosure for electrical apparatus which will withstand without injury any explosion of prescribed flammable gas that may occur within it under practical conditions of operations within the rating of the apparatus and recognised overloads (if any) associated therewith, and will prevent the transmission of flame such as will ignite any prescribed flammable gas that may be present in the surrounding atmosphere;

"**Flammable**" means capable of being easily ignited;

"**Flexible cable**" means a cable consisting of one or more cores, each formed of a group of wires, the diameters of the wires and the insulating material being such as to afford flexibility;

"**Flexible cord**" means a flexible cable in which the cross-sectional area of each conductor does not exceed 4 mm^2 (56.30 mm) or equivalent;

"**Fuse**" means a device for opening a circuit by means of a conductor designed to melt when an excessive current flows: and includes all the parts that form the complete device;

"**Manager**" means the Manager of the Tonga Electric Power Board established under the Tonga Electric Power Board Act, as amended;

"**High voltage**" means any voltage exceeding 650 volts but not exceeding 6,600 volts;

"**Incombustible**" or "**non-ignitable**" in relation to a material means that the material neither burns nor gives off flammable vapours in sufficient quantity to ignite at a pilot flame when heated;

"**Intrinsically safe**" —

(a) in relation to a circuit, means that any electrical sparking that may occur in normal working under specified conditions and with the prescribed components, is incapable of causing an ignition of the prescribed flammable gas or vapour;

(b) in relation to apparatus, means that it is so constructed that when installed and operated under specified conditions any electrical sparking that may occur in normal working, either in the apparatus or in the circuit associated therewith, is incapable of causing an ignition of the prescribed flammable gas or vapour;

"**Isolating switch**" means a switch suitable for disconnecting a circuit under no-load conditions only;

"**Joint box**" means a box forming part of wiring installation and provided to contain joints in the conductors of the cables of the installation;

"**Lampholder adaptor**" means an accessory for insertion into a lampholder for the purpose of connecting to the supply a current-using appliance;

"**Lighting fitting**" means a device for supporting or containing a lamp or lamps together with any lampholder, shade, or reflector, and includes a pendant with a ceiling rose, an electrolier, or a portable standard;

"**Live**" or "**alive**" in relation to a conductor of electricity, means charged with electricity so that a difference in electrical potential exists between the conductor and earth;

"**Low voltage**" means any voltage normally exceeding 32 volts alternating current or 50 volts direct current, but not exceeding 250 volts in either case;

"**Medium voltage**" means any voltage normally exceeding 250 volts but not exceeding 650 volts;

"**Multiple-earthed-neutral**" or "**M.E.N.**" means a neutral conductor of any low-voltage or medium-voltage alternating-current system, being a conductor that is earthed at the source of supply and at one or more other points along the distribution of service line, and at each consumer's premises, the resistance between any point of the neutral conductor and earth not exceeding 10 ohms;

"**Neutral-screened cable**" means a cable consisting of one or more insulated cores surrounded by an outer stranded conductor;

"**Non-reversible**", in relation to any accessory in the nature of an adaptor, or a plug and socket, for connecting apparatus, means so constructed and installed that the respective conductors between the adaptor or plug and accessory are always connected to the same pole, phase, neutral or earthed conductor as the case may be;

"**Point**" means a termination of the fixed wiring intended for the attachment of a lighting fitting or of a device for connecting to the supply a current-using appliance;

"**Point of attachment**" means the point at which the aerial conductors of a service line or, as the case may be, of a consumer's line are terminated on a building or structure;

"**Point of entry**" means the point at which a service main or a combined overhead or underground service-line and service-main cable enters a building;

"**Point of supply**" means the point at which connection is made between the service-line conductors and the service-main conductors; and where an overhead-line connector box is used, the connection between service line and service main is deemed to be made at the terminals of the box; and where an overhead or underground cable is used as a combined service line and service main the terminals at which the cable terminates on the premises are deemed to be the point of supply;

"**Portable appliance**" means an appliance that from the nature of its use requires to be moved while it is working or is so designed that it can readily

be moved while it is working and is connected to the fixed wiring by means of a flexible cord and plug or adaptor;

"**Premises**" include any land owned or occupied by a consumer or the Board, as the case may be, on which electricity is generated, transmitted, or used; but does not include any public street or road;

"**Readily accessible**" means able to be reached quickly and without climbing over or removing any obstruction or resorting to any device for climbing;

"**Semi-portable appliance**" means an appliance, not being a portable appliance as defined in these regulations, that from the nature of its use requires to be moved or is capable of being moved to a new position from time to time while it is working or between the periods when it is working;

"**Service fuse**" means a fuse installed by the Board for interrupting the supply to an installation on a consumer's premises from the Board's lines;

"**Service lift**" means a lift the car of which has a floor area not exceeding 1 m^2 and a height not exceeding 1.25 m and which is used only for the purpose of carrying goods or material or both and which is operated from outside the lift well;

"**Service line**" means an electric line connecting a consumer's installation to a distribution line;

"**Service main**" means that portion of the wiring on a consumer's premises between the main switchboard and the service line from which supply is obtained;

"**Source of supply**" means either the generating station, the substation, the transformer, or the secondary battery as the case may be, which is the place where electricity at the voltage at which it is delivered to the consumer, is derived;

"**Subcircuit**" means that portion of a circuit extending beyond the final circuit breaker or set of fuses;

"**Submain**" means those cables connecting a main switchboard or distribution board to any other distribution board, which cables shall be deemed to have their origin at the load terminals of the fuses or circuit breaker protecting them;

"**Switchboard**" means an assemblage of switchgear with or without instruments, but does not include a group of local switches on a subcircuit or any panel, on the premises of a consumer, that is used exclusively to house any meter, or control device, owned by the Board;

"**Switchgear**" means any apparatus for controlling the distribution of electricity, or for controlling or protecting electrical circuits, machines, and current-using appliances;

"**Theatre**" means any building —

(a) In respect of which an exhibitor's licence for the projection of cinematograph, television or video films under the Cinematograph Act and Regulations;

"**Unattended**", in relation to a motor, means that it is automatically controlled or that there is no person normally in attendance on it or on a machine or machines which it operates;

"**Voltage**" means the difference of potential between conductors or between conductors and earth.

3 Application

(1) These by-laws shall apply, subject to the exemptions in subsection (3) of this by-law, to all electrical installations connected or intended to be connected with any source from which electricity is available.

(2) Every addition to, or alteration of, an existing installation shall be deemed to be a new installation in part and subject to the exemptions in subsection (3) of this by-law, all the provisions of these by-laws shall apply to all work done in connection with any such addition or alteration.

(3) The exemptions referred to in subsections (1) and (2) of this by-law —

(a) Any electric line or work used or intended to be used as a distribution line or a service line or used by the Board elsewhere than on any premises;

(b) Electrical wiring or apparatus on any ship, boat, aircraft, conveyance, or vessel, other than that associated with portable or semi-portable appliances connected to the electricity supply on any premises and temporarily used on any ship, boat, aircraft, conveyance, or vessel or associated with any land based appliance connected to an electricity supply on any vessel;

(c) Electrical wiring or apparatus on any road vehicle, if the electrical wiring or apparatus is associated with the propulsion, lighting, or heating of the road vehicle, or is associated with any self-contained lifting or hoisting equipment and is used neither to supply electricity to, nor receive electricity from, any premises;

(d) Any primary battery or installation connected thereto;

(e) Any device or apparatus or material manufactured solely for export or imported solely for re-export;

(f) Any electric fishing machine.

4 Connections

(1) It shall be a condition of every licence granted under the Tonga Electric Power Board Act which is empowered to supply electricity that the Board

shall not connect, nor permit any other person to connect to its lines any consumer's installation except in accordance with law.

(2) Testing of a consumer's installation for the purposes of subsection (1) of this by-law shall be carried out in accordance with Part IX of these by-laws.

(3) It shall also be a condition of every licence that the Board shall not continue to supply electricity to, nor to connect or reconnect any existing installation or part thereof, if —

(a) The installations or any part thereof is not reasonably free from electrical hazard; and

(b) Such work in accordance with these by-laws as it directs is not done to make the installation reasonably so free:

Provided that it shall not be necessary to require strict compliance with these by-laws if unreasonable expenditure is involved and if the installation can otherwise be made reasonably free from electrical hazard.

(4) Where any installation and every appliance connected thereto complies with the requirements of these by-laws the Board may refuse to supply electricity to that installation on the ground that in its opinion the installation or any appliance connected thereto constitutes an electrical hazard.

5 Modification of requirements

(1) Where the Manager is satisfied that strict compliance with these by-laws would involve expenditure out of proportion to the degree of freedom from electrical hazard to be secured by compliance therewith, he may modify any such requirements if he is satisfied that reasonable freedom from electrical hazard can otherwise be secured or that no increase in electrical hazard will result.

(2) In granting any such modification, the Manager shall specify any special work or requirement he considers necessary to ensure reasonable freedom from electrical hazard.

(3) The Manager may at any time rescind any modification if he is satisfied that the electrical hazard has thereby in fact unduly increased.

6 Permission to use other methods and material

The Board may permit the use of methods or types of construction or materials not especially provided for in these by-laws and may impose such conditions as he deems necessary with respect to the use thereof.[2]

7 Prohibited equipment and methods

(1) The Manager may by notice given in the manner specified by subsection (3) to (10) of this by-law prohibit the installation and use of any appliance, apparatus, material, accessory, cable, fitting, machine, switchgear, switchboard, or any other device, or method or type of construction or material, or method of installation, which in his opinion constitutes or may constitute an electrical hazard.

(2) Every person who manufactures or imports for sale, or sells or offers for sale, and every person who installs or causes or permits to be installed, or assists to install on any premises, any device or apparatus or material which does not comply with the requirements of, or which is not of the character specified by these by-laws, or which, in the opinion of the Manager as notified in the manner specified in subsection (3) to (10) of this by-law, constitutes or may constitute an electrical hazard, commits an offence and shall be liable on summary conviction to a fine not exceeding $20.

(3) The Manager may from time to time give public notice or, without a public notice, give notice to any person —

(a) that any appliance, apparatus, material, accessory, cable, fitting, machine, switchgear, switchboard, or any other device or method or type of construction or material, or method of installation referred to in the notice, in his opinion, constitutes an electrical hazard, and that its installation and use are accordingly prohibited under subsection (1) of this by-law; or

(b) that any device or apparatus or material referred to in the notice does not comply with the requirements of, or is not of the character specified by, these by-laws in respect of the device or apparatus, or material, or in his opinion constitutes or may constitute an electrical hazard for the purposes of subsection (2) of this by-law.

(4) The opinion of the Manager on any matter to which subsection (3) of this by-law relates shall be final.

(5) For the purpose of this by-law, the term "public notice" means a notice published in the Gazette or in a newspaper circulating in the locality in which the matter of the notice arises or to which it relates, or the Tonga Broadcasting Commission.

All persons shall be bound by such public notice.

(6) For the purpose of this by-law, a notice may be given to any person by causing it to be delivered to that person, or to be left at his usual or last-known place of abode or business, or at the address specified by him in any application or other document received from him by the Manager, or to be posted in a letter addressed to him at that place of abode or business or at that address. Every person to whom the notice is given shall be bound thereby.

(7) If any such notice is sent to any person by registered letter it shall be deemed to have been delivered to him when it would have been delivered in the ordinary course of post; and proof that the letter was properly addressed and posted shall be sufficient proof that it was delivered.

(8) Every notice under this by-law shall take effect on the date, if any, specified in the notice, or if there is no date specified, when it is published or given. Any such notice may at any time be varied or revoked by a subsequent notice.

(9) Every notice under this by-law shall sufficiently describe by words of particular description or by reference to the maker's name, trade mark, trade name, manufacturer's number, catalogue number, or patent number, or by illustration or by any other means, the article or type of method referred to in the notice.

(10) Any notice under this by-law may, unless in the opinion of the Manager an electrical hazard does or may exist under all conditions specify the conditions or circumstances in which in the opinion of the Manager an electrical hazard does or may exist, or does not exist, in relation to the article, type, or method referred to in the notice.

8 Wiring or methods which do not comply

(1) Every person commits an offence and shall be liable on summary conviction to a fine not exceeding $20 who —

(a) Installs or causes or permits to be installed or assists to install on any premises, any wiring which does not comply with the requirements or which is not of the character specified by these by-laws in respect of that wiring; or any device or apparatus or wiring in a manner contrary to these by-laws;

(b) Assembles, wires up, or repairs any device or apparatus in a manner which does not comply with the requirements of these by-laws in respect to the device or apparatus;

(c) Uses or maintains or causes or permits to be used or maintained on any premises, any apparatus, device, or wiring which does not comply with the requirements or which is not of the character specified by these by-laws in respect of the apparatus, device, or wiring, or in a manner contrary to these by-laws;

(d) Knowingly continues to use or maintains or causes or permits to continue to be used or maintained for or in connection with the supply, distribution, or consumption of electricity any device or apparatus or wiring or any part of an installation if for any reason the device or apparatus or wiring or part of any installation has ceased to comply with the requirements or to be of the character specified by these by-laws in respect thereof.

(2) Subsections (1)(c) and (1)(d) of this by-law shall not apply to any apparatus, device, or wiring installed on any premises before the commencement of these by-laws if the apparatus, device, or wiring is in use on the premises where so installed and is free from electrical hazard.

9 Dispute on technical matters

(1) Any question as to the application of any technical electrical requirement of these by-laws to any electrical installation, appliance, apparatus, material, or method of construction, whether existing or proposed, or as to whether any such requirement that applies to any such installation, appliance, apparatus, material, or method has been or would be complied with, may be referred to the Manager for his advice.

(2) Where the question arises out of a dispute between an electrical contractor; electrician, consumer, or technical adviser of a consumer and the Manager the decision of the Board shall be final.

(3) Except where a final decision has been given by the Board in accordance with subsection (2) of this by-law, if any interested party is not satisfied with the advice given by the Manager, or if the Manager so determines, the question may be referred to the Board for its opinion.

(4) Where the question arises out of a dispute of the kind referred to in subsection (2) of this by-law, and the parties have not agreed to accept the decision of the Manager, the Board's decision shall be final.

(5) The cost of making any investigation under this by-law may be claimed by the Electric Power Board from any of the parties to the dispute as Manager may determine or may be apportioned by him in such manner as he thinks fit, and the amount of the cost shall constitute a debt to and recoverable by the Board.[3]

(6) Nothing in this by-law shall compel the Manager or the said Board to decide any such question as aforesaid, and nothing in this by-law shall preclude any court from deciding any such question as aforesaid, unless a final decision thereon has been given by the Board under subsection (2) or subsection (3) of this by-law.

(7) In this by-law, the Board means the Board of that name that is constituted at the commencement of these by-laws.

10 Permission to install electrical wiring or appliances

(1) Except as provided in by-law 14 hereof, which relates to repair work, every person commits an offence and shall be liable on summary conviction to a fine not exceeding $20 who installs, or commences to install, any electrical wiring, fixed appliance, or permanently connected semi-portable appliance, before he has obtained permission from the Board to carry out the work.

(2) The Board shall, within 21 days after the date of the receipt of an application on a prescribed form giving such details as may be required, give permission for the installation to be carried out. This permission shall not be considered evidence that electricity can or will be supplied.

(3) Should the person making application to carry out electrical wiring work already have had issued to him other permits for electrical wiring work which has not been completed, or for which the completion notice has not been returned within a reasonable period, the Board may refuse to issue a permit or grant permission to the person for new work until outstanding work has been completed and the completion notice or notices returned.

11 Electrical wiring not to be connected without permission

Except as provided in by-law 14 hereof, which relates to repair work, every person commits an offence and shall be liable on summary conviction to a fine not exceeding $20 who connects or causes or permits to be connected, any electrical wiring, fixed appliance, or permanently connected semi-portable appliance to the electric supply before —

(a) he has carried out the tests specified in Part IX hereof; and

(b) he has obtained permission to connect from the Board.

12 Conditions of issue of permit

(1) Every permit issued in accordance with by-law 10 hereof shall be deemed to authorise the installation of the electrical wiring and appliances only on condition that —

(a) the work is commenced within a reasonable period from the date of issue thereof and as notified on the permit and if the work is not commenced within the period the permit shall be void and of no effect;

(b) the work is completed within a reasonable time from the commencement thereof, and if the work be not in the opinion of the Board so completed the Board may by notice in writing to the person to whom the permit was issued withdraw the same and the same shall thereupon cease to have effect;

(c) during the currency of the permit no further permit shall be issued for the same work;

(d) the person undertaking to carry out the work shall, on completion of such work, notify the Board in writing that the work is completed, and that the tests prescribed in Part IX hereof have been satisfied and that, to the best of his knowledge and belief, the installation may be safely connected with the source from which electricity is available. The notice shall include the name and registration number of the electrician in charge of the work, and the results of the prescribed tests;

(e) when instructed in writing by the owner or occupant of the premises in which work is to be done, the Board may by notice in writing to the person to whom the permit was issued, withdraw the same.

(2) Every person who fails to comply with an obligation to notify the Board imposed on him by subsection (1)(d) of this by-law commits an offence and shall be liable on summary conviction to a fine not exceeding $20.

13 Special conditions of permits for temporary installations

(1) The Board may grant permission for a temporary electrical installation upon application being made as in paragraph 10 hereof. The permission will be subject to the same conditions as those issued under by-law 11 hereof and such conditions (not being repugnant to these by-laws) as the Board impose and set out in a written permit, including —

(a) a time limit for which the installation may remain connected;

(b) the frequency of maintenance and overhaul which, in no case, shall exceed 3 months;

(c) any requirements to ensure that this maintenance is carried out as specified; and

(d) the connecting of additions thereto.

(2) Upon the expiration of the period (including any extension thereof) for which the permit was issued, the occupier of the premises on which the installation exists shall have it demolished forthwith.

14 Repair work

(1) In any case of emergency due to breakdown or other accident, any person authorised pursuant to the Electric Power Board (Electrical Contractor) By-laws, to do electrical wiring work may, without obtaining a permit as required by these by-laws, but subject to the provisions of subsection (3) of this regulation, begin any work necessary to repair an installation.

(2) Any person authorised pursuant to the Electric Power Board (Electrical Contractor) By-laws, to do electrical wiring work may, without obtaining a permit as required by these by-laws, but subject to the provisions of subsection (3) of this by-law, repair or replace any faulty accessory, fixed appliance, or permanently-connected semi-portable appliance in an installation.

(3) Any person who carries out any work, repair, or replacement in accordance with subsection (1) or subsection (2) of this by-law that necessitates any alteration or addition to the fixed wiring or increases the connected load of the installation shall make an application for a permit under these by-laws to the Board within 2 working days after the work is begun.

15 Protection against contact with live parts

All live parts of electrical apparatus shall be protected against accidental personal contact either by the design and construction of the apparatus or by the manner of its installation.

16 Marking on apparatus and material

(1) Except as exempted in subsections (3), (4) and (5) of this by-law, all electrical apparatus and material shall be permanently and legibly marked to indicate clearly —

(a) the name of the manufacturer, or the registered trade name or registered trade mark; and

(b) tn the case of current-carrying apparatus, the maximum operating voltage and either amperage or wattage.

(2) In addition to the markings prescribed by subsection (1) of this by-law, there shall be permanently and legibly marked —

(a) on every generator having a capacity exceeding 0.5 kilowatt, the output, the voltage between terminals at the rated output, the speed in revolutions per minute, and, if an alternator, the number of phases and the frequency;

(b) on every transformer (other than a transformer used for radio, visual, or sound reproduction purposes) the output, the voltage between secondary terminals, the number of phases, and the frequency where the capacity exceeds 0.5 kilovolt-ampere, and, where applicable, if of the current-limiting type;

(c) on every battery charger and rectifier, the input, the voltage between input terminals, the voltage between the polarity of the output terminals, and in the case of alternating current the number of phases and the frequency;

(d) on every capacitor (other than a capacitor used for radio, visual, or sound reproduction purposes), or radio interference suppressor, the capacity, the working voltage, and where applicable, the number of phases, the phase connections, and the frequency.

(3) Marking of the maximum operating voltage and amperage or wattage, as required by subsection (1) of this by-law may be omitted from bayonet lampholders and lampholder adaptors, screw lampholders, ceiling roses, and overhead line connector boxes, that comply with the directions of the Manager.

(4) Marking as prescribed by subsections (1) and (2) of this by-law may be omitted from the integral components of apparatus where the apparatus as a whole is adequately marked for the purposes of this by-law.

(5) Marking of amperage or wattage, as required by subsection (1) of this by-law, may be omitted from electric dry-shavers.

17 Marking of cables

(1) Every cable, flexible cable, and flexible cord insulated, or sheathed, or both insulated and sheathed, with rubber or thermoplastic material shall have an acceptable marking or equivalent means of identifying throughout its entire length that it is the product of a particular manufacturer.

(2) Cables, flexible cables, and flexible cords insulated, or sheathed, or both insulated and sheathed, with rubber or thermoplastic material and having a grade of insulation other than 300-volt grade shall have a readily identifiable permanent marking to indicate the grade. The marking shall appear at intervals of not more than 300 mm.

18 Apparatus and materials submitted for opinion

Any electrical apparatus or material may be submitted to the Manager for his opinion as to its compliance with the requirements of these by-laws. Any such submission shall be in such form as the Manager may require, and a fee of $3.00 shall be payable for the inspection of each article submitted.

19 Submission of unsatisfactory apparatus

(1) Any electrical apparatus or material considered by any person to be unsatisfactory may be submitted to the Board for inspection.

(2) Any electrical apparatus or material considered unsatisfactory by the Board may be submitted to the Manager for inspection, in which case it shall be accompanied by a statement setting out in full the objections of the Board to its use.

PART III - SAFETY REQUIREMENTS

20 Construction and conditions of use

All conductors (including flexible conductors) and apparatus (including portable apparatus) shall be sufficient in size and power for the purposes for which the supply of energy is to be used and shall be constructed, installed, and protected so as to prevent danger so far as reasonably practicable.

21 Positions of fuses, switches, and circuit breakers

No fuse, non-linked switch, or non-linked circuit breaker shall be inserted in a conductor connected with earth; and all single-pole switches shall be inserted in live conductors only, except that a single-pole switch may be in an earthed conductor where it is necessary to prevent circulating currents.

22 Insulation and protection of live conductors

All live conductors, including those forming part of apparatus, shall be so insulated, and further effectively protected where necessary, or so placed and safeguarded, as to prevent danger from electric shock or fire.

23 Protection against excess current

Every distinct circuit shall be protected against excess current and energy by means of a suitable fuse or automatic circuit breaker of adequate breaking capacity suitably located and of such construction as to prevent danger from over-heating, arcing, or the scattering of hot metal when it comes into operation and as to permit the ready renewal of fusible metal without danger.

24 Precautions against metal becoming alive

Any metalwork (other than the current-carrying conductors) enclosing, supporting, or otherwise associated with any such conductors operating at a voltage in excess of extra-low voltage shall, where necessary to prevent danger, be connected with earth.

25 Protection against effects of leakage to earth

Every circuit shall be protected against the persistence of leakage to earth of currents liable to cause danger.

26 Isolation of installation and apparatus

Such efficient means, suitably located, shall be provided for cutting off all voltage from every part of an installation as may be necessary to prevent danger.

27 Position of apparatus

Every piece of electrical apparatus which requires operation or attention in normal use shall be so installed that adequate means of access and working space are afforded for its operation or attention. Every electric motor shall be controlled by an effective switch or switches for starting and stopping, and the Switch or switches shall be so placed as to be readily accessible to and easily operated by the person in charge of the motor.

28 Precautions for special conditions

All electrical apparatus and conductors exposed to weather, corrosive atmospheres, or other adverse conditions shall be so constructed or protected as may be necessary to prevent danger arising from such exposure. Where the conditions comprise exposure to flammable surroundings or an explosive atmosphere, the conductor or apparatus shall be protected by an enclosure of an appropriate standard of construction, or be otherwise of such construction or intrinsically safe characteristics as to prevent danger.

29 Addition to an installation

No addition, temporary or permanent, shall be made to the load of an existing installation, unless it has been ascertained that the current rating and the condition of any existing apparatus and conductors (including that of the Board) which will have to carry the additional load are adequate for the increased loading. The earthing arrangements shall also be adequate.

30 Voltage exceeding low voltage

Conductors and apparatus operating at a voltage exceeding low voltage shall be completely enclosed in earthed metal which is electrically continuous and adequately protected against mechanical damage; or, alternatively be so constructed, installed, and protected as to prevent danger so far as is reasonably practicable.

PART IV - DISTRIBUTION AND CONTROL

31 Switchgear

(1) Every main switchboard controlling the supply from an external source shall be fitted with the switchgear specified in table 1 hereof.

(2) Every distribution board shall be fitted with the switchgear specified in column 4 of table 1 hereof except that, where fuses are used at the point of tap-off from a common submain in accordance with regulation 45 hereof the fuses need not be controlled by an adjacent switch if there is not more than one such fuse per phase.

(3) Every main switchboard controlling the supply from a private generating plant or from secondary batteries shall be fitted with the switchgear specified in table 2 hereof.

32 Position of main switchboard

The main switchboard controlling an installation shall be readily accessible to the consumer, and both switchboard and meters shall be located to the satisfaction of the Board.

33 Position of switchboards

(1) Every switchboard shall be installed and maintained in an accessible position and (where possible) in dry, well ventilated situations where flammable or explosive dust, vapour, or gas cannot accumulate, and shall be arranged to prevent the access of corrosive fumes thereto.

(2) Every switchboard in a damp situation or in a situation where flammable or explosive dust, vapour, or gas is likely to be present, shall be of the enclosed type or of the flameproof type, as may be necessitated by the particular circumstances.

(3) No switchboard shall be erected above a stove, laundry copper, tub, washboiler, or the like, nor in a bathroom, lift well, freezing chamber, or cooling chamber.

(4) No switchboard shall be erected in a lavatory, or on or under a stairway, unless the switchboard is totally enclosed in metal except that any switchboard may be erected beneath a stairway built of fireproof materials.

34 Isolation

Provision shall be made for the isolating of all conductors of the installation from the supply for the purpose of tests. To avoid risk of interruption of a neutral conductor when any other conductor is energised, any link used in a neutral conductor shall be arranged so that either it is in contact before the switches in the other conductors can be closed or it shall be securely fixed by bolts or screws.

35 Access to switchboard wiring

(1) Where it is necessary to have access to the back of a fixed switchboard for wiring purposes, the switchboard shall be placed so that reasonable and adequate access can be obtained either from each side, or from one side and the top and bottom, or from the back.

(2) Where there is any live metal, at a voltage in excess of extra-low voltage, exposed at the back of a switchboard, the board shall be placed so that there will be a space of not less than 300 mm between the metal and any object (not being part of the switchboard) which is not readily movable. The live metal shall be made inaccessible by screening or otherwise. Where a door is provided for entry to the back of the switchboard, it shall be provided with a

spring or other device which shall ensure that the door remains wide open when not properly shut and locked.

(3) Where an access passageway is provided behind a switchboard, all stays and conductors shall be arranged so as to allow a clearance above floor level over the space behind the switchboard of not less than 1.8 m for stays and insulated conductors and not less than 2 m for bare conductors. The minimum width of the passage shall be 610 mm.

36 Busbars for neutral and earth continuity conductors

(1) Where the neutral conductor of the supply is earthed, there shall be fitted to each switchboard a busbar which shall be insulated from any earthed metal associated with the switchboard and to which neutral conductors shall be connected, and a separate busbar to which earth-continuity conductors shall be connected.

(2) The neutral busbar and the earth-continuity-conductor busbar shall both be of adequate dimension and shall be effectively connected together in such a manner that they may be readily separated for the purpose of testing.

(3) The neutral conductors and the earth-continuity conductors shall be connected to their respective busbars in such a manner that each conductor may be readily removed.

(4) In the case of a multiple-earthed-neutral system, the service-main neutral shall terminate in a separate permanently attached cable socket which, together with the main earthing lead cable socket, shall be securely and effectively connected to the neutral busbar on the main switchboard by means of a nut and a locknut in a manner which will readily permit separation of each cable socket from the busbar for the purpose of testing.

(5) Notwithstanding anything in subsection (4) of this by-law any potential wire required for the purpose of metering may be connected in the service-main-neutral cable socket.

37 Protection against spread of fire

Every switchboard shall be of such design and construction as to minimise the risk of fire on the switchboard itself or in its associated wiring, and also to minimise the risk of any fire, arcing, or sparking on the switchboard causing ignition of adjacent ignitable material, including wooden walls and ceilings. The ends of all cable ducts shall be made draught-proof.

38 Construction of switchboards

Switchboards shall be constructed wholly of durable materials having adequate mechanical strength and, where insulating panels are used, these shall have non-

ignitable or self-extinguishing properties and, if intended to be in direct contact with live metal, shall be of permanently high dielectric strength and insulation resistance.

39 Fuses, switches, etc. at rear of switchboard

Except where full rear access is provided, no fuse, circuit breaker, or switch (other than an isolating switch or link) shall be fixed on the back of any switchboard, if it is necessary to replace a fuse link, or operate the circuit breaker or switch, from behind the panel.

40 Identification

All control and protective apparatus on every switchboard shall be clearly and permanently labelled for the purpose of identification.

41 Common submain

Where there is more than one distribution board connected to a common submain, isolating switches or fuses shall be mounted on or adjacent to the point of tap-off for the purpose of isolating each distribution board from the submain.

42 Breaking capacity of protective devices

Throughout an installation, the breaking capacity of any fuse or circuit breaker shall be adequately related to the maximum short-circuit current attainable at the point of installation.

43 Position of switches and protective devices

(1) In a two-wire installation with one conductor earthed, single-pole switches, circuit breakers, fuses, or thermostats shall be fitted in the phase or outer (non-earthed) conductor only.

(2) Non-adjustable or pre-set control devices may be connected in the neutral conductor in any case where —

(a) they fulfil their designed purposes under fault conditions; and

(b) all parts liable to become alive are totally enclosed.

(3) In any two-wire installation in which neither conductor is earthed, all single-pole switches and circuit breakers shall be fitted in the same conductor throughout.

(4) Where switches or circuit breakers are required to control more than one live conductor of a circuit, they shall be arranged to operate simultaneously in all live conductors.

(5) Any linked or multi-pole switch or circuit breaker inserted in a neutral, middle, or earthed conductor shall be so arranged that the contacts to which the neutral, middle, or earthed conductor are connected cannot be opened before or closed after the contacts to which the live conductors are connected.

44 Relative ratings of conductor and protective devices

(1) Every conductor in an installation, unless exempted under the provisions of subsection (2) of this by-law, shall be protected against excess current by a fuse or circuit breaker fitted at the origin of the circuit of which it forms part. The current rating of every fuse used for this purpose shall not exceed that of the lowest-rated conductor (appropriate to the class of fuse) in the circuit protected. Every circuit breaker used for this purpose shall operate when the circuit protected is subjected to a sustained excess current of 1.5 times the rating (appropriate to this form of protection) of the lowest-rated conductor in the circuit.

(2) The exemptions referred to in subsection (1) of this by-law are the following —

(a) ring circuits installed in accordance with by-law 46 hereof;

(b) motor circuits installed in accordance with by-law 104 hereof;

(c) wiring of pilot-lamp circuits enclosed in earthed metal or non-ignitable insulating material and auxiliary circuits of apparatus contained within the enclosure of that apparatus;

(d) flexible cords connected to portable appliances;

(e) circuits in which the omission of a fuse is necessary for technical reasons;

(f) cables not exceeding 2 m in length used for connecting switchgear, if the rating of the cable is not less than half that provided under this by-law, except that, where the cables are used for connections in a fire-resistant enclosure behind a switchboard, the rating of the cable may be not less than one-fifth of that provided under this by-law but in no case less than 2.5 mm^2 (1/1.78 mm or 7/0.67 mm);

(g) busbars supplied at the mid-point of their length and protected by a fuse of not more than twice the current rating of the busbars;

(h) service mains where protection against excess current and energy is provided by the Board.

45 Service mains and submains

(1) Service mains and submains shall have a current-carrying capacity not less than the maximum demand of the installation connected thereto, save that —

(a) the neutral of a service main or submain need be capable of carrying 0nly the maximum current which may be imposed on it:

Provided that at no time shall it have a less cross-sectional area than its corresponding earth conductor, or be less than half the cross-sectional area of the related service main or submain phase conductors;

(b) the cross-sectional area of any service main conductor shall be not less than 4 mm2 (7/0.85 mm).

(2) The maximum demand of an installation for the purpose of subsection (1) of this by-law shall be determined by one or other of the following methods unless evidence acceptable to the Board is produced to justify a lower maximum demand being adopted —

(a) by a maximum-demand indicator or recorder installed to the satisfaction of the Board;

(b) by the current rating of a circuit breaker having fixed nonadjustable time/current characteristics and so connected as to limit the current in a service main or submain;

(c) by the load setting of the over-current release on a circuit breaker having adjustable time/current characteristics if the release is so connected as to limit the current in a service main or submain and is calibrated, adjusted, enclosed and sealed to the satisfaction of the Board:

(d) by estimation in accordance with table 3 of these by-laws.

46 Number of points on, and current rating of, subcircuits

(1) Subcircuits supplying one lamp, one plug socket, or one appliance are not limited as to current rating.

(2) Where more than one point is provided on a subcircuit, the maximum number of points of, and maximum protective current rating of the subcircuit shall be in accordance with the following —

Type of Subcircuit	**Maximum Number of Points**	**Maximum Rating of Subcircuit**	**Cable Size**
(a) Lighting, including fixed connections for small appliances not exceeding 100 watts rating	Any number	15 amperes	Not smaller than subcircuit rating.
(b) Plug sockets of similar rating protected by a fuse	4	30 amperes	Not smaller than subcircuit rating.
(c) Plug sockets of similar rating protected by a circuit breaker having fixed non-adjustable time/current characteristics	Any number	20 amperes	Not smaller than circuit breaker rating.
	Any number	60 amperes	Not smaller

Type of Subcircuit	Maximum Number of Points	Maximum Rating of Subcircuit	Cable Size
(i) Plug sockets rated at less than 10 amp (ii) Plug sockets rated at 10 amp or more			than circuit breaker rating.
(d) Plug sockets of differing current ratings protected by a circuit breaker having fixed non adjustable time-current characteristics	Any number	20 amperes	Not smaller than circuit breaker rating.
(e) Plug sockets for use with fused plugs and connected to a ring circuit protected by a fuse	House or flat - Any number Other premises -6	30 amperes	Not smaller than 20 amp rating.
(f) Plug sockets for use with fused plugs and connected to a ring circuit protected by a miniature circuit breaker having fixed non-adjustable time/current characteristics	Any. number	30 amperes	Not smaller than 20 amp rating.
(g) Fixed appliances and permanently connected semiportable appliances where each appliance has individual excess-current protection or the circuit protection provides each appliance with excess current protection	Any number	Not limited	Not smaller than subcircuit rating.
(h) Air conditioner separate circuit	1	Not limited	Not smaller than subcircuit rating.

47 Maximum demand of subcircuits

(1) The maximum demand in amperes of a subcircuit protected by a circuit breaker having fixed non-adjustable time/current characteristics shall be the current rating of the circuit breaker.

(2) The maximum demand in amperes of a sub-circuit protected by any other type of circuit breaker shall be the minimum tripping current of the circuit breaker and the calibration, adjustment, enclosure, and sealing of any such circuit breaker shall be to the satisfaction of the Board.

(3) The maximum demand of a subcircuit protected by a fuse or fuses shall be taken as the full connected load, and, for the purposes of this subsection —

(a) each lighting fitting shall be rated at 100 watts or the actual wattage of the lamp or lamps installed whichever is the greater and

(b) each subcircuit supplying plug sockets shall be deemed to have a full connected load equivalent to the current rating of the subcircuit as determined under by-law 46 hereof.

48 Control and indicating circuits

(1) Conductors of control and indicating circuits for remote-controlled equipment shall be protected in accordance with the requirements of by-law 44 hereof, which relates to the relative ratings of conductors and protective devices.

(2) Where any such conductors are completely enclosed in metal they need not be protected as required by subsection (1) of this by-law, if —

(a) the current-carrying capacity of the control-circuit or indicating-circuit conductors is not less than one-third of the current-carrying capacity of the subcircuit conductors;

(b) the equipment and its point of control or indication are both located on the same machine or apparatus, and the control or indicating circuit does not extend beyond;

(c) the point of control or indication is located on or within 300 mm of the control panel or equivalent, and the control or indicating circuit does not extend more than 300 mm beyond the control panel or equipment; or

(d) the opening of the control circuit would create a hazard.

(3) The provisions of subsection (2) of this by-law shall not apply to any aerial portion of a circuit that is otherwise enclosed in metal.

49 Control of points

(1) Every point shall be controlled by a switch or switches, unless it takes the form of a plug socket not exceeding 30 amperes rating connected to a low-voltage alternating current supply from which the plug is readily withdrawable. The means of control shall be readily accessible.

(2) Every plug socket connected to a direct-current supply shall be controlled by a switch immediately adjacent thereto or combined therewith.

50 Connection of subcircuit

(1) Every subcircuit shall be connected to a separate fuse or circuit breaker on a switchboard or where there is only one such subcircuit it may be directly connected to the main switchgear.

(2) Except as provided in subsection (3) of this by-law or by-law 80(12) hereof, which relates to aerial lines, the wiring of each subcircuit shall be electrically separate from that of every other sub-circuit.

(3) If, in an installation provided with three-phase supply, 2 or 3 two-wire low-voltage subcircuits are so wired that the live conductor of each subcircuit is supplied from a separate phase, those subcircuits may have a common neutral conductor if the following conditions are fulfilled —

(a) the 3 or 4 conductors, as the case may be, shall emerge from one distribution board;

(b) the neutral conductor shall not be smaller than the largest phase conductor;

(c) at all parts of the circuit the conductors shall be grouped together;

(d) there shall not be any inter-connection between the phases in any part of the subcircuit;

(e) the protection and control for all conductors of a circuit having a neutral in common shall, at the distribution boards, be so grouped and identified as to minimise the possibility of the disconnection of the subcircuit neutral from the source of supply while any subcircuit phase conductor remains alive.

PART V - INSTALLATION OF CONDUCTORS AND CABLES

51 Insulation of cables

Conductors of cables shall be insulated with the correct grade of insulation in accordance with by-laws or instructions issued by the Board to withstand a voltage not less than the highest sustained r.m.s, voltage to which they are likely to be subjected.

52 Maximum current in conductors

The maximum current in any bare conductor or cable conductor shall not exceed the current rating approved for the type of conductor or cable in accordance with conditions of use approved by the Manager.

53 Voltage drop in conductors

The size of every bare conductor or cable conductor shall be such that the drop in voltage from the terminals of the main switch on the main switchboard to any point in the installation does not exceed 2.5 per cent of the standard voltage at the main switchboard when the conductors are carrying their maximum current under normal conditions of service:

Provided that the requirements of this by-law need not apply during motor starting, solenoid closing, and other similar applications where high instantaneous currents may be experienced.

54 Minimum size of conductor

No cable having a conductor of a cross-sectional area less than 1 mm^2 (1/1.13 mm diameter) and no flexible cord having a conductor of a cross-sectional area less than 0.75 mm^2 (24/0.20 mm diameter) shall be used, save that —

(a) a conductor having a cross-sectional area not less than 0.5 mm^2 (16/0.20 mm diameter) may be used in the flexible cord connected to a portable appliance or to a lighting fitting that is supported by some means other than the flexible cord conductors;

(b) the minimum cross-sectional area of an earthing conductor shall be in accordance with by-law 149 hereof which relates to earth-continuity conductors, and by-law 150 hereof, which relates to earthing leads, as appropriate;

(c) the minimum cross-sectional area of any aerial conductor shall be 6 mm^2 (7/1.04 ram);

(d) this by-law shall not apply to the internal wiring of apparatus, appliances, and lighting fittings;

(e) flexible cord having a conductor of a cross-sectional area not less than 0.25 mm^2 (7/0.20 mm diameter) may be used with sub-miniature lamps in decorative lighting sets complying with any directions made by the Manager;

(f) the minimum cross-sectional area of any conductor of switchboard wiring shall be 2.5 mm^2 1.178 mm;

(g) any conductor supported by a catenary wire out of doors shall have a minimum cross-sectional area of 2.5 mm^2 and shall be stranded.

55 Maximum size of solid conductor

All conductors having a nominal Cross-sectional area exceeding 2.5 mm^2 (1.178 mm diameter) shall be stranded except the following —

earthing conductors in composite cables in accordance with table 7 of these by-laws;

earthing conductors of greater cross-sectional area than 35 mm^2 (19/1.53 mm or 276/0.40 mm);

conductors of mineral-insulated metal-sheathed cables;

conductors used within an appliance;

conductors used for switchboard wiring;

conductors within switchgear and controlling devices;

busbars;

collector or trolley wires;

conductors of solidal type cables.

56 Cables unsuitable for alternating current

Single-core cables armoured with steel wire or tape shall not be used for alternating current.

57 Enclosure of alternating-current cables

(1) Except in the case of high-voltage or extra-high-voltage cables for electric discharge lamp installations, all conductors of a circuit, when enclosed in magnetic material and carrying alternating current, shall be installed in the same enclosure.

(2) Where single-core cables having a non-magnetic metallic armouring or sheathing are used for alternating current, the lead and return cables shall be placed as near as possible to each other.

58 Identification of conductors

(1) Throughout an installation, conductors of cables used for fixed wiring shall, subject to the exemptions provided for in paragraph (5) of this by-law be identifiable by one of the following methods —

(a) the colour of the insulation or covering;

(b) the colour of an insulating-sleeve fitted on the dielectric or on the conductor where it emerges from the dielectric;

(c) a system of numbers where such is the prescribed method for a cable as may be prescribed;

(d) some other approved method.

(2) Where, for the purposes of paragraph (1) of this by-law the identification of conductors is by colour —

(a) the colour black shall be used only (and no other colour shall be used) for neutral or any other earthed conductors, for the middle wire of a direct current or single-phase alternating current three-wire system, and for the negative of a direct current two-wire system; and

(b) the colour green or the colours green and yellow in combination shall be used only (and no other colour shall be used) for earthing conductors.

(3) The core conductors of flexible cables other than flexible cords may, subject to the exemptions provided in paragraph (5) of this by-law, be of any colour:

Provided that the colour green or the colours green and yellow in combination shall be used only, and no other colour shall be used for earth continuity conductors.

(4) The core conductors of flexible cords shall, subject to the exemptions provided for in paragraph (5), be identifiable throughout their length by the colour of the insulation or covering of the conductors as follows —

(a) for single-phase three-core flexible cords the following combination of colours —

Either:

Phase conductor	red
Neutral conductor	black
Earth-continuity conductor	green

Or

Phase conductor	brown
Neutral conductor	blue
Earth-continuity conductor	green and yellow;

(b) for any flexible cords other than that specified in paragraph (a) of this subsection, core conductors may be of any colour:

Provided that the colour green or the colours green and yellow in combination shall be used only, and no other colour shall be used, for earth-continuity conductors.

(5) Conductors used for the purposes specified in paragraph (6) of this by-law shall be exempt from compliance with paragraphs (1), (2), (3), and (4) of this by-law:

Provided that, where there is more than one conductor all shall be of the one colour; and for this purpose bare conductors shall be considered to be uncoloured.

(6) Subsection (5) of this by-law shall apply to conductors which are of the following types or are used for the following purposes —

(a) aerial conductors;

(b) bare earthing conductors enclosed within the sheath of metal-sheathed, tough-rubber-sheathed, or PVC-sheathed cables;

(c) conductors used for high-voltage or extra-high-voltage electric-discharge-lamp wiring;

(d) conductors used as an integral part of the internal wiring of apparatus and appliances;

(e) two-core flexible cord connected to the supply by means of a reversible plug or adaptor;

(f) two-core flexible cord —

(i) in which the provision for identifying the manufacturer is also suitable as a means of identifying the conductors;

(ii) which has one tinned and one untinned copper conductor; or

(iii) of the flat twin type which has a longitudinal rib along the outer covering of one of the cores.

(7) The colours green and yellow in combination used for the identification of the earth-continuity conductor in a flexible cable or cord shall be clearly discernible and on any length of 15 mm of the core one of the colours green or yellow shall cover not less than 30 per cent, and not more than 70 per cent, of the surface of the core, the other colour covering the remainder of the surface.

59 Cable terminations

Terminations of cable conductors and of bare conductors shall be accessible for inspection, shall be mechanically and electrically sound, and shall comply with the following requirements —

(a) every connection to a terminal or cable socket shall securely contain and anchor all the wires of the conductor, and shall not impose any appreciable mechanical stress on the terminal or cable socket;

(b) the insulating material of the cable shall be terminated so as to maintain the quality of the insulation under the conditions of temperature and moisture it is subject to in service;

(c) the termination of cables in flammable or explosive situations shall be avoided wherever possible;, and where this is not possible the termination shall be protected by a flame-proof enclosure of an appropriate standard of construction, or be otherwise of such construction or intrinsically safe characteristics, as to prevent danger;

(d) soldering-fluxes containing acid or other corrosive substances shall not be used.

60 Connections between conductors

(1) All connections between conductors shall be mechanically and electrically sound, accessible for inspection (except in the case of cables buried in the ground, or floor-warming cables buried in concrete) and made either —

(a) at the terminals of accessories and appliances;

(b) by means of mechanical connectors; or

(c) by means of soldered, brazed, or welded joints.

(2) Connections shall be installed so that the mechanical and insulating properties of the cables so connected are maintained under the conditions of temperature and moisture to which the cables are subject in service.

(3) Connections between cables and flexible cords shall be made only by means of a plug and socket, a ceiling rose, or other suitable enclosed connecting device.

(4) Connections between flexible cords and between flexible cables, except within a lighting fitting or an appliance, shall be made only by means of a substantial coupling of connector of the plug and socket type properly insulated so that its live parts are guarded or recessed to prevent accidental personal contact therewith both when uncoupled and when coupled together.

(5) The connections between any aerial conductor and any service main, submain, or subcircuit conductor that is not an aerial conductor shall be carried out in conformity with the provisions of by-law 80 hereof, which relates to aerial lines.

61 Protection against mechanical damage

(1) All cables, including underground cables, shall be adequately protected against any risk of mechanical damage to which, having regard to the nature of their covering, they may be liable in normal conditions of service. Where conduits, ducts, trunking, or casings are liable to mechanical damage they shall be adequately protected.

(2) Except with the permission in writing of the proper authority, cables of any type not forming part of the lift installation shall not be installed in a lift shaft.

(3) All cables (other than trailing cables) installed for any purpose in a lift or hoist shaft shall be armoured, or be enclosed in steel conduit, duct, or trunking, or copper conduit, or high-impact rigid PVC conduit, or be of the mineral-insulated metal-sheathed type of the aluminium-sheathed type, except that multi-core control cables sheathed with non-flammable thermo-plastic material may be installed on the side of a suitable wood batten if they are mechanically protected by a metallic casing to the satisfaction of the proper authority.

(4) Where cables are installed under floors, they shall be located in such positions that they are not liable to damage due to contact with the floor or its fixings.

(5) Where a cable passes through structural metalwork, the hole shall be so treated as to prevent abrasion of the cable.

(6) Tough-rubber-sheathed cables shall not be exposed to direct sunlight.

(7) Where a cable is bent, the radius of the bend shall be not less than the appropriate values set out in table 4 hereof.

62 Protection of cables against damage by extremes of temperature

Every cable shall be so selected and installed as to be suitable for operation under such ambient temperatures of its surroundings as are likely to occur.

63 Protection of cables against fire or explosion

(1) Cables installed in a situation where flammable or explosive dust, vapour, or gas is likely to be present, or where explosive materials are handled or stored, shall be enclosed in conduit suitable for the location, or shall be metal-sheathed and armoured or mineral-insulated metal-sheathed cables. Where a run of conduit passes from a danger area to a safe area, a flameproof sealing box shall be inserted where the conduit enters the safe area.

(2) Where cables or their enclosures pass through party walls or fire-resisting floors, walls, partitions, or ceilings, the holes through which they pass shall be plugged with fireclay or similar non-ignitable material, no space through which fire might spread being left around the cables or their enclosures. In addition, where cables or conductors are installed in channels, troughing, or trunking which pass through fire-resisting floors, walls, partitions, or ceilings, such suitable internal fire-resisting barriers shall be provided as may be necessary to prevent the spread of fire.

64 Protection of cables and metal conduit against corrosion

(1) Unless they are suitably designed and installed, cables shall be fixed in positions where they, will not be exposed to rain, dripping, water, or condensed water, or accumulations of water or oil, or to corrosive substances.

(2) In damp situations and wherever they are exposed to weather, metal conduit or ducts, metal sheaths or armour of cables, and clips and their fixings, shall be of corrosion-resisting material or finish and shall not be placed in contact with other metals with which they are liable to set up electrolytic action. Aluminium-sheathed cables installed in underground pipes or in concrete ducts shall be provided with a suitable corrosion-resistant finish.

65 Supports for cables

(1) Every cable installed in or on a building shall be supported by one of the methods set out in paragraphs (a) to (f) of subsection (2) of this by-law, and supports shall be so arranged that there is no undue mechanical stress on any cable.

(2) The methods of support required by subsection (1) of this by-law shall be as follows —

(a) Cables of open wiring shall be supported on suitable insulators or cleats having smooth or rounded edges and so spaced as to prevent the cables

from coming into contact with each other or with any part of the building or other object;

(b) Tough-rubber-sheathed, tough-plastic-sheathed, or lead-sheathed cable installed in positions accessible without structural alteration shall be supported by clips at distances not exceeding those set out in table 5 hereof; and

(i) where run parallel with ceiling joists, shall be attached to the side thereof; and

(ii) where laid across ceiling joists at any angle, shall be attached to the side of soft-wood strips of adequate cross-sectional area which in no case shall be less than 650 mm^2 with a minimum depth of 20 mm:

(c) In situations where sheathed or armoured cables are inaccessible and unlikely to be disturbed, horizontal runs may rest without fixing on part of a building if the surface is dry and reasonably smooth. A vertical or near-vertical run without intermediate support in such a situation shall not exceed 2 m in length for a lead-sheathed cable without armour, or 5 m for tough-rubber-sheathed or tough-plastic-sheathed cable without armour, and the cable shall be supported at the top of the run by being clipped and brought over a rounded support of a radius not less than the appropriate value shown in table 4 thereof;

(d) Tough-rubber-sheathed or tough-plastic-sheathed cable supported by a separate catenary wire shall either be continuously bound up with the catenary wire or attached thereto at intervals not more than twice those set out in column 3 of table 5 hereof; and if lead-sheathed cables are so supported, they shall be attached at intervals not exceeding those set out in column 3 of table 5 hereof;

(e) Cable supported by a self-contained catenary wire shall not span a distance greater than that for which the cable is designed;

(f) Metal-sheathed cables, conduit, ducts, troughing, and wood casing shall be securely fixed.

66 Segregation of services

(1) Cables for power, lighting, and heating, operating at a voltage exceeding extra-low voltage, shall not be installed in the same conduit, duct, trough, or casing as the cables of extra-low-voltage systems or of radio, telephone, bell, call, or sound-distribution systems, unless the latter are insulated for the highest voltage present in the power, lighting, and heating cables.

(2) Where a common enclosure is used to contain cables insulated for the two categories of circuit, these shall be effectually segregated.

(3) Where controls or outlets for both categories of circuit are mounted in or on common boxes, switch plates, or blocks, the wiring and connections of the

two categories of circuit shall be separated from each other by means of rigidly fixed screens or partitions.

(4) Where any conductor of a multi-core cable, flexible cable, or flexible cord operates at a voltage exceeding extra-low voltage, no other conductor of that cable or flexible cord shall be used in any system operating at extra-low voltage, or in any radio, telephone, bell, call, or sound-distribution circuit unless all conductors are insulated for the highest voltage present in the cable or flexible cord, or the conductors used for extra-low voltage, radio, telephone, bell, call, or sound-distribution circuits are provided with an earthed metallic screen.

(5) The metal sheath or armour and the tough rubber or tough plastic sheath of all cables operating at a voltage exceeding extra-low voltage, and earth-continuity conductors or metal conduits, troughs, or trunking associated with those cables, shall, subject to the provisions of subsection (6) of this by-law be prevented from coming into contact with —

(a) Any part of a wiring system operating at extra-low voltage, or of any radio, telephone, bell, call, or sound-distribution circuit or other system not conforming to the requirements of these by-laws; or

(b) The metal pipes of other service, including gas or water, or non-earthed metalwork.

(6) Where it is impracticable to achieve the separation called for in subsection (5)(b) of this by-law the metal sheath and armour of cable, and the metal conduit, troughing, or trunking and other earth-continuity conductors of the electrical installation shall be bonded to the exposed metal of the other service or to the non-earthed metalwork so as to prevent appreciable voltage differences at points of contact.

67 Additional requirements for bare conductors

(1) Bare and lightly insulated conductors, including those that are taped or painted or both taped and painted, may be installed for the following purposes only —

(a) earthing connections;

(b) the conductors of extra-low voltage systems;

(c) protected rising-main and busbar systems;

(d) collector wires for travelling cranes or trolleys, or for similar purposes,

(e) secondary battery connections;

(f) high-voltage and extra-high-voltage electric-discharge-lamp connections not exceeding 300 mm in length;

(g) aerial conductors installed in accordance with by-law 80.

(2) Bare conductors used as collector or trolley wires shall be solid hard-drawn.

(3) For rising-main and busbar systems operating at a voltage exceeding extra-low voltage, bare conductors shall be installed in accordance with the following requirements —

(a) the conductors shall be so installed that they are inaccessible to unauthorised persons and shall either be totally enclosed in earthed metal or fixed in a chase, channel, trunking, or shaft specially provided for the purpose;

(b) the conductors and insulators shall be of adequate strength to withstand the electro-mechanical forces that may be set up by the prospective short-circuit current;

(c) the conductors shall be free to expand and contract, as the temperature changes, without detriment to themselves or to any other part of the installation;

(d) at each straining position, suitable straining gear fitted with adequate insulation shall be provided;

(e) conductors passing through floors, walls, partitions, or ceilings shall pass through directly and shall be protected by enclosure in non-absorbent, incombustible, insulating material, unless earthed metal trunking is used.

(4) For extra-low-voltage systems the insulation shall be adequate, and protection shall be provided to guard against risk of fire.

(5) Bare conductors used as earthing leads or earth-continuity conductors shall be adequately supported and shall be run, as far as possible, to avoid risk of interference and shall be protected against mechanical injury.

68 Additional requirements for open wiring

(1) In no case shall open wiring be used unless permission in writing is first obtained from the Board, which shall give such permission only where encased wiring would be unsuitable.

(2) Rubber-insulated and braided, or plastic-insulated cables may be installed on insulators without further protection of conduit, duct, troughing, or casing if the relevant requirements of by-laws 51 to 66 hereof and the following requirements are complied with —

(a) the Cables shall be open to view throughout their length, except where additional protection is provided;

(b) the cables shall pass directly through floors, walls, partitions, ceilings, and other similar things, and shall be protected by being enclosed in metal or other non-absorbent, incombustible conduits.

69 Additional requirements for cables that are metal sheathed or armoured or both

(1) Metal sheaths and armour of cables and associated accessories shall be earthed in accordance with the requirements of Part VIII of these by-laws which relates to earthing, and if the sheath and armour of either is used as the earth-continuity conductor the requirements of by-law 149 hereof shall be complied with. Where non-metallic joint boxes are used, means shall be provided to maintain the continuity, such as a metal strip having a resistance not greater than that of the sheath of the largest cable entering the box.

(2) Unarmoured metal-sheathed cables in which each core within the sheathing is independent mechanically of any other core and where unfilled interstices exist between the cores and the sheathing shall contain a bare earth-continuity conductor within the sheathing.

70 Conduit systems, metallic and non-metallic

Conduit systems normally enclosing rubber-insulated and braided or plastic-insulated cables shall comply with the following requirements —

(a) The conduits for each circuit shall be elected complete before any cable is drawn in;

(b) The maximum number of cables run in one conduit shall permit of easy drawing-in of the cables and shall be such that a space factor of 40 per cent is not exceeded;

(c) The radius of any conduit bend shall be such as to fulfil the requirements of by-law 61(7) hereof for the bending of cables and, in addition, the inner radius of the bend shall be not less than two and a half times the outside diameter of the conduit. Elbows or tees, other than those of the inspection type shall not be used except at the ends of conduits immediately behind accessories or lighting fittings;

(d) Ends of lengths of conduits shall be so reamed, and outlets from conduits shall be so bushed, as to obviate abrasion of cables;

(e) External outlets, unless terminating in a suitable accessory or connection box shall be set down at an angle of not less than 45° from the horizontal and terminate in a non-corroding bellmouth;

(f) Where conduits are buried in concrete, plaster, cement, or the like in any building, they shall finish at outlets in suitable boxes, and no inspection fittings, solid elbows, or tees shall be used. Draw-in boxes may be used if their covers are accessible;

(g) Conduit run on the surface shall terminate in —

(i) A box, suitably designed and constructed for the circumstances of its use; or

(ii) A suitably constructed part of an accessory or appliance.

71 Additional requirements for metal conduit systems

(1) Metal conduits shall be earthed in accordance with the requirements of part VIII of these by-laws, which relates to earthing, and shall be mechanically and electrically continuous across all joints. If the conduit is used as an earth-continuity conductor the requirements of by-law 149 hereof shall be complied with.

(2) Cables of alternating current systems installed in steel conduit shall always be so bunched that the cables of all phases and the neutral (if any) are drawn into the same conduit.

(3) Conduit systems not intended to be gas tight be self ventilating, and drainage outlets shall be provided at any points in the installation and drainage outlets shall be provided at any points in the installation where condensed moisture might otherwise collect.

(4) Where aluminium-alloy or zinc-base-alloy conduits and conduit fittings are used they shall be installed in compliance with the relevant requirements of by-laws 61, 64, and 70.

72 Additional requirements for non-metallic conduit systems

(1) Non-metallic conduit systems shall be made mechanically continuous throughout their length and, unless joints are made by screwing, the ends of every length of conduit shall be firmly anchored.

(2) Any metallic conduit fittings used in a non-metallic conduit system shall be earthed in accordance with Part VIII of these by-laws, which relates to earthing.

73 Additional requirements for flexible conduit systems

Where flexible conduit is used, bonding of metallic parts shall be by means of a separate earth-continuity conductor complying with the requirements of by-law 149 hereof, and any adaptor connecting the flexible conduit to any metal conduit, duct or troughing shall be of a type suitable for the connection of the earth-continuity conductor thereto. Where necessary, flexible conduit shall be adequately supported.

74 Additional requirements for duct and troughing systems

All types of metallic and non-metallic duct and troughing systems shall comply with the following requirements —

(a) Where cables are to be drawn in, or laid in, the duct or troughing shall be erected complete before the cables are installed;

(b) Where duct or troughing systems are liable to mechanical damage, they shall be adequately protected;

(c) All entries to finished ducts or troughing shall be so placed as to prevent the entry of water, or be protected against such entry;

(d) Every outlet for cables from a duct or troughing system, every joint in any such system, and every joint between such a system and another type of duct or trough or conduit, shall be so formed that the joints are mechanically sound and that cables drawn in are not liable to suffer abrasion;

(e) Bends in any duct or troughing system shall be so shaped on their inner radius of any bend in any cable drawn in or laid in the duct or troughing is not less than that prescribed in table 4 of these by-laws for the appropriate type of cable;

(f) The number of cables to be installed in ducts or troughing shall be such as will permit easy drawing-in without damage to the cables, and shall in no circumstances be such that the following space factors are exceeded —

(i) Thirty-five per cent where the duct or trough is of a closed type into which cables are drawn;

(ii) Forty-five per cent where the duct or troughing is of a type in which one side is removable or hinged for the whole of its length to allow cables to be laid therein;

(g) Cables of alternating current systems installed in steel ducts, troughs, or pipes shall always be so bunched that the cables of all phases and the neutral (if any) are drawn into the same duct, trough, or pipe;

(h) Rubber-insulated and braided cables, or unsheathed plastic-insulated cables, shall not be used in concrete ducts cast on the site without further enclosure.

75 Additional requirements for paper-insulated cables

Where a paper-insulated cable is so installed that drainage of the impregnating compound is liable to occur, it shall be of a type which will comply with the dripping or drainage test specified by the Board from time to time.

76 Additional requirements for cambric-insulated cables

The use of varnished cambric-insulated cables not metal-sheathed is permissible only where short lengths are required and where the cables are not exposed to moisture.

77 Wood casing

Wood casing, made from well-seasoned timber free from knots and shakes, dressed on all surfaces which will be exposed when fixed in position, and of suitable design and dimensions, may be used for the enclosure of cables:

Provided that —

(a) The wood casing shall not pass through any party wall or be fixed immediately below any water pipe or in contact with any hot, water pipe;

(b) The wood casing shall be used only in dry situations, except that in situations subject to occasional condensation, such as bathrooms and washhouses, it may be used if all blank ends are sealed and it is made waterproof after erection;

(c) Where the wood casing forms part of ornamental woodwork, ready access shall be provided to the cables enclosed therein;

(d) Wood casing used to enclose service mains or other cables for attaching to aerial lines, shall terminate inside the building in a substantial wood block; and the cables, where passing through the outside wall, shall be adequately protected against the ingress of moisture;

(e) Wood casing shall not be used for the enclosure of varnished-cambric-insulated cable without lead sheath, or unprotected aluminium-sheathed cable.

78 Additional requirements for neutral-screened cables

(1) Neutral screened cables used for fixed wiring, other than aerial cables, shall be of the tough-plastic-sheathed type having annealed "copper conductors".

(2) Except in the case of aerial cables, neutral-screened cables, used for fixed wiring without further enclosure shall have a radial thickness of tough plastic sheath not less than that prescribed in table 6 thereof, and the cables shall be installed in accordance with the requirements of these by-laws for tough-plastic sheathed cables.

(3) Where a connection is made between a neutral-screened cable and any other type of cable, or a neutral-screened cable is connected to any terminal except at a switchboard or within apparatus, the connection shall be effected within a suitable connector box and the protective coverings of the cable shall be brought within the box. Where the connector box is exposed to the weather it shall be so constructed and installed as to prevent the entry of moisture into the box or into the cable.

(4) When neutral-screened cable is used as an aerial cable —

(a) The cable shall be supported at intermediate points and terminations by suitable insulating means so that the covering or sheathing of the cable is not damaged or punctured;

(b) Joints shall not be made in, or connections made to, neutral-screened cable which is in tension;

(c) The connection of every neutral-screened aerial service line to a consumer's service main, or connection of a consumer's neutral-screened aerial line to circuit wiring, shall be made within a suitable overhead-line connector box, and the covering or sheathing of the neutral-screened cable shall be so enclosed by the box that the conductors and insulation are not exposed to the weather.

(5) Tough-plastic-sheathed neutral-screened cable with annealed copper conductors may be used unbroken as an aerial line and a service main, or a submain, or circuit wiring, that is to say, without the junction requiring an overhead-line connector box as prescribed in subsection (4) of this by-law.

(6) The surrounding outer conductor of a neutral-screened cable shall be used only as a neutral conductor or as an earthing conductor.

79 Additional requirements for flexible cables and flexible cords

Subject to compliance with the requirements of by-law 62 hereof in. respect of temperature limits, flexible cords for voltages exceeding extra-low voltage shall be selected and used in accordance with the following requirements —

(a) Flexible cables and cords shall be used only for connections to accessories, equipment, appliances, and lighting fittings, and shall be of the circular type, except as provided in paragraph (b) of this by-law;

(b) Twisted flexible cords and parallel-twin flexible-cords, with or without earth-continuity conductors, shall be used only for fixed lighting fittings and pendants, or where the flexible cord is open to view and is not subject to abrasion;

(c) Flexible cables and flexible cords, where they are subject to risk of mechanical damage or risk of contact with water, shall be protected by a tough-rubber or tough-plastic sheath;

(d) Light duty flexible cords with reduced thickness of insulation of sheath shall be used only in locations where they are not liable to mechanical damage;

(e) Flexible cord shall not be used as a substitute for fixed wiring, nor shall it be taken out of the room or compartment in which it is connected to the source of supply except in the case of temporary intermittent use with a portable appliance such as a vacuum cleaner.

80 Aerial lines of medium, low, and extra-low voltage

(1) Aerial lines operating at medium-low, or extra-low voltage shall consist of —

(a) cables provided with an outer covering or sheathing of a type suitable for continuous exposure to the weather;

(b) cables provided with outer insulation of a type suitable for continuous exposure to the weather;

(c) cables insulated for full working voltage and suitable for continuous exposure to the weather; or

(d) bare conductors, which may be used only for an earthed conductor as an alternative to the cables prescribed in paragraphs (a), (b), and (c) of this subsection.

(2) For the purpose of this by-law the expression "insulated for full working voltage" means that a cable is so insulated that it is safe to handle when alive.

(3) All conductors of every aerial line shall be stranded and of such cross-sectional area as to ensure that the voltage drop does not exceed the value prescribed in by-law 53 of these by-laws.

(4) Subject to the provisions of subsection (3) of this by-law —

(a) the cross-sectional area and mechanical strength of an individually supported single-core conductor, whether bare, covered, or insulated, shall be not less than that of the appropriate copper conductor shown in subsection (10) of this by-law; and

(b) the combined mechanical strength of all the conductors of any twin or multicore cable used as an aerial line shall, under similar conditions, be not less than the mechanical strength of the appropriate single-core copper conductor shown in subsection (10) of this by-law.

(5) Every aerial conductor or cable shall be effectively supported and terminated on suitable insulators, except that an aerial earth-continuity conductor or a catenary wire supporting an aerial cable may, without the use of an insulator, be attached to its supports by a suitable effective clamp.

(6) Covered sheathed, and insulated conductors shall be so attached to insulators that their cover, sheath, or insulation is not thereby impaired or likely to be impaired and, where binding wire is used to attach the conductors to insulators, adequate precautions shall be taken to ensure that either —

(a) the binding wire cannot become alive; or

(b) contact with binding wire that may become alive is prevented by the provision of effective insulation.

(7) Any iron or steel hardware or fittings used with an aerial line shall be effectively protected against corrosion.

(8) Every pole, post, cross-arm, or other support used for supporting an aerial conductor shall be of durable material, and of sufficient strength to withstand forces due to wind pressure, change of direction, and unequal length of spans, and shall be erected to the satisfaction of the Board.

(9) All single conductors and single-core cables that are not insulated for full working voltage shall be adequately spaced to prevent contact with each other under all conditions of sag and sway. The spacing between conductors at

supports, measured in any direction, shall be not less than that shown in the following table —

Span	Minimum Spacing (mm)
Not exceeding 10 m	200
Exceeding 10 m but not exceeding 30 m	350
Exceeding 30 m but not exceeding 50 m	450

(10) The following provisions shall apply in relation to length of span —

(a) The length of span of single-core copper aerial conductors, bare or insulated, shall not exceed the values specified in the table below, for the appropriate type and size of conductor:

Type of Conductor	Size	Maximum Span
Soft drawn Copper	7/1.04 mm or larger	10 m
Hard drawn Copper	7/1.04 mm	20 m
	7/1.35 mm	50 m
	7/1.70 mm	50 m

(b) Subject to the provision of subsection (4) of this by-law, the length of span of any twin or multicore cable, other than a cable supported by a catenary wire, shall not exceed the length prescribed in paragraph (a) of this subsection for the equivalent single-core copper conductor;

(c) The maximum length of span of a cable supported by a catenary wire shall be such that the safe working stress of the catenary wire is not exceeded;

(d) For types or sizes of conductors and cables not specified in paragraphs (a), (b), and (c) of this subsection the directions of the Manager shall apply.

(11) Except as provided for in subsection (12) and (13) of this by-law, very aerial conductor, including the connecting leads to the circuit wiring, hall be so erected as to be inaccessible under normal conditions to any person without the use of a ladder or other climbing device and so that the minimum clearance calculated for a temperature of 50° C as specified in the following table will be maintained —

Clearance to be Measured		Minimum Clearance	
		Cables that are Insulated for Full Working Voltage	Any Other Cable or Conductor
Vertically from ground level	Where the conductors cross any way open to the public	4.3 m	4.3 m
	Where the conductors cross any private way used by vehicles	3.7m	3.7 m
	In any other part	2.8m	2.8 m

Clearance to be Measured		Minimum Clearance	
		Cables that are Insulated for Full Working Voltage	Any Other Cable or Conductor
	crossed by the conductors		
Vertically from any roof or open balcony over which the conductors pass		2.3m	2.3m
Horizontally from any pitched roof over which the conductors pass		600 mm	1.2 m
Vertically from any roof above which the conductors terminate on a building or other structure		150 mm	2.3m
Between the conductors and any window that can be opened		600 mm	900 mm
Between the conductors and any telephone or telegraph line		300 mm	600 mm
Between the conductors and any radio or television aerial, counterpoise, or staywire: Provided that the conductors shall not pass under any such aerial, counterpoise, or staywire		600mm	1.8 m
Between the conductors and the highest point of any metal clothes line or similar metal over which the conductors pass		600 mm	1.8 m

(12) The minimum clearance vertically from any roof above which any neutral-screened cable terminates on a building or other structure shall be 150 mm.

(13) Where a neutral-screened cable is used as the connecting lead between circuit wiring and an aerial conductor for which the minimum above-ground level clearance is prescribed by subsection (11) of this by-law as 2.8 m, the minimum vertical clearance above ground level of the connecting lead shall be 2.6 m.

(14) Each aerial circuit not run as a separate and independent circuit from a switchboard shall have the aerial portion of the circuit protected by a weatherproof fuse, or fuses, fixed at the point of supply to the aerial line.

(15) An aerial line consisting of more than one two-wire subcircuit or submain may have a common neutral for the aerial part only of the subcircuits or submains, if provision is made to disconnect the neutrals for testing purposes.

(16) Any joint in an aerial conductor shall have an ultimate strength of not less than 90 per cent. of that of the conductor. Joints shall not be made in or connection made to an aerial neutral-screened cable which is in tension.

(17) The connection of every service-main, submain, and subcircuit conductor, not exceeding 7/1.7 mm (16 mm^2) diameter, to any aerial cable or conductor shall be by means of an overhead-line connector box.

(18) Compliance with the relevant provisions of these by-laws shall be deemed to be sufficient compliance with the foregoing provisions of this by-law:

Provided that, where an aerial line is attached to a building or other structure, including a pole located adjacent to a building or structure, being a pole to which is connected any submain or subcircuit conductor, only conductors having an approved covering shall be used for phase or other live conductors for a distance of not less than 20 m from the attachment of the line to the building, structure, or pole, or (where the line is less than 20 m in length) for the whole length of the line.

81 Aerial lines

Aerial lines at high or extra-high voltage shall conform to the requirements of the Board.

82 Temporary installations

(1) When the expected period of service of an installation does not exceed 3 months, the requirements of this regulation may be observed in place of the corresponding other provisions of these by-laws:

Provided that, when it is necessary to retain a temporary installation in service beyond the period of 3 months initially estimated, it shall be completely examined and defects rectified at 3-monthly intervals unless more frequent intervals are specified on the wiring permit issued under by-law 13 hereof.

(2) Every temporary installation shall be protected against excess current, and shall be effectively controlled by a conveniently situated switch or other means whereby all live conductors of the supply can be disconnected.

(3) Where a temporary installation is to be supplied from a permanent installation, the current rating of the permanent installation must be adequate for the total load to be imposed upon it.

(4) Every temporary installation shall be in the charge of a person who shall accept full responsibility on behalf of the consumer for the installation and for its use. The name and designation of the person shall be prominently displayed close to the main switch or circuit breaker.

(5) All cables in a temporary installation shall normally be sheathed with tough rubber or tough plastic, or be steel-armoured or neutral-screened or mineral-insulated copper-sheathed cables. Lead-sheathed or aluminium-sheathed cables shall not be used unless they are armoured. If steel conduit is used the installation shall conform with by-laws 69 and 70 hereof. The insulation of the cables shall be maintained in good condition.

(6) Flexible cords in a temporary installation shall comply with the relevant regulations and shall be used only where essential. Wherever exposed to risk of mechanical damage they shall be tough-rubber or tough-plastic sheathed.

(7) A temporary installation shall be tested before it is put into service, and shall comply as regards insulation resistance, correctness of polarity, and earth-continuity with the requirements of Part IX hereof, which relates to the testing and inspection of installations.

83 Heating wires and cables

(1) Bare conductors used for soil warming and space heating such as floor warming shall be supplied from the secondary winding of a double-wound transformer. The secondary winding shall be earthed at the transformer and the maximum voltage of the secondary Circuit shall not exceed 32 volts. Cables or flexible cords connecting busbars of the bare conductors to the secondary terminals of transformers shall be suitably insulated and protected.

(2) Where heating cables are energised at mains voltage, they shall be adequately insulated and protected against mechanical damage.

(3) Connections to heating wires or cables shall be suitable for the temperature encountered.

84 Access to wiring

(1) Where wiring is installed in any space reasonably sufficient to permit a person to work in it, adequate means of access to the space shall be provided.

(2) Where wiring is installed in any space not reasonably accessible as required by subsection (1) of this by-law access to connection boxes shall be provided.

PART VI - INSTALLATION OF ACCESSORIES, APPARATUS AND APPLIANCES

85 Voltage rating of apparatus

(1) All apparatus shall be rated for a voltage not less than the maximum steady r.m.s, voltage likely to be applied.

(2) Every fuse and circuit breaker shall be rated for a voltage not less than the maximum r.m.s, voltage difference which can normally develop under fault conditions.

86 Current rating of apparatus

All apparatus shall be rated for a current not less than the maximum steady r.m.s. Current likely to flow through it, and its maximum temperature rise at rated current during its normal period of service shall not exceed that appropriate to the insulation used.

87 Selection of apparatus for situation

All apparatus shall be of a design appropriate to the situation in which it is to be used and its mode of installation shall take account of the conditions likely to be encountered.

88 Damp situations

In damp situations, every item of apparatus shall be of the clamp-and-dust-proof type, and cable entries shall be provided with glands or bushings, or be adapted to receive screwed conduit.

89 Mechanical and other damage

No electrical apparatus, unless suitably protected, shall be installed in a position where it is exposed to water, oil, steam, or vapour, or to risk of mechanical damage.

90 Flammable or explosive conditions

Electrical apparatus installed or used where there is an explosion hazard shall, unless it is intrinsically safe apparatus, comply with the following requirements:

(a) In all instances where electrical apparatus may be exposed to a flammable concentration of gas or vapour, it shall be of flameproof construction; or such arrangements shall be made for the internal pressurisation or ventilation of the apparatus as will effectively prevent the ingress of any such gas or vapour:

(b) In areas which are hazardous because of the presence of combustible dust or dust of an electrically-conducting nature, electrical apparatus shall be of a suitable dust-excluding type of construction.

91 Risk of overheating

Every item of apparatus, including any resistor, inductor, capacitor, transformer, or rectifier, shall comply with the following requirements:

(a) Fixed apparatus of rating exceeding 60 watts shall be adequately ventilated and either enclosed in a suitably designed incombustible enclosure or so mounted that no wood (except hardwood) or other

combustible material is within 300 mm measured vertically above, or 150 mm measured in any other direction from the apparatus:

(b) Where the temperature of any part of the enclosure of fixed apparatus is liable to exceed 80° C, the case shall be so located or guarded as to prevent accidental contact therewith:

(c) Every rotating electrical machine fixed in a situation in which the surrounding air exceeds the limit of temperature permitted for the cooling air in the appropriate standard specification shall be of special construction or reduced rating, or (alternatively) of the pipe-ventilated, forced-draught, or induced-draught type, connected by ventilating ducts to a cool-air supply:

(d) A lamp which is near to, or might come into contact with, flammable material, shall be enclosed or protected by a robust shade or guard of non-flammable material. Celluloid shall not be used near a lamp or other source of heat:

(e) Where oil-filled apparatus of capacity exceeding a total of 100 litres is used, means .shall be provided to prevent the escape of oil into any other part of the building.

92 Ceiling roses

(1) Unless specially approved for the purpose no ceiling rose shall be used on a circuit having a voltage normally exceeding 250 volts.

(2) Unless the ceiling rose is specially designed for multiple pendants, not more than two flexible cords shall be attached to one ceiling rose.

93 Lampholders

(1) Lampholders for filament lamps shall normally be used on low-voltage and extra-low-voltage circuits only.

(2) Where centre-contact bayonet, or Edison-type screw lampholders are used, the outer or screwed contact shall be connected to the neutral or earthed conductor.

(3) Except where separate fuse protection is provided, or the lampholders and their wiring are enclosed in earthed metal or incombustible insulating material, lampholders shall not be connected to circuits having excess-current protection of rating exceeding the appropriate value stated in the following table:

Excess-current Protection of Lampholders	
Type of Lampholder	Maximum Rating of Fuse or Miniature Circuit Breaker Protecting the Circuit (amperes)
Small bayonet-type (B.15)	5
Small Edison-type screw (E.14)	5

Bayonet-type (B.22)	15
Edison-type screw (E.27)	15
Bi-pin type	15

(4) Lampholders in domestic installations shall not be fixed on a wall at a height less than 1.2 m above floor level unless suitably protected to prevent contact being made by any person with the contacts in the lampholder.

94 Lighting fittings

(1) Where a lighting fitting is supported by one or more flexible cords, the maximum weight to which either of the following twin flexible cords shall be subject shall be —

(a) 24/0.20 mm (0.75 mm^2) 3 kg:

(b) 32/0.20 mm (1.0 mm^2) 5 kg.

(2) Care shall be taken that any hooks or clips used as supports for flexible cord do not damage the insulation.

(3) Where it is necessary for a flexible cord from a hanging lighting fitting to pass into a ceiling to a plug socket or other connecting device the flexible cord shall be of the tough-rubber-sheathed or PVC-sheathed type and the mode of installation shall obviate risk of mechanical damage.

(4) All hanging lighting fittings exceeding 5 kg in weight shall be suspended by a metal chain, rod, or tube of adequate strength, or by several flexible cords, in which case the weight on any one cord shall not be more than that prescribed in subsection (1) of this by-law.

(5) All wall-bracket type lighting fittings shall be so erected that they are securely fixed.

(6) Every lighting fitting shall be so designed or installed that its surroundings will not be adversely affected by the temperature attained by the fitting in normal service.

95 Lampholder adaptors

(1) Lampholder adaptors shall not be used for supplying any apparatus requiring more than 1.25 amperes in the case of bayonet-cap adaptors and 2.6 amperes in the case of Edison-type screw adaptors, nor where earthing is required.

(2) Bayonet-cap lampholder adaptors shall not be used to supply any Edison-type screw or centre-contact bayonet lampholder, or any cord-extension socket having an earthing terminal or connections.

96 Plugs, plug sockets, and cord extension sockets

(1) Where a plug socket is mounted in or on a horizontal surface, means shall be provided to ensure that the surface may be cleaned without risk of detriment to the insulation of the installation.

(2) Where earthing of apparatus is necessary to comply with the requirements of these by-laws every plug socket and cord-extension socket shall be equipped with a contact for earthing purposes, and the contact shall be earthed.

(3) In the case of two-pin non-reversible type plug sockets and cord extension sockets, the neutral or earthed conductor, shall be connected to —

(a) The slot on the radial line; or

(b) The larger contact where the pins are of different size; or

(c) The circular contact where the pins are of different shape.

(4) In the case of two-pin and earth non-reversible plug sockets and cord-extension sockets —

(a) The earth-continuity conductor shall be connected to —

(i) The slot on the radial line; or

(ii) The contact for the longer or larger pin of the corresponding plug where its pins are circular; or

(iii) The outer shell where the corresponding plug has two pins and an outer metal shell; and

(b) The connections of sockets in accordance with the paragraph (a) (i) and (ii) of this subsection shall be earth-continuity conductor, live conductor, neutral (or other) conductor, in that order, clockwise round its face.

(5) Reversible-type plugs, plug sockets, and cord-extension sockets may be used only where the reversal of the polarity in the devices so connected will not create electrical hazard, or where the devices do not include any single-pole switches.

(6) No plug socket shall be installed in any bathroom, except that provision may be made for the use of electric dry shavers only, by installing an electric shaver supply unit complying with the directions of the Manager.

The earth terminal of the shaver supply unit shall be earthed in accordance with by-law 148 hereof, or alternatively protection shall be afforded by a voltage-operated earth-leakage circuit breaker installed in accordance with by-law 155 hereof, and the secondary circuit supplying the shaver shall be isolated both from the supply mains and from earth.

(7) Plugs, plug sockets, and cord-extension sockets having different current ratings, or being operated at different voltages in an installation, shall be non-interchangeable.

(8) The connection of any conductor other than a phase conductor to the phase terminals of a plug, plug socket, or cord-extension socket designed for polyphase supply is prohibited.

(9) In an installation the connections of any polyphase plug sockets and cord-extension sockets shall be standardised throughout the installation.

97 Switches and circuit breakers

(1) No pendant switch or other switch connected to a flexible cord shall be used —

(a) In any bathroom, lavatory, or washhouse; or

(b) In any location where the person operating it would be likely under normal conditions, to be simultaneously making contact with earth or earthed metal:

Provided that this paragraph shall not prohibit the use of a pendant switch for a crane, hoist or other machine if the pendant switch is of suitable design and construction, and is so installed, as to provide the maximum safety to the operator.

(2) Every circuit breaker shall be of the free-handle type.

(3) Every circuit breaker shall be adjusted so that it will open the circuit when a current flows equal to twice the rating of the smallest cable or conductor it is installed to protect:

Provided that this requirement shall not apply to a motor circuit, installed in accordance with by-law 104 hereof, which relates to motors and motor control.

98 Fuses

A fuse shall not be located in a ceiling rose, in a plug-socket, or in a lampholder.

99 Portable appliances

(1) Portable appliances shall be connected to the fixed wiring by means of plugs and plug sockets, or adaptors, of suitable capacity.

(2) Where portable appliances are used, the voltage between any two points in one room or compartment may exceed 250 volts only if —

(a) The metal frames and sheathings of every such appliance are earthed; or

(b) The appliances are of the all-insulated or double-insulated type, or are supplied from a source isolated from earth.

(3) Every portable appliance that is not subject to the provisions of by-law 103 hereof, which relates to special requirements for medical and dental appliances and apparatus, shall be provided with or used in conjunction with a safeguard of a type which (by paragraph (4) of this by-law) is approved for the purposes of this by-law and which (by paragraph (5) of this by-law) is declared to be suitable for the conditions of use thereof that for the time being apply.

(4) The following types of safeguards for portable appliances are approved for the purposes of this by-law —

(a) The fact that the portable appliance is of the all-insulated type, where that is the case:

(b) Direct earthing by means of the earthing-lead in a flexible cable or flexible cord not having a braided metallic covering:

(c) Direct earthing by means of the earthing-lead in a flexible cable or flexible cord having a braided metallic covering installed in accordance with the provisions of by-law 154 hereof, which relates to the connections of earthing leads, and fitted with suitable accessories:

(d) Double insulation complying with an approved standard:

(e) Supply from a source isolated from earth and having a voltage between conductors not exceeding 250 volts:

(f) Supply from a source connected to earth in such a way that the voltage to earth will not exceed 55 volts:

(g) Supply from a monitored earth circuit arranged to cut off supply automatically in the event of the earth-continuity conductor to the portable appliance breaking or becoming disconnected:

(h) Supply at extra-low voltage.

(5) The type of approved safeguard provided for or employed with any portable appliance under the conditions of use thereof that for the time being apply shall be one of those specified in the following table as suitable for those conditions:

Conditions of Use of Portable Appliance	**Suitable Type of Safeguard Specified in Subsection (4) of this regulation**
(a) In any dry indoor situation, whether there is complete freedom from earth or earthed metal or whether there is earth or earthed metal present, but not where exposed earthed metal is being worked upon	Any type
(b) In any dry indoor situation where exposed earthed metal is being worked upon	Any of the types described in paragraphs (c) to (h).
(c) In any outdoor situation or in any wet or damp situation in any building or other structure under construction, or in any factory where wet processing is carried on, or in any	Any of the types described in paragraphs (d) to (h).

other wet or damp indoor situation.	

(6) Every portable isolating transformer shall be located adjacent to its point of supply, unless the transformer and the flexible cable or flexible cord connected to its primary winding are provided with or used in conjunction with a safeguard in accordance with this by-law as though they were a portable appliance.

(7) Where more than one portable appliance is connected to a single secondary winding of an isolating transformer, the exposed metal of the appliances shall be effectively bonded together but not earthed.

(8) No portable domestic appliance shall be used at a voltage normally in excess of 250 volts to earth.

(9) No portable appliance, other than an electric shaver connected to an electric shaver supply unit installed in accordance with by-law 96(6) hereof shall be used in any bathroom.

100 Semi-portable appliances

(1) Subject to the provisions of paragraph (2) of this by-law every semi-portable appliance shall be provided with or used in conjunction with a safeguard suitable for the purpose of ensuring the safe operation of the appliance under the conditions of its use.

(2) Every curd mill or similar appliance in a dairy factory, and every concrete mixer and concrete vibrator, that is connected to the fixed wiring by means of a flexible cord or flexible cable and plug or adaptor shall be provided with or used in conjunction with a safeguard of a type which is one of the types described in by-law 99(4) hereof and which is specified in paragraph (5) of that by-law as suitable for the conditions of use that for the time being apply.

(3) No semi-portable appliance connected to the fixed wiring by means of a plug or adaptor shall be used in any bathroom.

101 Control of appliances

(1) Every appliance, excepting a clock, or a bell transformer fed from a separate subcircuit, that is not supplied from an adjacent plug socket shall be controlled by a manually operated switch, fuse switch, or push-button switch mounted within easy reach for normal operation and which shall be additional to any automatic control device, and arranged to isolate the appliance effectively from the supply.

(2) If a manually operated switch, fuse switch, or push button referred to in paragraph (1) of this by-law, is remote from the appliance, an additional means of isolation shall be provided adjacent to the appliance or, alternatively, provision shall be made for the remote means of isolation to be effectively locked in the off position.

102 Heating and cooking appliances

(1) Every electrically heated blanket for domestic use manufactured for sale or sold or offered for sale when unused, shall conform with the requirements as may from time to time be approved. The repair of every electrically-heated blanket for domestic use shall be carried out in accordance with directions from the Board from time to time.

(2) Any heating appliance installed in a bathroom, unless it is of a type with totally enclosed elements, shall —

(a) Be guarded in such a manner that the element or its connections cannot be touched with the standard test finger; and

(b) Be installed at a height of not less than 1.8 m above the floor and in such a position that it cannot be touched by a person standing in the bath.

(3) The boiling plates of every cooking appliance operated at a voltage exceeding extra-low voltage shall be metal-clad.

(4) All plug sockets fitted on a heating or cooking appliance shall have separate excess-current protection.

103 Appliances for heating water and other liquids

(1) Every appliance for heating liquids shall be so arranged and connected that the liquid entering into or issuing from it is at earth's potential.

(2) No appliance in which a live element is in direct contact with the liquid shall be connected to any source from which electricity is available, unless the appliance has been approved.

104 Control of motors and motor circuits

(1) Every electric motor shall be provided with effective means for starting and stopping, the latter so placed as to be easily operated by the person in charge of the motor.

(2) Every electric motor shall be provided with means to prevent automatic restarting after a stoppage due to drop in voltage or complete failure of supply, where unexpected restarting might cause injury to an operator in the course of his normal duties.

(3) Every electric motor shall be provided with effective means of isolation suitably placed and so connected that all voltage 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 shall be installed or, alternatively, provision shall be made for the remote means of isolation to be locked in the off position.

(4) Every electric motor having a rating exceeding 750 watts shall be provided with effective automatic overload protection which is not wholly an integral part of the motor shall be so arranged that, in operation, it disconnects all live conductors from the motor.

(5) Every alternating-current electric motor having a rating exceeding 2.2 kW shall, in locations where the Board so requires, be provided with means for limiting the amount of current taken when starting and accelerating to such reasonable value as the Board may require.

(6) Every motor rated at more than 100 watts which may be required to run automatically and unattended shall, in addition to the excess-current protection required by by-law 23 hereof, be provided with a thermal overcurrent relay or other equally effective protective device which may be of the automatic or hand reset type.

(7) The cables carrying the starting, accelerating, and load current of a motor shall be of rating at least equal to the full-load current rating of the motor when rated in accordance with the relevant Tongan Standard.

(8) A subcircuit supplying a motor shall be protected in accordance with the requirements of by-law 44 hereof, that is to say, the current rating of the associated fuse shall not exceed the current rating of the cable used, and any circuit breaker used shall operate when the sub-circuit is subjected to a sustained excess current 1.5 times the rating of the cable used, except that where, in compliance with Subsection (4) of this by-law, a starter is provided which affords protection against excess current in the motor and in the cables between the starter and the motor, the rating of the fuse or the operating current of the circuit breaker may be twice that specified as aforesaid in this subsection.

105 Control of transformers

Where a step-up transformer forms part of a consumer's installation, effective means shall be provided to isolate the transformer completely from the supply, save that where such a transformer is an integral part of apparatus that is provided with isolation in accordance with by-law 26 hereof, separate means of isolation for the transformer may be omitted.

106 Use of auto-transformers, choke coils, and resistors

(1) An auto-transformer shall not be supplied from a circuit operating at a voltage normally in excess of 250 volts to earth, except where the transformer is used —

(a) In motor starting or control gear; or

(b) In conjunction with or installed adjacent to a capacitor which is employed for improving power factor.

(2) An auto-transformer, choke coil, or resistor shall not be used to —

(a) Reduce the voltage to supply general wiring in buildings; or

(b) Supply any portable appliance, unless the auto-transformer, choke coil, or resistor is contained therein; or

(c) Supply any extra-low-voltage circuit.

(3) A step-up auto-transformer shall not be connected to an installation obtaining its supply from a system in which none of the poles of the supply is connected to earth.

(4) Choke coils or resistors shall not be enclosed within the covering of flexible cable or flexible cord.

(5) Where the temperature of part of the case of the register may exceed 80 degrees centigrade the case shall be located or guarded to prevent accidental personal contact therewith.[4]

107 Additional requirements for capacitors

Every capacitor, unless incorporated for the sole purpose of radio interference suppression, shall be provided with means, such as a high-resistance leak, for its prompt automatic discharge immediately the supply is disconnected. This requirement shall not apply to small capacitors where no risk of shock can arise.

108 Additional requirements for low voltage electric bells and buzzers

Electric bells and buzzers of suitable design and construction may be operated from a low-voltage circuit:

Provided that —

(a) The cover of the bell or buzzer shall be clearly and permanently marked, in letters not less than 2.5 mm high, with its operating voltage, followed by the words “DO NOT OPEN”: and

(b) Every bell-push shall be suitable for low-voltage use; and

(c) The wiring to every bell, buzzer, and push shall be carried out in accordance with the appropriate requirements of these by-laws.

109 Additional requirements for extra low voltage electric bells, buzzer, or signalling circuit

Provided that —

(a) The transformer shall be protected on the primary side against excess current conditions:

(b) The conductors of the extra-low voltage circuit where unenclosed, shall be secured by means of insulated staples and adequately protected from mechanical injury:

(c) Joints in the conductors of the extra-low voltage circuit shall as far as practicable, be avoided:

(d) The conductors of the circuit shall be provided with insulation suitable for the conditions in which they are installed:

(e) One conductor of the secondary side of the transformer shall be earthed.

110 Additional requirements for electric toys

Electric toys shall be operated only at extra-low voltage from a battery or from the secondary side of a double-wound transformer connected to a low-voltage alternating-current circuit, and the transformer shall comply with the requirements relating to transformers for use with electrically operated toys which may be stipulated under these by-laws.

111 Additional requirements for portable hand lamps

(1) All portable handlamps shall have a handle and body made of suitable insulating material capable of withstanding rough usage, heat generated by the lamp, and moisture, and shall be fitted with an effective lamp-protecting guard which, if of metal, must not be earthed.

(2) Handlamps shall be so constructed that the metal parts of the lampholder and any metal in contact therewith are shrouded by insulation to prevent —

(a) Contact between any such metal parts or metal and the guard; and

(b) Personal contact with any such metal parts or metal when the guard is removed and the lamp is in position.

112 Additional requirements for radio, visual reproduction, and sound reproduction apparatus

(1) This by-law shall apply to any radio visual-reproduction, and sound-reproduction apparatus which may be connected to the fixed wiring on any premises.

(2) Excepting as provided in paragraph (3) of this by-law, nothing in these by-laws shall apply to any part of the apparatus specified in paragraph (1) of this by-law beyond the secondary side of the power transformer where the apparatus is supplied with electricity by means of a power transformer incorporated in the apparatus.

(3) Electric mains-supplied radio and other electronic apparatus for acoustic or visual reproduction shall comply with any by-laws enacted from time to time,

which relates to the safety requirements for electric mains-supplied radio or other electronic apparatus for acoustic or visual reproduction.

(4) External reactances or resistances shall not be used to reduce the voltage of the supply of electricity for any apparatus.

(5) No single-pole switch mounted in any apparatus specified in paragraph (1) of this by-law shall be used to control the power input unless the electricity is introduced into the set by means of a non-reversible device. No single-pole switch shall be connected in any neutral conductor or earthed conductor.

113 Additional requirements for medical or dental appliances and apparatus

(1) Medical or dental appliances and apparatus containing any metal liable to become alive being metal which is or may be in direct contact with the body of a patient, shall, subject to the exemptions in paragraph (2) of this by-law, be connected to a supply from a source isolated of earth.

(2) The exemptions referred to in paragraph (1) of this by-law are the installation and use of —

(a) Medical appliances or apparatus with which, because of the nature of their design or use, it is practicable to comply with the requirements of subsection (1) of this by-law,

(i) The installation of the appliances and apparatus is in accordance with any relevant recommendations issued by the Minister of Health; and

(ii) The use of the appliances and apparatus is only by suitably skilled persons: and

(iii) The effectiveness of any earthing and earth connection is regularly and adequately tested and maintained:

(b) Dental units in which all metal parts are effectively earthed to a separate earth-continuity conductor run direct from any unit to the earth-continuity busbar at the switchboard supplying the subcircuit to the unit, and in which any transformer supplying extra-low voltage for the unit is so designed that the extra-low-voltage winding is separated from the low-voltage winding by —

(i) An earthed shield (in which case the transformer shall be so marked); or

(ii) Being wound on a separate limb Of a double-limbed transformer in which the whole of the lamination iron is effectively earthed.

114 Special requirement for electrode boilers and water heaters

Electrode boilers and electrode water heaters shall be connected to alternating-current systems only and shall be installed in compliance with the following requirements according to the type of equipment in use:

(a) The supply to the apparatus shall be controlled by a circuit breaker constructed and installed as follows:

(i) The circuit breaker shall be of the multi-pole linked type arranged to disconnect the supply from all electrodes simultaneously:

(ii) The circuit breaker shall be provided with over-current protective devices in each phase-conductor.

(iii) The circuit breaker shall be so placed that it may be easily operated by the person in charge and, where it is not adjacent to the electrode boiler, there shall be means at hand at the boiler to open the circuit breaker instantaneously;

(b) Adequate means such as an isolator adjacent to the boiler, or a locking device on the circuit breaker shall be provided to prevent the apparatus from being made live while persons are working thereon:

(c) Where the circuit breaker is remote from the electrode boiler, indicating lamps shall be provided adjacent to or mounted on the boiler to indicate whether the circuit breaker is in the on or off position:

(d) The connections of an electrode boiler to the supply neutral and to earth shall be as follows:

(i) An insulated conductor having a cross-sectional area not less than that of the largest associated phase conductor shall be installed and connected to the shell of the boiler and to the neutral bar of the switchboard supplying the boiler:

(ii) An earthing lead shall be installed direct from the shell of the boiler to the main earth electrode for the installation; and this earthing lead shall have a cross-sectional area not less than that of the largest phase conductor to the boiler, except that, where an earth-leakage protective device is in use, it may be smaller but shall have a current rating of not less than the operating current of the earth-leakage protective device:

(iii) Where metallic-sheathed cable is used to supply the boiler, the metallic sheath shall be effectively earthed to the main earth electrode of the installation:

(e) Where the electrodes are directly" connected to a high-voltage supply, a differential earth-leakage protective device shall be installed to disconnect the supply from the electrodes in the event of the occurrence of a sustained earth-leakage current in excess of 10 per cent of the rated current of the electrode boiler under normal conditions of operation, except that if in any instance a higher value is essential to ensure

stability of operation of the electrode boiler, the value may be increased to a maximum of 15 per cent. A time delay may be incorporated in the above device to prevent unnecessary operation in the event of unbalance of short duration:

(f) Where the supply to an electrode boiler is single phase and one electrode is connected to an earthed neutral conductor and there is no connection between the electrode and any piped water supply or earthed metal and where the electrodes and the water in contact with the electrodes are so shielded in insulating material that it is impossible to touch either the electrodes or the water in contact therewith while the electrodes are live, a fuse may be substituted for the circuit breaker required by paragraph (a) of this by-law.

115 Additional requirements for electric lifts

(1) Except as provided for in paragraph (10) of this by-law, the supply of electricity to every lift, other than a service lift, shall be taken direct from the main switchboard for the installation b v means of a submain or subcircuit to which no other lighting, heating, or power device is connected:

Provided that in the case of a large building or a detached building the supply may be taken direct —

(a) From the main distribution board in that part of the building in which the lift is located; or

(b) From a rising main or submain in that part of the building in which the lift is located.

(2) The main switch on any distribution board to which a lift is connected shall be clearly and legibly marked "THIS SWITCH SUPPLIES A LIFT".

(3) No circuit breaker operated automatically by a fire-alarm system shall interrupt the motive power, or the control, or the whole of the lighting, of a passenger-lift car.

(4) No circuit having a voltage exceeding medium voltage shall be connected to any lift car.

(5) A control switch or circuit breaker shall, be located in the lift-motor room adjacent to the door in a position, which is visible from the motor and which is safely and readily accessible. There shall be a clear working space of not less than 1 m in front of the switch or circuit breaker, and it shall not be possible to move the switch or circuit breaker into the on position from any other part of the building.

(6) Conductors for supply to a lift motor shall not be included in the same multi-core cable as cables for the control and safety devices of the lift.

(7) Trailing cables for use with lifts be of a suitable type, and shall be so installed that the wiring for the lighting, the wiring for the control, and the wiring for

each set of safety devices, of the lift car, will be entirely separate from each other and from other conductors except that a single trailing cable may be used for the wiring if all the conductors in the cable are insulated for the highest voltage present in the cable.

(8) Every lift, other than a service lift, operated by a polyphase motor shall be provided with means to prevent the motor from starting if —

(a) The phase rotation is in the wrong direction; or

(b) There is a failure in any phase.

(9) Every conductor connected to the adjustable safety devices and gate locks shall be stranded.

(10) The lighting for any lift, other than a service lift, shall comply with the following:

(a) A passenger-lift car shall have a minimum of two lights, one to be connected to the lift supply and one to be connected to some other part of the electrical installation of the building in which the lift is located or to some other source of supply:

(b) Passenger-lift car lighting shall be controlled by a switch or switches in the car, which switch or switches shall not be readily accessible to unauthorised persons:

(c) Machine-room lighting or pit lighting shall not be connected to the lift submain.

(11) Any electric heater in a lift car shall be connected to the supply by fixed wiring only, and shall be so designed or installed to preclude the possibility to causing fire.

116 Additional requirements for theatres

(1) In theatres all fixed wiring operating at a voltage in excess of extra-low voltage shall be carried out only in cables that are metal sheathed or armoured or both, or be enclosed in metal conduit or metal trunking, or cable enclosed in a sheath or enclosure of self-extinguishing material.

(2) Switchboards shall be fixed in readily accessible positions, but not so as to obstruct passageways or exit ways, except that every switchboard used for controlling the lighting or effects or both on a theatre stage shall be mounted in a convenient position not readily accessible to persons on the stage floor. The switchboard when mounted on or over a stage shall be either of the dead-front type or the switchgear and accessories shall be of the totally enclosed type. The switchboard and operator shall be protected from falling objects either by location or added protection.

(3) Switchboards shall be constructed only of fire-resisting materials, and all wiring associated with a switchboard shall be contained within a closefitting fire-resisting enclosure.

(4) Dimmers shall be so placed, guarded or arranged as not to endanger scenery or other material.

(5) All stage lighting shall be so wired that the maximum number of lamps on any subcircuit shall be such that the total current supplied from the subcircuit does not exceed 15 amperes.

(6) Conductors to suspended battens and similar lighting fittings shall be so supported that no stress is applied to the terminals to which they are connected, and they shall be either —

(a) Cable having not less than 7 strands per core, flexible cable, or flexible cord, in each case provided with a close-fitting outer sheath of thermoplastic or other self-extinguishing material; or

(b) Non-sheathed thermoplastic-insulated cables having not less than 7 strands per core and enclosed in plastic or stout canvas hose or other equally suitable and effective covering.

(7) The casings or containers of lighting fittings, including battens, footlights, and projectors, shall be constructed of heat-resisting material and adequately ventilated and supported. Such lighting fittings shall be so disposed or arranged as not to cause a fire hazard to scenery or other material.

(8) Separate subcircuits shall be provided for —

(a) The general lighting system:

(b) Stage lighting:

(c) Effects lighting:

(d) Orchestral lighting:

(e) Outline or exterior lighting:

(f) Exit-sign lighting:

(g) Any cinematograph machine and accessory in a motion-picture theatre.

117 Additional requirements for electric-fence controllers and electric fences

(1) Electric-fence controllers shall comply with an approved standard specification.

(2) Every mains-operated electric-fence controller shall be so installed that, as far as is reasonably practicable, it is free from risk of mechanical damage or unauthorised interference.

(3) A mains-operated fence controller shall not be fixed to any pole of an overhead power or communication line except that, where a low-voltage supply to an electric-fence controller is carried by insulated overhead line from a distribution board, the controller may be fixed to the pole carrying the supply.

(4) Any earth electrode connected to the earth terminal of an electric-fence controller shall be separate from the earthing system of any other circuit, and shall not be situated within a distance of 2 m of any electrode used for protective earthing.

(5) Not more than one controller shall be connected to any electric fence or similar system of conductors.

(6) Every electric fence or similar system of conductors and associated controller shall be so installed that it is not liable to come into contact with any power or communication apparatus or wiring, including an overhead power line, telephone, or telegraph wires or a radio aerial, or with an earth-continuity conductor.

(7) Any electric fence or portion thereof installed along a public road or highway or as a boundary-line fence shall be identified by signs, in the form specified in subsection (8) of this by-law, clamped to the fence wire or fastened to posts at suitable intervals.

(8) The signs required by subsection (7) of this by-law shall be in the form of a metal plate measuring not less than 200 mm by 100 mm having a bright-red background on both sides and with the inscription "ELECTRIC FENCE" in black on both sides, the lettering to be in block letters not less than 25 mm high.

118 Additional requirements for high voltage and extra-high-voltage installations

(1) Every high-voltage and extra-high-voltage installation shall be inaccessible to unauthorised persons.

(2) All high-voltage and extra-high-voltage conductors shall be so screened, protected, or placed that no person can make accidental contact therewith.

(3) Where the spread of fire could endanger other parts of a building, oil-filled apparatus installed indoors shall be located in an enclosure of fire-resisting construction.

(4) This by-law shall not apply to —

(a) Electric-discharge-lamp installations

(b) Medical and dental apparatus otherwise covered by the by-laws.

119 Additional requirements for extra-low-voltage installations

(1) Every installation or part thereof operating at extra-low-voltage shall comply with the requirements of these by-laws and with the special requirements prescribed in subsection (3) to (5) of this by-law, subject to the exemptions set out in subsection (2) of this by-law.

(2) Extra-low-voltage installations are exempted from the provisions of the following by-law hereof:

(a) By-law 4, which relates to connections to supply:

(b) By-law 10, which relates to permission to install electrical wiring or appliances:

(c) By-law 11, which prohibits electrical wiring being connected without permission:

(d) By-law 14, which relates to repair work:

(e) By-law 15, Which relates to private generating plant and installations connected thereto:

(f) By-law 16, which relates to protection against contact With live parts:

(g) By-law 22, in so far as it relates to the position of switches:

(h) By-law 53, which relates to voltage drop in conductors:

(i) By-law 68(1), which relates to the permission required for open wiring.

(j) By-law 93, which relates to lampholders:

(k) By-law 111, which relates to portable hand lamps:

(l) By-laws 143 to 155, which relate to earthing:

(m) By-laws 156 to 160, which relate to testing and inspection of installations:

(n) By-laws 161 to 163, which relate to inspection and certification of installations.

(3) The sizes of conductors shall be so selected that the drop in voltage from the terminals of the generator, transformer, or voltage-reducing apparatus to any point on the installation shall not exceed 10 per cent of the voltage at the said terminals when all conductors are carrying the maximum demand current under normal conditions of service.

(4) The maximum demand shall be determined in accordance with these by-laws, save that —

(a) A lighting point may be rated at not less than 40 watts; and

(b) A plug socket may be rated at not less than 600 watts in domestic installations, but where the plug sockets are installed in work-shops for extra-low-voltage tools the rating shall be based on the loading of the tools to be used.

(5) Where an extra-low-voltage installation and an installation of higher voltage are in the same premises, all plug sockets in the premises shall have their voltage distinctly marked and be of such form as to prevent insertion of an extra-low-voltage plug into a plug socket connected to a circuit of higher voltage.

120 Additional requirements for wiring for experimental and demonstration purposes

Where any wiring is used in connecting up any apparatus for experimental, testing, demonstration or research purposes in any electrical engineering workshop or test room, or in any laboratory or at any research project out of doors and if a suitably competent person is in charge, the wiring shall conform with the requirements of these regulations as far as is practicable so as to reduce any electrical hazard to a minimum. Adequate switching arrangements shall be provided so that live terminals and connections need not be handled and adequate protective apparatus shall be provided to take care of short-circuit or overload conditions. Notices warning persons against the danger of touching live metal and instructions in artificial respiration shall be prominently displayed.

121 Additional requirements for caravans and other vehicles intended for connection to an electricity supply system

(1) The electrical installation of any caravan intended for connection to a low-voltage single-phase multiple-earthed-neutral supply and having a maximum demand not in excess of 15 amperes, in addition to complying with the other provisions of these regulations shall conform with the following:

(a) Supply to the caravan shall be by means of a three-core tough-rubber-sheathed, or tough-plastic-sheathed flexible cord, each conductor of which shall have a cross-sectional area of not less than 1.5 ^{mm2} (30/0.25 mm) and which shall —

(i) Be in one piece; and

(ii) Be connected to the caravan wiring by means of a suitable plug of the inlet type fixed as high as practicable; and

(iii) Have fitted to the end distant from the caravan a weather-proof, 15 ampere, two-pin and earth, non-reversible plug conforming to British Standard No. 196:

(b) An insulator shall be fixed on the outside wall of the caravan to which the supply flexible cord is to be attached:

(c) Plug sockets installed for the supplying of electricity to these caravans shall be weatherproof, 15 amperes, two-pin and earth, non-reversible type:

(d) Caravans shall be wired with tough-rubber-sheathed or tough-plastic-sheathed cable and all plug sockets shall be of the three-pin type.

(2) Any electrical installation in any caravan not coming within the scope of subsection (1) of this by-law or in any other vehicle, and intended for connection to an electricity supply system, shall comply with the requirements of by-law 100 hereof, which relates to semi-portable appliances.

(3) It shall be contrary to these regulations for an electrical installation in any caravan or other vehicle to be connected to a supply of electricity, unless it complies fully with these by-laws.

122 Additional requirements for radio interference suppression devices

(1) Radio-interference suppression devices shall comply with the requirements set by the Board from time to time.

(2) The connection of a capacitor or inductor in the earth-continuity conductor of any appliance or apparatus is prohibited.

(3) The total impedance at power frequency of any inductor incorporated in phase or neutral conductors or both shall not impair the operation of the circuit protection devices.

(4) Any capacitor connected between any line conductor and exposed metal frame of a portable or semi-portable appliance shall not exceed 0.005 micro-farad in the case of alternating current and 0.1 micro-farad in the case of direct current.

123 Additional requirements for hospitals

In hospitals all fixed wiring operating at a voltage in excess of extra-low voltage shall be carried out only in cables that are metal sheathed or armoured or both or be enclosed in metal conduit or metal trunking, or cable enclosed in a sheath or enclosure of self-extinguishing material.

PART VII - INSTALLATION OF ELECTRIC DISCHARGE LAMPS

124 Scope of Part VII

(1) The special requirements of this Part of these By-laws shall be observed in addition to the requirements of all other By-laws.

(2) By-laws 130 to 142 hereof shall apply only to discharge-lamp installations in which a voltage exceeding 650 volts r.m.s, measured on open circuit, is used.

125 Switches

Any switch not specifically designed to break an inductive load of its full rated capacity shall, if used to control a discharge-lamp circuit, have a current rating of not less than twice the total steady current which it is required to carry, or, if used to control filament lamps and discharge lamps, have a current rating of not less than

the sum of the current flowing in the filament lamps and twice the total steady current flowing in the discharge-lamp circuit.

126 Loading of subcircuits

(1) In every subcircuit the sum of the normal steady currents shall not exceed the rating of the subcircuit in amperes, and in every subcircuit by which induction-operated discharge lamps are exclusively supplied, the total steady current in the subcircuit, multiplied by one and one-quarter, shall not exceed the rating of the subcircuit.

(2) Where inductor-operated discharge lamps and filament lamps are both supplied by a single subcircuit, the sum of the total steady current taken by the filament lamps and one and one-quarter times the total steady current taken by the inductor-operated discharge lamps shall not exceed the rating of the subcircuit.

127 Screening of live parts

(1) All live parts of an installation, including all apparatus and conductors but excluding the lamps except in the neighbourhood of their terminals, shall be provided with effective screens of earthed metal or insulating material of mechanical strength adequate to withstand the conditions of normal service, save that for installations on the exterior of a building those live parts may alternatively be so situated as to be accessible only to authorised persons.

(2) Insulating material used for the purposes of subsection (1) of this by-law shall be incombustible, non-hygroscopic, and non-tracking.

128 Motor generators and convertors

Every discharge-lamp circuit which is energised by a motor-generator or double-wound convertor shall be permanently earthed at a terminal of the motor-generator or convertor.

129 Voltage of 300-650 volts

Discharge-lamp equipment which operates under steady running conditions at an r.m.s, voltage exceeding 300 volts but does not use a voltage exceeding 650 volts r.m.s, measured on open circuit, shall either be inaccessible to unauthorised persons or be so designed and installed that no live metal is exposed in such a manner that it may be touched when a lamp is inserted or removed.

130 Maximum voltage permissible

No discharge-lamp circuit shall use an r.m.s, voltage exceeding 7,500 volts to earth, measured on open circuit.

131 Transformers of input exceeding 500 watts

Every high-voltage of extra-high-voltage circuit supplied from a transformer having an input exceeding 500 watts shall be provided with means for the automatic disconnection of the supply in the event of short circuit or of earth-leakage current which exceeds 20 per cent of the normal steady current in the circuit.

132 Installation of ancillary equipment

Ancillary equipment for high-voltage and extra-high-voltage installation, including inductors, chokes, ballast units, capacitors, resistors, and transformers, shall be either totally enclosed in a substantial earthed metal container (which may form part of a lighting fitting), or alternatively shall be placed in a suitably ventilated enclosure of incombustible material or of fire-resisting construction which is reserved for high-voltage or extra-high-voltage apparatus. A notice reading "DANGER HIGH VOLTAGE" shall be placed and maintained in a visible position on every such container or enclosure which is accessible to unauthorised persons, and otherwise where necessary. The word "DANGER" shall be in block letters not less than 10 mm high and the words "HIGH VOLTAGE" in letters not less than 5 mm high. The letters shall be red on a white background and the size of each notice shall be not less than 65 mm overall.

133 Disconnection from supply mains

A conductor which is in metallic connection with the terminals of a high-voltage or extra-high-voltage discharge lamp shall not be in metallic connection with any conductor of the supply mains otherwise than by means of a connection with earth, except that on alternating-current two-wire circuits which one pole of the supply is connected with earth, it shall be permissible to use auto-transformers delivering a maximum voltage of 1,500 volts measured on open circuit, subject to the provision of means for the disconnection of both poles of the supply.

134 Means of disconnection

One of the following means shall be provided for the disconnection from the supply of every self-contained fitting, or, alternatively, of every circuit supplying a high-voltage or extra-high-voltage discharge lamp —

(a) an interlock on the self-contained fitting, so arranged that before access can be had to live parts the supply is automatically disconnected;

(b) effective local means for the disconnection of the circuit from the supply shall be provided in addition to the switch normally used for controlling the circuit; or

(c) a switch or fuse which can be locked to prevent the restoration of the supply by unauthorised persons. Where an installation compresses more than one locked switch or fuse the keys shall be non-interchangeable.

135 Control

Every high-voltage or extra-high-voltage discharge-lamp sign and all high-voltage and extra-high-voltage discharge-lamp outline and decorative lighting, or the submain to the distribution board from which the sign or lighting is supplied shall be controlled by a separate switch, save that in the case of an indoor sign supplied from a plug socket the switch may be omitted. Every such switch shall be permanently and conspicuously marked with the words "ELECTRIC SIGN". In all cases the switch shall be mounted in a conspicuous position easy of access to any fireman.

136 Cables

Except as provided in by-laws 137 and 142 hereof, high-voltage and extra-high-voltage connections in discharge-lamp installations shall be made with suitably insulated cables enclosed in conduit or metal-sheathed, armoured, or metal-sheathed and armoured cables, except that insulated and braided cable may be used —

(a) in exterior installations for inter-lamp series connections not exceeding 3 m in length which are not likely to suffer mechanical damage, or which are installed in box signs:

(b) in the case of interior installations, in self-contained fittings.

137 Bare or lightly insulated conductors

Bare or lightly insulated conductors of copper (preferably tinned) or nickel, having a cross-sectional area not less than 0.5 mm^2 may be used for high-voltage or extra-high-voltage series connections, if either —

(a) the conductor does not exceed 1 m in length, is supported at intervals not greater than 500 mm, is not exposed to the likelihood of mechanical damage, and is completely protected by incombustible, non-hygroscopic, insulating material which is so arranged as to be reasonably secure against being so displaced as to expose any part of the live metal, and if in the form of glass tubing, has a wall thickness of not less than 1 mm, and an overall diameter not less than 5 mm; or

(b) the conductor is in an enclosure to the interior of which only authorised persons can have access.

138 Metal-sheathed, armoured, or metal-sheathed and armoured cables shall be installed in accordance with the following provisions of this by-law

(a) They shall be supported at intervals not greater than the following:

Cable Run	Metal-sheathed	Armoured or Metal-sheathed and Armoured
Horizontal	800 mm	1 m
Vertical	1.2 m	1.5 m

(b) The supports shall hold the cable securely and shall themselves be rigidly mounted;

(c) All metal sheaths and armour shall be earthed.

139 Insulated and braided cables and bare conductors

(1) Insulated and braided cables and bare conductors in high-voltage . or extra-high-voltage discharge-lamp installations shall be supported at intervals not greater than the following:

Cable Run	Insulated and Braided Cables	Bare Conductors
Horizontal	500 mm	500 mm
Vertical	800 mm	500 mm

(2) The supports shall be of glass or glazed porcelain or some other incombustible, non-hygroscopic insulating material shall hold the cable or conductor securely, and shall themselves be rigidly mounted.

140 Clearances

(1) The length in millimetres measured along its centre line, of every Support which serves to separate bare high-voltage or extra-high-voltage metal, or high-voltage or extra-high-voltage cables which are neither metal-sheathed nor armoured, from earthed metal work, woodwork, or surfaces likely to become damp, shall be not less than the value obtained by multiplying the voltage to earth of .the transformer secondary in kilovolts (r.m.s.) measured on open circuit, by 10.

(2) The air gap in millimetres from high-voltage or extra-high-voltage metal or cables which are neither metal-sheathed nor armoured to earthed metal, woodwork, or surfaces likely to become damp, shall be not less than the value obtained by multiplying the voltage to earth of the transformer secondary in kilovolts (r.m.s.) measured on open circuit, by 4.

141 The installing of cables

(1) Each cable in a high-voltage or extra-high-voltage discharge-lamp installation shall be supported close to each terminal connection and in no case at a distance greater than 150 mm, or 300 mm if a glazed porcelain electrode receptacle forming an adequate support for the cable is used.

(2) When a connection is made to a cable, the insulation exposed by removing the metal sheath or braid shall be suitably protected from the effects of ozone.

(3) Where likely to suffer mechanical damage, cables shall be armoured or otherwise suitably protected.

142 Earthed return conductors

(1) The return cable from an electrode to a transformer terminal which is earthed may be of 300 volt grade if the cross-sectional area of the conductor is not less than 2.5 mm^2 (1/1.78 mm of 7/0.67 mm).

(2) The metalwork of a rotating device may be used as a return conductor if adjacent uninsulated metalwork is permanently and effectively earthed.

PART VIII - EARTHING

143 Protection against leakage to earth

Electrical apparatus operating at a voltage exceeding extra-low voltage shall be protected against leakage to earth of dangerous currents by one of the following means —

(a) insulation which encloses the apparatus and is durable and substantially continuous, that is to say, of all-insulated construction;

(b) double insulation;

(c) earthing of exposed metal parts in accordance with the requirements of this Part of these by-laws;

(d) isolation of such metal as is specified in by-law 145 hereof.

144 Metalwork to be earthed

When earthing is used as a means of compliance with the requirements of by-law 143(c) hereof, the following shall be earthed —

(a) all metalwork associated with wiring systems (other than current-carrying parts), including cable sheaths and armour, conduit, troughing, boxes, and catenary wires;

(b) exposed metal of apparatus required to be earthed in accordance with the requirements of by-law 143 hereof;

(c) earthing contacts of plug sockets, and cord-extension sockets, except where otherwise specifically exempted.

145 Isolation

The application of by-law 143(d) hereof, which exempts, from the requirements of earthing, metal which is so isolated that it is not liable to come into contact with live parts or with earth or earthed metal, shall be restricted to the following apparatus —

(a) short isolated lengths of metal used for mechanical protection of tough-rubber-sheathed or tough-plastic-sheathed wiring;

(b) short inaccessible isolated lengths of metal conduct used for the mechanical protection of cleated wiring where it passes through floors, walls, partitions, or ceilings;

(c) clips for fixing cables;

(d) flush mounting metal outlet boxes used with tough-rubber-sheathed or tough-plastic-sheathed wiring system, if screened by non-conducting material;

(e) lamp caps;

(f) small parts such as screws or nameplates isolated by insulating material;

(g) metal chains for the suspension of lighting fittings;

(h) except where earthing is required for their operation, lighting fittings installed in a room having a non-conducting floor and mounted at such a height that they cannot readily be touched and are out of reach of earthed metal.

146 Earthing prohibited

(1) Notwithstanding the requirements of by-laws 143, 144 and 145 hereof, the following shall not be earthed —

(a) the guards of shrouded handlamps conforming to by-law Ill hereof other than portable flameproof electric handlamps;

(b) the secondary wiring of an isolating transformer used for the purpose of subsection (4)(e) of by-law 99 hereof or the exposed metal of any portable appliance supplied therefrom;

(c) the earthing contact of any plug socket connected to a supply isolated from earth for the purposes of subsection (4)(e) of by-law 99 hereof;

(d) the secondary winding of a double-wound transformer or the generator winding of a motor-generator used to supply any medical or dental

appliance in accordance with by-law 113(1) hereof and the exposed metal of any portable appliance supplied therefrom.

(2) The secondary winding of a transformer used for a manually operated, portable or semi-portable, arc welding set shall not be connected to the earthed metal of the transformer.

147 Additional precautions

Where segregation of wiring from metal-work of other services is impracticable, bonding and earthing shall be carried out in compliance with the requirements of by-law 66(6) hereof and by-law 149(3) hereof. The metalwork requiring bonding and earthing in these circumstances includes the following —

(a) exposed metal pipes, sinks, tanks, baths, wash tubs, taps, waste pipes, gas pipes, and other similar things;

(b) accessible structural steelwork;

(c) framework of cranes, lifts, and other similar mobile equipment on which electrical apparatus is mounted.

148 Basic requirement for earthing

The earthing arrangements of the consumer's installation shall be such that —

(a) On the occurrence of a fault of negligible impedance from a phase or non-earthed conductor to adjacent exposed metal, a current corresponding to three times the rating of the fuse or one and a half times the setting of the overload circuit breaker can flow so that the faulty circuit is made dead;

(b) In every case where the requirement of paragraph (a) of this by-law cannot be met, and with the consent of the Board, an approved earth-leakage circuit breaker or circuit breakers shall be installed in accordance with by-law 155 hereof.

149 Earth-continuity conductors

(1) Every earth-continuity conductor shall be so designed and installed that it affords compliance with the requirements of by-law 148 hereof.

(2) Every earth-continuity conductor shall be of high conductivity copper, save that metal conduit or troughing, the metallic sheathing and armour of cables, or a catenary wire supporting a cable, may be used as an earth-continuity conductor in accordance with subsection (4) of this by-law.

(3) The cross-sectional area of every earth-continuity conductor shall be not less than that specified in paragraphs (a) to (d) of this subsection as applicable; and where metal pipes or troughing or the sheath or armour of a cable can be used as" an earth-continuity conductor or as reinforcement thereof, the

requirements of paragraph (e) or paragraph (f) of this subsection, as applicable, shall be observed. The requirements mentioned in this subsection are as follows —

(a) The earth-continuity conductor in any metal-sheathed or tough-rubber-sheathed or tough-plastic-sheathed composite cable shall have a cross-sectional area in accordance with table 7 hereof:

Provided that, in the case of tough-rubber-sheathed and tough-plastic-sheathed cables used as submains, or laid direct in the ground outside buildings, the earth-continuity conductor shall have a minimum cross-sectional area of 1.5 mm^2 (1/1.38 mm);

(b) The earth-continuity conductor in any flexible cable or flexible cord, or in any cable not coming within the scope of paragraph (a) of this subsection, shall have a cross-sectional area equal to that of the current-carrying conductors;

(c) Every separate copper earth-continuity conductor not contained in a composite cable, flexible cable, or flexible cord shall have a cross-sectional area in accordance with table 8 hereof, and the conductance of every other separate earth-continuity conductor not of copper shall be equivalent to the that of the copper earth-continuity conductor specified;

(d) Every separate earth-continuity conductor installed in any conduct shall be insulated and stranded, and shall have a cross-sectional area related to its current carrying conductors as prescribed in column 6 of table 7 for current carrying conductors up to and including 16 mm^2 but in no case shall the earth-continuity conductor be less than 1.5 mm^2;

(e) Every copper conductor used for the purpose of bonding metalwork as required by by-law 147 hereof shall have a cross-sectional area appropriate to the particular installation, and in no case less than 4 mm^2 (7/0.85 mm) and any other type of conductor used for such purpose shall have equivalent conductance;

(f) Joints in metal conduits or troughing and metal sheaths and armour of cables, which are used for earth-continuity, shall be soundly made and protected where necessary against corrosion;

(g) Pipes and members of structural steelwork when used as an earth-continuity conductor shall have metal-to-metal joints:

(h) Pipes conveying gas or flammable liquid or other flammable material shall not be used as an earth-continuity conductor although they may be bonded thereto in compliance with by-law 64(6) and by-law 147 hereof.

(4) Metal conduit or troughing, the metallic sheathing or armouring of a cable, or a catenary wire external to or incorporated in cable and used for its support or the separate earth-continuity conductor of tough-rubber-sheathed or tough-plastic-sheathed cable may be used as an earth-continuity conductor only for

the protection of the conductors enclosed therein or supported thereby and for apparatus directly connected to those conductors.

(5) Any metal conduit or troughing, metallic sheathing or armouring Of a cable, or catenary wire, having an impedance in excess of that which would permit its use as an earth-continuity conductor under these regulations, but which is required to be earthed, shall be earthed by a separate earth-continuity conductor, having a cross-sectional area not less than that prescribed in paragraph (3) of this by-law, installed alongside and connected to the metal conduit, troughing, metallic sheathing, armouring, or catenary wire at each end and to all metal fittings or accessories attached thereto, and in the case of long unbroken runs of metal conduit or troughing or metallic sheathing or armouring, at suitable intervals throughout the run.

(6) An earth-continuity conductor run as an aerial conductor shall in no case be smaller than the size specified in by-law 80 hereof, which relates to aerial lines, according to the length of the span and type of conductor, and it shall be adequately supported.

(7) Flexible metal conduit, or armouring of similar construction, shall not be used as an earth-continuity conductor.

(8) At every switchboard earth-continuity conductors shall be connected in accordance with by-law 36 hereof.

(9) A bare earth-continuity conductor shall not be installed in any conduit.

(10) All earth-continuity conductors installed in any metallic trough or duct shall be bonded to the metal of the trough or duct at suitable intervals.

(11) Bare earth-continuity conductors installed within or behind accessories, mounting blocks, or switchboards and liable to come in contact with live conductors or their insulation, shall be insulated with a flexible sleeve of suitable material having a minimum thickness of 0.635 mm.

(12) The earth-continuity conductor in any tough-rubber-sheathed or tough-plastic-sheathed composite cable shall be insulated throughout its entire length.

150 Earthing lead

(1) In every installation connected to a multiple earthed-neutral system, or to some other source of supply having one conductor connected to earth, the following shall apply —

(a) A separate and independent earthing lead shall, except as provided in subsection (2) of this by-law, be taken from the neutral busbar fitted to the main switchboard controlling the installation to an earth electrode that complies with the requirements of by-law 153 hereof;

(b) At the main switchboard, the earthing lead shall terminate in a separate cable socket which shall be either a soldering socket, or a permanently attached cable socket of some other approved type, and which shall be

securely and effectively connected to the neutral busbar (or stud) by means of a nut and locknut in a manner that will permit separation of the cable socket from the busbar (or stud) for the purpose of testing;

(c) The earthing lead shall be of high-conductivity copper having a cross-sectional area in accordance with table 8 of these by-laws.

(2) Where the provisions of by-law 152(3) hereof apply, the separate and independent earthing lead shall be connected to the Board's distribution line neutral.

151 Protection of earth-continuity conductors and earthing leads

Every earth-continuity conductor and every earthing lead shall be protected against mechanical damage and corrosion.

152 Use of supply system earthed conductor for earthing

(1) Except as provided in paragraphs (2) and (3) of this by-law the earthed conductor of any system of supply shall not be used as an earthing conductor.

(2) The neutral of a multiple earthed-neutral system may be used, in the case of aerial conductors, for the earthing of stays, outdoor lamp brackets, isolated overhead-line connector boxes, earthing guards, or other line hardware if the stays, brackets, boxes, guards, or hardware are mounted on poles at a height of not less than 3 m above ground level.

(3) Where mobile units are required to be connected temporarily to a Board's aerial lines for a short period in locations where, in the opinion of the Board a separate connection with earth cannot be established without unreasonable expenditure or undue inconvenience, the distribution-line neutral of a multiple-earthed-neutral system may be used for the purpose of earthing if —

(a) the neutral and earthing conductors from the unit are run separately and are insulated from each other except where connection is made to the neutral bar and to the distribution-line neutral; and

(b) the connection of the neutral conductor and the earthing conductor to the distribution-line neutral are separately made, one on each side of the distribution-line pole; and

(c) the Board is satisfied that no increase in electrical hazard will result from the method of earthing.

153 Earth electrodes

(1) The earth electrode to which the earthing lead of an installation is connected in accordance with by-law 150 hereof shall consist of —

(a) a non-ferrous rod of 12 mm diameter, or a steel rod of not less than 16 mm diameter, or a galvanised iron pipe of not less than 20 mm internal diameter, driven into the ground to a vertical depth of not less than 2 m;

(b) a length of not less than 7.5 m of 7 mm diameter copper rod, or 25 mm by 1.6 mm section copper strip, or 1.5 mm internal diameter galvanised iron pipe, or 15 mm copper pipe, or 35mm^2 bare copper conductor, or a length of not less than 15.25 m of 16 mm^2 bare copper conductor, in each case buried at a depth of not less than 500 mm below ground level; or

(c) such other type of effective earth electrode as may be approved by the Board, save that as from the 1st day of January 1985 an earthed metallic water supply system shall not be used as the earth electrode for any new electrical installation, except by agreement between the Board and the Tonga Water Board.

(2) Any earthed metallic water supply system on a consumer's premises shall be bonded to the installation earth electrode by a copper conductor having a cross-sectional area not less than that of the earthing lead for the installation, and the connection of the conductor to the water supply system in any building shall be as close as practicable to the point of entry of the water supply system into the building.

(3) Pipes conveying gas or flammable liquid or other flammable material shall not be used as an earth electrode.

154 Connections of earth-continuity conductors and earthing leads

(1) The connection of every earth-continuity conductor to any pipe, trough, duct or cable sheath or armour, and the connection of every earthing-lead to an earth electrode shall be made by a substantial clamp or other device of non-ferrous metal in such a manner that the earth-continuity conductor or earthing lead may be readily detached for the purpose of testing.

(2) For metal-sheathed or armoured cables the clamp or device shall firmly grip the sheathing or armouring without damage to the insulation.

(3) For metal-sheathed and armoured cables, the armouring shall be bonded to the sheathing and the principal connection of the clamp or device shall be to the sheathing.

(4) Every earthing clamp or device shall be readily accessible.

(5) Every earth-continuity conductor and earthing lead connected to an earth electrode shall be labelled at or immediately adjacent to the point at which the connection is made. The label shall be of copper, or suitable plastic material, shall be securely attached to the earth-continuity conductor or earthing lead, and shall be permanently and legibly marked with the words "EARTHING CONDUCTOR-DO NOT DISCONNECT".

(6) Where supply to a device is given by means of flexible cable or flexible cord and plug and plug socket —

(a) the earth-continuity conductor shall form part of the flexible cable or flexible cord and shall be connected to a separate terminal at the plug; and

(b) if the flexible cable or flexible cord has a metallic covering, the covering shall, in addition, be effectively connected electrically and mechanically to the metal frame of the device and to the earthed metal of the plug and plug-socket connection; and

(c) the connection to earth shall be made automatically before the making of the corresponding current-carrying connections when the plug is inserted in the plug socket, and shall break after the current-carrying connections when the plug is withdrawn from the plug socket.

155 Earth leakage circuit breaker

Where, in accordance with by-law 148(b) hereof, an installation is protected by one or more earth-leakage circuit breakers the following shall apply —

(a) Every earth-leakage circuit breaker shall be so installed and connected that, in the event of any exposed metal part of the installation, including any part of the installation required to be earthed under by-law 143 hereof reaching a voltage of or exceeding 26 volts r.m.s, from earth potential under fault conditions, it will cause the installation to be disconnected from all live supply conductors;

(b) Every earth-leakage circuit breaker shall be installed in a readily accessible position on the main switchboard or at some other readily accessible position approved by the Board;

(c) The installation of an earth-leakage circuit breaker or circuit breakers shall be additional to and not instead of any other requirements as to the earthing of an installation contained in this Part of these by-laws;

(d) One end of the tripping coil of the earth-leakage circuit breaker shall be connected by means of a stranded copper conductor not smaller than 1.5 mm^2 to the neutral busbar or other metal to be earthed, and the other end shall be connected, by means of a 300-volt-grade insulated cable not smaller than 7/0.67 mm and which (where exposed to the weather) shall be weatherproof cable, to an independent earth electrode such as described in by-law 153(1) hereof, which by law relates to earth electrodes, and which cable shall be used solely for the purpose of the connection;

(e) The independent earth electrode referred to in paragraph (d) of this by-law shall be established in a place at least 150 mm from any gas, water, or other metal pipe above ground and at least 2 m distant from any other earth electrode or cable, or gas, or water, or other metal pipe on or

in the ground, and shall have a resistance to the general mass of earth not exceeding 200 ohms;

(f) The insulated earthing conductor shall be protected from damage throughout its entire length either by its position or by suitable covering;

(g) Unless protected by means of an earth-leakage circuit breaker, the service mains to an installation earthed on the earth-leakage circuit breaker system shall be of such form or installed in such a manner that double insulation is provided on the conductors;

(h) Every earth-leakage circuit breaker shall be provided with means for testing the effectiveness of its operation;

(i) Every earth-leakage circuit breaker shall have permanently and legibly marked either on the circuit-breaker cover or on an approved durable label not smaller than 65 mm by 40 mm and securely fixed in a prominent position immediately adjacent to the circuit breaker the words "The switch must be tested every month by the consumer. Press the test button. If the switch does not open either the switch or its connection is defective, in which case the Board must be notified":

Provided that the words "Turn the test key" may be substituted for the words "Press the test button" where the test circuit is operated by a test key;

(j) The marking of label referred to in paragraph (i) of this by-law shall be so located that it can be read easily when the circuit breaker is mounted in its operation position;

(k) Where an earth-leakage circuit breaker is installed to comply in all respects with the specified requirements of these by-laws for the main switch of an installation or for a switch for the control of a stated appliance, apparatus, or outlet, no other main switch need be installed in respect of the installation and no other control switch need be installed in respect of the appliance, apparatus, or outlet.

PART IX - INSPECTION AND TESTING OF INSTALLATION

156 Responsibility for inspection and testing

The inspection and testing prescribed in by-laws 157 to 160 hereof are to be carried out by, or under the direction of the electrician in charge of the work; and that electrician shall commit an offence and shall be liable on summary conviction to a fine not exceeding $20 if he fails to carry out or ensure the carrying out of any such inspection or test.

157 Verification of compliance with the by-laws

(1) On completion of every new installation or addition to an existing installation, an inspection shall be made of all the work carried out and tests shall be conducted to verify, as far as practicable, that the requirements of these by-laws have been met.

(2) Every defect revealed as the result of any such inspection and testing shall be rectified before the installation or addition is connected to the supply.

158 Insulation resistance tests

(1) Before a complete installation, section of an installation, or addition to an installation is connected to the supply, an insulation-resistance test shall be made between earth and all conductors of the installation, section, or addition, as appropriate, connected together. Apparatus may, if desired, be disconnected from sub-circuits during the test and tested separately.

(2) For the purposes of subsection (1) of this by-law, an installation, section of an installation, or addition to an installation may be subdivided.

(3) The insulation-resistance test required under subsection (1) and (2) of this by-law shall be deemed to be satisfied if the insulation resistance is not less than the minimum prescribed in the following table for the respective parts of an installation —

Wiring or Apparatus Under Test	**Minimum Insulation Resistance to Earth**
Complete installation	1 megohm
Section of an installation addition to an installation	50 megohms /Number of points - but not less than one megohm.
Apparatus disconnected from subcircuits	0.5 megohm.

(4) The voltage used for insulation-resistance tests shall be a unidirectional voltage not less than twice that which will normally be applied to the installation (twice the r.m.s, value if the supply is alternating current), except that it need not exceed 500 volts for medium-voltage circuits.

159 Test of ring circuit

A test shall be made to verify the continuity of all conductors of every ring circuit installed in accordance with by-law 46 hereof.

160 Test of earth leakage circuit breakers

Where earth-leakage circuit breakers are installed in accordance with by-law 155 hereof, their effectiveness shall be verified.

PART X - INSPECTION AND CERTIFICATION OF INSTALLATIONS

161 Admission to premises

(1) Any authorised Inspector may, at any reasonable time or times, upon producing evidence that he is so authorised, enter upon any premises and inspect and test any electrical installation or part thereof for the purpose of ascertaining whether the requirements of these by-laws have been complied with.

(2) The consumer, or any person acting on his behalf, shall render any authorised Inspector every reasonable facility for inspecting and testing the installation or part thereof.

(3) If any person, without reasonable cause, refuses to permit any authorised Inspector to make any inspection as aforesaid, that person commits an offence and shall be liable on summary conviction to a fine not exceeding $20; and the Board may disconnect the installation or part thereof from the source of supply.

(4) If any person, without reasonable cause, refuses to permit any person authorised by the Manager or Board to make any inspection as aforesaid, that person commits an offence and shall be liable on summary conviction to a fine not exceeding $20; and the Board shall, on demand in writing by the Manager, disconnect the installation involved from the source of supply.

162 Certification by authorised Inspector

(1) After having inspected any electrical installation or part of an installation the authorised Inspector, if satisfied that the work has been carried out in accordance with the requirements of these by-laws, shall certify in writing to the Board or at districts outside Tongatapu then to the Branch Manager, that he has duly inspected the installation or part of an installation and that the results of the tests prescribed in Part IX hereof are satisfactory, and that to the best of his knowledge and belief the installation or part of an installation may be safely connected with the source from which electricity is available.

(2) The Board or the Manager, as the case may be, shall, if supply is available, forthwith authorise the connection or unless requested to the contrary, arrange for the connection to be made.

(3) Nothing in any certificate issued in accordance with this by-law shall relieve the owner or occupier of any premises from the obligation to bring any installation or part of an installation into conformity with these by-laws if subsequently an authorised Inspector discovers any defects which render the installation or part of an installation electrically hazardous.

(4) Where any authorised Inspector withhold certification as aforesaid because of any defect in an installation or part of an installation or because an installation or part of an installation fails to comply with the requirements of these by-laws, any notice served by the Board on an electrician, electrical contractor, consumer, or owner of the installation, respecting the defects or failure to comply, shall quote the relevant by-law or by-laws concerned.

163 Special connections

(1) Notwithstanding anything to the contrary in by-law 162 hereof the Board or the Manager as the case may be, may under conditions of urgency permit an installation or part of an installation to be temporarily connected with the source from which electricity is available notwithstanding that any one or more of the tests prescribed in Part IX hereof have not been satisfied:

Provided that such permission shall not be granted —

(a) Unless the installation or part of an installation otherwise generally complies with the requirements of these by-laws and is certified by the authorised Inspector to be reasonably free from electrical hazard; or

(b) For a longer period than 1 month, unless this period is extended by the Manager on the direction of the Board.[5]

(2) On the expiration of the period, or extended period, as aforesaid for which the temporary connection has been permitted, the installation or part of an installation shall be disconnected from the source from which electricity is available, unless before the expiration the authorised Inspector has issued his certificate pursuant to by-law 162 hereof.

TABLE 1

By-law 31 — Main and Distribution Switchgear to Control Consumer's Wiring

1	2	3	4	5
System of Supply	Consumer's Mains, or Outgoing Submains, and Subcircuits*	Earth Connection of Supply System		Switchgear
			Circuit Breaker or Switch	Overload Trip Coils or Fuse Links
a.c. single-phase two-wire or d.c. two-wire	Two-wire a.c. or d.c.	None	Two-pole	In each conductor
		One-pole	One-pole	In non-earthed conductor
a.c. single-phase three-wire or d.c. three-wire	Two-wire a.c. or d.c., both outers	Neutral	Two-pole	In each conductor
	Two-wire a.c. or d.c., one outer, one neutral	Neutral	One-pole	In non-earthed conductor
	Three-wire a.c. or d.c.	Neutral	Two-pole	In each outer conductor
a.c three-phase four-wire (This includes a three-phase three-wire system with artificial neutral)	One conductor phase, other neutral	Neutral	One-pole	In non-earthed conductor
	Two-wire, both conductors phase	Neutral	Two-pole	In each conductor
	Three-wire, two conductor phases, other neutral	Neutral	Two-pole	In each phase conductor
	Four-wire, three conductors phases, other neutral	Neutral	Three-pole	In each conductor
	Four-wire, all conductors phases other neutral	Neutral	Three-pole	In each phase conductor

* Refer to by-law 41 (Common submain) for additional switchgear on certain submains where these come into a distribution.

† The circuit breaker or switch prescribed in column 4 may be omitted on any submain or subcircuit if the normal working current per conductor does not exceed 400 amperes.

‡ Where the supply is from an external source and a service fuse is installed and used solely for the installation of one consumer, the protection referred to in column 5 for use with a consumer's main switchgear may be omitted.

TABLE 2

Main Switchgear for Generators

By-Law 31(3)

1	2	3	4
Type of Generator	Earth Connection of Supply	Switchgear	
		Circuit Breaker or Switch	Overload Trip Coils or Fuse Links
a.c. single-phase two-wire or d.c. three-wire	None	Two-pole	In each conductor
	One-pole	One-pole	In non-earthed conductor
a.c. single-phase three-wire or d.c. three-wire	Neutral	Two-pole	In each conductor
a.c. three-phase three-wire	Means to be provided to give an artificial neutral; thereafter to be as for three-phase four-wire	Three-pole	In each phase conductor
a.c. three-phase four-wire	Neutral		

BY-LAW 45(2)(*d*) Table 3

Estimation of the Maximum Demand of an Installation, for Use in Computing the Sizes of Cables for Service Mains and Submains

Type of Equipment	Type of Installation				
	Individual Domestic Installations, including Individual Flats of a Block of Flats	Blocks of Residential Flats	Hotels, Boarding-houses, and the Like	Business Premises, Offices, Factories, Public Buildings, and the Like	Other Cases
Lighting	66 per cent connected load	50 per cent connected load	75 per cent connected load	90 per cent connected load	100 per cent connected load
Plug sockets* (not protected by a non-adjustable circuit breaker as per by-law **46**, hereof)	One plug socket—100 per cent connected load. Two to six plug sockets 100 per cent connected load of largest plug socket plus 25 per cent of connected load of other plug sockets 100 per cent connected load of two largest sockets plus 10 per cent sum of connected load of other plug sockets	100 per cent connected load of two largest plug 25 per cent of connected load of other plug sockets	75 per cent of connected load of plug sockets in main rooms, including dining-rooms, lounge, billiard rooms, offices, plus 25 per cent of connected load of other plug sockets	100 per cent sum of connected load of all plug sockets	
Plug sockets (protected by a non-adjustable circuit breaker as per by-law **46**, hereof)	100 per cent. largest circuit-breaker current-rating of individual circuits plus 40 per cent of the sum of circuit breaker current-ratings of other circuits		100 per cent largest circuit breaker current-rating of individual circuits plus 50 per cent of the sum of circuit breaker current-ratings of other circuits		

Fixed heating and power appliances other than motors, cookers, and water heaters	100 per cent connected load up to 10 amperes plus 50 per cent of any load in excess of 10 amperes	100 per cent connected load of largest appliance plus 50 per cent connected load of second-largest appliance plus 33 per cent connected load of fourth-largest appliance plus 20 per cent connected load of remaining appliances.	100 per cent connected load of largest appliance plus 80 per cent connected load of second-largest appliance plus 60 per cent connected load of remaining appliances	100 per cent connected load of largest appliance plus 75 per cent connected load of remaining appliances
Fixed cooking appliances	75 per cent of connected load up to 8kW of range loading plus 25 per cent of load in excess of 8kW		75 per cent connected load in all cases	
Waterheaters	100 per cent connected load in all cases			
Motors	100 per cent connected load of largest motor plus 50 per cent connected load of remaining motors.			

* For the purpose of this table a plug socket rated at 10 amperes 230 volts is deemed to be a connected load of 2,000 watts.
† Plug sockets, up to a maximum of two, fitted to an electric range in a domestic installation shall be excluded from consideration.

TABLE 4

By-law 61(7), 65(2)(*c*), 74(*e*)

Minimum Internal Radii of Bends in Cables for Fixed Wiring

Insulation	Finish	Overall Diameter	Minimum Internal Radius of Bend (Times Overall Diameter of Cable)
Rubber or P.V.C. (circular copper or circular stranded aluminium conductors)	Non-armoured	Not exceeding 10 mm	3
		Exceeding 10 mm but not exceeding 25 mm	4
		Exceeding 25 mm	6
	Armoured	Any	6
P.V.C. (solid or shaped copper conductors)	Armoured or non-armoured	Any	8
Impregnated paper	Lead or corrugated aluminium sheath with or without armour	Any	12
	Smooth aluminium sheath with or without armour	Not exceeding 30 mm	12
		Exceeding 30 mm but not exceeding 50 mm	15
		Exceeding 50 mm	18
Mineral	Copper or aluminium sheath with or without P.V.C. Covering	Any	6

TABLE 5

By-law 65(2)(*b*), (*d*)
Spacing of Supports for Cables Sheathed with Tough-rubber, Tough-plastic, or Lead

Number and Diameter of Wires Forming Conductor	Nominal Cross-sectional Area of Conductor	Maximum Spacing of Clips	
		Horizontal	Vertical
1	2	3	4
mm	mm^2	mm	mm
1/1.13	1.0	250	400
1/1.38	1.5	250	400
1/1.78	2.5	250	400
7/0.85	4	250	400
7/1.04	6	250	400
7/1.35	10	300	400
7/1.70	16	350	450
7/2.14	25	400	550
19/1.53	35	400	550

TABLE 6

By-law 78(2)
Minimum Radial Thickness of Tough-plastic-sheathing of Neutral-screened Cables Permitted to be Installed Without Further Enclosure

Number and Diameter (mm) of Wires Comprising Core Conductors	Nominal Area of Conductor	Minimum Radial Thickness of Sheathing		
		Two-Conductor Cables	Three Conductor (Flat) Cables	Four-Conductor (Circular) Cables
1	2	3	4	5
mm	mm^2	mm	mm	mm
7/0.85	4	1.8	1.8	1.8
7/1.04	6	1.8	1.8	1.8
7/1.35	10	3.2	3.2	3.2
1/1.70	16	3.2	3.2	3.2
7/2.14	25	3.2	3.2	3.2
19/1.53	35	3.2	3.2	3.2
19/1.78	50	3.2	3.2	3.2
19/2.14	70	3.2	3.2	3.2

TABLE 7

By-law 55, 149

Size of Copper Earth-continuity Conductor in Metal-sheathed, Tough-rubber-sheathed and P.V.C.-sheathed Cables with Copper Conductors

Size of Current-carrying Conductor		Flat Twin and Flat Three-core Metal-sheathed Cables	Size of Wires Forming Earth-continuity Conductor Flat Twin Tough-rubber-sheathed and Tough-plastic-sheathed Cables		
Nominal Cross-sectional Area (mm^2)	Number and Diameter (mm) of Wires	Approximate Cross-sectional Area of Earth-continuity Conductor (mm^2)	Number and Diameter (mm) of Wires	Approximate Cross-sectional Area of Earth-continuity Conductor (mm^2)	Number and Diameter (mm) of Wires
1	2	3	4	5	6
1.0	1/1.13	In Accordance with a recognised Standard Specification		1.0	1/1.13
1.5	1/1.38			1.15	1/1.38
2.5	1/1.78			2.5	1/1.78
4	7/0.85			1	7/0.85
6	7/1.04			4	7/0.85
10	7/1.35			6	7/1.04
16	7/1.7			10	7/1.35

TABLE 8

By-laws 149(3)(*c*), 150(1)(*c*)
Size of Separate Copper Earth-Continuity Conductor Not Contained in a Composible, and Size of Separate Copper Earthing Lead

Nominal Cross-Sectional Area of Associated Current-carrying Conductor	Minimum Cross-Sectional Area of Copper Earth-continuity Conductor or Earthing Lead
mm^2	mm^2
1.0	4
1.5	4
2.5	4
4	4
6	4
10	6
16	6
25	10
35	16
50	25
70	35
95	50
120	70
150	70
185	70
240	70
300	70
400	70
500	70
630	70

ENDNOTES

[1] 1988 Revised Edition Cap. 93 - GS 13/85, G 119/87

[2] Amended by G. 119/87

[3] Amended by G. 119/87

[4] Amended by G. 119/87

[5] Amended by G. 119/87