صاحب السمو الملكي
الأمير سلمان بن حمد آل خليفة
ولي العهد القائد الأعلى لقوة دفاع البحرين

حضرة صاحب الجلالة
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صاحب السمو الملكي
الأمير خليفة بن سلمان آل خليفة
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KINGDOM OF BAHRAIN

ELECTRICITY AND WATER AUTHORITY

REGULATIONS FOR ELECTRICAL INSTALLATIONS

PREFACE

This revised and enlarged edition of the wiring regulation replaces the 1985 edition of the Regulations for Electrical Installations. The EWA has adopted many of the clauses from the latest editions of the IEC, IEE & KUWAIT Regulations, modifying them to suit Bahrain conditions where necessary. It is the intention of the EWA to re-examine these Regulations periodically and to issue amendment sheets whenever it is considered necessary.

Engineers, Consultants, and Contractors are advised to contact the Electricity Distribution Directorate at six monthly intervals and collect any such amendment sheets which may have been issued.

Certain clauses and tables of the present Regulations are included by permission of the International Electrotechnical Commission which retain the copyright.

Some other clauses and material of the present Regulations are included from the 16th edition of the IEE Regulations which retains the copyright.

CONTENTS

GENERAL NOTES

In these Regulations, unless the context otherwise requires

"Authority"	means the Electricity and Water Authority.
"Customer Services Directorate"	means the Customer Services Directorate of the Electricity and Water Authority
"Person"	means a physical and/or legal person.
"Customer"	including an applicant for a supply of electricity or a prospective customer.
"Premises"	includes any building, structure, land or place,
"Street"	includes any square, road, bridle path, pathway, blind-alley, passage, footway, pavement, quay, public garden, or public place.
"EDD"	means Electricity Distribution Directorate of the Electricity and Water Authority.

Any failure on the part of any customer to observe or comply with the requirements of any of the Regulations or any failure on the part of the customer to comply with the provisions of any condition set out in the following sections hereto, shall give the right to EDD to refuse supply of electricity or to discontinue the supply, as the case may be, to the customer in respect of the premises wherever situated in Bahrain in respect of which he is a customer, notwithstanding any contract which may have been previously entered into, and without prejudice to any other rights or remedies which EDD may have against such customer in respect of such failure.

Any deviation from these Regulations, even if it is allowed by IEE regulations or other similar regulations, shall be with the approval of EDD. Any such deviation shall be brought to the notice of EDD by

consultants/ contractors and approval obtained, before the commencement of construction.

These Regulations shall be complied by all including traders and importers of electrical goods.

SECTION 1

SCOPE

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101 These regulations are applicable to all electrical installations in any premises fed by the Electricity distribution system of the Kingdom of Bahrain.

102 Compliance to these regulations is compulsory and electrical power supply shall not be made available if these regulations are not met with in their entirety.

103 These regulations are not intended to be design or material specifications but are primarily related to the requirements for electrical installations so as to ensure safety of persons and property from hazards arising from the use of electricity.

NOTE: EDD publishes from time to time standard specifications for electrical installation works. It is recommended that all customers make reference to the standard specifications and require compliance to them in their contract agreements with the electrical contractors.

104 The regulations do not provide for all types of conditions but encompasses the general type of installations generally encountered. Where difficult or special situations are met with which are not covered or allowed for in these regulations, the services of EDD may be sought to obtain the best solution.

105 Various explanatory notes are added to the different regulations. These notes are not part of the regulations and have been included to give a convenient explanation of the regulations only.

106 Existing electrical installations executed in accordance with the previous regulations and already connected to the electrical supply, shall be exempt from the additional safety requirements stated herein.

107 These regulations are equally applicable for all electrical installations in caravans and prefabricated buildings.

108 For construction purposes or otherwise, wherever a temporary supply is required, then such temporary electrical supply shall fulfil, as a minimum, all the safety requirements stipulated in this Regulations. Approval of EDD shall be obtained for such temporary supply in each case.

109 The section on temporary electricity supplies in construction and building sites shall also be complied with.

110 These regulations do not apply to protection of buildings against lightning. For guidance on protection of buildings against lightning refer to the British standard BS 6651. In case the building is protected against lightning, its lightning protection system shall not be bonded with the building's electrical earthing system.

SECTION 2

DEFINITIONS

Accessory. A device, other than current-using equipment, associated with such equipment or with the wiring of an installation.

Adapter, Socket outlet. An accessory for insertion into a socket outlet and containing metal contacts to which may be fitted one or more plugs for the purpose of connecting to the supply, the lighting fittings or current using appliances.

Ambient temperature. The temperature of the air or other medium where the equipment is to be used.

Appliance. An item of current-using equipment other than a luminaire or an independent motor.

Arm's reach. A zone of accessibility to touch, extending from any point on a surface where persons usually stand or move about to the limits which a person can reach with a hand in any direction without assistance.

Barrier. A part providing a defined degree of protection against contact with live parts, from any usual direction of access.

Bonding. Electrical connection putting the various exposed conductive parts at a common potential.

Bunched. Cables are said to be bunched when two or more are contained within a single conduit, duct, ducting, or trunking or, if not enclosed, are not separated from each other.

Cable coupler. A means enabling the connections at will, of two flexible cables. It consists of a connecter and a plug.

Caravan. Any structure designed or adapted for human habitation which is capable of being moved from one place to another.

Circuit-breaker. A mechanical switching device capable of making, carrying and breaking currents under normal circuit conditions and also of making, carrying for a specified time, and automatically breaking currents under specified abnormal circuit conditions such as those of short circuit.

NOTE: A circuit breaker is usually intended to operate infrequently, although some types are suitable for frequent operation.

Circuit conductor. A current carrying conductor forming part of a circuit or final circuit, but excluding the earth continuity conductor.

Connector. A device intended for connection to a Flexible cord or flexible cable which has protected current carrying contact tubes similar to those of a socket outlet.

Customer's installation. Wiring and apparatus situated upon the customer's premises and controlled or/and installed by him, excluding any switchgear of the supply undertaking.

Customer's Terminals. The point in the customers installation at which the incoming supply of energy is delivered to that installation.

Current-carrying capacity of a conductor. The maximum current which can be carried by a conductor under specified conditions without its steady state temperature exceeding a specified value.

Damp and Dust-proof. Applied to apparatus and accessories to denote that the live and other component parts are protected by an enclosure or enclosures being so protected and/or fitted as to prevent the ready ingress of dust and/or moisture.

Damp situation A situation in which moisture is either permanently present or intermittently present to such an extent as to be likely to impair the effectiveness of an installation conforming to the requirements for ordinary situations.

Danger. Risk of injury to persons (and livestock where expected to be present) from:

(i) fire, electric shock and burns arising from the use of electrical energy, and

(ii) mechanical movement of electrically controlled equipment, in so far as such danger is intended to be prevented by electrical emergency switching or by electrical switching for mechanical maintenance of non-electrical parts of such equipment.

Distribution board. An assemblage of parts including one or more fuses or circuit-breakers, arranged for the distribution of electrical energy to final circuits or to other distribution boards.

Duct. A closed passage-way formed underground or in a structure and intended to receive one or more cables which may be drawn in.

Earth: The conductive mass of earth, whose electric potential at any pint is conventionally taken as zero.

Earth-continuity conductor. The conductor including any clamps**,** connecting to the customers earthing terminal, those parts of an installation which are required to be earthed. It may be in whole or in part the metal sheath and/or armouring of a cable, or the special earth continuity conductor of a cable or flexible cord incorporating such a conductor.

Earth electrode. A metal rod or rods, or other conducting object, providing an effectual connection with the general mass of the earth.

Earth electrode resistance. The resistance of an earth electrode to earth.

Earthed. Effectually connected to the general mass of the earth.

Earth fault current. A fault current which flows to earth.

Earth fault loop impedance. The impedance of the earth fault current loop starting and ending at the point of earth fault. The earth fault loop comprises the following starting at the point of fault:
-Circuit protective conductor.
-The customer's earthing terminal and earthing conductor and
-The earth return path and the path through the earthed neutral point of the transformer and the transformer winding and the phase conductor from the transformer to the point of fault.

Earth leakage current. A current which flows to earth, or to extraneous-conductive-parts, in a circuit which is electrically sound. This current may have a capacitive component including that resulting from the deliberate use of capacitors.

Earthing. Connection of the exposed-conductive-parts of an installation to the main earthing terminal of that installation.

Earthing conductor. The final conductor by which the connection to the earth electrode, or other means of earthing, is made.

ELCB: The kind of **c**ircuit breaker set to operate against earth leakage current.

Emergency switching. Rapid cutting off of electrical energy to remove any hazard to persons, livestock, or property which may occur unexpectedly.

Enclosure. A part providing an appropriate degree of protection of equipment against certain external influences and a defined degree of protection against contact with live parts from any direction.

Excess current protection. Excess current protection is effected by the operation of the protective device to disconnect the circuit it protects within four hours when subjected to a sustained excess of 1.45 times the lowest of the current carrying capacities of any of the conductors of the circuit.

Final circuit. An outgoing circuit connected to a distribution board or otherwise and intended to supply electrical energy to current using apparatus either directly or through socket-outlets or spur boxes.

Fireman's switch. Switch that is coloured red and have fixed near it a nameplate marked with the words "FIREMAM'S SWITCH" in Arabic and English. The switch has its "On and Off" positions clearly indicated by lettering legible to a person standing on the ground.

Fixed equipment. Equipment fastened to a support or otherwise secured in a specific location.

Fuse element. A part of a fuse designed to melt when the fuse operates.

Fuse link. Apart of a fuse, including the fuse element(s), which requires replacement by a new fuse link after the fuse has operated and before the fuse is put back into service.

HRC fuse: The fuse which is usually cartridge type having high rupture capacity.

Insulation. Suitable non-conducting material enclosing, surrounding or supporting a conductor.

Isolator. A mechanical device capable of opening or closing a circuit under conditions of no load or negligible current, intended to cut off for reasons of safety the supply from all or a discrete section of installation by separating the installation or section from every source of electrical energy.

Live. In relation to a conductor means that under working conditions and a difference of voltage exists between the conductor and earth.
Neutral conductor. The neutral conductor of a three phase 4-wire system, the conductor of a single phase installation which is earthed by EDD.

Occupancy single. A single occupancy building is one which is normally occupied by one customer only and is provided with one kilo-watt-hour meter at each intake.

NOTE: Buildings and premises which have only one kilo-watt-hour meter but are occupied by different tenants will not be considered as a single occupancy.

EXCEPTION Residential hotels and other similar resorts will be considered as single occupancy buildings with one or more kilo-watt-hour meters to the same customer.

Occupancy-multi. A multi-occupancy building is one which is occupied by more than one tenant and is provided with one or more kilo-watt-hour meters.

Phase conductor. A conductor of an a.c. system for the transmission of electrical energy, other than a neutral conductor.

Plug. A device, provided with contact pins, which is intended to be attached to a flexible cable, and which can be engaged with a socket outlet or with a connector.

Point (in wiring). A termination of the fixed wiring intended for the connection of current-using equipment.

Portable equipment. Equipment which is moved while in operation or which can easily be moved from one place to another while connected to the supply.

Ring circuit. A final circuit arranged in the form of a ring and connected to a single point of supply.

Socket outlet. A device, provided with female contacts, which is intended to be installed with the fixed wiring and intended to receive a plug.

NOTE: A luminaire track system is not regarded as a socket outlet.

Space factor. The ratio (expressed as percentage) of the sum of the overall cross-sectional areas of cables (including insulation and any sheath) to the internal cross-sectional area of the conduit or other cable enclosure in which they are installed. The effective over-all cross-sectional areas of a non-circular cable is taken as that of a circle of diameter equal to the major axis of the cable.

Spur: A branch cable connected to a ring circuit.

Stationary equipment. Equipment which is either fixed, or equipment having a mass exceeding 18 kg and not provided with a carrying handle.

Switch. A mechanical switching device capable of making, carrying and breaking current under normal circuit conditions, which may include specified operating overload conditions, and also of carrying for a specified time currents under specified abnormal circuit conditions such as those of short circuit.

NOTE: A switch may also be capable of making, but not breaking, short circuit currents.

Switch, linked. A switch the contacts of which are so arranged as to make or break all poles simultaneously or in a definite sequence.

Switchboard. An assembly of switchgear with or without instruments, but the term does not apply to a group of local switches in a final circuit.

Switchgear. An assembly of main and auxiliary switching apparatus for operation, regulation, protection or other control of electrical installations.

Trunking. A system of enclosures for the protection of cables, normally of square or rectangular cross section, of which one side is removable or hinged.

Voltage nominal. Voltage by which an installation (or part of an installation) is designated. The following, ranges of nominal voltage (r.m.s. values for a.c.) are defined

Extra low voltage. Normally not exceeding 50 V a.c. whether between conductors or to Earth.

Low voltage. Normally exceeding extra-low voltage but not exceeding 1000 V a.c. between conductors, or 600 V a.c. between conductors and Earth.

NOTE: The actual voltage of the installation may differ from the nominal value by a quantity within normal tolerances.

SECTION 3

GENERAL REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

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301 All electrical equipment, accessories and fittings employed in electrical installations shall be fully suitable for use in the climatic conditions of Bahrain having the following salient features:

Maximum sun radiation temperature in summer 70°C
Maximum ambient temperature in summer 50°C
Average ambient temperature in summer 40°C
Minimum ambient temperature in winter 0°C

Periods of high humidity are common and the relative humidity can reach 100%. Even on comparatively still days, fine dust is likely to be carried in suspension in the air.

302 In buildings of substantial construction, all electrical equipment and cables shall be rated for continuous operation at an ambient temperature of 40°C. In plant and machine rooms an ambient temperature of 55°C shall be assumed.

303 All electrical switchgear and accessories shall be so designed and manufactured to operate continuously in the electricity supply system of Bahrain having the following characteristics

Nominal voltage: 400/230 volt $\pm$ 6%, three phase, four wire.
Frequency: 50 Hz. $\pm$ 2 %
Neutral arrangement: Solidly earthed.
Installation earthing: "TT" system as per IEC 60364-3.
Maximum prospective fault level: 50 kA (31 MVA) at 400 V and short time duration of 0.5 s (Maximum)

Where it can be established that the fault level within the wiring installation of a premises shall be less than 31 MVA due to the parameters and characteristics of the equipment, apparatus, lines or cables connected to the wiring installation, electrical switchgear and accessories with a lower interrupting capacity may be employed, subject to prior approval of EDD.

Wherever the supply of electricity is at 11,000 Volts the characteristics of the electricity supply system will be as follows :-

Nominal voltage:	11000 volt ± 6%, three phase, three wire.
Frequency:	50 Hz $\pm$ 2%
Neutral arrangement:	The system neutral is connected to earth through a low resistance at the sending end station.
Maximum prospective fault level:	20 kA (350 MVA) at 11 kV for a
short time	duration of 1 s. (Maximum)

304 All electrical wiring shall be so installed that when completed, the system will be free from short circuits and earth faults.

305 Devices intended to break current shall have a breaking capacity sufficient for the voltage employed and for the current that must be interrupted.

306 All electrical equipment shall be firmly secured to the surface on which it is mounted. Wooden plugs driven into holes in masonry, concrete, plaster or similar materials shall not be used.

307 All electrical equipment, accessories and fittings exposed to weather, corrosive atmosphere, or other adverse conditions

shall be so constructed or protected as may be necessary to prevent danger arising from such exposure.

308 Where electrical equipment, accessories, fittings and cables are likely to be exposed to flammable surroundings or an explosive atmosphere, it shall be protected by a flame-proof enclosure or be otherwise so designed and constructed as to prevent danger.

309 All electrical equipments, accessories, fittings and cables shall be installed in a neat and superior workman-ship like manner.

310 All materials used in electrical installations shall be of good quality and shall comply, as a minimum requirement, with the latest relevant recommendation(s) or specification(s) of EDD. In the absence of such recommendation(s) or specification(s) all such materials shall comply with the latest recommendation(s) or specification(s) of the institutions given below in the following decending order of priority in sequence:

Gulf Co-operation Council (GCC)
International Electro-technical Commission (IEC)
British Standards Institution (BSI)
Other national standards, provided they are compatible with GCC/IEC/BSI

311 No additional load, temporary or permanent, shall be made to the authorised load of an existing installation, unless it has been ascertained that the current rating and the condition of the existing conductors and equipment which will have to carry the additional load are adequate for the increased loading and that the earthing arrangements are also adequate.

Any additions to the existing installations shall only be executed after approval of the relevant application submitted to the Customer Services Directorate.

EDD reserves the right to disconnect the electrical supply to any customer who has carried out unauthorised additions or extensions to the originally approved electrical installation.

312 All electrical installation works, new and/or additional shall only be carried out by licensed Electrical Contractor(s) as authorised by EDD.

313 All electrical equipment including fractional H.P. motors, window A/C units, fluorescent light fittings etc., shall be so selected that the overall power factor is not less than the following:

Equipment/Appliance	**Min. P.F. At full load**
Fluorescent discharge lamp circuits	0.90
Window type A/C units	0.85
Refrigerators	0.85
Other single phase motors	0.80

Equipment/Appliance	**Min. P.F. At full load**
3-phase motors:	
Motors 15 HP - 50 HP – (1 kW - 37 kW)	0.83
Motors 50 HP – 100 HP – (37 kW - 75 kW)	0.85
Motors 100 HP – 200 HP – (75 kW – 150 kW)	0.87
Motors 200 HP – 400 HP – (150 kW – 300 kW)	0.88
Motors above 400 HP – (300 kW)	0.89

SECTION 4

CUSTOMER SERVICE POINT

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401 There shall be only one metering position within each premise, at which the meter(s) and other accessories belonging to EDD shall be installed, unless prior approval is obtained from EDD for the establishment of more than one metering position. Such meter position(s) shall be so selected as to meet with the approval of EDD.

The customer's switchgear shall be installed adjacent to the selected meter position.

402 Meter cabinet(s) of ample dimensions with hinged doors (not lockable) shall be provided in all premises to house the meter(s) and other associated equipment belonging to and at position(s) acceptable to EDD. An adequate and suitable vertical solid surface shall be provided at the meter position(s) in such a manner as to facilitate the installation and inspection of meter(s) and other accessories.

403 Duct(s) of not less than 150 mm diameter, at a depth of not less than 650 mm below ground level shall be provided from the boundary of the premises to a manhole of ample dimensions immediately below the demarcated meter position. Inspection chamber(s) and/or manhole(s) of adequate dimensions shall be provided along the route of the duct(s) at regular intervals or whenever the duct(s) change direction to facilitate installation of cables necessary for the connection of electricity to the premises. Such duct(s), inspection chamber(s) and/or manhole(s) shall be constructed in accordance with the requirements of EDD and shall be maintained by the customer to the satisfaction of EDD for as long as the premises is supplied with electricity.

In addition to the above duct(s) of not less than 60 mm diameter shall be provided to facilitate overhead service connections. Such duct(s) shall be installed from the point of entry of the overhead service line into the building up to the meter position following the shortest possible route with not more than two easy and smooth bends of not less than 90°. The

point of entry of the duct(s) into the building shall not be lower than 4.5 m from the ground level. These ducts may be incorporated into slabs, walls, beams, during the construction of the building.

The overall dimensions of the cable cut-out(s) and the minimum distance between the bottom of the cut-out(s) and the floor level shall be as indicated below.

Size of cut-out Amps	Height mm	Width mm	Depth mm	Min. distance from floor mm
100	230	240	110	1000
200	475/560	360/380	175/175	1000
300	-	-	-	1000
400	640/750	500/500	200/200	1000

Typical arrangements related to meter Cabinet(s), ducts(s), inspection chamber(s) and manhole(s) are shown in Drawings A/BA/609- R1 and A/BA/610- R1.

The meter shall be so installed that the centre of the display window of the meter should remain at a height of 1650 ± 100 mm from the finished floor level below the meter position.

404 EDD shall normally provide a three phase and neutral supply at 400/230 volt 50 Hz and the electrical installation shall be arranged for connection to the three phase. In situations where the installed load is less than 20 kW, EDD shall provide a single phase and neutral service.

Where the electrical maximum demand of a single customer exceeds 1.5 MVA, EDD shall provide a three phase service at 11,000 volt, 50 Hz and the electrical installation shall be so arranged as to receive electricity supply at this voltage. The distribution of electrical energy within such customer's installation shall be the responsibility of the customer.

405 Wherever the installed load in a development exceeds 100 kW, EDD in its absolute discretion shall have the right to request

a) the construction of suitable room(s) or
b) the allocation of suitable site(s)

for establishing distribution substation(s) for exclusive use by EDD. Such substation(s) shall be accommodated at the ground floor or at ground level within the development and at a location acceptable to EDD.

The customer shall be required to sign a declaration agreement with regard to the distribution substations.

Where an Air circuit breaker (ACB) of rating 800 A or more is needed for providing electricity supply to a customer, EDD will insist on the construction of suitable room(s) or for the allocation of suitable site(s) by the customer for establishing distribution substation(s) for the exclusive use by EDD. .

Failure to provide the room(s) or site(s), if requested, may result in the denial of supply of electricity to the development.

Structural requirements and specifications for the construction of the distribution substation(s) shall be provided by EDD on request. Physical dimensions of the room(s) may vary depending on the electrical maximum demand of the development.

406 The distribution substation(s) shall normally, comprise of an 11,000 volt switchgear and one or more step-down 11,000/400 Volt Transformer(s), and low voltage distribution board(s) all of which will be provided by EDD, except in cases of single customers with an electrical maximum demand in excess of 1.5 MVA. Low tension switch board controlling the electrical installation of the building or premises shall be provided by the customer and shall be installed in meter room(s) or in plant room(s) immediately adjacent to the distribution substation(s).

In cases of single customers with a maximum demand in excess of 1.5 MVA, EDD shall provide an 11,000 Volt incoming switchboard in a ring-main arrangement to be installed in the distribution sub-station. The customer shall provide his own 11,000 Volt switchboard, incorporating one or more incoming 11,000 Volt circuit breaker(s), on which the customer shall receive the electricity supply. The customer's equipment shall be installed in a switch room immediately adjacent to the distribution substation of EDD with an interconnecting door lockable only from the distribution substation.

Where power supply is to be provided at 11 kV, customer(s) shall comply with the requirements stated in the Appendix 6.

407 Distribution substation(s) within a development shall be provided with vehicular access open over 24 hours per day. The clearance available in front of the door of the substation(s) shall be at least five metres. Orientation of the substation(s) shall be done in such a way that the door of the substation faces the road. In case this regulation can not be met entirely, customer shall seek the advice of EDD before commencing the construction.

All substations shall be constructed as per the approved EDD drawings and regulations. Any deviation from the standard dimensions/ clearance around the substation shall be with the approval of EDD.

408 Wherever distribution substation(s) are provided within the development, building or premises, ducts in adequate number and of not less than 150 mm in diameter, inspection chamber(s) and/ or manhole(s) to the requirements of EDD shall be provided to facilitate installation of cables for the connection of electricity to the development.

409 The electrical installation in every building or premises shall be adequately controlled by a switchgear located adjacent to

the customer service point and which shall be readily accessible to the customer. The switchgear shall form an integral part of the low tension switchboard of the building and shall be completely enclosed in earthed metal or approved insulating material. The switchgear shall incorporate means of isolation, means of excess current protection and means of earth leakage protection.

For reasons of selectivity, means of earth leakage protection may be sub-divided and provided on the various outgoing feeders from the switchgear. In this event earth leakage protection on the incoming switchgear may be omitted.

410 In single metering buildings, the switchgear detailed in clause 409 shall also be the customer's main means of isolation and provision for installing the cable cut-out and kWh-meter of EDD shall be allowed immediately preceding the switchgear.

The kWh-meter may be integrated into the low tension switchboard of the building.

411 In multi-metering buildings, the switchgear detailed in clause 409 shall be considered only as a means of isolating the electricity supply from the entire building in the event of an emergency and separate means of isolating the electrical supply of each individual customer shall be provided. Such means of isolation shall incorporate separate means of excess current and earth leakage protection and shall be located at a position which is fully under the control of the customer.

In multi-metering buildings proper selection of both excess current and earth leakage protection is essential in order to ensure discrimination in the operation of these protective devices.

In multi-metering buildings, the requirements of a separate means of earth leakage protection as set out in paragraph 409 and 415 may be omitted, provided each individual customer's

switchgear is equipped with such protection and all metal work are bonded.

412 The means of isolation provided for individual customers in a multi-metering building or premises may be combined together and installed adjacent to the customer service point provided facilities are available for padlocking and sealing each individual means of isolation in the OFF position. Where such means of isolation is provided additional isolation within the customer's premises shall also be available.

413 The means of isolation shall be by a load break switch or a circuit breaker arranged to disconnect all the live conductors only and equipped with an isolator link on the neutral conductor.

414 The excess current protection shall be by means of over-current releases fitted in each live conductor. The rating of the excess current and isolation devices shall be determined in accordance with the total connected load or the anticipated maximum demand of the installation.

Section 5 of these regulations deals in detail with-excess current protection which shall be complied with fully.

415 The earth leakage protection shall be by means of an appropriate earth leakage circuit breaker or by means of an earth leakage relay operating the shunt trip of the circuit breaker. The earth leakage protection shall disconnect the electricity supply to the building or premises or sections thereof in the event of any danger from earth leakage currents.

416 The installation of automatic earth leakage protection as set out in clause 415 does not exclude the necessity of bonding all non current carrying metal to the earthing system or for the necessity of providing sufficient and adequate earth electrodes.

Section 6 of these Regulations deals in detail with earthing and earth leakage protection which shall be complied with fully.

417 The means of isolation, excess current and earth leakage protection may all be combined into one component equipment.

418 In multi-metering buildings or premises, the kWh-meters for all customers shall preferably be installed adjacent to the customer service point.

KWh-meters shall not be installed within the customer's premises or at locations which do not have ready access to the meter readers of the Customer services Directorate. All kWh-meters shall be installed prior to the customer's means of isolation.

Where a number of kWh-meters are grouped together at one place, they shall be housed inside a suitable and neatly manufactured and installed cabinet with hinged doors (not lockable) so as to conceal all wiring connections.

In multi-metering buildings or premises where it is impractical to group the various kWh-meters at one single location adjacent to the customer service point, kWh-meters may be grouped at different locations within the building, provided always that such locations are readily accessible for meter readers and the approval of EDD has been obtained.

419 In multi-metering buildings or premises the feeders from the customer service point to the individual customer's switchgear shall always be installed in separate conduits and no conduit shall contain the feeders to more than one customer.

Where bus bar trunking is employed for load contribution to different floors of a multi-metering building or premises, then the feeders from the floor distribution boards to the individual

customers switchgear shall comply with the above requirements.

420 Sufficient and adequate working space shall be provided in the vicinity of the customer service point and associated switchgear to permit safe operation, inspection and repairs. Unless the customer service point and switchgear are located in a separate room, access to which is available at all times, it, shall be properly enclosed to prevent entry by unauthorised persons.

421 All cables required for the connection of the customer's installation on to the kWh-meter of EDD shall be provided by the customer and the actual connection shall be carried out by authorised employees of EDD. The current rating of the cables to be provided shall not be less than the rating of the customer's switchgear.

422 Wherever busbar trunking is employed by the customer, all cables required between the busbar trunking, the kWh-meter and the customer's switchgear shall be provided by the customer and the connection onto the kWh-meter shall be carried out by authorised employees of EDD. The current rating of the cables to be provided shall not be less than the rating of the customer's switchgear.

Any switchgear installed in accordance with paragraph 409 and 411 and/or any busbar trunking employed by the customer shall remain the customer's property. The customer shall be totally responsible for maintaining such switchgear and/or busbar trunking in good working order and EDD shall not be held responsible for any discontinuance of the electricity supply due to any fault occurring in such switchgear and/or busbar trunking. The electricity supply shall be reconnected to the customer's premises only after EDD is satisfied that the fault in such equipment has been rectified.

423 In cases where electricity supply to the customer's incoming circuit breaker is to be connected directly from a distribution substation within the customer's premises, the cable between EDD's ACB to customer's ACB shall be provided by the customer. The customer or his Electrical Contractor shall supply all necessary materials to facilitate the connection of the aforesaid cables onto the incoming circuit breaker. Details of the cables, which shall be used in each case can be provided by EDD on request.

424 Adequate illumination shall be provided in the vicinity of customer service point and switchgear. Where a separate room is to be provided for customer service point in multi-occupancy buildings or other public premises, self-contained emergency lights capable of providing illumination (of intensity not less than 100 lux) for a period of three hours from a battery source shall be provided. Such emergency lights shall be switched on automatically in the event of failure of supply. Alternatively, lights connected to a maintained / emergency source with automatic changeover in the event of failure of normal supply shall be provided.

425 Approval of EDD shall be obtained for the wiring layout of all the 11 kV work, and for loads of 500 kW and above in the case of LV work before commencing the construction work.

SECTION 5

EXCESS CURRENT PROTECTION

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501 Every phase conductor in an installation, other than an earth conductor or those exempted under clause 504 shall be protected against excess current by a circuit-breaker fitted at the origin of a circuit of which the conductor forms a part.

502 The current rating of every circuit breaker employed for the purpose of affording excess current protection shall be such that it will trip within the time assigned to it for that purpose when subjected to a sustained excess of 1.45 times the rating of the conductor to be protected.

503 Clause 501 may be omitted in the following cases:

a) Circuits in which the omission of excess current protection is necessary, e.g.. shunt trip circuit of a circuit breaker.

b) Auxiliary circuits of apparatus contained entirely within the enclosure of the apparatus.

504 Fuses, if any, contained in electrical appliances shall be of HRC (High rupture capacity) cartridge type. Rewireable fuses shall not be employed.

505 The rating of the excess current protective device indicated in clauses 503 above applies to the phase conductor only and in a 3 phase, 4 wire installation, having a reduced neutral conductor, the excess current protective device need not be related to the rating of the neutral conductor.

506 When distribution boards for individual floors/ storeys are connected by means of tap off units from adjacent busbar trunking, excess current protection device must be located at the origin of the circuit close to the tap off. (Refer Appendix 13)

In case the above requirement can not be met due to practical limitations, and the protection device is to be placed in the same room as that of the distribution board for the individual floors/ storeys, approval of EDD shall be obtained.

507 Each excess current protective device shall be fully suitable for withstanding the maximum short circuit current attainable at that location.

508 The selection and ratings of excess current protective devices throughout an installation shall be so arranged that proper discrimination is ensured during operation of these excess current protective devices.

SECTION 6

EARTHING AND EARTH LEAKAGE PROTECTION

INDEX TO REGULATIONS

601 Every customer who is provided with a separate service point by EDD shall provide adequate earth electrode(s) immediately adjacent to the service point. The earth electrode(s) shall be housed in an approved hand-hole which shall be fitted with a heavy duty inspection cover. The earth electrode(s) shall comprise of copper clad rod(s) of at least 15 mm diameter driven to a depth as indicated in the Appendix 11. The top of the electrode shall be provided with a corrosion resistant terminal connection. The connection of the earthing lead to the earth electrode(s) shall be soundly made electrically and mechanically in a satisfactory manner and suitably labelled.

602 The resistance between the earth electrode(s) and the general mass of earth shall not be more than 1.0 ohm. In order to achieve this resistance value in areas of high soil resistivity, it may be necessary to install more than one earth electrode as detailed in Appendix 11. Where this value of earth resistance can not be obtained in spite of using multiple electrodes as detailed in Appendix 11, EDD must be consulted.

603 The resistance between any point on the earth wiring in the installation and the earth electrode shall not be more than 1.0 ohm.

604 Every customer's electrical installation shall be provided with an earthing terminal which shall be located adjacent to the customer service point. Throughout the customers electrical installation, an earth continuity conductor of adequate size and coloured green/yellow shall be provided and connected to the earthing terminal. The cross sectional area of copper earth continuity conductors shall be in accordance with the appropriate table in Section 14. In mechanical plant rooms and other similar locations, flat copper tape may be employed in place of stranded conductors.

605 The connection from each piece of equipment to the main earth continuity conductor shall be by separate branch earth continuity conductors of adequate sizes and in accordance with

the appropriate table in Section 14. Branch earth continuity conductors shall be connected to main earth continuity conductors by permanently soldered, fusion welded or mechanically clamped joints that will not be accidentally or unwittingly broken. The series method of earthing one piece of apparatus to another shall not be permitted except in the case of socket outlets connected to a ring circuit and lighting points.

606 The customer's earthing terminal mentioned in clause 604 shall be connected by an earthing lead of appropriate size to the earth electrode located adjacent to the customer service point . The main earthing lead from customer earthing terminal to the earth electrode shall not be run through steel or other conduit or duct of magnetic material, but shall be protected from damage by suitable sheathing which shall not completely encircle the earth conductor, if the sheathing is of steel or other magnetic materials. No earthing lead run separately shall be smaller than 6 sq. mm. The size of earthing leads shall be in accordance with the appropriate table in Section 14.

607 The earthing terminal of every socket outlet shall be connected to the earth continuity conductor of the final circuit by a conductor of adequate size.

608 At every lighting point an earth terminal shall be provided and connected to the earth continuity conductor of the final circuit. An earth terminal connected to the earth continuity conductor of the final circuit shall be provided at every lighting switch position unless this takes the form of an earthed metal box having a means of fixing the switch plate in reliable electrical contact with the box.

Note: The earth point is needed to meet any future requirement in the event of a change from plastic bodied switch to metal bodied one.

609 Where wiring is enclosed in a continuous system of metallic conduit or trunking, such conduit or trunking may not be employed as an earth continuity conductor. The steel

armouring of cables shall not be employed as an earth continuity conductor.

610 All metal work of wiring systems (other than current carrying parts) including cable sheaths and armour, conduits ducts, trunking and boxes shall be connected to the appropriate earth continuity conductors. The exposed metal work of all stationary or portable domestic machinery shall also be connected to appropriate earth. Continuity conductors. The exposed metal work of motors, starters and other non-domestic equipment like package and central air-conditioning units, air handling equipment, laundry, lift machinery and the like, shall also be effectively connected to a main earth continuity conductor which is directly connected at both ends to earth electrodes.

611 Every customer's installation shall in addition to the foregoing be equipped with earth leakage protection by one or more current operated earth leakage circuit breakers (ELCB) to afford the protection stipulated in Clause 612 to 613.

612 The following degree of protection against earth leakage shall be provided throughout the electrical installation.

Maximum 10 mA trip rating – for under-water lighting
Maximum 30 mA trip rating – all socket outlets and domestic apparatus
Maximum 300 mA trip rating – lights, A.C., water heater, cooker without socket etc.
Maximum 500 mA (Preferably 300 mA) trip rating – all other apparatus and equipment such as A/C plants, lifts pumps, etc.

EXCEPTION: 1. Where an immediate disconnection of the electricity supply will cause difficulties to customers, (Example: Continuous process industry, chemical factories etc.) EDD may permit omission of earth leakage circuit breakers provided in each case a separate approval is obtained and the portion of the installation so exempted is provided with an audio-visual alarm indicator.

2. For motors driving fire pumps, the provision of current operated earth leakage circuit breakers will not be permitted and an audio visual alarm indicator shall be provided.

3. For motors over 15 HP, earth leakage protection for a group of motors will not be permitted.

613 In multi-occupancy buildings and other similar locations the operation of any current operated earth leakage circuit breaker shall not interrupt the electricity supply of any other customer in the same premises.

614 The neutral conductor shall not be earthed anywhere within the premises.

615 Throughout the low voltage electrical installation the earthing system shall be separated and divorced from the earthing systems of 11 KV or higher voltage systems.

SECTION 7

WIRING AND DISTRIBUIION ARRANGEMENTS
INDEX TO REGULATIONS

700 WIRES AND CABLES

700-1 Every cable for use as fixed wiring shall be selected from the list given in Appendix 12:

700-2 The maximum permissible drop in voltage from the customer's terminal to any point in his installation shall not exceed 2.5 % of the nominal voltage when the conductors are carrying full load current (6 volts for single phase and 10 volts for three phase systems).

700-3 Sizes of single core and multi-core cables shall be such that current carried by them shall not exceed those shown in the appropriate tables in Section 14.

700-4 Cables shall not generally be connected in parallel except where for a particular loading, a single cable is insufficient and it is not practical to employ bus bar trunking. In such situations single core or multicore cables may be connected in parallel provided that the cables are of the same type, size and length and each cable can continuously carry a minimum of 75 % of the full load current (jointly carried by both the cables), under the same conditions of installation.

700-5 Identification of wires and cables

a) Single core, PVC insulated, non-armoured cables used for wiring shall be identified by the following colours

Phase	:	Red or Yellow or Blue
Neutral	:	Black
Earth	:	Green or Green-Yellow

b) The conductors of multi-core PVC insulated and nonarmoured cables shall be identified by the following colours

Two-core cable : Red, Black

Two core cable :	Red (Phase), Black (Neutral)	
Three core cable:	Red, Yellow, Blue	- All phases
Three core cable:	Red	- Phase
(For single phase use)	Black	- Neutral
	Green or Green-Yellow	– Earth
Four-core cable:	Red, Yellow, Blue	- All phases

c) All wires or conductor to the neutral of the supply shall have "BLACK" outer layer of insulation and shall not be used as phase conductor. Similarly, Green/Yellow coloured wires or conductors of cables shall be used as "EARTH" conductor only.

700-6 All Conductors and cables shall be adequately protected against any risk of mechanical damage to which they may be liable in normal conditions of service.

700-7 Cables shall not be run in a lift shaft unless they form a part of the lift installation. Cables of lift installations other than travelling cables in such a shaft shall be protected from mechanical damage and shall be armoured or mineral insulated cables or enclosed in metal conduits.

700-8 The different cables specified in Clause 700-1 shall be installed in the manner indicated below:

a) Multi-core PVC or XLPE insulated armouredd and, PVC sheathed cables may be directly buried in the ground, laid in trenches and trays or drawn through ducts. The maximum current carried by any cable will depend upon the worst conditions of installation.

b) Multi-core PVC or XLPE insulated, non-armoured and PVC sheathed cables may be installed in cable trays and in trenches or fixed to the walls by cleats. These cables shall

only be installed at locations where they will not be damaged.

c) Single core PVC insulated cables shall only be run in conduits or in trunking.

d) Twin core and earth PVC insulated and PVC sheathed cables may be run on wooden battens fixed to the walls or may be installed within metallic partitions provided always that they are not liable to damage.

e) Mineral insulated cables may be installed at locations where flame-proof installations are necessary or at locations of high temperature and elsewhere as required.

NOTE: The ends of mineral insulated metal sheathed cables shall be protected from moisture by being suitably sealed and the installation shall be thoroughly dry before the sealing material is applied. Such sealing material and any material used to insulate the conductors where they emerge from the insulation, shall have adequate insulating and moisture-proofing properties, and shall retain these properties throughout the range of temperatures to which the cables are subject in service.

f) Multi-core silicone rubber insulated PVC sheath bonded to coated aluminium foil cable with fire resistant and retardant properties may be employed where flame proof installations are necessary, or at locations of high temperature or for emergency and fire alarms circuits and elsewhere as required.

g) Single core PVC or XLPE insulated and non-armoured cables may be installed in cable trays, trenches and ducts or fitted to the walls by cleats. At all locations they shall be protected from damage.

h) Single core PVC or XLPE insulated and non-magnetic armoured cables may be installed in cable trays, trenches

and ducts or fitted to the walls by cleats. At all locations they shall be protected from mechanical damage.

701 FLEXIBLE CORDS AND CABLES

701-1 No size smaller than 16/0.2 mm (0.5 mm²) shall be used. Size of flexible cords and cables shall be such that the current normally carried by them shall not exceed the values shown in the appropriate table in Section 14.

701-2 Where apparatus requires to be earthed, flexible with earth core shall be used.

701-3 Flexible cords and cables shall be so connected to plugs or ceiling roses, etc., that the Brown or Black sheathed conductor is connected to the phase, the Blue sheathed conductor to the neutral and the Green/Yellow conductor to the earth.

701-4 Flexible cables and cords shall be so connected to portable or fixed apparatus, standard lamps, etc., that the green/yellow conductor is connected to the frame of the apparatus and any single pole switches are so connected that they break the phase conductor to the apparatus.

701-5 In all situations where flexible cables and cords are exposed to the risk of mechanical damage, they shall as a minimum be of a type sheathed with rubber or PVC and where necessary shall also be armoured.

701-6 Where flexible cables and cords are normally exposed to the risk of damage due to high temperatures, they shall be insulated with silicone rubber or other approved insulating materials.

701-7 Every connection between conductors and between a conductor and equipment shall provide durable electrical continuity and adequate mechanical strength.

701-8 A flexible wiring system when installed, excessive tensile and torsional stresses to the conductors and connections shall be avoided.

701-9 All flexible cables and cords shall have the following identifications:

a) Two core	:	Brown……..Phase Blue……..…Neutral
b) Three core	:	Brown or Black……Phase Blue…….Neutral Green –Yellow……..…Earth
c) Four or Five core	:	Brown……..Phase Blue…….Neutral Green –Yellow…..……Earth

701-10 Flexible cables and cords shall be used only for the following purposes:

a) As pendants
b) As wiring of fixtures
c) As connection of portable lamps or apparatus
d) As lift travelling cables.

NOTE: In other special situation flexible cable may be employed after the prior approval of the EDD.

701-11 Flexible cables and cords shall not be used as a substitute for fixed wiring.

702 JOINTS, CONNECTIONS AND TERMINATIONS

702-1 Joints shall be avoided in conductors of all sizes wherever possible, and in final circuits feeding two or more lights, switches, sockets and/or other accessories, the loop-in system of wiring shall be employed.

702-2 Where joints are essential, they shall be housed in purpose made boxes and/or otherwise readily accessible for inspection throughout the life of the installation. Under no circumstances shall joints be drawn into conduits or positioned in the thickness of walls, ceiling or floor, etc., or behind plaster, tile or panel finishes etc.

702-3 Joints in cable conductors shall be mechanically and electrically sound and shall be made by soldering, brazing, welding or mechanical clamps or be of the compression type. All mechanical clamps and compression type sockets shall securely retain all the wires of the conductors.

702-4 Every joint in a cable shall be provided with insulation not less effective than that of the cable cores and shall be protected against moisture and against mechanical damage. Soldering fluxes which remain acidic or corrosive at the completion of the soldering operation shall not be used.

702-5 Joints in earth continuity conductors, earth leads, etc., shall be made in a similar manner to those in current carrying conductors.

702-6 Joints in flexible cables and cords shall not be permitted.

702-7 All terminations of cable conductors shall be mechanically and electrically sound and every termination shall be made by means of a terminal, soldering socket or compression type of socket. The termination arrangement shall contain and anchor all the wires of the conductor and shall not impose any serious mechanical strain on the terminal or socket.

702-8 At all terminations of cables, the insulation shall be neatly stripped without nicking the strands of the conductor. The conductor shall be tightly twisted and doubled backed (where space is available in the terminal) before being clamped with pinching screws. Where two or more cables are looped into

the same terminal, their conductors shall be tightly twisted together before being inserted into the terminal. In no case shall bare conductor be allowed to project beyond any insulated shrouding or mounting of a live terminal.

702-9 At all terminations of wires and cables, sockets or cable lugs shall be used unless adequate pinching screw terminals or clamps are provided and their use approved by EDD. In case sweating sockets are used, the cable ends shall be tinned solid. Only acid-free soldering fluxes shall be used. Lugs and sockets shall be connected in a manner that they remain mechanically and electrically sound and efficient. Any insulation and/or protective covering on the cables damaged by heat of the soldering shall be replaced by suitable and approved insulating sleeves. Where XLPE cables are used, termination shall be done using compression type sockets/ lugs

703 BUNCHING AND SEGREGATION OF CONDUCTORS

703-1 Where conductors or bunches of conductors are protected by metallic sheathing, installed in metallic conduits, trunking or ducts, the conductors of all phases and neutral, associated with any one circuit**,** shall be included in the same sheath, conduit, trunking or duct.

703-2 Where conductors pass through the metallic case of any switch, distribution board or other apparatus, or through any structural steel of any building, etc., all phase conductors and the neutral associated with any circuit shall pass through the same hole or aperture.

703-3 The dividing of the conductors of any circuit in such a manner that they induce magnetic fluxes or electrical currents in their sheathing or adjacent or surrounding metal of any sort shall not be permitted.

703-4 Where 230 volt loads are fed from a three phase and neutral distribution board, multi-gang switch or socket outlet box shall not contain the wiring fed from more than one phase and shall preferably be using the same circuit.

703-5 Not more than three lighting circuits or two socket circuits shall be bunched in the same conduit.

703-6 Where circuits are bunched together while proceeding from the distribution board and then separated, they shall not be brought back again in to any common conduit. (i.e. these circuits should run in separate conduits after separation.)

703-7 Circuits fed from distinct sources of supply different distribution boards or through separate isolators shall not be bunched in one conduit.

704 RIGID METALLIC CONDUITS

704-1 The use of rigid metallic conduits shall be permitted for general electrical installation provided that it is from heavy gauge steel and hot-dip galvanized inside and outside. Black enamelled steel conduits shall not be used for electrical installation. All metallic conduits shall be screwed typed.

704-2 The metallic conduit and its accessories shall form a continuous metallic sheath of adequate strength surrounding the cables throughout the length of the conduit.

704-3 Metallic conduits shall not be run under floor tiles of buildings.

704-4 The bores of all conduits shall be smooth and free from projections and/or edges which may injure the wires or prevent them being drawn in. The internal edges of the end of all lengths of conduit shall be reduced or chamfered before assembling into position.

704-5 All runs of conduit shall be assembled complete with all necessary accessories and the whole firmly attached to the structure of the building before any wires are drawn in. All wires shall be drawn through the covers of inspection and other fittings installed for the purpose.

704-6 All threads, vice marks, tool marks and breaks in the protective coating on metallic conduit and conduit fittings shall be painted with a steel preserving paint immediately after erection.

704-7 No run of conduit shall exceed 10 metres between adjacent draw-in points, nor shall contain more than two right angle bends, set or other deviation from the straight line.

704-8 Inspection couplings or long through draw-in boxes shall be used where necessary in straight runs of conduits for drawn-in purposes and shall be placed so that cables can be inspected and if necessary withdrawn throughout the life of installation.

704-9 Where conduit and/or conduit fittings are attached to switches, distribution boards, boxes or other equipment, smooth bore male brass bushes and flanged couplings shall be used.

704-10 Circular or hexagonal heavy locknuts shall be used at all positions where running joints are required and great care shall be taken to see that they seat firmly and evenly into mating faces of couplings or other adjacent accessories.

704-11 Where exposed to water, rain or weather, all covers shall be arranged or fitted with machined joints and/or fitted with durable gaskets such that water cannot get inside.

704-12 All runs of conduits shall be truly vertical or horizontal except where the architectural features of the building demand otherwise.

704-13 Except where provision is made for fastening a box or other conduit fitting directly to the structure of the buildings and such fastening is made, conduit shall be saddled to the structure of the building within 15 cms. of each terminal box, angle box, bend or other conduit fitting and at intervals not greater than 1.5 m. Couplings and through type drawing boxes shall be counted as part of a straight run of conduit.

704-14 All boxes, bends and other accessories shall be of the same material as the conduit and shall have the same protective coatings. Grey cast iron boxes etc. may be used with metallic conduit, but shall be finished in the same manner as the conduit to which they are directly attached.

704-15 The number of single core PVC insulated non-sheathed cables run in metallic conduit shall be such as to permit easy drawing of the cables. The actual number of cables drawn into any conduit shall not be greater than the number given in the appropriate table in Section 14. Where different sizes of cables are drawn into a conduit, the number and sizes of cables installed shall be selected in accordance with the method detailed in Section 14.

704-16 Metallic conduits system must be provided with a separate insulated earth wire and the conduit itself may not be considered as the earthing system. All joints shall be made mechanically and electrically continuous.

704-17 The minimum size of metallic conduit that may be used in electrical installations shall be 16 mm diameter. Other sizes of conduits shall be limited to the following diameters 20 mm, 25 mm, 32 mm, 38 mm and 50 mm.

705 RIGID NON-METALLIC CONDUITS

705-1 Rigid non-metallic conduits may be employed in general electrical installations provided it is made from polyvinyl chloride or equivalent material that bas been certified as

suitable for use at ambient temperatures of not less than 55°C. Additionally the material shall not soften or suffer any structural degradation at a temperature of 85°C, shall be non-hygroscopic, and self-extinguishing type.

NOTE: Rigid non-metallic conduits shall not be used at locations where they will be subjected to mechanical damage.

705-2 The inside and out side surfaces of non-metallic conduits shall be smooth and free from burrs and similar defects. The interior and ends of conduit fittings shall have no sharp edges and corners, shall be smooth and well rounded to permit easy drawing in of cable and prevent any damages to cable insulation.

705-3 The entries of non-metallic conduit fittings shall be so designed that are liable water tight joint can be made between the conduit and fittings. Vinyl cement shall be used to make all joints. A vinyl solvent shall be used for permanent joints and a cement of the type that shall continue to remain in a sticky condition shall be used for expansion couplers.

705-4 Rigid non-metallic conduits shall be so constructed that it will be possible to bend the conduit easily with the aid of bending spring and all conduits and conduit fittings shall be of the unthreaded type.

705-5 The minimum size of rigid non-metallic conduit used for general electrical installation shall be 16 mm in diameter. Other sizes of rigid non-metallic conduits shall be of the following diameters:

20 mm, 25 mm, 32 mm, 38 mm and 50 mm

705-6 The number of single core PVC insulated non-sheathed cables run in one conduit shall be such that it permits easy drawing of the cables. The actual number of cables drawn into any conduit shall not be greater than the number given in the

appropriate table in Section 14. Where different sizes of cables are drawn into a conduit, the number and sizes of cables installed shall be selected in accordance with the method detailed in Section 14.

NOTE: Where a number of cables are bunched in one conduit, the current carrying capacity of the cables shall be reduced by using the stipulated grouping factor. For full details, refer to section 14.

705-7 A separate insulated earth wire shall be drawn into all rigid non-metallic conduits.

705-8 Rigid non-metallic conduits shall be installed generally in accordance with the requirements set out for metallic conduits. Additionally the method of supporting rigid non-metallic conduit shall allow for the longitudinal expansion and contraction of the conduits.

705-9 Where a lighting fitting is suspended from a non-metallic conduit box, care shall be taken to ensure that the temperature of the box does not exceed the permitted safe temperature of the material and is fitted with screwed metal insert clips. The mass suspended from the box shall not exceed 2 kgs.

706 CABLE TRAYS

706-1 Cable trays may be employed in warehouses and other industrial buildings for supporting cables. In residential and commercial buildings cable trays may be employed in mechanical equipment and plant rooms. Where service floors or similar facilities are available cable trays may be employed at other locations in commercial and residential buildings also.

706-2 Cable tray system shall comprise of a unit or assembly of units or sections, and associated fittings, made of metal or other non-combustible materials forming a rigid structural system. Cable tray systems include ladders, troughs, channels and solid bottom trays.

706-3 Multi-core armoured or non-armoured cables may be supported by cable trays. Single core insulated and sheathed cables may also be installed in cable trays.

706-4 Cable trays shall not be used in lift shafts or at locations where they will be subjected to severe physical damage.

706-5 Cable trays shall have adequate strength and rigidity to provide satisfactory support for the cables contained within it. All sharp edges, burrs and projections shall be removed and the tray shall be finished smooth to prevent injury to cables.

706-6 Metallic cable trays shall be adequately protected against corrosion by galvanising or shall be made of corrosion resistant material.

706-7 Non-metallic cable trays shall be made from polyvinyl chloride or equivalent and shall be fully suitable for continuous service in the climatic conditions of Bahrain.

Note: PVC used in cable trays shall comply with the requirements of Clause 705.

706-8 All cable trays shall be equipped with sides of adequate dimensions. All fittings bends, tees, employed shall be completed before the installation of cables.

706-9 Cable trays shall be installed as complete system with bends and other accessories. Each run of cable tray shall be completed before the installation of cables.

706-10 Adequate supports shall be provided to prevent stress on cables where they enter or leave the tray. Where cable trays extend transversely through partitions and walls additional protection in the form of non-combustible covers shall be used.

706-11 Sufficient space shall be provided and maintained around cable trays to permit adequate access for installing and maintaining the cables.

706-12 The number of multi-core cables that may, be installed in a ventilated or solid bottom cable tray shall not be greater than the number given in the appropriate table in Section 14.

Note: Where a number of cables are installed in a cable tray the current carrying capacity of the cables shall be reduced by using the stipulated grouping factor. For full details, refer to Section 14.

706-13 Metallic cable trays shall not be used as an earth continuity conductor.

707 CABLE TRUNKING

707-1 Cable trunking may be employed for housing single core cables at special location where it is difficult to install conduits. They may be of metallic or non-metallic construction. Non-metallic cable trunking shall be constructed from non-combustible insulating material like polyvinyl-chloride which shall be fully suitable for use in the climatic conditions and shall comply with the requirements of Clause 705. Metallic cable trunking shall be adequately protected against corrosion by galvanising or shall be made of corrosion resistant material or stove enamelled. All cable trunking shall be provided with removable covers.

707-2 Cable trunking shall generally be run exposed and the trunking shall be completely erected before drawing in the cables. Where adequate means of access is readily available throughout its length, cable trunking may be concealed.

707-3 Every entry to trunking shall be so placed as to prevent the ingress of water and all dead ends shall be closed. Only unbroken lengths of trunking shall be employed for crossing positions and walls.

707-4 Where a common cable trunking is employed for housing both power and communication circuits, or for housing circuits operating at different voltages, the trunking shall be provided with separate compartments for the different types of circuits.

707-5 Cable trunking shall be manufactured from substantial sections to provide adequate strength and rigidity. All sharp edges, burrs and other projections shall be removed and the trunking finished smooth to prevent injury to cables.

707-6 All bends, tees and other accessories of cable trunking shall be substantial sections and of the same quality as the trunking itself.

Note: Where a number of cables are bunched in trunking the current carrying capacity of the cables shall be reduced by using the stipulated grouping factor. For full details, refer to Section 14.

707-7 Cable trunking shall be securely supported every metre, when run exposed.

707-8 The number of single core cables that may be housed in a trunking shall be such that a space factor of 45 percent is not exceeded or shall be selected in accordance with the method detailed in Section 14.

707-9 Metallic trunking shall be provided with a separate insulated earth wire. The trunking itself may not be considered as the earthing system. All joints shall be made mechanically and electrically continuous. The different sections of the trunking shall be bonded by copper links.

707-10 Non-metallic trunking shall be provided with an insulated earth wire for each circuit.

708 FLEXIBLE CONDUITS

708-1 Flexible conduits may be employed for connecting electric motors and other equipment subject to adjustment of position and vibration to the fixed wiring and at similar positions.

708-2 Flexible conduits may be of the metallic or non-metallic type. Flexible conduits shall not be used as the sole means of providing earth continuity and in both type of flexible conduit separate earth continuity conductor of appropriate size shall be provided.

708-3 In damp and wet locations all flexible conduits shall be of the type that prevent the ingress of water and moisture.

708-4 Flexible conduits shall be run exposed and shall be so positioned that they are not susceptible to mechanical damage. Where necessary flexible conduits shall be adequately supported.

709 BUS BAR TRUNKING

709-1 Busbar trunking may be employed as horizontal feeders from main switch board to sub-main switch boards and as risers to the different floor distribution boards. The bus bars shall be totally enclosed in metallic housing of substantial construction and of adequate strength to withstand the electro-mechanical forces that may be induced by the prospective short circuit current.

709-2 All bus bar trunking shall be so designed and arranged that they are free to expand and contract without detriment to themselves or to adjacent parts of the installation. All dead ends of bus bar trunking shall be closed. Fire barriers shall be provided at each floor level.

709-3 All bus bar trunking shall be surface mounted and so installed that they are inaccessible to unauthorised persons. They shall be securely supported and only unbroken lengths shall be

permitted at floor crossings. Bus bar trunking shall not be installed in lift shafts.

709-4 No branch connections shall be permitted except through tap off units. Tap off units shall incorporate the required excess current protective devices.

Note: Clause 506 allows omission of excess current protection subject to the approval of EDD, if floor distribution board is in the same room as that of the excess current protection device.

709-5 All bus bars employed in bus bar trunking shall be of high conductivity copper supported on adequately rated and sized insulators.

710 FINAL CIRCUITS

710-1 Where an installation comprises more than one final circuit, each final circuit shall be connected to a separate way in a distribution board. The wiring of each final circuit shall be electrically separate from that of every other final circuit, so as to prevent the indirect energising of a final circuit intend to be isolated.

710-2 The wiring of each final circuit shall be electrically separate from that of every other final circuit and each circuit shall be provided with its own separate neutral.

EXCEPTION: In ware-houses, factories, workshops, hangars and other larger areas where it is desirable to connect adjacent lights to different phase of the supply, it is permissible to employ a three phase and neutral circuit comprising of 4-wires as a final circuit provided the circuit is controlled by at triple pole breaker in the distribution board.

710-3 Final circuit having a rating exceeding l5/16 Amperes shall not supply more than one point.

EXCEPTION: 1) 13 ampere socket outlets connected to a radial or a ring circuit as per Clause710.10 and 710.11.

2) Two or more 30/32 ampere socket outlets feeding portable x-ray or welding equipment etc., may be connected to one final circuit and protected by a maximum 30/32 ampere circuit breaker provided it is ascertained that the maximum load on the circuit will not exceed 30/32 ampere and the circuit wiring is rated as minimum for this current.

3) Two or more 60/63 ampere socket outlets feeding portable x-ray or welding equipment, etc., may be connected to one final circuit and protected by a maximum 60/63 ampere circuit breaker provided it is confirmed that the maximum demand on the circuit will not exceed 60/63 amperes and the circuit wiring is rated as minimum for this rating.

4) A cooker control unit incorporating a socket outlet or a lighting track system in which individual luminaries are suitably protected against excess current.

710-4 No cable with a conductor smaller than 1.5 mm² shall be used as a final circuit.

710-5 A l.5 mm² cable may be employed as a final circuit for supplying lighting points and protected by a circuit breaker of 10 amps rating provided the circuit loading is limited to 2000 VA.

Note: Circuits for discharge lamps including fluorescent lamps shall be designed to carry total steady current viz, that of the lamp and any associated control gear and also their harmonic current. Where more exact information is not available, the demand in voltamperes may be taken for the purpose of this regulation as the rated lamp watts multiplied by no less than 1.8. This multiplier is based on the assumption that the circuit is corrected to a power factor of 0.85 lagging as required per Clause 313 and also takes into account control gear losses and harmonic current.

710-6 Cables with conductor of 2.5 mm² or greater may also be employed for supplying points where large distances or high wattage fittings are involved.

710-7 Two socket outlets of 13 amps rating may be connected to a single phase and neutral circuit wired with 2.5 mm² cable, protected by a circuit breaker of rating not exceeding 15/16 amps.

710-8 One socket outlet of 15/16 amps rating may be connected to a single phase and neutral circuit wired with 2.5 mm² cable, protected by a circuit breaker of rating not exceeding 15/16 amps.

710-9 Six socket outlets of 13 amps rating may be connected to a single phase and neutral circuit wired with 2.5 mm² cable, protected by a circuit breaker of rating not exceeding 15/16 amps, serving one room only of less than 50 sq. metres floor area which is not a kitchen, provided that no fixed water heater or window air conditioning unit shall be connected to any of those points.

710-10 Six socket outlets of 13 amps, rating may be connected to a single phase and neutral circuit wired with 4 mm² cable, protected by a circuit breaker of rating not exceeding 25 amps, provided that the total connected load of the circuit does not exceed 5 kVA.

710-11 Ten socket outlets of 13 amps rating may be connected to a single phase and neutral ring circuit subject to the following provisions:

1. The circuit shall consist of a ring of 2.5 mm² cable looped from one socket to the next throughout the circuit and from the last socket back to the distribution board. Except in the case of the sockets connected on a spur as indicated in sub-clause 4, not more than two conductors shall be connected into one terminal of any socket. No joints shall be permited in any box housing a socket.

2. The circuit shall be protected by a circuit breaker of rating not exceeding 30/32 Amps.

3. Ring circuit shall not be used where there is any likelihood of the total connected load of the circuit exceeding 7 kVA.

4. In special situations not more than two sockets may be connected as spur from the ring.

5. A diagram illustrating the ring circuit appears as in appendix 4.3 to this Regulations.

710-12 All wire sizes indicated in sub-clause 710-4 to 710-11 inclusive, relate to PVC insulated cables run as single circuits viz., without assuming any grouping factor. Where mineral insulated cables or cables with other insulating materials are employed for final circuits, the wire sizes stipulated in the above sub-clauses may be appropriately reduced and wire sizes having the same current rating as those specified for PVC insulated cables may be employed.

710-13 Where two, socket outlets are housed in one common box, this will be considered as one outlet only for purposes of interpreting sub-clauses 710-7 to 710-11, both inclusive.

710-14 All single phase socket outlets in any one room shall normally be connected to the same phase of the supply. In larger rooms and other areas, socket outlets connected to any one phase are grouped together and no two socket outlets connected to different phases of the supply are less than 2 metres apart.

EXCEPTION: Where an under-floor ducting system is employed the minimum distance between any two outlets to different phases of the supply may be further reduced to 1.2 metres.

710-15 Fixed window type air conditioning units, and other fixed equipment like water heaters, shall be connected to the circuit only by means of a switch or circuit breaker.

710-16 A shaver outlet provided with a double wound isolating transformer may be fed from a lighting circuit.

710-17 For all other final circuits the size of cable employed shall be suitable for the load connected and no diversity shall be allowed . Section 14 provides a detailed method of selecting circuit sizes and the excess current protective device to be employed, which shall be adhered to for all circuits.

711 WIRING ACCESSORIES – LOCAL SWITCHES

711-1 All local switches shall be of adequate capacity. For outdoor use switches shall be water-tight and metal-clad, Switches not designed to break an inductive load of its full rated capacity if used to control discharge lighting circuits shall have a current rating of not less than twice the total steady current which it is required to carry.

711-2 Normally all local switches shall be mounted with the dolies between 1.0 m and 1.5 m above the finished floor level. Where several switches are mounted in two or more horizontal rows, the lowest row shall have dollies at least. 1.0 m above the finished floor level. Unless prevented by the swing of the door, all switches shall be mounted inside the room on the side of the door where the catch or lock is situated the nearest switches being approximately 15 cms from the door frame. The switch nearest to the door shall control one or more of the principal lights of the room. In large rooms where groups of switches are employed the switching arrangement shall be carried out in a symmetrical manner.

The switches can be arranged in vertical columns as well, in such case the lowest and the highest points in the array of switches shall remain within 1.5 m and 2 m from the finished floor level.

711-3 In kitchens and other situations excepting bath rooms, where water is regularly used, no switch shall be mounted within the zone of exclusion around any tap, basin, sink or metal drainage board.

711-4 In bath rooms all switches shall be of the ceiling mounted cord operated type if located inside. Otherwise, switches shall be located in an accessible position outside the bath room and immediately adjacent to the door.

711-5 All one way switches both single and double pole shall be so mounted that the dolly is up when the switch is in the "OFF" position. All single pole switches shall be so connected that they control the phase lead to the light or other consuming device.

712 WIRING ACCESSORIES – SOCKET OUTLETS AND PLUGS

712-1 Socket outlets shall be of the 13 Amps, 3 pin type or 15/16 amps, 3 pin round pin type with shuttered line sockets. The earth contacts of each socket shall be effectively connected to the earth continuity conductor and the phase and neutral shall be connected to the correct sockets. When viewed from the front in its final mounted position, earth socket shall be at the top, the neutral socket shall be below to the left and the phase socket shall below to the right.

712-2 No socket outlets shall be mounted in any bath room except for socket outlets conforming to BS 3535.

712-3 No socket outlet shall be mounted within the zone of exclusion around any tap, sink or basin in any kitchen, cloakroom, etc., as shown in Appendix 15 'Arms reach' . Except where otherwise specified, all socket outlets shall be mounted 30 cm above the floor or work bench where bench

apparatus specified will be used. Socket outlets shall not be mounted at locations where they are liable to come into physical contact with fabrics or other material that may catch fire due to transmission of heat. If the height of mounting is different, it should be with the approval of EDD.

712-4 Socket outlets and plugs for use on more than one phase shall include a pin or other approved contact for the earth continuity connection which shall make contact before and break contact after all the phase connections and the neutral connections where such is fitted. Where a pin for the neutral conductor is fitted it shall make contact not later than and break contact not earlier than all the pins for the phase conductors. The design of the socket and plug shall be such that the plug cannot be inserted in such a manner that the neutral and any phase conductors become wrongly connected to the supply.

712-5 All three phase socket outlets (which are usually installed in industrial premises) shall be combined with switch so interlocked with the plug that the plug can not be withdrawn or inserted with the switch in the "ON" position.

713 WIRING ACCESSORIIES-JUNCTION BOXES AND SPUR BOXES

713-1 Junction boxes shall be complete with a terminal block suitable for connecting up to 10 mm^2, 3 core copper conductor cables and an all-insulated moulded cover plate. The cover plate shall permit easy connection of outgoing cable.

713-2 Spur-box shall be un-switched type equipped with 13 A circuit breaker. The terminal shall accommodate 3 core, 4 mm^2 copper conductor cables.

714 WIRING ACCESSORIES – LAMP HOLDERS

714-1 All lamp holders shall preferably be of the all-insulated pattern and if not separately and firmly attached to a bracket, conduit or block shall have a substantial cord grip with the flexible wire so connected that no pull due to the weight of the holder, lamp shade or fitting or pull on the flexible can be transmitted to the connections of the conductors to the terminals.

714-2 All batten, back-plate or thread mounted lamp holder shall be free from edges or other projections which might damage the wiring.

714-3 In bath room, kitchen and other places where water is regularly used, no lamp holder shall be located within the zone of exclusion (as shown in Appendix 15 'Arms reach') around any tap, bath, basin or sink, unless it and the lamp are totally enclosed in a fitting of all insulated construction and the lamp-holder is of the splash-proof type. Such fitting shall not be of the type which is suspended by the flexible cord, but shall be permanently mounted on the wall or otherwise supported independently of the current carrying conductors.

714-4 All lamp-holders of the screw cap lamps shall be so connected that the contact formed by the screw cap is connected to the neutral conductor.

715 WIRING ACCESSORIES – CEILING ROSES

715-1 All flexible cords and cables not connected to the supply by plug and socket shall be connected by means of insulated ceiling roses. Where the flexible cord or cable contains an earth continuity conductor, the ceiling rose shall be of the three or four plate type with the following terminals:

For three plate: Two + Earth (Phase, Neutral and Earth)

For four plate: Two + Loop-in + Earth (Phase, loop-in, neutral and Earth)

The terminals shall be clearly marked for identification by letters stamped or cast into material of which the ceiling rose is made. The ceiling rose shall be of a design/ material approved by EDD.

715-2 Ceiling roses shall be securely fixed to the structure of the building and shall not hang on or strain any wires feeding them. Flexible shall be securely anchored so that no pull from them can be transmitted to the conductor connections.

715-3 Where flexible cables supplying fixed apparatus are too large to be connected by a ceiling rose, a suitable heavy duty junction box may be used instead. In all cases the flexible cable shall be so arranged and secured that any pull on the cable shall be transmitted directly to the structure of the box and not to any current carrying or earth continuity connections.

716 WIRING ACCESSORIES – MOUNTING BOXES

716-1 Where conduits are run on the surface of walls of the building, all branch switches, sockets, ceiling roses, etc., shall be mounted on purpose made galvanized, P.V.C. or equivalent boxes specially designed for surface installation. All such boxes shall be securely fixed to the structure of the building in such a manner that they cannot rotate or rock throughout the life of the installation.

716-2 Where conduits are run buried in walls of the building, all branch switches, sockets, ceiling roses, etc., shall be housed in purpose made galvanised, PVC or equivalent boxes and all switch plates, socket plates and accessories shall be installed flush with the plaster.

717 SWITCHES AND ISOLATORS

717-1 All switches and isolators shall be of the load break type, of adequate size and robust construction. Main switch and sub-

main switch shall be completely enclosed in a heavy gauge rust-proofed sheet steel or all insulated housing with the cover interlocked with the operating handle in such a manner that the cover cannot be opened whilst the switch is in the 'ON' position.

717-2 Double pole switches shall break phase and neutral conductors simultaneously. Switches controlling more than one phase shall not break the neutral conductor but shall break all phases simultaneously.

717-3 No switch shall be mounted in the zone of exclusion around any water taps, basins, sinks, metal drainage boards etc., as shown in Appendix 15 'Arms reach'. Switches shall not be installed in any room containing a bath or shower bath or shower unless they are of the cord operated ceiling type.

718 DISTRIBUTION BOARDS

718-1 Distribution boards shall be housed in purpose made heavy gauge, rust-proofed sheet steel housing. The distribution boards shall be so installed that its centre shall remain at a height of 1500 ± 100 mm from the finished floor level. Alternatively, they may be housed in non-metallic enclosures provided the material employed is fully suitable for use in the climatic conditions and has the required insulation level.

718-2 Each distribution board shall have a circuit schedule pasted or otherwise permanently fixed inside the cover or adjacent to the board stating what each way controls and the size or rating of the circuit breakers to be used. All such schedules shall be in both Arabic and English.

718-3 Where multi-phase circuits are connected to a distribution board, the corresponding circuit breaker in each phase shall control the same circuit.

718-4 Each phase of every distribution board shall have an adequate busbar of high conductivity electrolytic copper to distribute the electricity to the various circuit breaker. Such busbar shall be provided with an adequate terminal or clamp to take the incoming main conductor. Busbars shall of the type approved by EDD.

719 UNDERFLOOR DUCTS

719-1 The installation of underfloor ducts shall be permitted beneath the surface of concrete or other flooring material.

719-2 Under floor conduits shall not be installed at locations which are regularly washed or where they are subject to corrosive vapours. In hazardous locations under floor ducts shall not be employed.

719-3 Unless adequate protection against corrosion is provided, metal underfloor ducts, junction boxes and fittings shall not be installed in concrete. Metallic and non-metallic underfloor ducts shall be of substantial construction.

719-4 All underfloor ducts shall be laid in straight lines and junction boxes shall be installed at all changes in direction. All junction boxes shall be levelled to the floor. Dead ends of all ducts shall be closed.

719-5 Underfloor ducts shall be provided with tap off position for outlets at regular spacing.

719-6 Throughout the underfloor duct system joints in conductors shall not be employed.

719-7 The combined cross sectional area of all conductors installed within the duct shall not exceed 40 percent of the interior cross sectional area of the duct or the duct size shall be selected in accordance with the method detailed in Section 14.

719-8 Where underfloor ducts serve more than one service as telephones, intercoms, etc. in addition to socket outlets, multi-sectioned ducts shall be provided and each service shall be housed in a separate duct. Outlet boxes serving different services and installed within the same box shall be provided with suitable separators.

720 CONSERVATION OF ELECTRICITY

All commercial premises including hotels and leisure centres shall be fitted with power saving devices which will automatically cut off electricity to lighting circuits with a built-in time delay, while occupants are away.

SECTION 8

ELECTRIC MOTORS, MOTOR CIRCUITS AND CONTROLLERS

INDEX TO REGULATIONS

801 All motors shall generally be totally enclosed, fan-cooled. Other types of enclosures may be employed provided that they are suitable for the particular application.

802 All motors, control gears and all ancillary apparatus (e.g. remote push buttons, pressure, float or limit switches, interlocks, relays, etc.) shall be of robust construction and shall have all windings, contacts and all current carrying live parts and components insulated with suitable materials. For certain applications and locations other superior classes of insulating materials may be applicable, and each situation shall be carefully studied in order to ensure that the temperature rise of the motor as declared by the manufacturer + ambient temperature is at least 10°C below the maximum operating temperature of the insulating material used.

NOTES: 1. The ambient temperatures in plant rooms should be taken as 55°C.

2. In all cases where the motors depend totally on the outside air for cooling whether by natural ventilation or by mechanical ventilation of the motor room, the entering cooling air temperature shall be taken as not less than 50°C for the purpose of calculating the amount of ventilating air.

803 Motors and their control gears shall be located so that adequate ventilation is provided and so that inspection and maintenance can be readily accomplished.

804 If any motor is to be located out of doors, such motor shall be protected from over heating by the sun with a canopy of approved design.

805 Motors below 1 H.P. (0.75 kW) may be connected to single phase supply. Under special conditions to be approved by EDD for each individual case, motors upto 5 H.P. (3.75 kW) may be connected to single phase supply. No motor higher than 5 H.P. (3.75 kW) shall be connected to single phase.

806 Self-contained air conditioning units upto 2.5 kW can be connected to a single phase supply.

807 Motors up to 150 H.P. (112 kW) may be connected to the 400 volts supply system. Where a customer proposes to use motors of higher capacity, he should contact the EDD to obtain the approval of such supply before purchasing any motor or appliance. If power supply at voltages higher than 400 volts are required, EDD can only supply 11000 volts, 3 phase, 50 Hz.

808 3-Phase motors upto and including 5 H.P. (3.75 kW) may be started direct on line (D.O.L.). motors above 5 H.P. (3.75 kW) shall be provided with equipment to ensure that starting current does not exceed 2.5 time the full load current. For larger motors, method of starting and voltage dips must be discussed with and approved by EDD in each case before the motors are connected to power supply.

809 All three phase motors over 1 H.P. (0.75 kW) shall be provided with starters which have means for automatically disconnecting them from the electric supply in the event of failure of supply, serious drop in voltage or flow of excess current

EXCEPTION: For motors driving fire pumps, the above protections may be omitted. Where no volt releases are fitted to such motors they shall be of the automatic resetting type.

810 All motors shall be provided with means of isolation suitably placed and so connected that all voltage may be cut off from the motor and an all-lockable 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. This means of isolation may be an isolator or "stop-lock" button.

811 Where a group of motors function as one unit, means shall be provided in the control system, to prevent the simultaneous starting of all motors at one and the same time. Where this is not possible for any reason whatsoever, the method of starting shall be approved by the E.D.D.

812 Starters shall be provided with overload relays of the thermal, magnetic or electronic type with automatic compensation for variation in ambient temperature between 0°C and 55°C.

813 All starters and push buttons shall be clearly labelled in English or English & Arabic stating the machines they control and the function of the various buttons.

STOP push buttons shall have large mushroom heads and/or coloured bright red.

START push buttons shall be shrouded to prevent accidental operation and must be coloured green.

814 All motors, single phase and three phase, shall have a power factor according to clause 313 at full load. Final circuit conductor sizes for motors shall be selected in accordance with the method indicated in Section 14.

815 All motors shall be suitably earthed in accordance with the requirements set out in Section 6. A frame earth terminal shall be provided in addition to the terminal block earth.

816 LIFT AND ESCALATORS :

816-1 All elevators, and escalators shall be provided with a separate means of isolating the entire electrical supply to the equipment.

816-2 On single and multicar installations where a separate power is used for signals or lights or any other equipment common to the group, a separate means of isolating the electrical supply

to such devices shall be provided.

816-3 Where interconnections between control panels are necessary for operation of the system on multicar installations that remain energized from a source other than the isolating means, a warning sign shall be mounted on or adjacent to the isolating means. The sign shall be clearly legible and shall read "Warning-Parts of the control panel are not de-energized by this switch".

816-4 All isolators shall be located in a readily accessible location. Where practicable, the isolators shall be located adjacent to the door of the machine room or enclosure.

816-5 Electrical elevators driven by polyphase alternating current motors shall be provided with a means to prevent starting of the elevator motor when:

(1) the phase rotation is in the wrong direction, or

(2) there is a failure in any phase

816-6 Elevator, escalator, driving machines, motor-generator sets controllers, auxiliary control equipment and isolators shall be installed in a room or enclosure set aside for that purpose. The room or enclosure shall be secured against unauthorised access.

816-7 Sufficient clear working space shall be provided around control panels to provide safe and convenient access to all live parts of the equipment necessary for maintenance and adjustment.

816-8 In public buildings and other premises it is recommended that a Fireman's break glass type switch or similar device be installed to override all operating controls and bring all the lifts to the ground floor during an emergency.

816-9 Adequate illumination shall be provided in the vicinity of the lift machinery room. Self contained emergency lights capable of providing illumination for a period of 3 hours from a battery source shall be provided. Such emergency lights shall be automatically charged and shall be switched on automatically in the event of failure of supply. Alternatively, lights connected to a maintenance/emergency source with automatic change over in the event of failure of normal supply shall be provided.

SECTION 9

OTHER ELECTRICAL EQUIPMENT
INDEX TO REGULATIONS

900 DOMESTIC APPLIANCES

900-1 All domestic appliances such as electric kettles, toasters, mixers, refrigerators, freezers, washing machines, etc., shall be adequately rated for the correct electrical supply conditions.

900-2 All domestic appliances shall be provided with a totally enclosed and fully shrouded terminal box which shall include a substantial earth terminal.

900-3 All domestic appliances shall be connected to the electrical supply by means of plugs and sockets or by means of junction boxes and isolators depending upon the location of the appliances.

900-4 Flexible cables employed for the purposes of connecting domestic appliances shall be fully suitable for the purpose, of ample rating and provided with an earth conductor. All flexible cables shall be in accordance with Clause 701 of this regulation.

900-5 All domestic appliances shall be used in circuits which in addition to excess current protection be provided with automatic earth leakage protection that will trip the circuit in the event of a leakage current in excess of 30 milli amperes.

900-6 The non-current carrying metal work of all domestic appliances shall be securely connected to the earthing system.

901 AIR-CONDITIONERS

901-1 Switch used for switching on/ off the Air-conditioner shall have the following additional feature:

In the event of a power failure, supply to the Air-conditioner can be restored only after a preset time. The preset time shall

not be less than what is recommended for the type of Air-conditioner connected to the switch.

902 ELECTRIC STORAGE WATER HEATERS & ELECTRODE BOILERS

902-1 All electrical water heaters shall have means of protection from excess pressure by cutting off of electricity using thermostats and by safety vents.

902-2 Pressure type storage water heaters may be installed in particular locations where the vented type or cistern type water heaters are not practicable. Pressure type water heaters shall be provided with adequate safety devices in order to ensure that any pressure build up within the heater which is in excess of the safe working pressure of the heater is immediately and effectively released. All pressure type water heaters shall in addition to safety valves and control thermostat shall also be fitted with high limit safety thermostat to cut off the power supply in case of the control thermostat does not function.

902-3 Storage water heaters upto 3 kW may be connected to the single phase and neutral supply. Storage water heaters above 3 kW shall be suitable for connection to the three phases.

902-4 All storage water heaters shall be connected to the earthing system in accordance with Section 6 and shall additionally be protected by a current operated earth leakage circuit breaker having a trip rating not exceeding 30 milliamps.

902-5 Electrode boilers having two or more electrodes may be employed in large premises, hospitals, industries, etc. The electrical supply to electrode boilers shall be controlled by a circuit breaker of the multiple linked type and arranged to disconnect the supply from all electrodes simultaneously. The circuit breaker shall also be provided with excess

current protection in each conductor feeding an electrode.

902-6 The earthing of the electrode boiler shall comply with the requirements of section 6. Additionally all armouring of cables, if any, shall also be connected to the shell of the boiler. The circuit feeding the boiler shall be provided with a current operated earth leakage circuit breaker having a trip rating of 300/500 milliamps.

NOTES: 1) Where in some special cases it is also required to connect the neutral conductor to the shell of the boiler, EDD's prior approval shall be obtained before effecting such a connection.

2) In special situations where a 300/500 milliamps trip rating will cause nuisance tripping a higher trip current may be permitted, but this should be approved by EDD.

902-7 Where an electrode boiler is to be connected to a supply exceeding low voltage, then the method of connection shall be submitted to EDD for their prior approval.

903 UNDERWATER LIGHTING

903-1 All circuits feeding under water lights shall be so designed and installed so that they ensure full safety for personnel.

903-2 All underwater lighting circuits shall operate at voltage not exceeding 36 volts.

EXCEPT - In large decorative fountains, where adequate fencing and guarding is provided to ensure that only competent persons can come in contact with the pool the normal system voltage may be employed.

903-3 Lighting fixtures and all other equipment employed in the pool shall be of approved manufacture and tested to ensure complete safety in operation with EDD's approval.

903-4 All circuits feeding pool lights shall be protected by a current operated earth leakage circuit breaker having a trip rating of 10 milliamps. Also other equipment associated with the under water lights viz. pumps etc., shall be protected by a current operated earth leakage circuit breaker having a trip rating of 300/500 milliamps.

903-5 All electrical equipment, lighting fittings, transformers and accessories shall be connected securely to the earthing system.

903-6 All metallic parts of the pool structure, including the reinforcing steel, all forming shells, all metal fittings within or attached to the pool structure and all metal parts of electric equipment shall be bonded together and earthed. The related electrical drawing of the swimming pool shall be made available to EDD inspector to check the single point earthing.

903-7 All float switches for water reservoirs shall be operated at extra low voltage (Not more than 36 V)

SECTION 10

EMERGENCY AND STAND-BY SYSTEMS
INDEX TO REGULATIONS

SECTION 10

EMERGENCY AND STAND-BY SYSTEMS

1000 EMERGENCY SYSTEMS

1000-1 The emergency system of the electrical installation shall be approved / confirmed by the concerned Ministry. Necessary fool-proof interlock shall be provided to avoid paralleling of emergency system and the normal power system during switching over to the emergency power system during power failure.

Emergency systems shall generally be provided in places of assembly where artificial illumination is required like buildings subject to occupancy by large number of people, hotels, theatres, multi-storey buildings, sports arenas, hospitals and similar premises and in such premises adequate illumination shall be provided from the emergency system to safely evacuate personnel. All stair ways, landings, exits and similar locations shall be provided with emergency lighting. This system shall also be capable of providing power to essential services and equipment in hospitals, refrigeration plants, in bulk cold stores, air conditioning systems in operating theatres, lifts, fire alarm systems, fuel filling stations, fire pumps, industrial processes equipment where an interruption of the normal supply would produce serious hazards, and for all other similar functions.

1000-2 The emergency system shall have adequate capacity and rating for the emergency operation of all equipment connected to the system.

1000-3 The emergency system shall be so designed and constructed that in the event of failure of the normal supply to or within the building, emergency lighting and emergency power where such is required, will be immediately available.

1000-4 The type of emergency system adopted shall depend upon the nature of the occupancy and the load and one of the following systems may be provided

(a) **Storage Battery**

A storage battery of suitable rating and capacity along with inverters etc. to supply and maintain at not less than 90 percent of the system voltage the total load of the circuits supplying emergency lighting and emergency power for a minimum period of 2 hours with not less than 90% of the system voltage. The system shall be complete with automatic battery charging means.

(b) **Generator Set**

A generator set driven by a prime mover of suitable rating and capacity to supply and maintain at system voltage the total load of the circuits supplying emergency lighting and emergency power. Means shall be provided for automatically starting the prime mover on failure of the normal supply. Automatic means shall also be provided for transferring from the normal supply to the emergency supply those loads necessary during emergency. For hospitals, the transition time from the instant of failure of the normal supply to the emergency supply shall not exceed 10 seconds.

NOTE: EDD's approval shall be obtained for the type of automatic transfer from normal to emergency supply.

(c) **Built-in Equipment**

Individual unit equipment for emergency illumination shall comprise of a rechargeable battery, a battery charging means, lighting fixture and a relaying device arranged to energise the lamps automatically upon failure of normal supply. The batteries shall be of suitable rating and capacity to supply and maintain at not less than 90 percent of the normal battery voltage,

the total lamp load for a period of at least 1.5 hours.

1000-5 Prime movers associated with generator sets shall be provided with an on-site fuel supply sufficient to operate the prime mover for at least 3 hours.

1000-6 All circuit wiring for emergency system shall be kept entirely independent of all other wiring and equipment and shall not enter the same trunking or tray as normal wiring except in transfer switches, exit or emergency light fixtures, or where the wiring is common for both systems.

1001 STAND-BY SYSTEMS

1001-1 In addition to the emergency system due consideration shall also be given in the selection and rating of such systems to afford standby power also to non-emergency system during a failure of normal supply.

1001-2 For stand-by systems a manual or automatic change over from normal supply to standby supply shall be provided.

NOTE:
1. Under no circumstances shall there be any possibility to back feed the generator set to the main network.
2. E.D.D's approval shall be obtained for the type of change over system adopted from normal supply to emergency or stand-by supply.

1001-3 Stand-by systems with adequate essential supply shall be provided to all premises where loose of supply will affect services provided to citizens especially those mentioned in clause 1000-1.

SECTION 11

INSPECTION AND TESTING
INDEX TO REGULATIONS

1101 Every installation shall, on completion and before being energised, be inspected, tested and approved by EDD's Inspector in accordance with this section. All necessary application forms and other details as stipulated shall be submitted to the EDD prior to testing the installation.

1102 A visual inspection shall be made to verify that the installed equipment and installation methods are in accordance with the approved drawings. The EDD's Inspector will also ensure that there is no damage to any part of the installation.

1103 Visual inspection shall also be carried out to ensure satisfactory and approved methods are adopted for the following.

i) Connection of conductors

ii) Identification of conductors

iii) Connection of single pole devices in phase conductor only

iv) Correct connection of socket outlets and lamp holders

v) Presence of fire barriers and protection against thermal effects

vi) Method of protection against direct contact including measurement of distances

vii) Labelling of circuits, switches, etc.

1104 The EDD Inspector shall carry out insulation résistance test and earth continuity test. Insulation résistance test in large buildings may be divided into groups of outlets, each containing around 50 outlets. An outlet shall include every point and every switch except that a socket outlet incorporating a switch shall be regarded as one outlet. A 500 volts D.C. supply shall be applied to the installation and the insulation resistance obtained shall not be less than one (1) megohm.

1105 Earth continuity test shall be carried out between the customer earthing terminal and the remote end of earth continuity conductors. The résistance value obtained shall not exceed that stated in clause no. 603.

1106 The EDD Inspector shall also carry out appropriate tests to ensure efficient and correct operation of all earth leakage circuit breakers and other protective devices.

1107 The contractor shall submit the values of individual load connected to the installation (in the form approved by EDD for that purpose) to EDD before the visit of EDD inspector to the installation. The tests on the installation shall be done by the contractor as per the instruction of the EDD inspector.

NOTE: The role of EDD Inspector is to witness these test only and certify the test certificates, three copies of which will be prepared, one for retention by EDD.

1108 The contractor shall carryout measurements as per the guidance of the EDD inspector to determine the earth electrode resistance by approved methods. All necessary assistance required for carrying out this test, including the testing apparatus and auxiliary electrodes, shall be provided by the contractor.

1109 In the event of any fault or the installation not meeting the requirements of the regulation, the contractor shall rectify the fault/ complete the shortcomings and then request for another date for the visit of the EDD inspector. In case the contractor does not appear for assisting inspection of the installation at the date and time fixed and informed by EDD, an amount of BD 50/- will be charged for allowing another inspection date and time for the same installation. If the contractor defaults for over four times, his licence will be suspended for three months. In case the defaulting continues thereafter as well, the licence will be withdrawn.

1110 Any alteration to the existing installation shall also be inspected and approved by EDD.

1111 Periodic Inspection and testing shall be carried out by a licensed contractor in accordance with this section. The licensed contractor shall submit the necessary periodic testing certificate to the Customer Services Directorate. The frequency of periodic inspection and testing shall not exceed the following periods:

Domestic Installations	10 years
Commercial Installations	5 years
Industrial Installations	3 years
Schools, Hotels, Parks, Malls and other Public locations	1 year

1112 The ministry has the right to disconnect supply to premises not passed the periodic inspection or not fulfilled the requirement of this section.

SECTION 12

ELECTRIC DISCHARGE LAMP INSTALLATIONS
INDEX TO REGULATIONS

1201 Regulations contained in this section shall be applicable to discharge lamps used for signboards and for commercial propaganda, inside or outside the building.

1202 A fireman's emergency switch shall be provided for Exterior Electric Discharge lighting installations and/or Interior Electric Discharge lighting installations which run unattended (window lighting for display purposes).

1203 Every fireman's switch shall be arranged to isolate the installation from all poles of the supply, except that it need not isolate the installation from the neutral conductor of a 3-Phase 4-wire supply.

1204 Fireman's switch shall be coloured red and have fixed near it a nameplate marked with the words " FIREMAM'S SWITCH' in Arabic and English. This plate should be of minimum size 150 mm by 100 mm with lettering not less than 15 mm high.

1205 Fireman's switch shall have its "On and Off" positions clearly indicated by lettering legible to a person standing on the ground.

1206 Fireman's switch shall be fixed in a conspicuous position, reasonably accessible to firemen, and not more than 2.75 metres from the ground.

1207 For exterior installations Fireman's switch shall be outside the building and adjacent to the electric discharge lamps(s), or alternatively a notice indicating the position of the switch shall be placed adjacent to the electric discharge lamp(s).

1208 For interior installations, Fireman's switch shall be in the main entrance to the building or alternatively in a position to be agreed with the local fire-brigade authority.

1209 The voltage to earth across the lamp shall not exceed 5 kV. Any deviation on this regulation shall be with the approval of EDD.

SECTION 13

TEMPORARY ELECTRICITY SUPPLIES IN CONSTRUCTION AND BUIILDING SITES

INDEX TO REGULATIONS

1300 Wherever applicable and relevant, installations for temporary supply shall comply with the regulations applicable for permanent installations. The regulations given in this section are additional requirements.

1301 The customer shall provide a distribution board for availing of the temporary power supply, in case the permanent distribution facility is not ready at site.

1302 The reliability and adequacy of circuit protection, both mechanical and electrical, and earthing arrangements shall be ensured at all times. Frequent periodic maintenance including inspections and tests shall be carried out by the electrical contractor. (Due to the adverse conditions prevailing at construction and building sites, temporary installations, including supply cables, conductors, and portable appliances, are subject to accelerated wear and tear.)

1303 Supplies for portable hand-lamps and portable tools shall be operated at 110 volts or less, through a double wound transformer specially manufactured for this purpose. The primary winding terminal must be enclosed in insulating material and earthing terminal provided. The secondary winding shall terminate in a suitable socket outlet attached to the transformer or its enclosure.

1304 CABLES

1304-1 Wiring for, semi-permanent parts of the site installation, such as site offices and buildings, shall comply with these Regulations.

1304-2 For all other parts of the installation the following additional precautions shall be taken.

a) Underground cables shall be of a type having a continuous and earthed metal sheath or armour. The metal sheath or armour shall not be used as the sole earth conductor.

b) Except for situations where the risk of mechanical damage is slight, armoured cable should be used for the wiring.

c) Overhead lines shall not be permitted in locations where vehicles are intended to pass underneath such overhead lines. In other locations, overhead lines shall be fully insulated and supported at suitable intervals, and where necessary suspended by catenary wires at a height not less than 5 metres from the ground.

d) All joints shall be mechanically and electrically sound, fully insulated, inaccessible to workmen, and clear of all materials.

1304-3 The contractor shall submit drawings to EDD, showing details of laying the underground cable, for approval.

1305 EARTHNG

Earthing shall be in accordance with these Regulations.

1306 SWITCHES, SOCKETS, COUPLERS

All switches, switched socket outlets, plugs and cable couplers shall be contained in weatherproof enclosures unless they are-of the weather-proof type.

1307 LIGHT FIXTURES

Light fixtures used outdoors, or at locations where there is likelihood that such fixtures are subject to splashing water, shall be of the weatherproof type.

1308 PORTABLE APPARATUS

All metal-clad portable apparatus shall be effectively earthed at all times.

1309 FLAMABLE OR EXPLOSIVE LOCATIONS

All appliances or accessories intended for use in flammable/explosive locations and the associated wiring there of, shall be in accordance with the latest relevant B.S.I. standard.

1310 The approval issued by EDD for temporary power supply will be initially valid for six months. If the approval is to be extended thereafter, inspection of the installation shall be carried out by EDD staff, after every six months.

SECTION 14

APPENDICES, TABLES, GRAPHIC SYMBOLS

NOTES:

1. Various appendices, tables, graphic symbols, etc. are provided in this Section. These are to be construed as a part of the Regulations and shall be complied with.

2. Where for a particular condition of installation, the appendices, tables etc. do not apply, then EDD's prior approval shall be obtained for the method adopted.

3. The latest version of IEE Regulations can be referred to for more accurate calculations.

APPENDIX 1

CO-ORDINATION BETWEEN CONDUCTOR SIZE AND EXCESS CURRENT PROTECTION DEVICE EMPLOYED

General Condition:

For compliance with Clause No. 710-17 of the Regulation the following conditions are to be fulfilled

(i) The excess current protection device's nominal current or current setting (I_N) is not less than the design current (I_B) of the circuit, and

(ii) Its nominal current or current setting does not exceed the lowest current carrying capacity (I_Z) of any of the conductors of the circuit and

(iii) The current causing effective operation of the protective device (I_2) does not exceed 1.45 times the lowest of the current carrying capacities (I_Z) of any of the conductor of the circuit.

The above condition may be stated as formulae

$I_B \leq I_N \leq I_Z$

$I_2 \leq 1.45\ I_Z$

In order to determine the size of the cable to be used for a particular condition of installation, it may be necessary to apply one or more of the following correction factors:

(i) For ambient temperature - Table 2.5 of Appendix - 2 which gives correction factor to be applied for the actual ambient temperature of the installation when it exceeds 40°C.

(ii) For grouping - Tables 2.2, 2.3 and 2.4 of Appendix - 2 which gives correction factors for various grouping of circuits.

Determination of Size of Cable to be used

Having established the designed current of the circuit under consideration and having chosen the type and nominal current or current setting of the excess current protective device it is intended to use in accordance with general condition above, the following procedure shall be adopted to determine the size of cable.

(i) DIVIDE the nominal current of the excess current device by the appropriate ambient temperature correction factor given in Table 2.5 for the type of cable to be used.

(ii) Then further, DIVIDE by any applicable correction factor for grouping given in Tables 2.2, 2.3 and 2.4.

(iii) The size of the cable to be used shall be such that its tabulated current carrying capacity for the installation method concerned is not less than the value of the nominal current of the excess current protective device adjusted as above.

EXAMPLE:

(a) A circuit feeding a balanced three phase load of 21 kW at 0.8 P.F. 400 volts, at an ambient temperature of 50°C by means of single core, PVC insulated cable in conduit along with another circuit.

Design Current = $21/(\sqrt{3} \times 0.400 \times 0.8)$ = 37.9 A

Nominal current
of excess current protective device = 40 A

Adjustment for
ambient temperature from Table 2.5 = 40/0.85 = 47 A

Adjustment for
grouping from Table 2.2 = 47/0.67 = 70.15 A

Size of cable from Table 2.6 = 25 mm².

(b) If the above circuit is run in separate conduits,

Adjustment for
ambient temperature from Table 2.5 = 40/0.85 = 47 A

Size of cable from Table 2.6. = 16 mm^2

(c) A single phase, 230 volts lighting circuit having a load of 2000 VA in an ambient temperature of 45°C and wired with single core PVC insulated cable run in a conduit having two more circuits (i.e) three circuits together and protected by 10 amps circuit breaker.

Design Current = 2000/230 = 8.7 A

Nominal current of the
excess current protective device = 10 A

Adjustment for
ambient temperature from Table 2.5 = 10/0.91 = 11.0

Adjustment for
grouping from Table 2.2 = 11/0.69 = 16 A

Size of cable from Table 2.6 = 2.5 mm^2

(d) If the above circuit is run in a separate conduit:

Adjustment for
ambient temperature from Table 2.5 = 10/0.91 = 11 A

Size of cable from Table 2.6 = 1.5 mm²

APPENDIX 2

General Methods of Installation of Cables:

TABLE 2.1
Methods of Installation

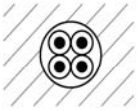
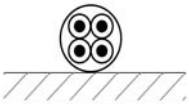
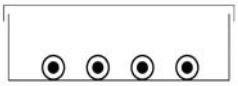
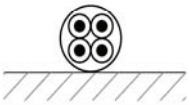
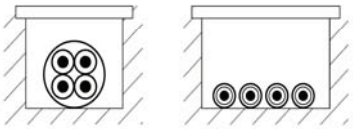
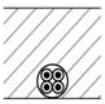
Type *Description*	*Examples*
1. Single core PVC insulated cable with or without shealth in conduit buried in concrete or block work.	
2. Single core PVC insulated cable with or without shealth in conduit run on surface of wall or structure.	
3. Single core PVC insulated cable with or without shealth in trunking.	
4. Single core PVC insulated and sheathed cable or multi-core PVC/XLPE insulated armoured and non-armoured cable run on trays.	
5. Multi-core PVC/XLPE armoured and non-armoured cable fixed to the surface of wall or structure.	
6. Single core PVC insulated non-magnetic armoured cable or multi-core PVC/XLPE armoured and non-armoured cable run in trench.	
7. Single core PVC insulated non-magnetic armoured cable or multi-core PVC/XLPE armoured and non-armoured cable run in duct.	
8. Multi-core PVC/XLPE insulated armoured and non-armoured cable directly buried in ground.	

TABLE 2.2

Correction factors for groups of more than three single-core cables

Type of Installation method	Number of Cables and Correction Factors											
	4	6	8	10	12	16	20	24	28	32	36	40
1, 2, 3	0.80	0.69	0.62	0.59	0.55	0.51	0.48	0.43	0.41	0.39	0.38	0.36

Note: In case of one three phase circuit employing 4 wires, no correction factor is applicable and the ratings given in Tables 2.6 and 2.7 shall be adopted. Where more than one three phase circuit is bunched in a conduit or trucking, then, appropriate grouping factor shall be taken into consideration.

TABLE 2.3

Correction factors for groups of more than one multi-core armored and non-armored cables

Type of Installation Method	Number of Cables and Correction Factors											
	2	3	4	5	6	8	10	12	14	16	18	20
4, 5, 6 & 7	0.80	0.70	0.65	0.60	0.57	0.52	0.48	0.45	0.43	0.41	0.39	0.38

Note: Where spacing between adjacent cables exceeds twice their overall diameter, no reduction factor need be applied.

TABLE 2.4

Correction factors for groups of more than one Multi-core armoured and non-armoured cable buried in ground

Type of Installation Method – 8	Number of Cable and Correction Factor				
	2	3	4	5	6
Cables laid touching each other	0.81	0.70	0.63	0.59	0.55
Cables laid 15 cms apart	0.87	0.78	0.74	0.70	0.68

TABLE 2.5

Correction factors for ambient temperatures higher than 40°C to be applied to the current carrying capacity shown in various tables

Ambient Temperature	Type of Insulation			
	PVC	XLPE	Mineral	
			PVC Covered	Bare
45°C	0.91	0.94	0.89	0.98
50°C	0.85	0.89	0.80	0.96
55°C	0.70	0.82	0.69	0.91
60°C	0.57	0.74	0.54	0.88

TABLE 2.6

Current carrying capacity of PVC insulated single core copper cables with or without sheath at 40°C ambient temperature and for installation methods 1, 2 and 3

Nominal cross-sectional Area of conductor mm²	Single-phase a.c. (Amperes)	Three-Phase a.c. (Amperes)
1.5	15	14
2.5	21	18
4	28	24
6	36	31
10	50	44
16	66	59
25	88	77
35	109	97
50	131	117
70	167	149
95	202	180
120	234	208
150	261	228
185	297	258
240	348	301
300	398	343
400	475	406
500	545	464
630	626	532

TABLE 2.7

Current carrying capacity of single core PVC insulated and Sheathed copper cables at 40ºC ambient temperature and for installation method 4

Nominal cross-sectional area of conductor (mm^2)	Single-Phase a.c. (Amperes)	Three-Phase a.c. (Amperes)
1.5	17	15
2.5	23	21
4.0	31	28
6.0	40	36
10.0	55	50
16.0	74	66
25.0	97	88
35.0	120	109
50.0	146	131
70.0	185	167
95.0	225	202
120.0	260	234
150.0	299	269
185.0	341	307
240.0	401	361

TABLE 2.8

Current carrying capacity of PVC insulated multi-core copper cables at 40ºC ambient temperature and for installation methods 4,5,6 & 7

Nominal cross-sectional area of conductor (mm²)	Armoured (Amperes)	Non-armoured (Amperes)
4.0	28	28
6.0	36	35
10.0	49	47
16.0	64	62
25.0	84	78
35.0	104	100
50.0	128	122
70.0	157	153
95.0	191	187
120.0	224	218
150.0	257	250
185.0	290	287
240.0	347	341
300.0	392	391
400.0	455	452

TABLE 2.9

Current carrying capacity of multi-core XLPE insulated copper cables at 40ºC ambient temperature and for installation methods 4,5,6 & 7

Nominal cross-sectional area of conductor mm²	Armoured (Amperes)	Non-armoured (Amperes)
4.0	36	33
6.0	47	43
10.0	64	59
16.0	87	80
25.0	115	106
35.0	139	128
50.0	168	155
70.0	214	197
95.0	263	242
120.0	304	280
150.0	353	325
185.0	402	370
240.0	476	438
300.0	542	499

TABLE 2.10

Current carrying capacity of single core and multi- core mineral insulated copper cables at 40°C ambient temperature

a) Having the sheath covered overall with PVC
b) Having the sheath bare and not exposed to touch

Note: Where cables of type (a) are installed bunched, the appropriate grouping factors given in table 2.2 and 2.3, shall be applied for the particular installation condition. For cable of type (b) no grouping factor is necessary.

Nominal cross-section area of conductor		Single Core						Multi Core			
		Single Phase a.c. (Amperes)		Three Phase a.c. (Amperes)		Single Phase a.c. 2 Core (Amperes)		Three Phase a.c. 4 Core (Amperes)		7 Core (Amperes)	
		(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
LIGHT DUTY	1.0	19	24	15	24	15	20	12	17	9	12
	1.5	23	31	20	31	19	25	15	21	11	14
	2.5	31	41	26	41	25	35	20	29	15	21
	4.0	39	54	35	54	32	45	28	38	-	-
	6.0	50	70	44	70	42	58	-	-	-	-
	10.0	68	94	60	94	-	-	-	-	-	-
HEAVY DUTY	1.0	20	28	17	28	16	22	14	18	9	13
	1.5	25	35	22	35	20	28	17	23	12	16
	2.5	33	45	29	45	27	37	22	31	16	22
	4.0	43	60	37	60	35	49	29	40	20	29
	6.0	54	74	48	74	45	62	37	52	-	-
	10.0	72	101	64	101	60	84	50	70	-	-
	16.0	94	134	84	134	80	110	66	94	-	-
	25.0	128	173	111	173	105	149	89	120	-	-
	35.0	153	211	136	211	-	-	-	-	-	-
	50.0	191	264	170	264	-	-	-	-	-	-
	70.0	234	322	204	322	-	-	-	-	-	-
	95.0	281	389	247	389	-	-	-	-	-	-
	120.0	323	451	285	451	-	-	-	-	-	-
	150.0	374	518	327	518	-	-	-	-	-	-

TABLE 2.11

Current carrying capacity of multi- core copper cables at 30°C ground temperature and for installation method 8

a) PVC insulated and armoured.
b) XLPE insulated and armoured.

Nominal cross-sectional area of conductor mm²	PVC insulated and armoured (Amperes)	XLPE insulated and armoured (Amperes)
4.0	37	43
6.0	47	54
10.0	62	73
16.0	81	100
25.0	108	125
35.0	129	150
50.0	154	176
70.0	185	217
95.0	222	261
120.0	255	300
150.0	284	334
185.0	321	375
240.0	375	435
300.0	420	490

TABLE 2.12

Current carrying capacity and mass supportable for Flexible copper cords insulated with silicone rubber

Nominal cross-sectional area of conductor mm²	Current carrying capacity single or three phase a.c. (Amperes)	Maximum mass support-table by twin flexible cord (kg.)
0.5	3	2
0.75	6	3
1.0	10	5
1.25	13	5
1.5	15	5
2.5	20	5
4.0	25	5

NOTE - These rating apply up to an ambient temperature of 120°C

TABLE 2.13

NUMBER OF CABLES THAT MAY BE INSTALLED IN CABLE TRAYS

1. SINGLE CORE INSULATED AND SHEATHED CABLES AND SINGLE CORE INSULATED NON-MAGNETIC ARMOURED CABLE

   (a) Where single core cables are installed in ventilated cable trays, the sum of the combined cross-sectional area of all cables installed in the tray shall not exceed 50 percent of the interior cross- sectional area of the cable trays.

   (b) Where single core cables are installed in solid bottom cable trays, the sum of the combined cross-sectional area of all cables installed in the tray shall not exceed 40 percent of the interior cross-sectional area of the cable tray.

2. MULTI-CORE ARMOURED OR NON-ARMOURED CABLES

   (a) Where multicore cables are installed in ventilated cable trays, the sum of the diameters of all cables installed shall not exceed 90 percent of the cable tray width and the cables shall be installed in a single layer.

   (b) Where multicore cables are installed in solid bottom cable trays, the sum of the diameters of all cables installed shall not exceed 80 percent of the cable tray width and the cables shall be installed in a single layer.

APPENDIX 3

CAPACITY OF CONDUITS, TRUNKING AND UNDERFLOOR DUCTS

TABLE 3.1

Capacity of conduits for simultaneous drawing of single core PVC insulated cables for a straight run upto 10 metres without bends

Nominal cross-sectional area of Conductor (mm^2)	Size of Conduit (mm)					
	16	20	25	32	38	50
1.5	6	11	-	-	-	-
2.5	5	8	-	-	-	-
4.0	3	5	10	-	-	-
6.0	2	4	7	13	-	-
10.0	-	2	4	7	10	-
16.0	-	2	3	6	9	-
25.0	-	-	2	4	5	10
35.0	-	-	-	3	4	7
50.0	-	-	-	2	3	5
70.0	-	-	-	-	2	4

TABLE 3.2

Capacity of conduits for simultaneous drawing of single core PVC insulated cables for a run upto 10 metres with one bend

Nominal cross-sectional area of Conductor (mm^2)	Size of Conduit (mm)					
	16	20	25	32	38	50
1.5	5	8	-	-	-	-
2.5	4	6	-	-	-	-
4.0	2	4	8	-	-	-
6.0	2	3	6	11	-	-
10.0	-	-	3	6	8	-
16.0	-	-	2	5	7	12
25.0	-	-	-	3	4	8
35.0	-	-	-	2	3	6
50.0	-	-	-	-	2	4
70.0	-	-	-	-	-	3

TABLE 3.3

Capacity of conduits for simultaneous drawing of single core PVC insulated cables for a run upto 10 metres with two bends

Nominal cross-sectional area of conductor **(mm^2)**	Size of Conduit (mm)					
	16	20	25	32	38	50
1.5	3	6	11	-	-	-
2.5	2	4	8	-	-	-
4.0	2	3	6	-	-	-
6.0	-	2	4	8	11	-
10.0	-	-	2	4	6	10
16.0	-	-	2	3	5	9
25.0	-	-	-	2	3	5
35.0	-	-	-	-	2	4
50.0	-	-	-	-	-	3
70.0	-	-	-	-	-	2

Note: 1. Table 3.1, 3.2 and 3.3 apply to both steel and PVC conduits.

TABLE 3.4

Capacity of conduits for simultaneous drawing of different sizes of single core PVC insulated cables in runs upto 10 metres without bends, with one bend, and with two bends

For each size of cable it is intended to use, obtain the appropriate factor from Table 3.4A.

Add all the cable factors so obtained and compare with the conduit factor given in Table 3.4B.

The conduit size which will satisfactorily accommodate the cables is that size having factor equal to or exceeding the sum of the cable factor.

TABLE 3.4 A

CABLE FACTOR

Nominal cross-Sectional area of conductor mm²	Size of Conduit (mm)									
	1.5	2.5	4.0	6.0	10.0	16.0	25.0	35.0	50.0	70.0
	22	30	43	58	105	121	193	253	342	451

TABLE 3.4 B

CONDUIT FACTOR

Conduit size	**16 mm**	**20 mm**	**25 mm**	**32 mm**	**38 mm**	**50 mm**
Upto 10 metres run without bend	150	244	442	783	1092	1943
Upto 10 metres run with one bend	120	196	358	643	883	1571
Upto 10 metres run with two bends	86	141	260	474	646	1149

TABLE 3.5

Maximum number of single core PVC insulated cables in trunking of various sizes

For each size of cable it is intended to use, obtain the appropriate factor from Table 3.5A.

Add all the cable factors so obtained and compare with the trunking factor given in Table 3.5B.

The trunking size which will satisfactorily accommodate the cables is that size having a factor equal to or exceeding the sum of the cable factor.

TABLE 3.5 A

CABLE FACTOR

Size of Cable (mm²)	1.5	2.5	4.0	6.0	10.0	16.0	25.0	35.0	50.0	70.0
Cable Factor	8	11	15	22	36	45	68	90	121	158

TABLE 3.5 B

TRUNKING FACTOR

Trunking size (mm²)	50x50	75x50	75x75	100x50	100x75	100x1001	50x50	150x75	150x100
Turnking Factor	1037	1555	2371	2091	3189	4252	3147	4718	6294

TABLE 3.6

Maximum number of single core PVC insulated cables in underfloor ducts of various sizes

For each size of cable intended to use, obtain the appropriate factor from Table 3.6 A.

Add all the cable factors so obtained and compare with underfloor ducts factor given in Table 3.6 B.

The underfloor ducts size which will satisfactorily accommodate the cables is that size having a factor equal to or exceeding the sum of the cable factor.

TABLE 3.6 A

CABLE FACTOR

Size of Cable (mm^2)	1.5	2.5	4.0	6.0	10.0	16.0
Cable Factor	8	11	15	22	36	45

TABLE 3.6 B

UNDER FLOOR DUCTS FACTORS

Underfloor ducts (mm)	75x25	100x25	150x25	75x38	100x38	150x38
Underfloor ducts Factor	660	875	1312	990	1312	1970

APPENDIX 4

MISCELLANEOUS TABLES AND DETAILS

TABLE 4.1

SIZE OF EARTH CONTINUITY CONDUCTORS AND EARTHING LEADS

Nominal cross-sectional area of largest associated copper circuit conductor (mm^2)	Nominal cross-sectional area of copper earth continuity conductor (mm^2)	Nominal cross-sectional area of copper earthing lead (mm^2)
1.5	1.5	6.0
2.5	1.5	6.0
4.0	2.5	6.0
6.0	2.5	6.0
10.0	6.0	6.0
16.0	6.0	6.0
25.0	16.0	16.0
35.0	16.0	16.0
50.0	25.0	25.0
70.0	50.0	50.0
95.0	50.0	50.0
120.0	50.0	50.0
150.0	50.0	50.0
185.0	70.0	70.0
240.0	70.0	70.0
300.0	70.0	70.0
400.0	70.0	70.0

Note: P.V.C. insulation of earth continuity conductor should be coloured green - yellow.

TABLE 4.2

GRAPHIC SYMBOLS

Symbol	Description
	Pendant or ceiling light
	Bracket light
	Weather proof bracket light
	Flourescent light
	Flood light on pole
	Ceiling fan
	Bracket or wall fan
	Fan regulator with switch adjacent
	Extract fan on wall or glass
	Extract fan on ceiling
	13 amps. 3 Pin switch socket

Symbol	Description
	High level 13 Amps 3 Pin socket controlled by separate switch
	Weather proof 13 Amps 3 Pin socket controlled by separate switch
	Three phase or three phase and neutral switch socket outlet
	Three phase or three phase and neutral weather proof switch socket outlet
CCU	Cooker control unit
JB	Junction box with connector
	One way switch
	Two way switch
	Ceiling switch (cord pull oprerated)
	One way weather proof switch
	Fuse
	Moulded case circuit breaker
	Miniature circuit breaker

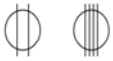
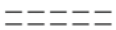
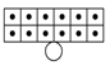
Symbol	Description
	Current operated earth leakage circuit breaker
	Earth leakage relay
	Kilowatt hour meter
	Distribution board
	Switch fuse
	Change over switch
	Main switch board assembly (for details see schematic diagram)
	Submain switch board assembly (for details see schematic diagram)
	Under ground cables
	Duct for cable entry
	Earth electrode
	Bell push
	Bell indicator or with bell (dots show no. of ways)
	TV aerial socket

TABLE 4.3
CONNECTION OF 13 A SOCKETS
IN RING CIRCUIT IN NON-METALLIC CONDUIT

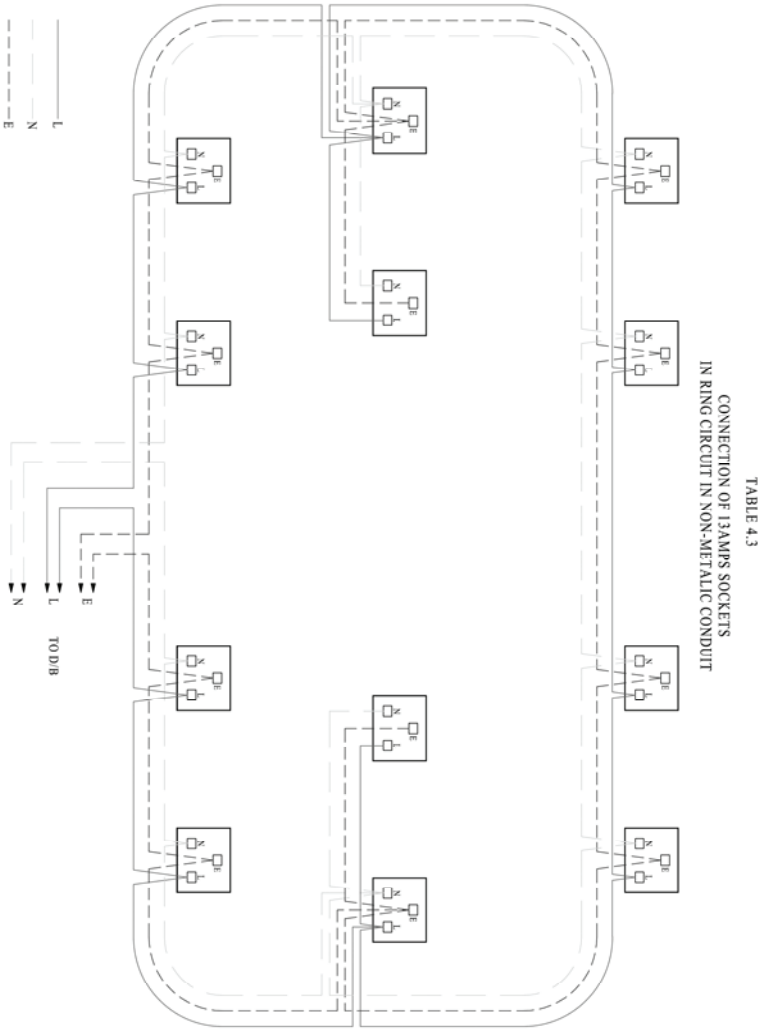


TABLE 4.3
CONNECTION OF 13AMPS SOCKETS
IN RING CIRCUIT IN NON-METALIC CONDUIT

APPENDIX 5

TESTING OF CABLES

All cables for use in Bahrain must have the approval of EDD.

Electrical test requirements:

The test shall be made with alternating voltage of approximately sine-wave form, having a frequency in the range 50 Hz to 60 Hz., and of r.m.s. values as given in Table 5.2. The required electrical tests to be applied at the cable shall be of time and temperature as shown in Table 5.2. The tests are:

a) Conductor resistance at 20 °C. (Ω/km)
b) Voltage test on compete cable (No breakdown of insulation shall occur during the test)
c) Insulation resistance at 70 °C must have the minimum values as shown in Table 5.1
d) Resistance of insulation to d.c. (the exterior of insulation shall show no damage)

TABLE 5.1

Nominal cross sectional area of conductor (mm^2)	Number and diameter of wires per conductor (No./mm)	Maximum conductor resistance (plain annealed copper) (Ω/km)	Radial thickness of insulation (mm)	Mean overall diameter (Upper limit) (mm)	Minimum insulation resistance at 70 °C (MΩ/km)
1.5	1/1.38	12.1	0.7	3.3	0.0110
1.5	7/0.53	12.1	0.7	3.4	0.0100
2.5	1/1.78	7.41	0.8	3.9	0.0100
2.5	7/0.67	7.41	0.8	4.2	0.0090
4	7/0.85	4.61	0.8	4.8	0.0077
6	7/1.04	3.08	0.8	5.4	0.0065
10	7/1.35	1.83	1	6.8	0.0065
16	7/1.7	1.15	1	8	0.0050
25	7/2.14	0.727	1.2	9.8	0.0050
35	19/1.53	0.524	1.2	11	0.0045
50	19/1.78	0.387	1.4	13	0.0040
70	19/2.14	0.268	1.4	15	0.0035
95	19/5.52	0.193	1.6	17	0.0035
120	37/2.03	0.153	1.6	19	0.0032
150	37/2.25	0.124	1.8	21	0.0032
185	37/2.52	0.0991	2	23.5	0.0032
240	61/2.26	0.0754	2.2	26.5	o.oo32
300	61/2.52	0.0601	2.4	29.5	0.0030
400	61/2.85	0.0470	2.6	33.5	0.0028
500	61/3.2	0.0366	2.8	37	0.0028
630	27/2.52	0.0283	2.8	41	0.0025

TABLE 5.2

ELECTRICAL TEST APPLIED

Test	Unit	Values	Test requirements
Voltage test on complete cable:			
Length of sample (Minimum)	Meter	20	No breakdown of the insulation
Period of immersion (Minimum)	Hours	24	
Temperature of water	°C	20±5	
Applied voltage (a.c.)	V	2500	
Time of application	Minute	15	
Conductor resistance at 20 °C:			
Length of sample	Metre	1	Not more than the maximum value shown in Table 5.1
Insulation resistance:			
Length of sample	Metre	5	
Period of immersion (Minimum)	Hours	2	Not more than the maximum value shown in Table 5.1
Temperature of water	°C	70±2	
Resistace of insulation to d.c.:	Metre	5	
	Days	10	No damage at the insulation
	°C	60±5	

Length of sample Period of immersion Temperature of solution Duration of applied voltage Test voltage	 Days V d.c.	 10 220	

TABLE 5.3

PHYSICAL TEST REQUIREMENTS

THE INSULATION SHALL BE SUBJECTED TO THE TESTS DETAILED UNDER

Test method	Property under test	Test requirements
A, B.	Minimum tensile strength (N/mm^2)	12.5 N/mm^2
	Minimum elongation at break (%)	125%
C1, C2	Cold bent test: Temperature at which specimen shall not crack (°C)	-15±2°C
E3	Loss of mass after ageing at 115 ± 2°C (Max.) (mg) (cm^2)	1.5 mg/ cm^2
E1	Number of days of ageing	10
	Ageing temperature(°C)	135±2°C
	Tensile strength after ageing (Minimum value N/mm^2)	12.5 N/mm^2
	Maximum variation from unaged value (%)	125%
	Elongation at break after ageing – minimum value (%)	25%
	Maximum variation from unaged value(%)	95±2°C
F1, F2 F3	Hot pressure test temperature (°C)	50%
	Maximum deformation (%)	
G1, G2	Heat shock test: Temperature at which specimen shall not crack (°C)	150±2°C
H	Minimum insulation resistance constant (K value) at 20 °C (M/km)	180 M/ km

The test certificatess shall be approved by EDD

APPENDIX 6

TERMS AND CONDITIONS FOR PROVIDING 11 kV SUPPLY

As per the present policy of EDD, certain consumers with an anticipatd maximum demand in excess of 1500 kVA are required to receive supply at 11 kV and be responsible for transformation and distribution of electricity within their premises.

To protect the electrical network of EDD, it is desired that the following be rigidly adhered to by the customer.

1. EDD would establish an 11 kV intake substation within the premises of the customer and be responsible for installationn and maintenance of all equipment within the same. Metering will be done at 11 kV and supply to the customer will be through EDD switchgear installed after the metering unit. The customer will provide the building to EDD free of charge and his switchroom would preferably be adjoining the EDD intake substation. The substation shall preferably be near the road/ entrance and must have 24 hour unhindered access to EDD authorised personnel and vehicles.

2. The customer will establish an 11 kV board in his switchroom to receive the incoming EDD supply at 11 kV, through one or more incoming breakers depending on the load. Customer must refer to EDD for details of breakers and cables to be used. The incoming breaker should have a breaking capacity of 350 MVA and will be equipped with overcurrent and earth fault protection devices. Prior to commissioning of the incoming breaker, the customer will liaise with EDD engineers so that proper discrimination is achieved between EDD relays and the relays of the incoming breaker. This is to ensure that in case of a fault within the customer premises, the incomimg breaker in the customer switchroom would always trip thus isolating the fault and not allowing it to reflect on the EDD network.

3. The responsibility of EDD would cease at the outgoing terminals of the 11 kV switchgear in the EDD intake substation. The customer will be responsible for installation, operation and maintenance of all equipment beyond this point., including the interconnecting cable between EDD intake substation and the customer's switchroom.

   The termination of inter-connecting cable at EDD intake substation is to be done by EDD whereas the termination at the customer's side is the customer's responsibility.

4. The customer will have to provide LV supply to the distribution board of EDD intake substation.

5. The customer's 11 kV system should be earthed as per standards independently and should in no way be inter-linked with EDD earthing.

6. The customer will carryout proper maintenance of all his equipment especially the incoming breaker and its accessories such as relays, battery bank for the tripping circuit, etc., so that it functions properly at all times. For this purpose the customer will either employ properly qualified authorised personnel or engage the services of a contractor who is classified as Grade 1 by EDD. In either case, the list of personnel proposed to engage in these works must be submitted to EDD for approval. If required, EDD will arrange for a familiarisation programme for these personnel through the operations department.

7. Depending upon the circumstances, EDD may also stipulate installation of incoming breakers with the additional facility of directional protection if required.

8. In case of a fault within the customer's premises, involving his 11 kV installation the customer will immediately inform the EDD control room even if only the in-coming breaker has tripped. Restoration of supply should be attempted only after

receiving clearance from EDD authorities preferably in conjunction with a properly authorised EDD engineer.

9. All the equipments such as VCB panel, transformers, etc to be installed by the customer shall be approved by the concerned departments of EDD.

10. No future load shall be added to the installation without prior approval of EDD and formal submission of electricity application at Customer Services Directorate.

11. The electrical installation work in the customer premises shall only be carried out through an approved Grade 1 Electrical contractor licensed by EDD.

12. All the equipment such as 11 kV switchgear panel(s), transformers, etc to be installed by the customer shall be approved by the concerned departments of EDD.

13. All 11 kV equipment installed by the customer are to be tested by a Grade 1 Electrical contractor and witnessed by an authorised representative of EDD before energising.

    EDD reserves the right to inspect the electrical system at any time after its energisation in the premises of the customer.

14. Supply to the customer will be connected only after his written confirmation to abide by the above terms and conditions and by the operational procedures for HV customers.

APPENDIX 7

MAXIMUM DEMAND, CABLE SIZES AND CUT-OUT/ CIRCUIT BREAKER SIZES

UNDERGROUND SERVICES

MAXIMUM DEMAND (kVA)	DESCRIPTION OF REQUIREMENTS	
	CABLE /SIZE (XLPE /mm^2)	CUT-OUT OR CIRCUIT BREAKER
1 to 40	4 x 25 Aluminium	60 A Cut-out
41 to 70	4 x 70 Aluminium	100 A Cut-out
71 to 100	4 x 120 Aluminium	160 A Cut-out
101 to 170	4 x 240 Aluminium	250 A Cut-out
151 to 340	2 Nos. 4 x 240 Aluminium	500 A MCCB
341 to 500	4 Nos. 1 x 500 Copper	800 A MCCB
501 to 1000	7 Nos. 1 x 500 Copper	1600 A MCCB
1001 to 1500	7 Nos. 1 x 1000 Copper	2500 A ACB

OVERHEAD SERVICES

MAXIMUM DEMAD (kVA)	DESCRIPTION OF REQUIREMENTS	
	CABLE /SIZE (XLPE /mm^2)	CUT-OUT OR CIRCUIT BREAKER
1 to 14	Single phase, 2C x 35 mm^2 Copper	60 A Cut-out
15 to 40	Three phase, 2 Nos. 2C x 35 mm^2 Copper	60 A Cut-out
41 to 70	Three phase, 2 Nos. 2C x 35 mm^2 Copper	100 A Cut-out

APPENDIX 8

BUILDING PERMISSION REQUIREMENTS

1. The developer will need to obtain the approval of the wiring and layout drawings of the multi-storey building by the Construction Department of EDD prior to commencing work at site, in case the total load exceeds 170 kVA.

2. Form of Building permission:

   Name:…….Building permission No.:……/200…….

   Address: Plot/ House: …….. Road:……. Block: ……Area:……...

Warning:

- In the interest of safety, it is strictly prohibited to move or remove the service cables/ wall boxes/ meters from the customer's premises, without prior official approval from the Electricity & Water Authority.

- The Authority will be taking all necessary legal action towards all violators. Moreover, in case of any negligence in applying the Ministry's safety rules, the owner or his representative will take full responsibility regarding the safety of personnel alongwith all relevant compensations required due to the damages resulting from that negligence.

- It must be noted that in case the regulations are violated, the Authority will not be responsible for the customer's inconvenience, if the delay in connecting the service is due to the violation of the regulations.

No objection subject to the following conditions:

2.1. Submit application to the Customer Services Directorate for disconnection and / or dismantlement or removal of

temporary portacabins of existing service connection (meter,cut-out, service wall box, underground/ overhead service connection) and obtain site clearance certificate from the competent authority prior to demolishing existing structure on site.

2.2 All possible precautions will need to be taken to prevent accidental contact with existing high voltage cable(s) / underground/ overhead line(s) to the ……& ……of the plot.

2.3 All possible precautions will need to be taken to prevent accidental contact with existing low voltage overhead line to the ……..& …….. of the plot. All composite structure including balcony/ garage and compound wall will need to maintain a minimum of ……m clearance from the nearest live conductor adjacent to the plot.

2.4. Substructure foundation shall not encroach the boundary line shown on survey certificate drawing and need to maintain a minimum of ……m clearance from the existing underground cable(s) adjacent to the ……& ……..of the plot boundary line.

2.5. Supply of electricity to the premises will depend on allocation/ acquisition of a suitable substation site in the area.

2.6. Extension of network or servicing the demand of the installation will depend on grading / demarcation of the planned and approved service corridor.

2.7 Connected load of the installation shall not exceed ……kW (…….kVA).

2.8 The developer will need to install:

(a) 50 mm diameter overhead service pipe as per current electricity practice for receiving overhead house connection.
(b) 150 mm diameter underground service duct as per current electricity practice for receiving underground house connection.

2.9 Authorised electrical contractor will need to submit formal application for power connection ……..months in advance

2.10. The developer will need to provide a site and construct a substation in accordance with approved specification drawing no. …….issued by the electricity authority. Location of the substation site and type of the substation building will need to be discussed and agreed with the civil engineer. The owner of the property will need to sign an agreement (Right of way) with EDD.

2.11. The developer will need to establish low voltage switch room adjacent to the substation for receiving single point supply for the entire installation as shown in the attached drawing.

2.12. The developer will need to establish a meter room at a mutually agreed location for receiving single point supply of electricity.

2.13. The developer/ authorised representative will need to inform and obtain clearance certificate to the existing cables / O/H lines / Street lighting poles from DPCU (Damage prevention & Control unit) prior to commencing works on site as per attached report.

2.14. Other remarks:……
…….

APPENDIX 9

LIMITS OF HARMONICS IN THE POWER SYSTEM

9.1 CONTINUOUS HARMONIC LEVELS

The level of harmonics in the EDD power system shall not exceed the values listed below on a continuous basis:

Voltage level (Volts)	Total harmonic voltage distortion (%)	Individual harmonic voltage distortion (%)	
		Odd	Even
400/230	5	4 for $n < 14$ 1.5 for $n \geq 14$	2
11000 V	4	3	1.75

Notes:

1. 'n' is the harmonic order, or multiple of the fundamental frequency.
2. Voltage distortion is expressed as a percentage of the fundamental voltage.
3. Individual harmonic distortion refers to the distortion at an individual harmonic frequency. Total harmonic distortion refers to the root mean square value of the distortion at all harmonic frequencies.
4. The indicated values refer to the maximum continuous levels.

9.2 MOMENTARY HARMONIC LEVELS

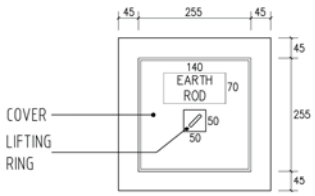
The total harmonic distortion in the EDD power system shall not exceed a value of 7% averaged over a three second interval.

9.3 INDIVIDUAL CUSTOMER'S HARMONIC LIMITS

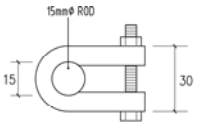
Each customer shall ensure that his load does not elevate the harmonic content of the supply, at his interface with the EDD power system, above the standard requirements. If a new load generates odd harmonics exceeding 1% voltage distortion or even harmonics exceeding 0.6%, or if its contribution to the total harmonic distortion at the customer interface exceeds 1.6%, the customer shall be required to make provision for the possible future installation of compensating apparatus.

APPENDIX 10

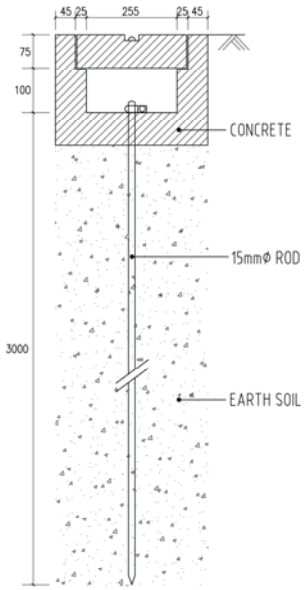
EARTH ROD ARRANGEMENT WITH HANDHOLE



PLAN



DETAIL OF CLAMP

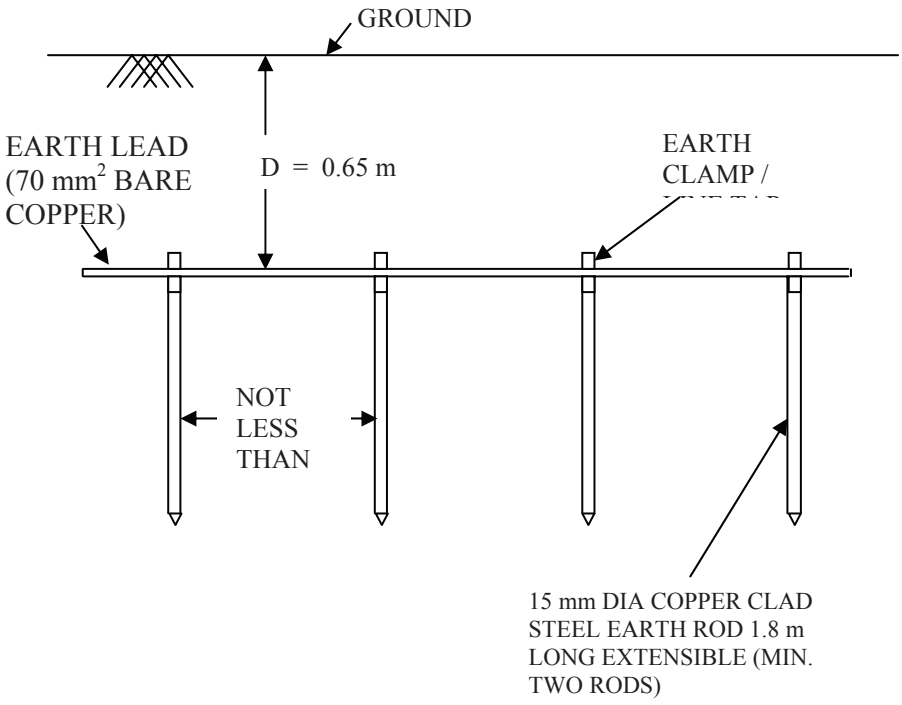


SEC. ELEVATION

DRAWN	Jonathan A.	KINGDOM OF BAHRAIN ELECTRICITY & WATER AUTHORITY ELECTRICITY DISTRIBUTION DIRECTORATE	
CHECKED	Sheffi. J		
APPR D	A. M. Shakeeb		
DATE	26-03-13	TITLE	DRG. No.
SCALE	N.T.S.	EARTH ROD ARRANGEMENT	A/BA/715

APPENDIX 10 (Continued)

CUSTOMER'S INSTALLATION EARTHING ARRANGEMENT



NOT TO SCALE

FIGURE 1

APPENDIX 11

LIST OF CABLES WHICH CAN BE USED FOR INSTALLATION

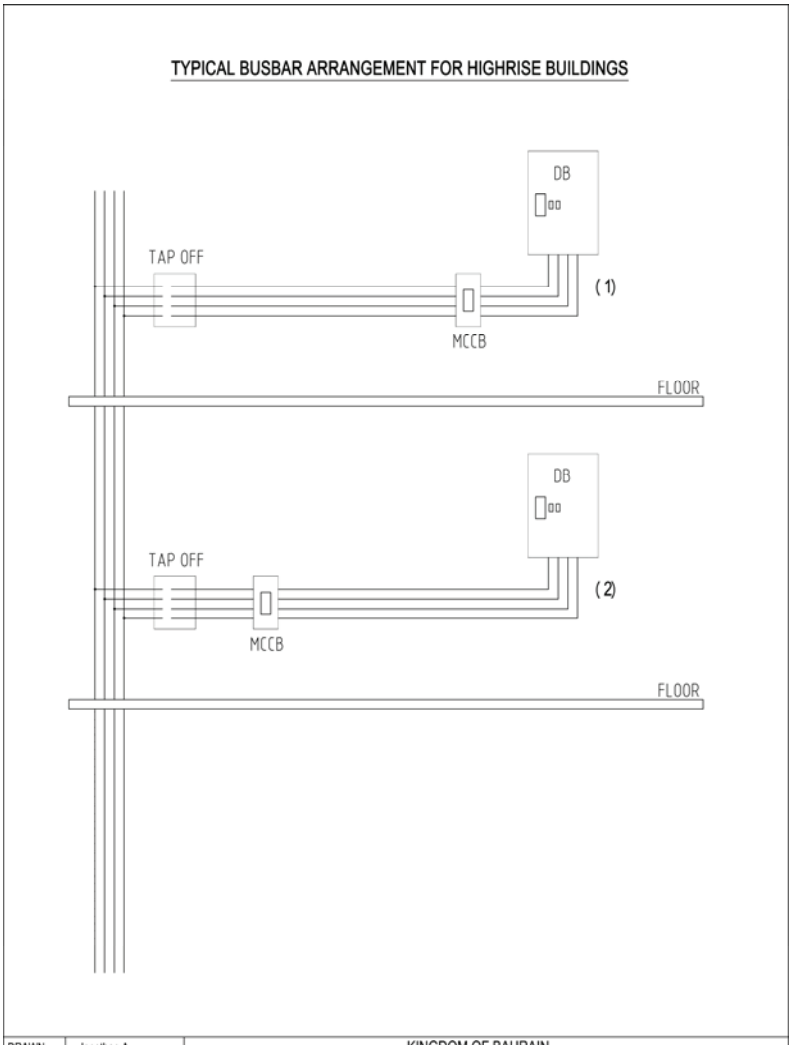
i) 600/1000 Volts multi-core PVC insulated and PVC sheathed armoured and unarmoured cables.
ii) 600/1000 Volts multi-core XLPE insulated PVC sheathed armoured and unarmoured cables.
iii) 450/750 Volts single core PVC insulated cables.
iv) 450/750 Volts single core PVC insulated and sheathed cables.
v) 450/750 Volts Twin core and earth PVC insulated and sheathed cables.
vi) 600/1000 Volts single core PVC or XLPE insulated and non-magnetic armoured cables.
vii) 600/1000 Volts mineral insulated cables.
viii) 600/1000 Volts multicore silicone rubber insulated hard grade PVC sheath bonded to coated aluminium foil cable with fire resistance and fire retardant properties.
ix) Other cables subject to the approval of EDD.

All cables shall have conductors of plain annealed copper. The PVC insulation employed shall be suitable for the site conditions.

Note: Cables not listed above can be used subject to the approval of EDD.

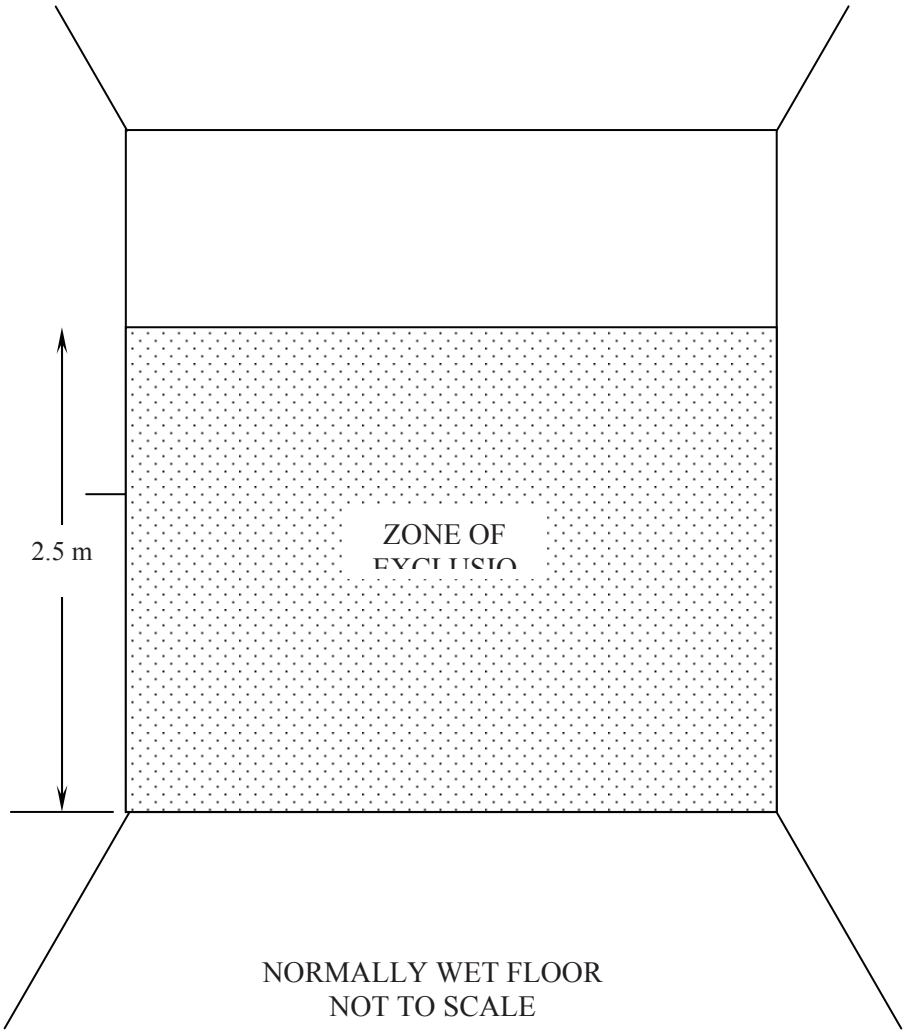
APPENDIX 12

BUS RISER ARRANGEMENT FOR MULTI-STOREY BUILDING

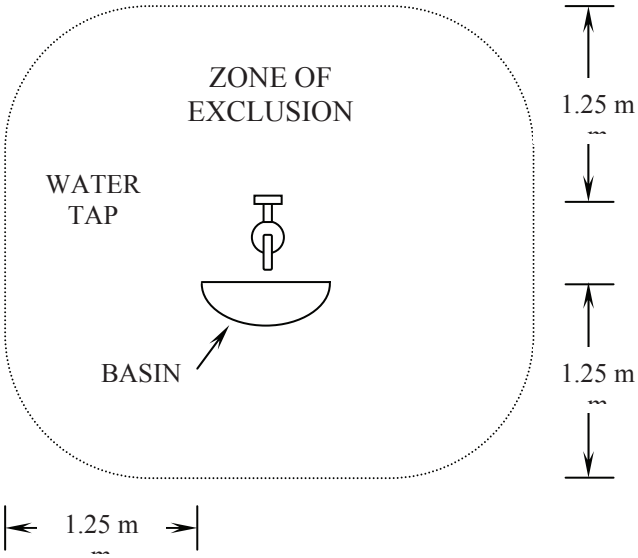


APPENDIX 13

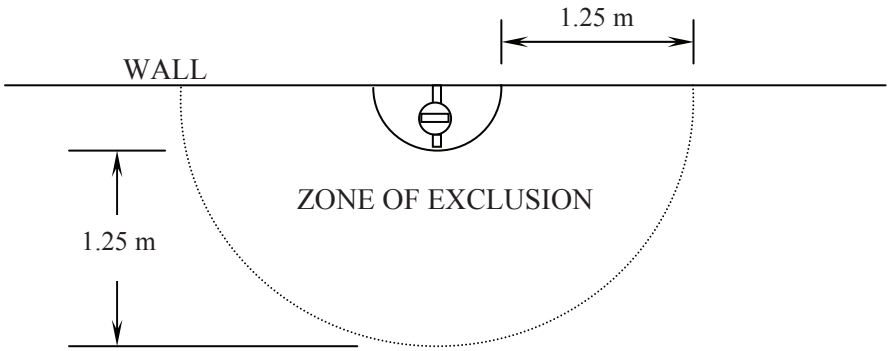
ARMS REACH



APPENDIX 13 (Continued)



ELEVATION

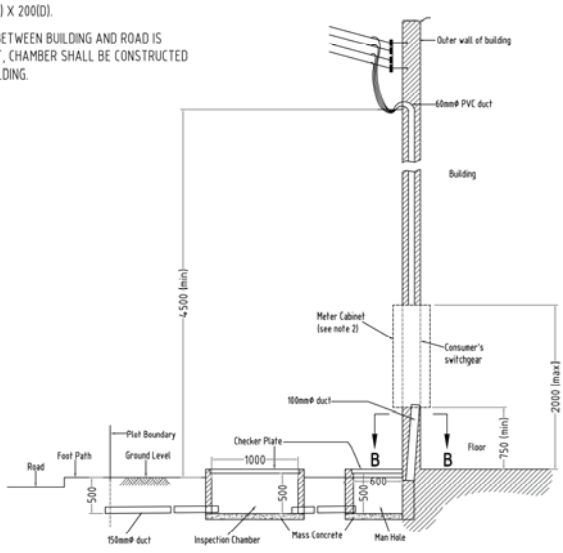


PLAN
NOT TO SCALE

DUCTING ARRANGEMENT FOR SINGLE CUSTOMER BUILDING

NOTES:

1. IF DISTANCE 'A' EXCEEDS 15 METERS, DUCTING AND CHAMBER SHALL BE CONSTRUCTED EVERY 15 METERS.
2. MINIMUM DIMENSIONS OF METER CABINETS 600(H) X 450(W) X 200(D).
3. IF THE SPACE BETWEEN BUILDING AND ROAD IS NOT SUFFICIENT, CHAMBER SHALL BE CONSTRUCTED INSIDE THE BUILDING.



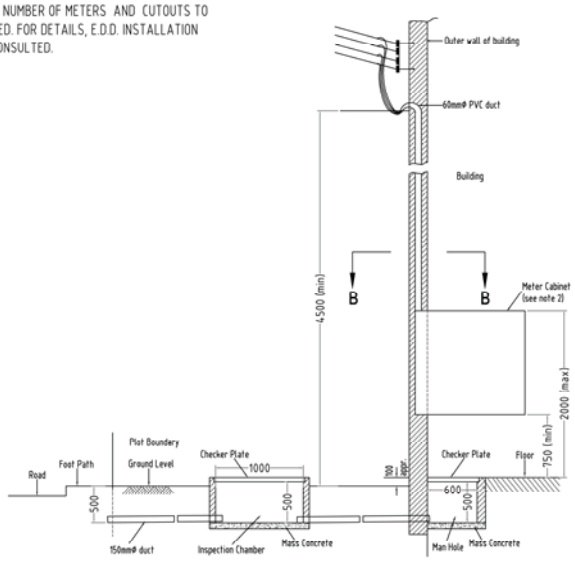
DRAWN	Jonathan A.	KINGDOM OF BAHRAIN ELECTRICITY & WATER AUTHORITY ELECTRICITY DISTRIBUTION DIRECTORATE	
CHECKED	Sheffi. J		
APPR D	A. M. Shakeeb		
DATE	26-03-13	TITLE: GENERAL DUCTING ARRANGEMENT FOR ELECTRICITY SUPPLY SERVICE TO SINGLE CONSUMER BUILDING	DRG. No. A/BA/609
SCALE	1:50		

DUCTING ARRANGEMENT FOR MULTI-METERING BUILDINGS

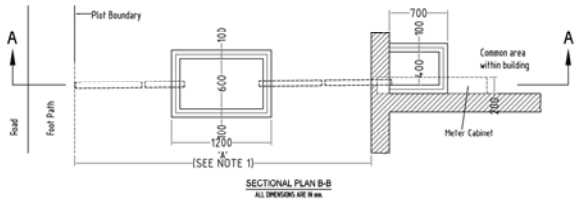
NOTES:

1. IF DISTANCE 'A' EXCEEDS 15 METERS, DUCTING AND CHAMBER SHALL BE CONSTRUCTED EVERY 15 METERS.

2. DIMENSIONS OF METER CABINETS SHALL BE DEPENDANT ON THE MAXIMUM NUMBER OF METERS AND CUTOUTS TO BE ACCOMMODATED. FOR DETAILS, E.D.D. INSTALLATION SECTION TO BE CONSULTED.



SECTION A-A



SECTIONAL PLAN B-B
ALL DIMENSIONS ARE IN mm.

DRAWN	Jonathan A.	KINGDOM OF BAHRAIN ELECTRICITY & WATER AUTHORITY ELECTRICITY DISTRIBUTION DIRECTORATE	
CHECKED	Sheffi. J		
APPR D	A. M. Shakeeb		
DATE	26-03-13	TITLE: GENERAL DUCTING ARRANGEMENT FOR SERVICE INTAKE TO MULTI-METERING BUILDINGS, NOT ACCOMMADATING DISTRIBUTION SUBSTATION	DRG. No. A/BA/610
SCALE	1:50		