الهيئة الاتحادية للكهرباء و الماء
Federal Electricity & Water Authority

United Arab Emirates

The Electricity Wiring Regulation Book

AUG 1 2020

Federal Electricity & Water Authority

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1. Introduction & Commencement:

The document provides an authoritative reference for the safe and efficient connection of consumer's installations to electricity networks.

The objective of the regulation is to provide consumers, consultants, contractors, electrical engineers & technicians with general guide for design, installations in order to safeguard person and property from hazards arising from use of electricity.

The regulation however is not intended to substitute detailed specifications nor to serve as an instruction manual for untrained persons. It is essential that all consultants, contractors, electrical engineers & technicians study and abide by these regulations. This of course does not absolve the concerned parties from obtaining other necessary approvals from FEWA.

References are generally made to the seventeenth edition of the IET (Institution of Engineering and Technology) wiring regulation and International Electromechanical Commission (IEC) documents. Consideration has been given to the prevention of fire and shock hazards as well as proper operation and maintenance of wiring installation and equipment.

As part of the modernization plans to provide better services and facilities to the consumers, FEWA wishes to install Smart Electricity meters and thereby implement a state of art Advanced Metering Infrastructure (AMI) system.

These Regulations shall come into force on [Aug. 2020].

2. General Application of the Regulation

These Regulations shall apply to all Customers, Property Owners, Licensed Contractors, or any other persons involved in the installation, maintenance or operation of Electrical Installations in any Premises or other place where there is an electricity supply provided by FEWA.

The Regulations shall apply to the requirements of design, erection, inspection and testing of all electrical installations within Premises and any additions, alterations to the existing buildings and installations therein, in the region served by FEWA, except for electrical installations which are in mobile units such as aircrafts, motor vehicles and sea-going vessels.

Installations, wherein construction of high voltage substation/s is required, shall be referred to FEWA at the preliminary design stage for incorporating any specific requirements.

The regulations are not intended to take the place of a detailed specification, to instruct untrained persons, or to provide for every circumstance. Where a difficult or special situation arises which is not covered or allowed for in the regulations, FEWA may be sought to obtain specific advice.

3. Scope and Enforcement:

- Compliance with these regulations is compulsory. Electrical power supply will not be made available if these regulations are not met with entirely. Any deviation from this regulation, must be noticed by the contractor or consultant.
- These regulations does not provide for all types of conditions encompass the type of installation generally encountered. Where difficult or special situations arise which are not covered or allowed for in these regulations, may be sought to obtain the best solution.
- Installations, wherein construction of High Voltage substation/s is required, shall be referred to FEWA at the preliminary design stage for incorporating any specific requirements.
- All wiring diagrams shall indicate clearly in plan the main switchboard, distribution board, the runs of various mains and sub mains and the position of points with their classifications and controls. All circuits shall be indicated and numbered in wiring diagram and all points shall be given the same number as the circuit to which they are electrically connected. Distribution boards shall also be marked to indicate the circuit number controlled by them.
- The Consultant shall prepare fabrication, detailed working drawings, and obtain approval of FEWA. All works shall be carried out only on approval of drawings.
- Approval of drawings does not relieve the contractor of his responsibilities to meet the intents of specifications.
- Location of panel boards, distribution boards, switch boards, light fittings, cable routes, conduit/ CTS wiring routes, earth pits etc. shall be marked at site and approval of FEWA in-charge Engineer must be obtained before proceeding with the installation work.
- Rated Power, Voltage and Frequency of supply of current consuming devices and materials used in installation shall be suitable for the power, voltage and frequency mentioned in these regulations.
- No extension or alteration to an electrical installation may be made without approval from FEWA approval.
- All extensions or alterations to an existing Installation must comply with the requirements of these Regulations.
- Repairs to existing installations may be made using standards of equipment compliant with the old installation, but limited to work of an essential nature on a case-to-case basis. Work on any part of the installation other than Final Circuits, including any Distribution Board and any items at the Supply Intake, must be notified to FEWA.

Applicable regulation for Scope of Smart Meter Communication

- All communication wiring diagrams shall be indicated clearly in plan, the runs of various ducts and conduits and the position of termination points.
- All wiring in communication circuits wherever applicable shall be indicated and numbered in wiring diagram.
- Junction Boxes shall also be marked to indicate the communication channels to meters distributed by them.
- The Consultant shall prepare fabrication, detailed working drawings, and obtain approval of FEWA. All works shall be carried out only on approval of drawings.
- Approval of drawings does not relieve the contractor of his responsibilities to meet the intents of specifications.
- Location of all components of the smart water metering system shall be marked at site and approval of FEWA in-charge Engineer must be obtained before proceeding with the installation work.
- No extension or alteration to any communication wiring installation may be made without prior notification or approval from FEWA
- All extensions or alterations to an existing Installation must comply with the requirements of these Regulations.

RS485 Cables

All RS485 cables shall comply with industry standards with following requirement

STP (cable Cat 5 or Cat6)
heavy-duty installation cable
2 x 2 x 0.22 mm^2, solid conductor
shielded, outer sheath: 7.8 mm diameter, inner sheath: 5. 75 mm ± 0.15 mm diameter

- These regulations does not apply to:
  - ✓ Those aspects of installation in potentially explosive atmosphere relating to methods of dealing with the explosion hazard which are specified in BS5345 and CP1003 or in Premises where the fire risks are of an unusual character so as to require special measures.
  - ✓ Those parts of commercial telecommunications (e.g. radios, telephone, bell, call and sound distribution and data transmission) Fire alarm, Intruder alarm and emergency lighting circuits and equipment that are fed from a safety course. Requirements for the segregation of other circuits from such circuits are however included.
  - ✓ Electric traction equipment
  - ✓ Electrical equipment's of motor vehicles, except those to which the requirements of these regulations concerning caravans are applicable
  - ✓ Electrical equipment's on offshore installations.
  - ✓ Electrical equipment's of air crafts.
  - ✓ Electrical equipment's on board ships.
  - ✓ Installations in mines and quarries
  - ✓ Radio interfere suppression equipment, except so far as it affects the safety on an electrical installation.
  - ✓ Motor Control Centre (MCC). The manufacturer drawings of MCC shall not be evaluated or approved by FEWA.
  - ✓ Street Lighting Control Panel. The manufacturer drawings shall not be evaluated or approved by FEWA.

4. Definitions:

Following definitions shall apply for the purpose of the regulation

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

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 a person may stand or move about, to the limits which such person may reach without assistance (i.e. without any tool or ladder etc.) Such a distance may normally be taken as 2.5m height from the standing surface, and 1.25m horizontally from the standing position.

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

Bonding Conductor
Means a protective conductor providing equipotential bonding

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

Cable cleat
A component of a support system, which consists of elements spaced at intervals along the length of the cable or conduit and which mechanically retains the cable or conduit.

Cable Tray
A cable support consisting of a continuous base with raised edges and no covering. A cable tray is considered to be non-perforated where less than 30% of the material is removed from the base.

Cable Trunking
A manufactured enclosure for the protection of cables, normally of rectangular cross section, of which one side is removable or hinged.

Circuit Protective Conductor:

Class I Equipment
Equipment which includes a means for connection of Exposed Metallic Parts of the equipment to the Earth Conductor, thus providing protection against electric shock in case of failure of the basic insulation of the equipment or other fault condition.

Class II Equipment
Equipment which does not include a means for connection to an Earth Conductor, and which provides supplementary insulation in addition to the basic insulation of the equipment, such as a plastic outer enclosure.

Class III Equipment
Equipment in which protection against electric shock relies on supply at SELV and in which voltages higher than SELV are not generated in the equipment. Company Earth;

Circuit
An assembly of electrical equipment supplied from the same origin and protected against over-current by the same protective device(s). The following are related definitions:

Circuit-breaker
A device capable of making, carrying and breaking normal load current and also making and automatically breaking, under pre-determined conditions, abnormal currents such as short circuit currents. It is usually required to operate infrequently although some types are suitable for frequent operation.

Competency License
A license issued by FEWA to a consultant/ contractor assessed as competent for work on Electrical Installations.

Conduit
A part of closed wiring system for cables in electrical installations, allowing them to be drawn in and/or replaced, but not inserted laterally.

Connected Load
The aggregate load of Appliances and other electrical equipment/points of load at a Premises

Consumer Unit
Where this is generally an integrated unit containing the main isolation device and Protective Devices, principally in domestic Installations.

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.

Current-using equipment
Equipment which converts electrical energy into another form of energy, such as light, heat or motive power.

Connection Point (CP)
The point which defines the boundary between the Customers Installation and that of the FEWA. This point will normally be at the incoming cable of the Main Distribution Board and before the main circuit breaker.

Customer Earthed system (TT)
Where the Customer provides a Main Earth Terminal for the Installation, which is connected to a sufficient number of local Earth Electrodes.

Customer
Any person, corporate body, or company who has an agreement with FEWA for the supply of electricity.

Danger
Risk of injury to persons or animals or risk of damage to property

Direct Contact
The accidental or inadvertent contact with electricity by a person,

Distribution Board
An assembly designed for housing isolation switches and Protective Devices and for connecting multiple cable Circuits, including their associated neutral and Earth Conductors.

Double Insulated Equipment
Equipment which does not include a means for connection to an Earth Conductor, and which provides supplementary insulation in addition to the basic insulation of the equipment, such as a plastic outer enclosure.

Duct
A closed passageway formed underground or in a structure and intended to receive one **or** more cables, which may be drawn in.

Earth Conductor
The protective conductors used to connect the Exposed Metallic Parts of an Electrical Installation and associated Appliances to Earth, via a Main Earth Terminal to local Earth Electrodes or FEWA Earth. This includes 'circuit' Earth Conductors and 'main' Earth Conductors. Outside of these Regulations these may also be known as the Circuit Protective Conductor (CPC) or Earth Continuity Conductor (ECC) or commonly known as the 'Earth Wire'.

Earth Electrode Resistance
A conductor or group of conductors in intimate contact with Earth, providing an electrical connection to Earth, and normally having a known and measurable value of Earth Resistance. (May also be known outside of these Regulations as 'Earth Rod', or Grounding Rod'.)

Earth Fault current
A fault current which flows to Earth.

Earth Fault Loop Impedance (Zs)
The total impedance presented to an earth fault current, comprising the impedance of the following parts of an Installation
- The circuit Earth Conductor;
- The distribution transformer winding;
- The main Earth Conductors connecting to Earth Electrodes or the Distribution Company Earth
- The Main Earth Terminal;
- The neutral earth connection at FEWA transformer;
- The path of earth fault current through the general mass of Earth, or through the conductors or Earth sheath or armouring of the Distribution Company cable
- The phase conductors of the circuit back to the point of fault.

Earth Leakage Circuit Breaker (ELCB)
A circuit breaker which is designed to open the phase and neutral conductors of a circuit upon detection of a leakage of current (above a specified value) through the Earth Conductor or through Extraneous Metallic Parts of an Installation.

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.

Earth Resistance
The resistance (in Ohms) of any point on an Installation to Earth, being measured using an approved testing device and approved procedure.

Earth
The conductive mass of the Earth, whose electric potential at any point is conventionally taken as zero.

Earthed System (TN-S)
Where provides a connection to the Customer's Main Earth Terminal, using the distribution network Earthing system, generally via the armouring or metallic sheath of the main incoming supply cable.

Electric Shock
A dangerous physiological effect resulting from the passing of an electric current through a human body or livestock.

Electrical Installation
An assembly of associated electrical equipment supplied from a common origin to fulfill a specific purpose and having certain co-ordinate characteristics.

Enclosure
A part providing protection of equipment against certain external influences and in any direction Emergency switching: An operation intended to remove, as quickly as possible, danger, which may have occurred unexpectedly protection against direct contact.

Equipment
Any item for such purposes as generation, conversion, transmission, distribution or utilization of electrical energy, such as machines, transformers, apparatus, measuring instruments, protective devices, wiring systems, accessories, appliances and luminaries.

Equipotential Bonding Conductor
The connection of Extraneous Metallic Parts, materials or components within a Premises which are not part of the Electrical Installation (e.g. water pipes, steel beams etc.), using a designated conductor or cable, such as to maintain these at substantially the same potential (voltage) in the event of passage of electrical fault current through such parts. This may also be known as 'PME Bonding', outside of these Regulations.

Exposed Metallic Part
A metallic part of an Installation or Appliance which can be touched by persons and which is not normally live but may become live due to a fault condition. Exposed Metallic Parts are normally required to be connected to Earth.

Exposed-Conductive Part
A conductive part of equipment which can be touched and which is not a live part but which may become live under fault conditions.

External Influence
Any influence external to an electrical installation which affects the design and safe operation of that installation.

Extra Low Voltage (ELV)
A voltage not exceeding 50V A.C. or 120V D.C whether between phase conductors or between phase conductors and earth

Extraneous Metallic Part
A metallic part, structure or any metalwork within a Premise which is not part of the electrical Installation and which is not designed to carry current, but which may become live due to a fault condition. Extraneous Metallic Parts are required to be connected to Earth using Equipotential Bonding Conductors where there is significant risk that they may become live due to a fault condition.

Fault current
A current resulting from a fault.

Fault
A circuit condition in which current flows through an abnormal or unintended path. This may result from an insulation failure or abridging of insulation. Conventionally the impedance between live conductors or between live conductor and exposed-or extraneous-conductive parts at the fault position is considered negligible.

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Final Circuit
A circuit connected directly to current-using equipment, or to a socket-outlet or socket-outlets or other outlet points for the connection of such equipment.

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

Flexible Cable
A cable whose structure and materials make it suitable to b flexed while in service.

Flexible Cord
A flexible cable in which the cross-sectional area of each conductor does not exceed 4mm2.

High Voltage (HV)
An A.C. voltage greater than Low Voltage and less than 36 KV between phases or 21 kV between any phase and Earth. (Internationally referred to as Medium Voltage);

Indirect Contact
Contact of a person with electricity through Exposed Metallic Parts of an Installation or Appliance or through Extraneous Metallic Parts in a Premises which have become live during fault conditions.

Installation Certificate
A certificate in the format indicated in these Regulations which is issued by a Licensed Contractor after completion of work on an Installation and provided to the Customer/Owner of the Premises.

Installation
Suitable non-conductive material enclosing, surrounding or supporting a conductor.

Isolation
A mechanical switching device which, in the open position, complies with the requirements specified

Junction Box (Communications)
Junction box for the terminations of the RS 485 multi-drop connection to the smart electricity meters

Licensed Contractor
A company which has been assessed by FEWA as competent to work on Electrical Installations and issued a Competency License.

Live part
A conductor or conductive part intended to be energized in normal use, including a neutral conductor.

Low Voltage (LV)
An A.C. voltage below 1000V between phases, or below 600V between any phase and earth, or, a D.C. voltage below 1500V between phases, or below 900V between any phase and earth.

Luminaire
Equipment which is generally designed to house one or more electric lamps and which may include diffusers, fixtures, transformers and auxiliary Circuits but is taken to exclude the lamps themselves. Note: outside of these Regulations a Luminaire may commonly be referred to as a 'light fitting'.

LV Switchgear and Control Gear Assembly
A combination of one or more low-voltage switching device together with associated control, measuring, signaling, and protective, regulating equipment, etc. completely assembled under the responsibility of the manufacturer with all the internal electrical and mechanical interconnection and structural parts. The components of the assembly may be electromechanical or electronic. The assembly may be either type-tested or partially type tested.

Main Distribution Board (MDB)
The Distribution Board which, in general, accepts the main incoming LV supply from FEWA or Customer's transformer. The MDB may also be known as the 'Consumer Unit' where this is generally an integrated unit containing the main isolation device and Protective Devices, principally in domestic Installations.

Main Earth Terminal
The main connection point at which the nominal value of Earth Resistance for an installation is taken, and at which Earth Conductors from the Earth Electrodes will be connected. This will normally be at or close to the Customer Connection Point. Outside of these Regulations the Main Earth Terminal may also be known as the 'Main Earth Bar'

Neutral conductor
The neutral conductor of a 3-phase 4-wire system or the conductor of a single phase installation which is earthed at the source of the supply.

Non-combustible
A non-combustible material is one which is not capable of undergoing combustion and satisfies the performance requirements.

Over-Current
A current exceeding the rated value. For conductors the rated value is the current-carrying capacity.

Overload current
An overcurrent occurring in a circuit which is electrically sound.

Owner
The legal owner of a building or property in which an Electrical Installation is installed and connected to a supply of electricity. Note: in some cases, an Owner may also be a Customer.

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

Premises
Any occupied or un-occupied building or enclosure or other place where there is an electricity supply. Such locations would include, but are not limited to, domestic Premises, commercial Premises, industrial Premises, public buildings, parks, farms, temporary supplies (construction sites, wedding tents etc.), outbuildings, caravans, street lighting and traffic signs.

Prospective Fault Current
The value of current that would flow due to a short circuit fault of negligible impedance between live phase conductors, or between phase conductors and earth. The maximum Prospective Fault Current for an installation is normally taken at the Customer Connection Point. Also known as ‘fault level’.

Protective Conductor / Earth continuity Conductor (ECC)
The protective conductors used to connect the Exposed Metallic Parts of an Electrical Installation and associated Appliances to Earth, via a Main Earth Terminal to local Earth Electrodes or FEWA Earth. This includes ‘circuit’ Earth Conductors and ‘main’ Earth Conductors. Outside of these Regulations these may also be known as the Circuit Protective Conductor (CPC) or Earth Continuity Conductor (ECC) or commonly known as the ‘earth wire’.

Protective Device
A device installed at the start of a Circuit which will automatically disconnect the input of electricity in the event of a fault or overload occurring on that Circuit. Such devices include fuses, fuse links, miniature circuit breakers (MCB), Moulded Case Circuit Breaker (MCCB), earth leakage circuit breakers (ELCB), and residual current devices (ELCB/RCD).

PVC (as insulation or sheath of cable)
Polyvinyl Chloride Compound.

Radial Circuit
A Circuit which is wired in a 'radial' or 'branch' configuration, emanating from a Protective Device to the area to be supplied requirements for the connection of Appliances (e.g. plugs and sockets).

Residual Current Device (ELCB/RCD)
A Protective Device which is normally installed to automatically isolate the supply to a Circuit or Distribution Board when the algebraic sum of currents in the phase and neutral conductors reaches a preset value.

Resistance Area (for an earth electrode only)
The surface area of ground (around an earth electrode) on which a significant voltage gradient may exist.

Ring Circuit
A Circuit which is wired from a single Protective Device, being run thorough an area to be supplied (via appropriate socket outlets, connectors etc.) and returning back to the same Protective Device, thus forming an electrically continuous loop risk of electric shock.

RS 485 Communication
RS485 communication system consists of a single linear 2 wire cable with 120 ohm termination resistor and used as a multi dropped connection to the meters from the Gateway Master Node.

Smart Electricity Meters
Advanced Electronic meters with extended object measurements, control connect / disconnect capabilities and remote communications.

Short-Circuit Current
An overcurrent resulting from a fault of negligible impedance between live conductors having a difference in potential under normal operating conditions.

Socket-outlet
A device, provided with female contacts, which is intended to be installed with the fixed wiring, and intended to receive a plug. A luminaire track system is not regarded as a socket outlet system

Space Factor
The ratio (expressed as a percentage) of the sum of the effective overall cross-sectional area of cables forming a bunch to the internal cross-sectional area of the conduit, pipe, duct, trunk or channel in which they are installed.

Spur Circuit
A Circuit which is wired in a 'radial' or 'branch' configuration from any point on a Ring Circuit;

Sub Distribution Board
Any Distribution Board which is supplied from the Main Distribution Board in a Premises and which is used to distribute wiring and Circuits within a designated area (e.g. one floor in a multi-story building)

Supply Intake
A term used to describe the location or room housing the main cable and equipment provided by FEWA to provision a supply of electricity to a Premises (includes the Customer Connection Point).

Switch gear
An assembly of main and auxiliary switching apparatus for operation, regulation, protection or other control of an electrical installation.

Switch
A mechanical device capable of making, carrying and breaking current under normal circuit conditions, which may include specified operating overload conditions, and also of carrying current for a specified abnormal circuit conditions such as those of short-circuit. It may also be capable of making, but not breaking, short-circuit currents.

Switchboard
An assembly of switch gear with or without instruments, but the term does not apply to groups of local switches in final circuits.

XLPE (as insulation of cable)
Cross linked polyethylene

5. Electricity Supply & General Requirements

5.1 Declared Voltage & Frequency

The nominal electric supply voltage from FEWA is 240/415V ±10% (IEC 60038), 50 Hz, 3- Phase, 4- Wire with separate neutral and protective conductor (generally metallic covering of the cable supplying the installations). The neutral is solidly earthed at FEWA's substations and shall not normally be earthed elsewhere in the electrical installations.

All equipment, apparatus, materials and accessories used in the electrical installations shall be designed and rated for operation on this electric supply. Appropriate protective devices against over voltages, fluctuations, transients & harmonics, loss of one or more phases and any unforeseen interruptions shall be provided in all consumer installations as deemed essential, in addition to overload, short- circuit and earth leakage protective devices.

5.2 Environmental Conditions

All equipment, apparatus, materials and accessories used in the electrical installations shall be suitable for the purpose intended and capable of operating with satisfactory performance in the climatic conditions of the Northern Emirates which are as follows:

Altitude	:	Sea Level (Coastal)
Max. outdoor ambient temperature (shade)	:	50º C
Max. Ambient Air Temperature	:	48º C
Relative humidity	:	100% (Max.)
Thunder storms per year	:	Occasional
Ground Temperature	:	35º C (at depth of 90 cm)
Soil thermal resistivity	:	According to local condition

5.3 Harmonics, Voltage Disturbance & Power Factor

Harmonics refers to the amount of distortion that occurs to the voltage or current sine wave and is commonly referred to as electrical noise. In the electrical installation, this can be caused by various sources such as non-linear loads, Variable Speed Drives, Variable Frequency Drives, Capacitor banks, UPS back-up power supplies, fluorescent light ballasts, fan speed controls, halogen lights, low voltage transformers for indoor/outdoor lighting, unfiltered dimmer switches, A/C-D/C power supplies etc. found in various electronic devices such as computers, printers, fax machines, televisions, etc.

A consumer's load is not allowed to cause deviations of the voltage characteristics other than those allowed in BS EN 50160, IEC 61000 and ENA Engineering Recommendation

Customers' Installations and the use of electrical equipment therein, must be designed to avoid the generation of disturbances in the electricity supply. These may include voltage fluctuations, voltage dips, voltage unbalance and harmonics, which are of a magnitude that adversely affect other Customers.
The capacitor banks installed for power factor correction, are major contributors to potential resonance. Such resonance conditions can magnify harmonic levels. Parallel resonance gives rise to a high impedance across the network and can cause voltage and current amplification.
Network studies should be carried out to ensure the correct rating of capacitors and their operation without causing resonance. Mitigation measures shall be taken such as installing suitable harmonic filters or reactors. The capacitors shall be suitable for operation under harmonic current conditions. To minimise this risk of harmonic currents, harmonic filter reactors shall be provided in series with capacitors. Tuning of the capacitors, Harmonic filter reactors shall be made below the lowest harmonic order considered in the network.

The power factor at the Connection Point between FEWA and the Customer's Installation must be maintained at 0.92 lagging or higher. Power factor correction equipment must be used where required to achieve this value.

5.4 Approved Contractors

All contractors who undertake electrical installations are required to have license issued by FEWA and is responsible for correct installation and shall supervise and test the entire electrical works. The competency License will be issued by FEWA only to those individuals, who fulfill the requirements set- forth by FEWA, can understand and apply FEWA's Regulations. A register of Licensed Contractors shall be kept up to- date and provided on request to any person. All electrical installation works, new and/or additions shall only be carried out by licensed electrical contractors as authorized and classified by FEWA. Each contractor who under takes electrical installations is required to have sufficient number of engineers, engineer assistants, foremen, electrician, electrician helpers as per FEWA contractor's classification rules.

All above persons have to attend the competency exams to perform Electrical works and the contractors have to be categorized in accordance to the size of the work they can do according to the staff they have. The competency licensees and Final completion certificates will be issued only to categorize contractors after fulfill FEWA requirements. Electrical contractors' responsibility is to carry out all electrical works in a neat orderly workman manner and to pay attention to the mechanical execution of the work in connection with any electrical works.

5.5 Application Procedure

- Before the commencement of any electrical installations, large or small, new or additional, drawings with the following details of the proposed installations shall be submitted to FEWA office, for review and approval there of:
- Drawing check list stamped by consultant.
- Building Electrical Checking form (Appendix 19)
- Complete electrical drawings showing
- Single line diagram for M.D.B showing loads & amp calculations
- Single line diagram for S. M.D.B showing loads & amp calculations
- Load schedules for all final D.B"S showing loads & amp calculations
- Electrical lighting and power plans.
- All electrical rooms layout drawings in details.
- The design and layout drawings of substations, which are specified for individual installations, shall also be prepared in compliance with Regulations for substations, and submitted in advance for approval.
- On completion of the electrical installations, the consumer can apply to get power as per the requirements of FEWA.

6. General Safety Requirements

6.1 Workmanship & Materials (General Requirements)

- These Regulations provide guidelines and technical standards which are consistent with the principles contained in BS 7671:2008. Where any provision in these Regulations contradicts any provision in BS 7671, the requirements, standards or specifications under these Regulations shall apply.
- Where a provision or technical requirement is not covered by these Regulations, BS 7671 may be used as a guideline or specification, with prior approval from FEWA.
- All electrical installations work, new or additional shall be carried out in a neat, orderly workmanship. All works shall only be carried out by a licensed electrical contractor. Careful attention shall be paid to the mechanical execution of the work in connection with any electrical installation.
- All materials used in electrical installations shall be of good quality and installed in a neat and orderly manner.
- All materials and equipment shall comply with relevant recommendations of the International Electro technical Commission (I.E.C.) and International Standards Organization (ISO) recommendations and if this not available to the latest relevant British Standard Specifications (B.S.S.) Material of other national standards may also be employed provide they are comparable with IEC / BSS. Materials must also be as per the requirements of FEWA before use. In case of doubt over acceptability of materials to be used, the contractor may be required to obtain approval from FEWA.
- Manufacturers name, trademark or other descriptive marking to identify manufacturer is to be present for all electrical equipment. For accessories, the marking shall be of sufficient durability to withstand the environment involved.
- Reference must be made, where relevant, to UAE or Gulf standards which may be issued from time to time by the Emirates Standardization and Metrology Authority (ESMA).

6.2 Requirements for Safety

- The provisions of these Regulations require that all Electrical Installations are designed and constructed so as to ensure the safety of all persons who may operate, maintain or otherwise use or be affected by any part of an Installation.
- In addition to the requirements detailed under the relevant sections of these Regulations, the following general safety principles shall apply.
- All parts of an Electrical Installation shall be designed and constructed so as to prevent danger.
- All parts of an Electrical Installation shall be sufficiently sized and rated to safely carry out the function for which they are required.
- All parts of an Electrical Installation shall be appropriately insulated to the function they serve, in consideration of the expected operating environment, so as to prevent danger.
- All Exposed-Metallic-Parts of an Installation and of Appliances must be connected to Earth via appropriate Earth Conductors, so as to protect against electric shock.
- Except in specified circumstances, all Electrical Installations shall be provided with Earth Leakage Protection at the source of supply, at all Final Circuits and at other appropriate points. Where Earth Leakage Protection is not provided, the requirements for Earthed Equipotential Bonding shall apply.
- All Electrical Installations must be protected against damage caused by excess current due to a fault or overload by suitable Protective Devices.
- All Electrical Installations must be provided with a means of isolating the electricity supply at suitable sections, subsections and Circuits, and at points where appliances are used.
- All parts of an Electrical Installation must be suitably located so as to provide safe access for operation, maintenance and repair and must be protected against accidental or deliberate interference or damage.
- Electrical Installations must be designed and constructed with particular consideration given to the risk of fire due to electrical faults and the propagation of fire through parts of the Installation.
- All Electrical Installations must be inspected and tested at the time of first commissioning and at regular intervals thereafter to ensure ongoing safety.
- Re-wired fuses are not permitted under any circumstances.

6.3 Fault levels

The design fault level depends on substation KVA rating. The following table indicates the accepted KA rating level for the various KVA rating of substations.

SUPPLY TRANSFORMER RATING (KVA)	KA (SHORT CIRCUIT OF MAIN DISTRIBUTION BOARD, DURATION OF 1 SECONDS MINIMUM)	MVA (SHORT CIRCUIT OF MAIN DISTRIBUTION BOARD, DURATION OF 1 SECONDS MINIMUM)
2000	50	36
1500	44	31.5
1000	44	31.5
500	25	18
250	25	18

6.4 Labeling & Identification

- All Electrical Installations must be suitably labelled so as to give information on the electricity supply parameters, the source of supply, location in relation to other Installations, and any special precautions to be taken. (Appendix 2a).
- The means of isolation of the main source of supply must be clearly labeled and accessible to authorized persons.
- The provision of Earth Leakage Protection must be clearly indicated at appropriate isolation points, including a notice informing Customers of the need for regular testing of ELCB/RCD/RCCB devices.
- Individual Circuits (including neutral and Earth Conductors) must be identified by numbering at the source end and, where appropriate, at intervals along the route.
- For non-domestic Installations, all accessories and fittings must be marked with Circuit identification numbers. [Note: Circuit identification numbers must indicate the Distribution Board from which an Accessory or fitting is supplied,

and may be fixed externally or internally, i.e. either outside or inside cover plates.]

- Load distribution schedules, as shown in (Appendix 2b), must be provided at each Distribution Board. An overall wiring diagram showing the location and interconnection of Distribution Boards must be provided at the Supply Intake.
- Where parts of an Installation are accessible or visible to the general public they must be labeled with a warning: "LIVE –1000 VOLTS – DANGER OF DEATH" or similar wording. This warning must be written in English and Arabic. However, parts of final Circuits and other points of normal use may be excluded from this requirement.
- Manufacturers name, trademark or other descriptive marking to identify manufacturer is to be present for all electrical equipment. For accessories, the marking shall be of sufficient durability to withstand the environment involved.

6.5 Segregation of Circuit Categories

CIRCUIT CATEGORY

- There are 4 categories of circuit as defined in the Wiring Regulations as follows:
    A. Category 1 circuit means a circuit that operates at low voltage, but does not include a Category 3 circuit;
    B. Category 2 circuit means a circuit for telecommunication, radio, telephone, sound distribution, intruder alarm, bell and call, or data transmission which is supplied with electricity from a safety source, but does not include a Category 3 circuit;
    C. Category 3 circuit means a circuit for emergency lighting, exit signs, air pressurization systems and fire services installations including fire detection and alarm, fire pumps, fireman's lifts and smoke extraction; and
    D. Category 4 circuit means a high voltage circuit.

SEGREGATION OF CATEGORY 1, 2 AND 3 CIRCUITS

- Where a residential Premise is supplied with a three phase supply, as far as possible, the light fittings, socket outlets, water heaters, cookers and other single phase apparatus installed within any room shall not be connected to more than one phase. Wherever more than one phase cannot be avoided, a minimum distance of 2.0 meters shall be maintained between any outlets, accessory or appliance connected to different phases of the supply.

- Circuits from different distribution boards shall not be installed in a common conduit or in trunk.
- The circuit wires of different voltage grades shall be segregated with barriers in trunk runs or installed in separate conduits.
- The circuit wires of individual categories such as lighting, power, emergency, etc. shall be segregated with barriers in trunk runs or installed in separate conduits.
- Where a wiring system is located in close proximity to non-electrical service, the wiring system shall be adequately segregated and protected against hazards likely to arise from the presence of the other service in normal use. Provision shall be made for safe and adequate access to all parts of the wiring system which may require inspection, maintenance or replacement.
- Low voltage circuits should be segregated from extra-low voltage circuits.
- Fire alarm and emergency lighting circuits should be segregated from all other cables and from each other
- Telecommunication circuits should be segregated
- Cables of Category 4 circuits are not allowed to be drawn into the same conduit, duct, ducting or trucking as cables of other circuit categories.

7. Substations, Service Arrangements & Distribution Boards

- FEWA shall be responsible for making the decision regarding requirement of substations for provision of supplies to new developments. No changes to the requirements given may be made without prior written agreement from FEWA
- The substations will be constructed to drawings provided by FEWA and no equipment will be installed in the substation before structure has been approved by the concerned engineer.
- In general, where the total connected load exceeds 250 KW, a plot for FEWA's substation should be made. In some circumstances a substation may be required for connected load less than 250 KW.
- Main electrical Room should be adjacent to Transformer Room, cable route and arrangement to be provided by consumer.
- Main electrical room and Sub- Electrical Rooms must meet the requirements of point of Supply point rooms listed below in (Chapter 8).
- Main electrical switch room shall be located near to the plot entrance, in ground floor area. Wherever substation is provided within the building, the main electrical switch room shall be provided in the ground floor area adjacent to transformer room.
- Wet area above substation shall not be provided. In exceptional unavoidable situation FEWA shall be referred for specific advice.
- Single room substation clear height should be 3.7M (minimum) at ground floor. RMU room should have a clear height of 3.0m (minimum) in split/basement substation.
- Transformer room height at basement should be 3.0m (minimum).
- Finished floor level (FFL) of substation room is to be maintained 0.15m to 0.30m higher than the outside adjacent ground level (towards door side)
- Level difference of transformer room at basement level is to be maintained between 0.075m to 0.15m higher than the outside adjacent ground level (towards door side).
- All electrical rooms shall be adequately ventilated and provided with necessary heavy duty exhaust fan/s and fire resistant/ metallic louvered door/s, as applicable. Adequate level of illumination shall be provided to facilitate safe operation at all time.
- Substation room shall be provided with necessary heavy duty exhaust fan/s and fire resistant/ metallic louvered door/s, as applicable. Adequate level of illumination shall be provided to facilitate safe operation at all time.

- Foundation and trenches of the Substation room shall be provided by consumer and to be approved by FEWA before construction.
- Typical layouts and minimum space requirements for LV switch rooms are given in Appendix 4a, 4b, 4c].

- LV switch rooms must meet the requirements of the point of supply rooms listed below.

Standard Size For main/sub electrical Rooms, Sample	
Main Circuit Breaker rating (A)	Dimension (m)
600-1000	2.5X2.5
350-600	2.5X2
100-350	2X2

- Electrical equipment rooms shall be adequate in size and layout such that all electrical equipment components can be conveniently accessed for inspection and/or maintenance and can be conveniently removed for repair or replacement. All clearances required and recommended by equipment manufacturers shall also be submitted for approval prior to install.

HV SWITCHGEAR:

- For Industrial load more than 4MW (5MVA), Switch gear room to be provided for the supply of Premises, the design and construction requirements and maintenance for the room will be the responsibility of the main electrical contractor and consumer, including substation rooms. All drawings and layout for HV switchgear room and substation rooms should be submitted to FEWA for approval before construction.

NOTE: IN ALL CASES, APPROVAL & A DETAILED STUDY WILL BE CARRIED OUT BY FEWA CONCERNED ENGINEER

8. Incoming Supply & Tariff Metering

8.1 General

- The point of supply which defines the boundary of FEWA equipment and where electricity is made available to the consumer shall be decided by FEWA. Point of supply shall be made available only at one location, within a Premise/project, unless otherwise approved/ specified by FEWA. This point will normally be at the incoming cable of the Metering cabinet or LV Main Distribution Board and before the main circuit breaker.
- Consumer shall, before commencement of building construction, obtain confirmation from FEWA on availability of power supply.
- The Supply point must be positioned in an area which is readily accessible to FEWA staff and other authorized persons, particularly in an emergency, and must be at or close to the outside perimeter of Premises.
- The Point of Supply must always include a means of emergency isolation in the case of a fault or breakdown (e.g. main circuit-breaker) which is readily accessible and clearly marked so as to be easily operated. Where more than one incoming supply is available, in any Premises, each 'Main Switch' shall be marked to indicate which installation or section of the installation it controls.
- The consumer shall take all steps necessary to keep safe and protect FEWA’s supply lines/cables, equipment, metering, etc., provided for and/ or within the consumers’ premises from tampering, steeling, unauthorized access or operation, etc., and shall immediately report any violation, defect or damage to any of FEWA's lines or equipment or metering.
- All incoming cable terminations/Live connections in metering cabinets and other main and sub-main distribution boards shall be adequately shrouded and insulated.
- Trenches and Pipes should be arranged by consumer for incoming FEWA Supply and Outgoing cable.
- Incoming supply cables to the consumer's main Distribution board/s shall be total segregated and identified from the consumer's cables.
- Termination of incoming supply cable at the Consumer's Metering Cabinet/Main Distribution board (MDB) shall be carried out by consumer's contractor.

- Where a main L.V. distribution panel is connected directly to the low voltage side of the transformer, the main incomer circuit breaker proposed in the L.V. panel shall be totally withdrawable type air circuit breaker for load more than 1000 A.
- Where consumer's Main Low Voltage distribution board/panel is connected to FEWA's two or more distribution transformers, separate bus-sections with mechanically and electrically interlocked bus-section breakers/isolators (4-pole) shall be provided.
- Consumer's main & sub-main Panels/Distribution Board/s and final distribution boards shall all be installed in locations to which access is available at all times. A minimum space of 1500 mm shall be provided in the front and 750 mm on the sides, to permit safe operation, inspection, testing and maintenance, for cubicle type panels/switch boards. Panels with rear access doors shall have, in addition, a minimum space of 750 mm in the rear. The mounting height (to the top of the board/s) shall normally be 2 meters from the ground/floor level.
- All Main Electrical switch rooms and other Sub electrical switch rooms in which capacitor banks are installed shall be air-conditioned. The non-air-conditioned electrical rooms shall be adequately ventilated and provided with necessary heavy duty exhaust fan/s and fire resistant/metallic louvered door/s, as applicable.
- Door opening of electrical switch room shall be arranged outwards, be kept free from obstructions and shall not be open towards driveway, staircase, steps, etc.
- The point of supply room must not be located on the reverse side of the bathroom or kitchen wall, in addition it must not located below any water services or pipes, such as mains water supply, storage tanks, air conditioning chillers, or other liquids or hazardous materials.
- The point of supply room shall be adequately ventilated and provided with necessary heavy duty exhaust fan/s and fire resistant/ metallic louvered door/s, as applicable. Adequate level of illumination shall be provided to facilitate safe operation at all time.
- The point of supply must not be positioned in an area controlled by one of the tenants in a multi occupancy building.
- The use of Supply's point rooms as storage rooms for any tools, equipment or other materials is prohibited.
- The need for delivery of heavy equipment to the supply point room during installation and maintenance must be taken into account in the location of the room.

- At least one emergency lighting unit must be fitted in all supply's point room, which must be provided with a battery rated for minimum 3 hours illumination, and subject to adequate routine maintenance.
- For the point of supply rooms of greater than 6 m in length more than one door shall be provided as a means of emergency access.

8.2 Load Categories

- Single phase Smart Meter– directly connected to main system (20-80) A: used for installed load less than 12 KW.
- Three phase Smart Meter– directly connected to main system (20-120) A: used for installed load from 12 KW up to 90 KW, and in case the installed load is 1-ph with 3-ph equipment or three numbers of 1-ph A/C installed.
- Three phase CT operated current Smart meters: more than 90 KW installed load.

8.3 Types of Meters

General

- For individual consumer premises, such as villas, farms, gardens, accommodation blocks, etc. the metering cabinet, with main incomer circuit breaker and metering shall be installed outside, recessed, in the compound wall.
- Minimum 2-meter clearance shall be maintained between electricity and water service cabinets/ points. A 1" conduit concealed in the wall should be installed between the two cabinets for future communications. The Electricity Meter cabinet shall be provided with a 15mm hole sealed with a grommet. The hole shall be close to the bottom hinge of the panel.

- Reference to the (Appendix 27-31) shall be made for the typical installation of the smart meters in villa areas with the associated Communication Panels etc.

- The installation of the Communication panel in case of complete Housing projects shall be as per (Appendix 27-31) and located close to the Feeder panels.

- The communication panel installation shall be first approved by FEWA. The details of the conduit requirement and assembly including the foundation is shown in the (Appendix 27-31).

- In multiple consumer Premises such as residential/commercial buildings, industries, large utility complexes, schools, etc. the main and sub-main distribution boards with associated metering shall be installed in separate electrical switch rooms, in location close to which access is available at all times for operation, testing, inspection, maintenance and repair. Prior approval shall be obtained from FEWA for every such Premise.
- All tariffs metering will be normally provided by FEWA and restricted to one for each consumer installation, unless otherwise approved/ specified by FEWA.
- The minimum space required for installation of KWH meter shall be 300 mm wide and 500 mm high.
- A minimum space of 1200 mm shall be provided in the front of KWH meter cabinet/ meters.
- The general arrangement and dimensional layout of the metering cabinets and array of meters installed in electrical switch room/s and enclosures along with associated wiring shall be subject to FEWA approval. The typical arrangement of KWh metering cabinet/KWh meters is given, for guidance in Appendix (5a, 5b).
- FEWA Meter Technician will specify the fitting of seals to all Meters, where such seals are installed; they shall only be removed by a person authorized by FEWA.
- The metering section/compartment in all MDB/s and SMDB/s if and when incorporated within, shall completely be segregated from other sections/ compartments.
- In multiple-meter installations, it shall be possible to remove any meter without interrupting other consumers.

- Reference to the (Appendix 26-30) shall be made for the typical installation of the smart meters in Buildings.

- The installation of the Communication panel in case of Buildings shall be as per (Appendix 26-30) and located in the Electricity Meter room.

- The installation of the communication and associated wiring / trunking / terminations shall be first approved by FEWA. The details of the conduit requirement and assembly is shown in the (Appendix 26-30).

- Metering by means of Current Transformers (CTs) shall be installed where the circuit breaker rating at the point of supply is 200 Amps and above. FEWA will

provide the KWh meter/s and associated CTs for tariff metering of 200 and 400 Amps supply. In some circumstances consumer may be permitted to provide the KWh meter and CTs, complying with FEWA Technical Specifications and the Data schedule given below. The above meter and CTs shall be tested & calibrated by FEWA prior to installation at site. The CTs shall be located on the busbars immediately after the circuit breaker/ isolator, where the complete installation is to be metered at. Removable links of adequate length shall be provided in the busbar of each phase to enable easy maintenance and replacement of CTs. Three CTs shall be provided for each metering.

The communications in case of all CT / PT meters will be using direct 2G/3G or 4G modems. These will be provided and installed by FEWA and is not in the scope of the contractor.

STANDARD RATINGS	SINGLE PHASE METER - DIRECT CONNECTION TO MAIN	THREE PHASE METER -DIRECT CONNECTION TO MAIN
Basic Current (Ib)	20 Amps	20 Amps
Max. current (Imax)	80 Amps	120 Amps
Reference voltage (Uref)	Single phase 240V 2-wire	Three phase, 4-wire 3X240/415V
Reference frequency	50 Hz	50 Hz
Accuracy class	Class 1, according to IEC-62053-21	Class 1, according to IEC- 62053-21
Starting current	0.4% Ib (62053-21)	0.4% Ib (62053-21)

STANDARD RATINGS	THREE PHASE CT OPERATED CURRENT METERS
Current rating	1.5 to 6 Amps (secondary of CT)
Reference voltage (Uref)	Three phase, 4-wire 3X240/415V
Reference frequency	50 Hz
Accuracy class	0.5 for LV CT Meter & 0.2S For HV CT meter, according to IEC- 62053-21
Starting current	0.2% Ib (62053-21)

DESCRIPTION	CURRENT TRANSFORMERS
Rated secondary current	5A
Max. Primary voltage	600 V
Rated Frequency	50 Hz
Rated Primary current (only one is applicable)	200A, 400A, 600A, 800A, 1200A,1600A, 2500A, 3200A
Rated Burden	5 VA
No. of Phases	1
Accuracy class	0.5 up to 400A & 0.2s for more than 400A
Medium of installation	Air
Size of busbars (Primary) Rated Primary current a) 200A, b) 400A c) 600A, 800A d) 1200A, 1600A e) 2500A f) 3200A	Busbar Size 20 mm X 10 mm 30 mm X 10 mm 50 mm X 10 mm or 2 Nos. 30 mm X 10 mm 2Nos. X 60 mm X10 mm 2Nos. X 80 mm X 10 mm 3Nos. X 60 mm X 10 mm

NOTE: ALL OTHER CATEGORIES TO BE APPROVED BY LABORATORY (MENTIONED ABOVE)

NOTE: CAPACITY OF THE INSTALLED BUSBAR SIZE CALCULATIONS SHOULD BE SUBMITTED AND CONFIRMED BY ELECTRICAL CONTRACTORS

- The current transformer of following Rated Transformation Ratio shall be used as a standard requirement:

a) 200/5
b) 400/5
c) 600/5
d) 800/5
e) 1000/5
f) 1200/5
g) 1600/5
h) 2000/5

i) 2500/5
j) 3200/5

- Each current transformer shall have the following markings:

a) Manufacturer's name and /or trade mark.
b) Rated primary current and secondary current.
c) Rated frequency and primary maximum voltage
d) Accuracy class.
e) Rated output (VA)
f) Terminal (secondary winding) identification (S1, S2…).
g) Power flow direction (P1, P2)

- Manufacturer may include any other markings that he considers to be included.
- For LV three phase with CT operated, the voltage wire shall be directly connected to the busbar without fuses.

Specifications of Meter's cabinets:

- Transparent viewing window shall be provided in all metering cabinets and doors of enclosures housing the meters with associated distribution switchgear, for facilitating meter reading.
- All metering cabinets and enclosures shall be constructed from fire-resistant/ noncombustible material. When meters are installed in electrical switch room/s, fire-resistant/ non-combustible base plates shall be provided. Single core PVC or XLPE insulated and PVC sheathed cable to BS 6004 shall be used for connection to KWh meters, except when installed/segregated with in separate metering cabinets.
- All metering cabinets/compartments shall be provided with padlocking and wire sealing facilities on their external door/cover which shall normally be of hinged type.
- Generally, all apparatus, circuit breakers, isolators, busbars, removable lid section of bus bar-trunk, etc. installed on the supply side of any FEWA's metering shall have provision for sealing by FEWA.

9. Load Demand & Selection of Components

9.1 Load Balancing

- All distribution boards shall be rated for total connected loads. The demand load of each final sub-circuit is determined by adding the actual or assumed load of individual points/appliance/equipment, whichever is higher.
- The details of load distribution schedules shall be submitted for FEWA's approval in the format that can be provided through any FEWA offices. The total connected load of individual distribution levels/circuits shall be determining the maximum demand at the main or sub-main distribution level.
- For a circuit having non-simultaneous or cyclic loads such that only one of these loads can be in use at any one time, the greatest of these loads should be used in calculating the current demand of the circuit
- In all cases where three phase supply is availed, the various categories of connected load such as lighting, socket outlets, water heaters, single phase air-conditioning units, equipment, apparatus, etc. shall be distributed and connected on Red, Yellow and Blue phases as evenly as possible, to ensure load balance between the phases at all distribution levels. For Main distribution board only 3% difference between any two phases is allowed. For Sub Main distribution board only 10% difference between any two phases is allowed.

9.2 Selection of Cables

CABLES & CONDUCTORS GENERAL REQUIREMENTS

- For general purposes and in normal situations PVC/XLPE insulated, stranded copper conductor cables complying with respective BS 5467, BS 6004, BS 6724, BS 7211, BS 7629, BS 7846, BS 7889, BS 8436 shall be used for all fixed wiring installation of buildings and other Premises as applicable. Solid-core or Aluminum conductor cables are not permitted.
- For locations subject to a higher than normal risk of interference or damage armoured cables are recommended.
- For locations with higher than normal fire risk, cables must be installed either in metal conduit or mineral-insulated copper- clad (MICC) complying with BS EN 60702 or enhanced fire-resistance cables must be used. In addition, safety Circuits

such as fire alarms, emergency lighting and control Circuits, which are required to remain operational in the event of a fire, must be installed in metal conduits or supplied by MICC cables.

- The location and selection of cables must take into consideration any special requirements for the prevention of spread of fire. Fire barriers, low smoke insulation or other measures may be required (relevant building regulations should be referenced).
- General-purpose flexible cables and cords for Appliances must be PVC insulated, with a PVC over sheath, stranded copper conductors, and comply with BS EN 50525
- Cables for high temperature Appliances (e.g. electric heaters, irons, pendant lighting, connections within luminaries) must be heat resistant rubber insulated, with over sheath, stranded copper conductors, and comply with BS EN 50525.
- Cables under repetitive mechanical strain (e.g. lifts, heavy outdoor machinery, etc.) must comply with BS EN 50214
- Where cables are installed underground they must be armored or installed in ducts to protect against mechanical damage and enable future removal.
- Cables for connection between ceiling rose and lamp holder for pendant type fittings and for enclosed luminaire shall be heat resistant silicone rubber insulated stranded copper conductor complying with BS EN 50525
- KWH meter tails shall normally be single core PVC insulated and sheathed cables complying with BS 6004.
- For lifts and similar applications rubber insulated or PVC insulated flexible cables complying with BS EN 50214 shall be used. The cables used for control, relays, instrument panels, etc. shall comply with BS 6231.
- Single core cables armored with steel wire or tape shall not be used for ac circuits.
- All cables must be armored or installed in plastic or metal conduit or trunk throughout their entire length.
- Cables running through inaccessible areas such as walls, floors and solid ceilings shall be installed, without exception, in conduit or trunk so as to be withdrawable in the future. In such cases, suitable inspection plates and pulling out points must be provided.
- Exceptions may be allowed only for sheathed or flexible cables which will remain accessible but in locations free from undue risk of damage or interference (e.g. above head height, or in unoccupied areas). Such cables must be securely supported by cable clips, cable tray or other fixings at suitable intervals.

- All cables must be installed between purpose-made termination points (switches, junction boxes, Distribution Boards) and be terminated with purpose-made lugs, crimps, screw connectors or other connectors. Joints between such points are strictly prohibited. Termination points and junction boxes must remain accessible to facilitate future inspection, repair and alteration.
- Where cables are terminated at high temperature Appliances their insulation must be suitable for the expected operating temperature or, where necessary, shall be protected by heat resistant material. (Appendix 6)
- Cables must not be installed in lift shafts other than those serving lift functions.

Selection of Conductor Size

- Sizing of cable conductors should take into account the following factors:
- The expected load; the insulating material; the ambient temperature in which the cable is installed; the installation conditions and the voltage drop from the origin of the circuit to the load
- Voltage drop from the Customer Connection Point to the remote end of any Final Circuit must not exceed 20Volts, except in special cases where equipment has been designed to operate under a greater voltage drop (such cases must be clearly stated in the Installation design and approved by FEWA).

Minimum Size of Conductors

[Appendix 7 table 1,2 & 3]

Color Identification

The color identification for cables is given in (Appendix 8)

9.3 Selection of BusBars & Bus Risers

- Busways, bus ducts, bus bar risers or other similar systems may be used in Premises for the supply of large loads where they provide a more economical or practical option than cables.
- Busways shall be permitted for installation only where adequate access is available for inspection and repair throughout their entire length.
- The design, manufacture, testing and performance of the bus bar trunk system shall be in accordance with the latest edition of BS EN 61439. IP rating shall be considered depending on the location of installation, indoor, outdoor, proximity to wet areas etc. (BS EN 60529).

- Each piece of bus bar trunk shall be tested before it leaves the factory for 3.5kV Dielectric test for 4 seconds & 1000V Megger test. Test certificates for the same shall be produced during FEWA inspection.
- Connections to switchgear shall be with flanged end units of specific design and manufactured by the bus bar trunk manufacturer.
- The bus-bar trunk shall be properly aligned and securely fixed, not exceeding 1.5m (or as recommended by the manufacturer) centers with adequate support to take the weight of the bus bar by means of galvanized fixing brackets; comprising hanger clamp, fixing channel and damping screw, supplied by the bus bar trunk manufacturer. Additional supports shall be provided where required and as recommended by the trunk manufacturer.
- The bus-bar trunk system including flanges, elbows, tap-off boxes, supports etc. shall be of the type, size and location as indicated in the FEWA approved drawings.
- The bus-bar shall carry its rated current without exceeding 55ºC over an ambient temperature of 50ºC at 90% relative humidity in any plane without de-rating and without affecting the FEWA power supply requirements.
- Wherever bus-bar trunk system is installed on the supply side of any FEWA's KWh metering, suitable provision for sealing by FEWA shall be made
- The phase bus-bar, neutral bar and earth bar shall be of copper and colour identified. The neutral bar shall be of the same cross section as the phase busbar.
- The requirement of earth continuity conductor (ECC) and equipotential bonding shall be provided.
- Wherever the busway passes through the wall or floor, it shall be provided with fire barrier/sealing to the degree of fire resistance required.
- The tap of unit installed at each floor level in a busbar riser shall be at a height between 50 cm and 180 cm from finished floor level and shall have adequate access for operation, maintenance and replacement.
- Busways, bus ducts and bus bar risers shall be totally enclosed (non-perforated) for protection against mechanical damage, moisture, dust and other environmental effects.
- All busbars in a cubicle switch panel shall be rigidly supported throughout their route length and marked with their phase colour for identification (Appendix 9). In cubicle panel the main bus bars shall be located in their own section, completely segregated from all other parts of the switchboard, with either front or rear access. All bus bars shall be of rectangular cross section and of tinned copper. Busbars may be bare or shrouded with a continuous extruded sleeve

marked with phase colours. In no circumstances will busbars wrapped with any type of tape be accepted.

BUSWAYS, BUS DUCTS AND BUSBAR RISERS

- Busways, bus ducts, bus bar risers or other similar systems may be used in Premises for the supply of large loads where they provide a more economic or practical option than cables **(**Appendix 10)
- Busways, bus ducts and bus bar risers shall comply with the relevant reference standards given in (Appendix 1)

- Busways, bus ducts and bus bar risers shall be totally enclosed (non-perforated) for protection against mechanical damage, moisture, dust and other environmental effects.
- Busways, bus ducts and bus bar risers shall not be located in areas prone to mechanical damage or where they may be exposed to hazardous materials, liquid or gases, unless special precautions are taken.
- Busways, bus ducts and bus bar risers shall be located so that they are accessible for future maintenance and repair throughout their length. They shall not be installed in habitable areas such as flats, offices, shops, etc. (a separate riser shaft or room must be provided).
- Busways, bus ducts and bus bar risers shall have neutral conductors of equal size to the phase conductors and shall have a dedicated Earth Conductor. The use of the metal casing as an Earth Conductor shall not be permitted.
- The current rating of busways, bus ducts and bus bar risers shall be based on the Connected Load of the relevant part of the Installation being supplied. However, additional diversity factors may be applied for high-rise buildings or other large installations rather than taking the sum of Connected Loads. Any applied diversity factors must be justified and submitted with the design for approval by the FEWA.
- Purpose made plug-in circuit-breaker units may be used with bus bar risers systems where they are mechanically interlocked to prevent removal whilst energized.
- The number of busways, bus ducts or bus bar risers required for a high-rise building and the number of floors served by each must be selected by taking due account of the future accessibility, maintainability and safety of the system.

Note: A typical arrangement may be to serve each 10 floors of a 30 story building by a separate bus riser; however, other arrangements are not precluded.

9.4 Conduit, Trucking & Cable trays

SPECIFICATION OF CONDUITS AND FITTINGS

- PVC conduits and fittings used in building installation shall be from high impact rigid PVC complying with BS 4607, BS EN 60423 & BS EN 61386 , suitable for use at ambient temperature up to 50^{o}C. The material shall not soften or suffer structural degradation at a temperature of 70^{o} C and shall be non-hygroscopic and fire retardant.
- Steel conduits and fittings shall comply with relevant specifications in BS EN 60423, BS EN 61386 and shall be hot-dip galvanized to class 4 protection, protected against corrosion both inside and outside. Flexible steel conduits and fittings shall be comply with BS EN 61386. Conduit systems must be designed and installed so as to exclude moisture, dust and dirt. Small drainage holes must be provided at the lowest part of the system to avoid the accumulation of condensed moisture. PVC conduits shall be provided with copper/brass terminals.

SPECIFICATION OF TRUNKING

- Where applicable, surface and underfloor (duct) trunk and their fittings shall comply with BS EN 50085. Trunk and fittings shall be constructed of steel, hot dip galvanized, both inside and outside or non-combustible insulating material with removable covers. Installation of the trunk shall be carried out strictly as per the manufacturers' guidelines.
- The protective conductor must run inside the trunk and not in parallel. Internal fire barriers shall be provided where very long run trunk /cable tray crosses the floors /walls.
- Small insulated cables shall not be installed in perforated trunk/cable trays.
- Additional supports shall be provided where cable tray /trunk changes direction or cable drops out of the cable tray.
- Trunk and conduit shall be completely installed before any cable is drawn in.

- Every entry to trunk shall be placed so to prevent the ingress of water and all dead ends shall be closed. Only unbroken lengths of trunk shall be used for crossing partitions and walls.
- Where cable trunk passing through walls, floors or other barriers it shall be provided with a continuous cover and an internal fire barrier where fire separation is specified for the Premises.
- Where a common cable trunk is used for housing both power and communication circuits, or for housing circuits operating at different voltages, the trunk shall be provided with separate compartments for the different types of circuits.
- All bends, tees and other accessories of cable trunk shall be of substantial sections and of the same quality as the trunk itself.
- The different sections of trunk shall be bonded by copper links although the trunk shall not be used as ECC.
- Only galvanized steel or rigid, high impact, heavy gauge PVC conduit shall be used for any installation where conduits are to be installed.
- The minimum internal radius of any bend or elbow fitting in a conduit shall be 2.5 times the diameter of the conduit.

SPECIFICATION OF CABLE TRAYS & SUPPORTS

- Steel cable trays, accessories and supports shall normally be hot-dip galvanized or PVC coated and shall be either of the perforated type or ladder.
- The cable trays shall have adequate strength and rigidity to support the cables installed. The trays shall be provided with upstands on both sides.
- All fittings, bends, tees, elbows, couplers, etc. shall be of substantial sections and of the same quality as the trays. Cables shall be fastened securely by purpose made clips, cleats or saddles.
- Earth bonding shall be provided between sections / gaps in all cable tray/trunk runs and bolted connections.
- Cable tray systems, cable ladder systems and their fittings shall comply with BS EN 61537.
- Cable trays shall be installed as complete systems with bends and other accessories and each run of cable tray shall be completed before the installation of cables.
- Metallic cable trays shall not be used as an ECC, although sections shall be bonded using copper links.
- Cable trays shall be installed so as to provide ease of access to cables through the route.

- Where cable tray passing through walls, floors or other barriers it shall be provided with a continuous cover and an internal fire barrier where fire separation is specified for the premises.
- Plastic conduits or trunk must not be used in situations subject to higher than normal temperatures or fire risk (e.g. near industrial machinery, generator rooms, workshops, petrol stations, plant rooms, etc.). Where a plastic conduit is installed outdoors, it should be suitable for exposure to solar radiation.

INSTALLATION OF CONDUITS, TRUNKING, TRAYS & ACCESSORIES

TRUNKING AND CONDUITS

- The type and material of the trunk and conduits shall be selected appropriately to suit individual site locations and complying with Regulations specified above.
- The trunk and conduit wiring installations shall be carried out in a neat, orderly manner with purpose made accessories such as inspection bends/tees, terminal/draw – in boxes, etc. (Refer to Appendix 12)
- As far as possible, the trunk and conduit runs from the electrical switch room/s to the individual consumer DB/s shall be routed only within common electrical service routes & riser ducts.
- Long trunk and conduit runs from the electrical switch room/s located on ground floor to consumer DB/s located on upper floor/s shall be avoided and armored cables shall be installed in cable trays
- Cable trunk may be used for housing single core PVC cables at special situations, where installation of conduits is difficult due to space limitations.
- Trunk and wiring conduit installations which are surface exposed shall, as far as possible, have straight runs with branches at right angle only.
- Draw-in boxes shall be provided in all straight conduit runs exceeding 15 meters. Conduit runs having '90º bends' shall be provided with draw-in boxes for every 2 bends.
- Trunk and conduit shall be completely installed before any cable is drawn in.
- Draw-wires shall be provided in all concealed conduits (and ducts) with the ends left free at the outlet boxes for pulling the wiring cables.
- All the trunk and conduit runs shall be free from sharp edges and burs throughout their lengths. Suitable grommets and bushes shall be provided at the terminal outlets.
- The trunk and conduit runs shall be supported at regular intervals and the number of cables that may be installed in trunk shall suitably be selected as recommended in Tables 1 & 2.

- All the terminal and intermediate ends of the PVC conduits shall be firmly secured with suitable adhesives as recommended by the manufacturer.
- The circuit wires, bunched and installed in all vertical trunk runs shall be clamped/ secured within the trunk at regular intervals, not exceeding 2 meters and at the terminal ends.
- The standard conduit boxes, draw-in boxes and mounting boxes of light fittings and appliances shall be fixed to the building structure independently or the wiring conduits.
- All exposed threads, tool-marks or visible damage to the protective finish of the steel trunk and conduits shall be coated with Zinc rich paint immediately after installation.
- Suitable expansion couplers shall be provided in all trunk and conduit runs at the expansion joints in the building structure and at regular intervals in all runs exceeding 7 meters in length or as recommended by the manufacturer.
- Suitable purpose-made boxes with adapters, ceiling roses etc. shall be provided at all individual outlet points of the wiring installations.
- Light fittings used with tungsten filament and halogen lamp shall be suitably segregated and supported from the PVC conduits and terminals outlet boxes to prevent deterioration due to associated high temperature.
- The conduit runs which are concealed within the building structure such as in floor, wall, roof column etc. shall be provided with a minimum screed cover of 10 mm.
- When the trunk and conduit runs are installed with chases in the building structure they shall be firmly fixed at regular intervals with purpose-made crimpers and/or saddles.
- The standard conduit boxes, draw-in boxes, floor-outlet boxes etc. shall be installed with its cover/lid flush with the outer finish of the building structure.'
- Only flush type switches, socket outlets and accessories shall be used for concealed wiring.
- In surface mounted industrial installations and where situations subject to fire risk, only galvanized steel conduits shall be used. PVC conduits shall not be used for such applications.
- Galvanized steel conduits shall not be used under floor tiles of buildings in concealed wiring systems embedded in walls or floors. PVC conduits shall be used for all such applications.

CABLE TRAYS

- Trays for supporting cables are recommended for use in warehouses, industrial plant and equipment room, cable trenches, shafts in buildings, etc. (Refer to Appendix 13)
- The type and material or the cable trays shall be selected appropriately to suit individual site locations, and complying with Regulations specified above.
- The cable trays shall be supported at regular intervals with purpose made supports and the number of cables installed in the trays shall be suitably selected as recommended in Table 1 & 2.
- Cable trays installed in outdoor locations, wherein the cables are exposed to the sun shall be provide with sun-shade covers, secured to the trays, with adequate ventilation and as recommended by the manufacturers.
- Cables shall be fastened securely by purpose-made clips, cleats or saddles at spacing as recommended in table 1. Cable ties shall not be used to support multi core cables installed on cable trays fitted vertically.
- Cable trays shall not be used in locations where they will be subjected to severe physical damage.
- Sufficient space shall be provided and maintained around cable tray to permit adequate access for installing and maintaining the cables.

SPACING OF SUPPORTS FOR TRUCKING, CONDUITS AND CABLES

Recommended maximum spacing of Clips, Cleats, Saddles or Supports

TRUNKING:

METHOD OF INSTALLATION	SPACING OF SUPPORT IN CM	
	Steel	Rigid PVC
Horizontal	150	100
Vertical	180	120

CONDUIT:

METHOD OF INSTALLATION	SPACING OF SUPPORT IN CM	
	Steel	Rigid PVC
Horizontal	120	100
Vertical	150	120

ARMOURED:

METHOD OF INSTALLATION	SPACING OF SUPPORT IN CM	
	Steel	Rigid PVC
Horizontal	35	100
Vertical	60	80

CAPACITY OF CONDUITS AND TRUNKING

CONDUCTOR (MM2)	DIAMETER OF CONDUIT (MM2)		
	20	25	32
	Maximum number of conductors		
1.5	7	12	12
2.5	5	9	9
4.0	3	6	8
6.0	-	5	6
10.0	-	3	4
16.0	-	-	3
25.0	-	-	-

NOTE: FOR CABLE TRAYS AND TRUNKING THE SPACE FACTOR (TOTAL CROSSSECTIONAL AREA OF CABLES COMPARED WITH THE INTERIOR CROSS-SECTIONAL AREA OF TRUNKING) MUST NOT EXCEED 50%

9.5 Distribution Boards

MAIN & SUB MAIN DISTRIBUTION BOARDS

- The Main & Sub-Main Distribution Board/s (MDB/s & SMDB/s) which are installed within the consumer installations shall be factory built assembly, type-tested and complying with relevant BS EN 61439/IEC 61439.
- The assemblies shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stress as well as the effects of humidity which are likely to be encountered in normal service.
- Distribution Boards must be of robust construction, capable of withstanding expected electrical, thermal, and environmental stresses in normal service and during faults.
- Apparatus forming part of the assembly shall have clearances, creepage distances and isolating distances complying with BS EN 61439/IEC 61439, maintained during the normal and relevant service conditions.

- The phase bus bar, neutral bar and earth bar shall be of copper and colour identified (Appendix 14).
- The neutral bar shall be of the same cross section as the phase bus bar.
- The Circuit Breakers, Bus Bars, etc. provided in the MDBs and SMDBs shall be designed and rated to suit individual applications at the site conditions. The details and parameters of the individual equipment & components in MDBs/SMDBs, in general, may be appropriately selected and specified as per the typical guidelines given in Appendix 7
- In general, a voltmeter (with R-Y-B 'OFF' selector switch) Ammeter (with CTs as applicable) Max. Demand indicator/recorder, P.F. meter, indicating lamps and associated protective devices shall be provided in all MDB/s of 200 A. rating and above. Provision of these in SMDB/s is not precluded.
- The switch gear, equipment and accessories shall generally comply with the standards specified in Appendix 1), as applicable (BS EN 60670, BS EN 60898, BS EN 60947, BS EN 61439,IEC 61439)
- Every circuit breaker or fuse within the distribution board shall be identified and labelled to indicate the apparatus or circuit it controls.
- Each Distribution Board must have a neutral bar which is mounted on insulators and which has a sufficient number of terminal points of adequate size for the largest cable expected to be used.
- Each Distribution Board must have an Earth bar which has a means of connection to the incoming Earth Conductor and cable gland of the incoming cable
- All Final Distribution Boards must have at least two bus bar sections (split bus bars) so as to provide for different levels of Earth Leakage Protection for lighting & power circuits
- Each floor of a premise shall be provided with at least one Final Distribution Board installed in an easily accessible location.
- The number of Final Distribution Boards and Sub Distribution Boards provided in a Premise shall take into account the future accessibility, maintainability and safety of the system, whilst limiting the extent of possible power outages to serviced areas.
- Single-phase Distribution Boards may be permitted in a Premise where adequate provision is made for balancing the total load at the Supply Intake between the three phases.
- All Distribution Boards must be provided with only circuit breakers and shall not contain fuses of any kind, except for capacitor banks.

- All Distribution Boards must be installed in locations easily accessible for inspection, operation and maintenance. Such locations must be secured from unauthorized interference.
- All distribution boards shall be installed flush or surface mounted at a height not exceeding 2 meters from the finished floor level to the top of the distribution board.
- All Low Voltage panels of 1600Amps and above shall be of Form 4 type.
- Main, sub-main or final Distribution Board/s shall not be installed within bath rooms, toilet, damp or wet locations, bed rooms, kitchen, above sinks, store rooms, high ambient rooms, dangerous or hazardous locations or below any stair case.

FINAL DISTRIBUTION BOARD

- The distribution Board/s (DB/s) installed for connection of the final Circuits within the electrical installations shall be factory built complying with BS EN 61439/IEC 6143 An integral isolator shall be provided for isolation of the incoming supply.
- The circuit breaker accessories, etc. shall generally comply with the standards specified in (Appendix 2b)
- Distribution Boards and all electrical equipment installed outdoors must be corrosion resistant and give protection against mechanical damage and a minimum ingress protection of IP55 unless otherwise specified in these Regulations.
- Re-wired type fuses shall not be permitted in any type of wiring installation.
- Maximum allowed number of final circuits in any final distribution board should be (42) circuits, and maximum rating of MCCB/Isolator should be 125A.
- The details of parameters of the individual equipment & components and the DBs, in general, may appropriately be selected and specified as per [Chapter10] below:
- Flexible cables from switches or isolators to fixed Appliances (such as water heaters, cookers, etc.) must be adequately rated and securely fixed with a purpose-made flex outlet plate (Appendix 24)

FINAL CIRCUITS

- The sizing of Final Circuits must take into account the possible increases in load requirements.
- Radial Circuits should be provided to large Appliances, particularly those in continuous or near continuous operation, or those of importance for safety or other priority functions within a Premises. Examples include main water pumps, air conditioning units, water heaters, room heating, fire or intruder alarms, cookers and ovens, etc.
- Ring Circuits should be provided to areas within a property which can be most economically served by several Appliances sharing the same cable feed, arranged in a loop, from one circuit-breaker on the Final Distribution Board. This is particularly suitable where Appliances are expected to operate at diverse times of the day. Ring Circuits would typically be installed in bedrooms, living rooms, kitchens (except major Appliances such as cookers), partitioned office areas, etc.
- For domestic Premises all Circuits supplying one room must be on the same phase, other than for kitchens, and for ceiling lighting.

SWITCHES

- The switches provided for local isolation of electric supply to individual apparatus and/or circuits shall comply with BS EN 60669. The rating of the switches shall be selected based on individual applications, such as for resistive or inductive loads. The minimum current rating shall be 5 A.
- For industrial use the switches shall be metal clad. Weatherproof switches shall be used for all outdoor installations, damp or wet areas (BS EN 60669).
- Switches installed for control of discharged lighting shall have a current rating not less than twice the steady state continuous current of the circuit
- Wall-mounted switches must not be installed in bathrooms, shower rooms or other locations where normal body resistance is reduced due to the presence of water. In such locations, ceiling mounted cord-pull switches may be used or wall-mounted switches may be used outside the room. Wall-mounted switches may be used in kitchens but at least 2 m from a sink or other source of water.
- For areas with higher-than-normal risk of fire or explosion, gas-sealed switches must be used (BS EN 60079). For example, in gas storage areas, battery rooms, etc.

- Switches with neon indicators must be provided for Appliances such as water heaters, air conditioning units, cookers, fridges and freezers, where a visual indication of the presence of power is desirable. (Appendix 15)

10. Installation Details

10.1 Lighting & Fans

- Minimum load for normal light is 100W and for LED light is 35W. If it is more than 35W for LED, it will be as per actual load.

MCB Rating	Wire size
10A for load up to1200W	2.5 sq. mm – up to 2000 W
16A, if more than 1200-2000W	more than 2000 W wire size should be as per actual load**.**

- Strip Light / Flood Light, will be consider as per actual load.
- Chandelier will consider as per actual load as per number of points if available or 500W
- Fluorescent lamp per circuit / per point.
- Ground light and garden lights 30mA ELCB
- Wherever fittings with discharge light, compact fluorescent lamps or low volt lamps installed, the circuit breaker rating, circuit conductor sizes and number of fittings may be suitably selected based on the actual load, including losses, for specific application.
- All lightings must be connected to Final Circuits using a ceiling rose or other purpose made connection point and not directly to such Circuits. Where cables are run within lightings they shall be of the heat resistant type, or protected by heat resistant sleeving.
- Lighting Circuits in false ceilings or voids must be installed in conduit or trunk However, short lengths (less than 3 m) of flexible or sheathed cables may be provided between a lighting connection point or ceiling rose and a light, provided that provision is made for future access and maintenance.
- Outdoor lighting should be of suitable weatherproof construction with appropriate connection points and fittings.
- Underwater lighting must be supplied by a Separated Extra-Low Voltage System (SELV) not exceeding 12V a.c. or 30V d.c.

10.2 Plugs & Socket Outlets

- The single phase plugs and socket-outlets used in domestic and commercial installations shall comply with BS 1363**.** The socket outlets shall be shuttered type, double pole, 3 pin flat type with switch.
- The industrial plugs and socket –outlets shall comply with BS 4343 (BS EN 60309) and shall be with switch, integrally built in or attached to it. The rating and type of socket-outlets with plugs provided shall be selected to suit individual applications and shall not be interchangeable for different current ratings.
- A radial final sub-circuit maybe installed to serve maximum of four 13A switched socket outlets in rooms other than kitchen and controlled by 20A circuit breaker in the distribution board with 4 mm copper wire.
- A maximum of eight 13 Amp sockets is permitted to connect on a single circuit supply in one ring circuit controlled by a 32 A circuit breaker.
- Maximum 6 ring circuits to be connect in one ELCB.
- A maximum of ten sockets are permitted to connect on a single ELCB of 30mA.
- A maximum of one 15 Amp socket is permitted to connect on a single phase supply in radial circuit.
- No socket-outlets shall be installed in a bathroom except for a socket-outlet complying with BS 3535 and (BS EN 61558) **(**shaver socket outlet including a safety isolating transformer).
- Socket-outlets for normal use must be positioned at a height of 450 mm above floor level or 100 mm above work surfaces. Where required, low level or skirting height may be used (e.g. in offices) at a minimum of 100 mm above the floor level, and where adequate precautions are taken against damage. Access for limited ability persons must be given due consideration in such cases (e.g. alternative socket-outlets provided). (Appendix 3a & 3b)
- Floor socket-outlets may be used where there is no undue risk of water ingress or flooding and which are designed to relevant international standards
- Socket-outlets in kitchens or other areas where water is used must be positioned at least 1.0 m away from sources of water (e.g. sinks, basins, filter units, supply taps). Consideration must be given to the use of splash proof socket outlets (IP 56).
- All socket-outlets in one room or service area shall be connected to the same phase.
- Outdoor socket-outlets must be of the weather protected type (IP55) and incorporate a 30mA ELCB/RCD/RCCB.

- For Schools, Universities & Similar places where the need of discrimination for individual equipment's is required, the use of RCCB is preferable.

10.3 Cooker Control Units

- Every stationary cooking appliance in domestic premises shall be controlled by a cooker control switch complying with BS 4177**,** separate from the appliance and installed within 2 meters of the appliance. The cooking appliance shall incorporate an integral earthing terminal. The cooker control switch shall be 2 pole for 1-phase and 4 pole for 3-phase appliance and connected to a separate final sub-circuit from the distribution board through 100 mA ELCB
- Use of cooker control unit incorporating a general purpose socket – outlet shall be avoided, to allow grouping of socket-outlet circuits in separate 30mA ELCB/RCD/RCCB section. (Appendix 3c)
- Breaker rating for cooker control unit is to be minimum 32A MCB and wire size 6mm2 or to be selected as per the connected load of the appliance.

10.4 Household & Similar Electrical Appliances

- The electrical appliances such as water heaters, cookers, hot plates, etc. which are used in consumer installation shall generally comply with B 3456 (BS EN 60335)

10.5 Control Of Water Heater

- Double pole switches (with neon indicator) of appropriate rating shall be provided for control of water heaters. The final connection to the heater shall be made from a flex outlet plate mounted adjacent to the heater. Water heater shouldn't, under any circumstances, be located near to the showers/sinks. The control switch for water heater situated/installed in a bathroom or toilet shall be installed outside the bathroom/toilet.
- Water heater shall be connected to a separate final sub-circuit from the distribution board. The heater shall incorporate an integral earthing terminal adjacent to the phase and neutral terminals. All terminals shall be housed in suitable recess with a splash proof removable cover. Every heater circuit shall be protected by 30mA RCCB/ELCB/RCD.
- Solar water heater must be connected to separate DB (Not connected to FEWA)

10.6 Control Air- Conditioning Units

- A 15 Amp switched socket outlet shall be provided for room air-conditioners to connect units only with cooling capacity up to 18000 Btu/hour. Double pole switch, of appropriate rating, with flex outlet mounted adjacent to the unit shall be provided for control of other room air-conditioning unit.
- Each room air-conditioning unit shall be connected to a separate final sub-circuit, for the distribution board.
- A maximum of one air-conditioning unit is permitted to connect on a three phase
- supply.
- A maximum of three air-conditioning units are permitted to connect on a single ELCB of 100mA.
- For more than nine air-conditioning units, separate final distribution board to be provided. For the load up to 40KW with 100Amp MCCB and more than 40KW final DB not allowed, SMDB to be provided.

10.7 Extra Low Voltage Safety Apparatus

- The extra low voltage safety apparatus such as electric buzzers & bells, mirrors, lights & shaver socket outlets for installation in bathroom, light fittings for underwater installations, etc. shall incorporate appropriately rated double wound safely isolating transformer either integrally built-in or mounted separately, with cartridge fuse or MCB in the secondary circuit.
- The safety isolation transformer shall comply with BS 3535 (BS EN 61558).

10.8 HV Discharge Lightening Equipment's

- Switching of Circuits containing discharge lighting or other lighting with high inductance may require special consideration due to high switching voltages that may occur. In order to accommodate the switching voltage in discharge lighting Circuits, the rating of the switch shall be suited to the conditions expected and shall not be less than twice the load current.
- High voltage discharge lighting (such as neon signs) must comply with BS 559 and be provided with an emergency isolation switch which must be clearly marked and located in an easily accessible position.
- Every High Voltage Discharge lighting equipment & installations shall be rated for voltages not exceeding 5 kV, RMS to earth, measured on open circuit and shall comply with BS 559.

- H.V. discharge lighting equipment, including neon signs for advertising or any other purposes, shall not be installed without prior approval from FEWA.

10.9 Emergency Lights

- Emergency light fittings must comply with BS 5266 and shall be provided with a battery of minimum 3 hours continuous operation.
- Emergency light shall be installed in at least one location in the Premise.
- All electrical switch rooms and operational areas shall be provided with adequate numbers of emergency light fittings.

10.10 Electric Motors & Starters

- Control of Electric Motors shall comply with BS EN 60204, If the equipment is within its scope.
- Motors up to and including 11 kW (15 HP) may be connected for direct on-line starting with over current protection.
- Every Electric motor having rating exceeding 0.37 KW shall be provided with control equipment incorporated means of protection against over load of the motor. Installation of 1-phase motors rated up to 3.7 kW (5HP) and 3-phase motors up to 110 kW (150 HP) only shall normally permitted unless otherwise approved by FEWA. Where large number of motors above 150 HP are proposed, the advice of FEWA shall be sought on availing a bulk supply.
- All electric motors shall be adequately protected against overload, short circuit, earth leakage and additionally, against loss of one or more phases, voltage fluctuations, etc. as deemed essential to suit individual applications.
- Starters shall be provided with overload relays of the thermal type with automatic compensations for variation in ambient temperature between 2.8^{o}C and 48^{o}C.
- The starting equipment to limit the current may consist of any of the following type or other approved by FEWA
  a) Adjustable speed drive
  b) Intelligent controllers

- All single- phase motors above 1 HP and three- phase motors above 3 HP shall be provided with current starting equipment to effectively keep the starting current within the following limits:

Type of Supply	Rating of Motor	Max. permissible starting current
Single Phase	1 HP – 5 HP	5 × full load current
Three Phase	less than 15 HP	5 × full load current
	15 HP up to 50 HP	2 × full load current
	50 HP and above	1.5 × full load current

- All motors shall be provided with an isolator, for isolating the motor from the supply during periods of inspection or maintenance. Such means of isolation shall effectively interrupt the supply on all phases. The isolator may be integral with the control gear or separate, but shall be in close proximity to the motor. An emergency stop push button shall be incorporated in the control gear.
- When motor starting gear is energized from an auxiliary circuit, the circuit shall also be isolated during maintenance.
- All starters, isolators and pushbuttons shall clearly marked in Arabic and English stating which machine they control and their function. To avoid confusion, the word 'START' and 'STOP' and not 'OPEN' and 'Closed' shall be used.
- Motor and their control gear shall be located in well ventilated areas with adequate space for operation and maintenance

10.11 Standby Generator

- A generator may be connected to a consumer's installation provided that it cannot be connected to FEWA network distribution system.
- The change-over circuit breaker or isolator shall have 4- Poles for 3-phase supply and 2- Poles for 1- Phase supply to ensure that the phases and neutral of the systems remain separate and distinct.
- The installation shall ensure that there will be no possibility of paralleling generator supply with FEWA supply under any circumstances or conditions.
- Adequate mechanical and electrical interlock between the incomer circuit breakers or isolators of both generator and FEWA supplies shall be provided.
- The full details of the equipment, circuit and wiring diagrams, details of essential loads, etc. shall be submitted to FEWA for drawing approval before commencement of the work.

11. Circuit Arrangement

11.1 Division of Installations into Circuits

- All Electrical Installation and individual circuits therein must be provided with devices that protect against thermal, electromagnetic and other detrimental effects caused by overload and short circuits. Such devices must be located at suitable sections and circuits so as to give effective automatic disconnection in such conditions.
- All circuits must be individually protected against overloads and short circuits by suitable devices. Replaceable or re-wired fuse links are not permitted for this purpose.
- A schematic wiring diagram showing the main distribution system should be displayed near the main MDB.

11.2 Basic Requirements of Circuits

11.2.1 PROTECTION

- Each circuit should be protected by an overcurrent protective device with its operating current value closely related to the current demand of the current using equipment connected or intended to be connected to it and to the current carrying capacity of the conductor connected. This arrangement will avoid danger in the event of a fault by ensuring prompt operation of the protective device at the appropriate current value which will otherwise cause damage to the cable or the current using equipment.
- Ceiling roses shall be provided with insulated terminals for the switched live, neutral and protective conductors
- A fault on one circuit should not result in the shutting down of any unrelated parts of the installation as far as reasonably practicable. For this, it is recommended that:
  - fixed lighting fittings of an installation should be arranged to be fed by two or more final circuits
  - lighting final circuits should be electrically separated from power circuits except that it may be connected to bell transformers or electric clocks
  - Power circuits for kitchens should be electrically separated from other power circuits.

- Where the supply is designed to be taken from more than one transformer, interconnection facilities between the main incoming circuit breakers should be provided if requested by the electricity supplier. All incoming and interconnection circuit breakers should be of 4-pole type interrupting all live conductors (i.e. phase and neutral conductors) and electrically and mechanically interlocked to prevent the electricity supplier's transformers from operating in parallel.
- All Electrical Installations must be designed, constructed and maintained to provide protection against the following:
    a) overload;
    b) Short-circuits (phase to phase or phase to Earth)
    c) Electric shock (due to Direct or Indirect Contact with electricity).
- Protection against conditions of overload and short-circuit will normally be provided by MCBs, MCCBs or similar devices
- Overload protective devices should be capable of breaking any overload current flowing in the circuit conductors before such a current could cause a temperature rise detrimental to insulation, joints, terminations, or surroundings of the conductors
- Protection of persons against electric shock due to Direct Contact or Indirect Contact must be provided by one of the methods detailed above.
- Such devices must be located at suitable sections and Circuits so as to give effective automatic disconnection in such conditions.
- The main circuit-breaker at the Customer Connection Point must be of MCCB up to 1000A and ACB type for more than 1000A and adequately rated for the maximum Prospective Fault current.
- To ensure protection against overload, Circuit conductors must be sized taking into account the time-current characteristic of the Protective Device.
- In order to provide adequate protection against overload the Protective Device nominal rating must be not more than the maximum rating of the Circuit for which overload protection is required
- Every overcurrent protective device should be provided on or adjacent to it an indication of its intended nominal current as appropriate to the circuit it protects Where circuit breakers may be operated by persons other than a registered electrical worker, they should be designed or installed so that it is not possible to modify the setting or the calibration of their overcurrent releases without a deliberate act involving either the use of a key or tool. A visible indication of the setting or calibration is recommended.
- Operating handles of circuit breakers should be made accessible without opening any door or cover giving access to live parts

11.2.2 EARTH LEAKAGE CIRCUIT BREAKER

- The operating current setting for ELCB devices at the Supply Intake must take into account the nature of the Installation (e.g. commercial, industrial, etc.), the likelihood and magnitude of earth fault currents, and the requirement for protection against Indirect Contact.
- For domestic Premises the residual current rating for ELCB devices must be 100 mA for Final Circuits supplying fixed equipment (e.g. lighting and air conditioning) and 30 mA for Final Circuits where Appliances may be used by persons (e.g. all socket outlets, all kitchen Appliances, other Appliances accessible to persons), and 30 mA for all Circuits in a bathroom
- Recommended value of operating current of ELCB/RCCB/RCD in Consumer installations: -

Sr. No.	Circuit/ Equipment/ Apparatus	Rated operating Current (mA)
1	13 A switched socket outlets	30
2	Water heaters/Coolers	30
3	Refrigerator/ Washing machine and similar apparatus	30
4	Domestic water pumps	30
5	Jacuzzi pumps	10
6	Under water lighting	10
7	15A switched socket outlets (general purpose)	30
8	General lighting	30/100
9	Flood lighting	100/300
10	Window/Split type Air Conditioner	100
11	Fan coil/ Air Handling – units/ VAV	100
12	Package type A/C unit	100/300
13	Chiller	100-500-1000
14	Irrigation pump	100
15	Electric Cooker	100
16	Industrial machine	100/300
17	Elevators/ Escalators	300/500

18	Neon sign	300
19	Marine Pedestal sockets	30

Notes:-

- Grouping of circuits under one ELCB/RCCB is permitted for lighting circuits, general purpose switched socket outlets, single-phase equipment/appliance, etc. in such cases maximum number of circuits proposed under each group shall be suitably selected considering the type of project such as Residential, Commercial, Industrial, etc. and the possible interruptions.
- For industrial installations which are designed with coordinated operational system of plants and machines, the earth leakage protection shall be suitably selected considering the safety operational requirements.

11.2.3 CONTROL

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

11.2.4 IDENTIFICATION

- Protective devices of each circuit should be clearly labeled or identified so that the rating of the devices and the circuits they protect can be easily recognized.
- Every socket in a three phase installation should be marked with the appropriate phase identification in a permanent manner.

11.2.5 LOAD DISTRIBUTION

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

12 Special Installations

12.1 Construction Sites

- This Regulation applies to construction sites and other permanent or temporary outdoor supplies due to the additional risks of damage and interference to outdoor installations the following precautions should be catered for in the design and construction of such systems:
  a) All cables which are not installed in conduit or trunk must be armored and adequately protected against accidental or deliberate interference by persons, and against the effects of weather; [Note: Armored cables complying with BS 6007 (BS EN 50525) are recommended.]
  b) Outdoor Electrical Installations must have a minimum ingress protection level of IP55 and switchgear assemblies must comply with BS 4363 and BS EN 60439
  c) Cables passing on or over walkways and access roads must be adequately enclosed to avoid danger. Buried cables must be installed so as to afford adequate protection against damage. (Appendix 22)
  d) Particular attention should be given to the location, signing and protection of equipment where the public may have access, in particular children.
  e) Equipment should be located and adequate notices displayed so that emergency disconnection of the electricity supply can be effected without delay.
  f) Locking arrangements should be such that these can be removed in an emergency (e.g. panic bar or keys available in break-out box);
  g) The requirements for periodic inspection and testing must be done strictly complied with (Regulation 8.2);
  h) An Earth Leakage Protected System must be provided. In addition, outdoor socket outlets must be provided with integral ELCB/RCD protection with a residual operating current of 30 mA or less. [Note: water coolers and drinking fountains must be provided with individual ELCB/RCD protection, in addition to that provided at the Final Distribution Board.]
- Consideration should be given to the use of a reduced voltage supply (RLV) for portable tools where there is a high exposure to potential damage, or where persons are required to operate such equipment in confined spaces or other hazardous circumstances. [Note: RLV may be preferred on construction sites compared with supply by ELPS to avoid nuisance tripping and the potential failure of ELCB/RCDs in harsh outdoor environments.]

12.2 Tents (Weddings, Funerals, Festivals, Etc…)

- Due to the high risk of Accidents & life loss in these occasions, the following precautions should be catered for in the design and construction of such installations:

A. The source of supply to be decided only by FEWA.
B. All Lights should be at a distance not less than 40cm
C. All the wirings inside the tent should be made inside PVC conduits.
D. Cables are not allowed to be laid from the source point unless with proper excavation & backfilling
E. Each AC unit should be provided with individual circuit breaker, individual ELCB/RCD
F. The MDB & DB should comply with all the requirements in (9.6 & 11) above.

12.3 Swimming Pools

- The requirements for protection against electric shock for swimming pools are similar to those of bathrooms, with some exceptions, as follows:

A. All Final Circuits must be protected by an ELCB/RCD of rating 10 mA and complying with BS EN 61008 and BS 4293. Such protection may be grouped across several Circuits at the Final Distribution Board. Exceptions may be allowed for high current applications where ELCB/RCD protection of 100 mA residual current may be allowed, but only where such equipment is out of reach of persons;
   [Note: An example of Circuits where 30 mA ELCB/RCD protection may not be practical is floodlighting or large water pumps. Such items must be out of reach of any person using the swimming pool or any associated washing areas.]
B. No socket-outlets are permitted within Arm's Reach from a swimming pool. Socket-outlets may be provided outside this distance for purposes such as cleaning of the pool, which must have a minimum ingress protection of IPX6 and must have an integral ELCB/RCD of residual current rating 10 mA.
C. All Appliances, Luminaries and other Accessories must have a minimum level of moisture ingress protection of IPX4
D. No Appliances, Luminaires or other Accessories may be installed within Arm's Reach from a swimming pool. However, such items are permitted within the swimming pool area (but not shower room area) at a distance greater than Arm's Reach from the pool.

E. Appliances, Luminaires or Accessories which are within Arm's Reach from a swimming pool must be supplied by SELV or PELV and have a minimum level of ingress protection of IPX7. Underwater lighting must be supplied by SELV at a maximum voltage of 12 V A.C. or 30 V D.C. and with ingress protection IPX8.

- The provision of Earthed Equipotential Bonding is not required in swimming pools and associated wash facilities where the Installation is classified as an Earth Leakage Protected System. In particular, the requirement for Earth Leakage Protection on Final Circuits, along with back-up earth fault protection at the Supply Intake, must be met.
  EEB and Supplementary Equipotential Bonding will be required where back-up earth fault protection has not been provided, even where ELCB/RCD protection has been provided at the Final Distribution Board supplying the swimming pool and associated areas

12.4 Water Fountains

- The requirements for protection against electric shock for water fountains are similar to those required for swimming pools, with some exceptions, as follows:

[Note: it is assumed that persons may enter a water fountain for the purpose of maintenance, or other reason, and the exposure to electric shock is therefore similar to that of swimming pools.]

A. All Final Circuits must be protected by an ELCB/RCD of rating 30 mA and complying with BS EN 61008 and BS 4293. Such protection may be grouped across several Circuits at the Final Distribution Board. Exceptions may be allowed for high current applications where ELCB/RCD protection of 100 mA residual current rating may be allowed, but only where such equipment is out of reach of any person;

   [Note: An example of Circuits where 30 mA ELCB/RCD protection may not be practical is floodlighting or large water pumps. Such items must be out of reach of persons whilst standing within the water fountain.]

B. No socket-outlets are permitted within Arm's Reach from a water fountain. Socket-outlets may be provided outside this distance for purposes such as cleaning of the water fountain, which must have a minimum ingress protection of IPX6 and must have an integral ELCB/RCD of rating 30 mA.

C. All Appliances, Luminaires and other Accessories must have a minimum level of moisture ingress protection of IPX4;

D. No Appliances, Luminaires or other Accessories may be installed within Arm's Reach from a water fountain. However, such items are permitted at a distance greater than Arm's Reach from the water fountain.

E. Appliances, Luminaires or Accessories which are within Arm's Reach from a water fountain must be supplied by SELV or PELV and have a minimum level of ingress protection of IPX7. Underwater lighting must be supplied by SELV at a maximum voltage of 12 V A.C. or 30 V D.C. and with ingress protection IPX8.

- The provision of Earthed Equipotential Bonding is not required for water fountains where the Installation is classified as an Earth Leakage Protected System. In particular, the requirement for Earth Leakage Protection on Final Circuits, along with back-up earth fault protection at the Supply Intake, must be met. EEB and Supplementary Equipotential Bonding will be required where back-up earth fault protection has not been provided, even where ELCB/RCD protection has been provided at the Final Distribution Board supplying the water fountain and associated areas.

12.5 Street Lights

- Supply to the Main distribution board/ Final distribution boards shall be through 4 pole MCCB.
- Lighting distribution box (LDB) is a pad-mounted-explosion proof type provided with the following equipment and devices.

1) One incoming C.B.
2) Outgoing circuit breakers.
3) Automatic contactor (photocell or timer)

- All lighting circuits will include an equipment grounding conductor, and will be bonded to the non-current-carrying metal parts of each lighting standard and luminaire.
- Protection against electric shock for street lighting shall be provided by an Earth Leakage Protected System.
- Temporary supplies taken from street lights, such as for decorative lighting or signboards, must be provided with Earth Leakage Protection using ELCB/ RCDs of rating no greater than 30 mA where within reach of persons, or 100 mA where not within reach of persons.

12.6 Bathrooms & Similar Locations

- Special provisions are required for the protection against electric shock of persons in locations containing a bath or shower. Such provisions, as listed in the following clauses, must also be applied in other similar situations where persons are likely to be partly clothed and in contact with water, with or without footwear.
  [Note: similar locations would include washrooms, toilets, wudu areas in mosques, etc.
- The following principal requirements must be met for bathrooms and similar locations:

A. All Final Circuits must be protected by an ELCB/RCD of residual current rating 30 mA and complying with BS EN 61008 and BS 4293. Such protection may be grouped across several Circuits at the Final Distribution Board. However, fan-coil units mounted in a ceiling void in a bathroom may be provided with 100mA ELCB/RCD protection.

B. No socket-outlets are permitted except those supplied by an isolating transformer and complying with BS 3535 BS EN 61558-2-5 **(**e.g. 'shaver' socket-outlet);

C. All Appliances, Luminaires and other Accessories must have a minimum level of moisture ingress protection of IPX4

D. Appliances, Luminaires or other Accessories may not be installed within Arm's Reach from a bath, shower or similar facility. However, such items are permitted within the room containing a bath or shower at a distance greater than Arm's Reach from the bath, provided that the requirements above are complied with. In addition, all switches associated with such equipment must be installed outside the bathroom or provided with a cord-pull switch.

E. Appliances, Luminaires or Accessories which are within Arm's Reach from a bath, shower or similar facility must be supplied by SELV or PELV and have a minimum level of ingress protection of IPX4. Underwater lighting must be supplied by SELV at a maximum voltage of 12 V A.C. or 30 V D.C. and with ingress protection IPX8.

[Note: items which are within a distance of Arm's Reach but are inaccessible to persons need not comply with (d) above. For example, water pumps installed under a bath which are not accessible without removal of covers requiring a tool.]

F. The provision of Earthed Equipotential Bonding is not required in a bathroom or similar location where the Installation is classified as an Earth Leakage Protected

System, the requirement for Earth Leakage Protection on Final Circuits, along with back-up earth fault protection at the Supply Intake must be met. Earthed Equipotential Bonding and Supplementary Equipotential Bonding are required where back-up earth fault protection is not provided even where ELCB/RCD

G. Protection has been provided at the Final Distribution board supplying the bathroom or similar location.

12.7 Sauna Rooms

- If separated extra-low voltage (SELV) is used, protection against direct contact must be provided by:

    A. Enclosures or barriers providing protection to IP24. This means protection against entry of human fingers and from splashing water, and
    B. Insulation which will withstand a voltage of 500 V r.m.s. for one minute.

- All equipment must be protected to at least IP24, and no equipment other than the sauna heater may be installed in zone A. There must be no socket outlets in a sauna room, nor other switchgear which is not built into the sauna heater; lighting switches must be positioned outside the sauna room. As well as having no socket outlets within the sauna room, it is advisable not to install them close to the room at all, which could encourage the introduction of portable appliances. In the lower part of the room where it will not be so hot, there is no special requirement concerning the heat resistance of equipment. If installed in zone C, equipment must he suitable for operation at an ambient temperature of 125°C, and only luminaires, mounted so as to prevent them from overheating, are allowed in zone D. All wiring must be carried out with flexible cables or cords having 180°C rubber insulation complying with BS 6141: 1992, although where higher rated cables are required they may be 180°C rubber insulated to BS 6007.
- All wiring must be enclosed within insulated wiring enclosures such as plastic trunk.
- There is no specific requirement to use RCD protection for sauna equipment, but where it is desired to do so, attention is drawn to the high leakage currents common with sauna heating elements, particularly when water is applied. The manufacturer should be consulted to ensure that leakage currents are unlikely to cause problems with an RCD rated at 30 mA. In some cases, an RCD with a 100 mA rating may be more satisfactory.

12.8 Marinas and Similar locations

- Electrical installation in a Marinas environment shall be designed to minimize the following:
    a) Risk of electric shock due to the wet environment and proximity to water.
    b) Deterioration of condition of electrical equipment due to presence of salt and water.
    c) Damage to supply cable and flexibles cord connections
    d) Risk of fire and explosion.

Cables

- The following wiring systems are suitable for marinas:
    a) Cables with copper conductors and thermoplastic or elastomeric installation and sheath installed within**:**
        1. Flexible non-metallic conduit
        2. Heavy or heavy-duty galvanized conduit
    b) Mineral-insulated cables with PVC protective covering
    c) Cables with armoring and serving of thermoplastic or elastomeric materials
- Where cable management system is used, they shall be installed to allow the discharge of water by drainage holes and /or installation of equipment on an incline.
- Where flexible cables are used, they shall be in accordance with BS EN 50525

Distribution board and Pedestals

- Distribution board and Pedestals and all equipment mounted thereon and installed outdoors must be corrosion-resistant and give protection against mechanical damage and ingress of dust and sand. A minimum ingress protection of IP55 is required (Appendix 23).

12.9 Solar

- This Regulation applies to Electrical Installations associated with solar photovoltaic (PV) systems. [Note: solar PV system intended for standalone operations (not connected in parallel with the Low Voltage distribution system) are not covered in these Regulations.]
- The design of solar PV systems shall be submitted to the relevant Distribution Company for approval. [Note: the solar PV system shall be inspected and tested by the Distribution Company prior to energizing the solar PV system.]

- Solar PV system components and switchgear assemblies shall comply with the relevant equipment standards listed in Appendix 1. The design of a solar PV system shall consider the potential risks during the installation, operation and maintenance of such systems. The design should consider the assessment of the installation constraints including wind and structural loading.
- Precautions shall be made to ensure that live parts are either not accessible or cannot be touched during installation, operation and maintenance.
- [Note: PV Modules cannot be switched off. A String of solar PV Modules can produce a voltage in excess of 1000 V D.C.]
- The design and installation of solar PV system shall enable maintenance and service work to be carried out safely.
- Solar PV system components shall be selected and erected so as to minimize the risk of overloads, and short-circuits.
- wiring of solar PV systems shall withstand external influences such as wind, temperature and solar radiation.
- Equipment on the D.C. side of the solar PV system shall be suitably rated in consideration of the highest D.C. voltage and highest D.C. current.
- The current carrying capacity for solar PV system D.C. cables shall be at least 1.25 times Short Circuit Current (Isc) under standard test conditions at any location.
- All PV D.C. cables shall be Double Insulated and black in colour.
- [Note: to minimize Voltages induced by lightning, the area of all wiring loops shall be as small as possible.]
- PV Modules may be connected in series up to the maximum allowed operating voltage of the PV Module and the PV Inverter, whichever is lower.
- The D.C. side of the solar PV system shall be protected by the use of Class II Equipment.
- For Inverters that are able to feed D.C. fault currents to the A.C. side of the Electrical Installation, a type B RCD, in accordance with IEC 62423, shall be provided for the automatic disconnection of the supply.
- Where the d.c. side of the Electrical Installation is constructed to meet the requirements of an installation using double or reinforced insulation, no connection to Earth between the PV Modules or frame and main Earthing terminal is required.
- Where blocking diodes are used, they shall be connected in series with the PV String, and their reverse Voltage shall be rated for 2 times Open Circuit Voltage (Voc) under standard test condition of the PV String.

13. Earthing & Earth Leakage Protection

13.1 General

- An earthing system should be of the highest integrity and of robust construction to ensure that it remains safe and will not endanger the health and safety of persons or their surroundings. Every consumer installation shall be provided with separate earthing system within the consumer's plot limits, installed and maintained by the consumer.
- The earthing system of the installation may be subdivided; in which case each part thus divided shall comply with the requirement of regulation.

CONSUMER'S EARTHING SYSTEM

- Every consumer installation shall be provided with separate earthing system installed and maintained by the consumer.
- Each consumer's earthing system shall comprise of 'Earth electrode/s' main earth lead conductor connected between the 'Earth electrode/s' and the consumer's main earthing terminal/s or earth bus bar, Earth continuity conductors (ECCs) shall be provided for every outgoing circuits from the main, sub-main & final
- distribution boards, equipotential bonding of all metal work & exposed conductive parts and enclosures, etc.(Appendix 16)
- MV, LV, ELV Networks, Private Generators & Lightning Protections shall have separate earthing networks and shall not be connected with the main Electrical Earthing System
- The use of water mains for earthing purposes shall not be permitted. In general, metallic pipes, e.g. for gas, oil, compressed air, or drainage, shall only be bonded to the protective conductors but not used for the sole means of earthing.
- Earth electrodes shall not be installed close to a metal fence, unless they are used for earthing that fence; this is to avoid the possibility of the fence becoming live and thus dangerous at points remote from the substation, or alternatively giving rise to danger within the resistance area of the electrode by introducing a good connection with the general mass of the earth.

13.2 Main Earth Electrode

- The following types of earth electrodes may be used;

    1. Earth rods or pipes
    2. Earth tapes or wires
    3. Earth plates
    4. Earth electrodes embedded in foundations
    5. Metallic reinforcement of concrete
    6. Other suitable underground structure

- For supplies of 400 A rating and above, at least two independent Earth Electrodes must be provided, regardless of the Earth Resistance value achieved for each Earth Electrode, and connected to the same Main Earth Terminal.
- The efficacy of any earth electrode depends on local soil conditions and one or more earth electrodes suitable for the soil conditions and value of earth resistance required should be selected the value of earth resistance of earth electrode may be calculated or measured.
- The type and embedded depth of earth electrodes shall be such that soil drying and freezing will not increase the earth resistance of earth electrodes above the required value
- The material used and the construction of earth electrodes shall be such as to withstand mechanical damage due to corrosion
- The design of the earthling arrangements shall take into account of possible increase in earth resistance of earth electrodes due to corrosion
- Lead sheaths and other metallic covering of cables not liable to deterioration through excessive corrosion may be used as earth electrodes provided the consent of the owner of cables is obtained and suitable arrangements exist for the user of electrical installation to be warned of any proposed changes to the cable that may be affect its suitability as an earth electrode

CONSUMER'S MAIN EARTH ELECTRODE

- In general, minimum one Main Earth electrode shall be provided for each incoming point of supply/consumer's Main Distribution Board (MDB), within the consumer's premises. For installations with main incomer 200A and above, a minimum of 2 earth pits shall be provided.

- The earth electrode shall normally comprise of 20mm/26mm diameter copper/steel core bonded earth rod set with driving pin and head driven to a minimum depth of 3 meters. The earth electrode shall be installed inside a 300mm × 300mm × 300mm earth pit with inspection cover. The connection to the earth electrode, within the inspection pit shall be soundly made by a corrosion resistant terminal clamp. (Appendix 25)
- The consumer's 'Main Earth electrode' shall be installed as close to the main distribution board as possible. Wherever, more than one 'Earth electrode" is installed, within the consumer premises, these shall be spaced at minimum 6 meters apart. For load centers located laterally 50 meters or more from the main DBs, additional back-up earthing may be required near the same.
- The main earth electrode resistance shall not exceed 1 Ohm, for each incoming FEWA supply/MDB**.**
- The resistance from any point of the Earth Continuity Conductor to the Main Earth Electrode shall not exceed 0.5 ohm.
- The consumer's earth electrode resistance and continuity of ECCs shall be periodically checked and maintained as above, to ensure consumer safety (BS 4444)**.**
- Circuit Earth Conductors must run alongside the associated phase and neutral conductors.

13.3 Earth Continuity Conductor (ECC)

- Every circuit in the Main, Sub-Main and final distribution boards shall be provided with a separate, green and yellow (G/Y), PVC insulated copper 'ECC'. The minimum cross sectional area of ECCs shall be selected as specified in this Regulation [Appendix 17**]**
- The ECCs shall be terminated at electrical equipment, apparatus and distribution, switchgear, light fittings, mounting boxes of switches & socket-outlets, etc. with tinned copper lugs, as applicable, at both ends of purpose made earth terminals.
- All bus bar risers installed for electrical distribution in high rise buildings and other consumer installations shall incorporate an adequately sized 'ECC' either integrally within or run separately along the riser.
- For guidance on the earthing and ECCs, BS 7430 shall be referred to.
- Gas pipes, oil pipes, metallic conduit, support wires or other flexible metallic parts, or constructional parts, shall not be used as an ECC.
- ECC shall be suitably protected against mechanical and chemical deterioration and electrodynamics effects.

- Where two ECCs are used, the ends of the ECC shall be terminated independently of each other at all connection points throughout the circuit, the distribution boards, junction boxes and socket outlets. This requires an accessory to be provided with two separate earth terminal.

13.4 Equipotential Bonding

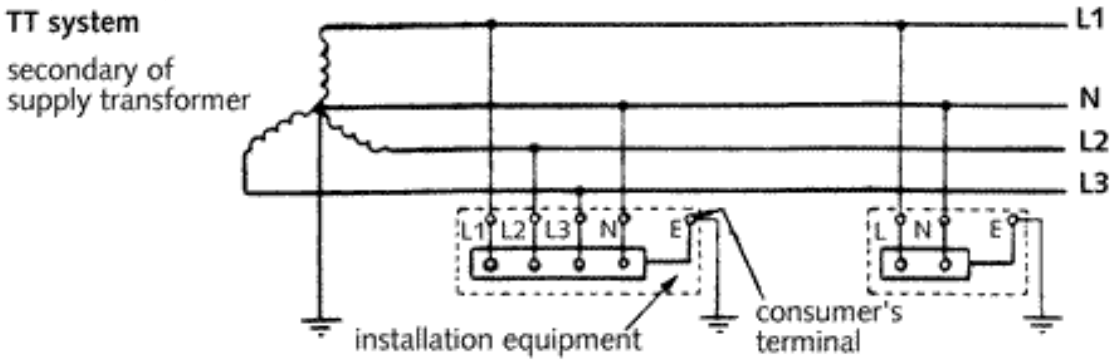
- All metal work of the consumer's installation, other than current carrying parts, including cable armor, metal conduits, metal cable tray & trunking sections, metal accessory boxes, exposed metal works of consumer's appliance, apparatus, equipment, machines, building structures, metallic enclosure and parts, metal water pipes, etc. shall be provided with equipotential bonding conductors.
- A main protective bonding conductor shall have a cross sectional area not less than half the cross sectional area required for ECC of the installation and not less than 6mm2. The cross sectional area need not exceed 25mm2 if the bonding conductor is of copper or a cross sectional area according equivalent conductance in other metals
- The equipotential bonding conductors shall be connected to the main earthing terminal within the consumer's wiring installations and the continuity shall be tested and maintained by the consumer.
- All connection points in an Installation must include an Earth Conductor for future use.

13.5 Lightning Protection

- Lightning protection installations should be installed to IEC 62305, BS EN 62305, AS/NZS 1768, NFPA 780 or equivalent.
- Lightning protection systems and associated earth electrodes must be separate from the electrical Installation earthing system.
- A minimum distance of 7 m must be provided between lightning protection earth electrodes and the Installation Earth Electrodes.
- Surge protective devices must be used at the Connection Point for Premises with a lightning protection system. These shall be installed typically at the Main Distribution Board.
- Lightning protection systems must be designed, constructed and maintained in accordance with BS 6651, except that the lightning protection system is not to be bonded to the Installation Main Earth Terminal.

13.6 Earthing System

- The consumer's main earthing terminal shall be connected to Earthing so as to maintain a resistance not more than 1 ohm.
- The preferred method of earthing is the TT system:
- This arrangement covers installations not provided with an earth terminal by FEWA. Thus it is the method employed by most (usually rural) installations fed by an overhead supply. Neutral and earth (protective) conductors must be kept quite separate throughout the installation, with the final earth terminal connected to an earth electrode by means of an earthing conductor.
- Effective earth connection is sometimes difficult. Because of this, socket outlet circuits must be protected by a residual current device (ELCB/RCD) with an operating current of 30 mA



14. **Power Factor Correction & Under Voltage Relay**

14.1 Power Factor Correction

- The power factor of every consumer installation shall be within the range of 0.92 lagging and unity
- For all premises which requires FEWA service feeders of 300 KW and above (except villas), where individual load compensation cannot be achieved, overall compensation at main or sub-main distribution levels by incorporating capacitor banks with automatic regulated steps, shall be provided.
- For all industrial load, Capacitor bank must be installed with automatic regulated steps.
- Capacitor banks and associated components shall be suitably designed and selected to ensure reliable and continuous operation at a maximum system Voltage of 440 V and at a maximum ambient temperature of 50°C.
- The capacitor bank shall be installed as nearest as possible to main distribution Board
- The P.F. correction capacitor shall be dry, encapsulated, sealed type. (conform to IEC 61921**)**
- In general all Air-Conditioning units/plants/equipment, machines, motors, light fittings with discharge lamps/mercury vapour/sodium vapour/ fluorescent tubes, etc. for use in the Region of FEWA, shall be provided with capacitors or other approved means to achieve and maintain a power factor of 0.92 lagging or above, throughout their normal working range.
- The capacitors and associated components such as PF regulator, indicating instruments, contactors (of capacitor switching duty), control switches, etc. shall be designed and rated for operation on the electric supply and ambient conditions specified under Section 1 and selection details recommended in Section-4 of this Regulation. Capacitor units shall be designed for temperature class D.
- The current carrying capacity of conductors that connect a capacitor to the terminals of a motor or to motor circuit conductors shall not be less than one third the current carrying capacity of the motor circuit conductors and in no case less than 1.5 times the rated current of the capacitor.
- The capacitor bank panel shall be provided with a suitably rated main incomer isolating switch. This shall be a three-pole isolator or MCCB. The handle of the incomer isolator or MCCB shall be interlocked with the door to ensure that the capacitor bank is de-energized when the door is open.

- capacitor bank shall not be a part of the motor control centre, main LV panel or sub-main panel, but it shall be accommodated in a separate cubicle
- Only one capacitor bank must be installed in each premise – otherwise an approval must be taken from FEWA.
- The size, MCCB rating and step number of capacitor banks required is dependent on the load type and number and size of inductive devices utilized at the location.
- The Current Transformer (CT), rating for the capacitor bank must be same Current rating of the incomer main breaker.
- All non-current carrying metal parts of capacitor shall be earthed.
- the capacitor, PF regulator, contactor, etc must be designed at required current taking in consideration the load of supply premise.
- All light fittings with discharge lamps, mercury vapour/sodium vapour, fluorescent tubes, etc. shall incorporate capacitors to obtain a power factor of 0.92 or above, lagging.
- Capacitors shall be enclosed or guarded to prevent accidental contact or conducting metal parts with exposed energized parts, terminals or buses associated with them.
- The capacitors installed for P.F. correction shall be provided with means for its prompt automatic discharge immediately when the capacitor is disconnected from the source of supply. The discharge circuit shall be either permanently connected to the terminals of the capacitor of capacitor bank, or provided with automatic means of connection it to the terminals of the capacitor bank on removal of voltage from the line. Manual means of switching or connecting the discharge circuit shall not be permitted.
- The current carrying capacity of the conductors used in capacitor circuit shall not be less than 1.5 times of the rated current of the capacitor.
- An over current device shall be provided in each circuit for each capacitor bank, a load side of a motor overload protective device. The rating or setting of the over current device shall be as low as practicable.
- The capacitors shall be suitable for operation under harmonic current conditions.
- The contactors used in the capacitor bank shall be withstanding switching surges.
- Means shall be installed to isolate each capacitor, capacitor bank, or capacitor installation from all sources of voltage and to remove from service as unit.
- Each capacitor shall be provided with a nameplate indicating rated voltage, frequency, KVAR, number of phases, discharge device and name of the manufacturer.
- The controls and protection device provided in the capacitor bank shall be checked and maintain regularly.

- Preliminary power factor to be calculated by Consultant for Industrial, Investment & more than 300KW commercial load

14.2 Under Voltage (U.V.) Relays with Auto-Reset Timer

- All Air-Conditioners or Air-Conditioning units/plants/equipment installed within the consumer's installation shall be provided with Under Voltage (U.V.) relays with fixed voltage cut off setting at 75% of the nominal supply voltage, within 0.2 seconds, and auto-reset timer with adjustable time setting between 5 and 10 minutes.
- The circuit breakers/contactors associated with the under voltage (UV) relays, shall have 'auto closing' facility (motorized operation) to restore supply to the chillers/air conditioning units, after normalization of supply voltage, when the relay is reset automatically.
- The auto-reset timer of the U.V. relays shall be set at values specified in the schedules, approved by FEWA, to suit individual installation. Necessary provision for sealing may be incorporated in the relay to restrict access for adjustments of the setting.
- The U.V. relays with auto-reset timer shall normally be incorporated within the respective air-conditioning unit/equipment or in their control panels. For small air conditioners, provision of UV relays with auto-reset timer within the consumer's distribution board shall be permitted for individual or group of units. Prior approval shall be obtained from FEWA on every such application.
- The U.V. relays with associated controls shall be checked and maintained regularly.

15. Inspection & Testing

15.1 Electrical Installation Certificate

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

- In the case of a repair, alteration or addition to an installation, only the affected parts of the installation need to be inspected, tested and certified.
- In order to verify compliance with these Regulations the approved Contractor shall complete and sign an Electrical Installation Certificate in the format that attached with FEWA application with load cards. (maybe the same contractor)
- Two original copies of the Electrical Installation Certificate and associated test results shall be provided, one to the Customer or Owner of the Premises, and one to FEWA. An additional copy must be affixed at the Main Distribution Board or Supply Point.

15.2 Routine Inspection Procedure

15.2.1 INSPECTION OF LOW VOLTAGE INSTALLATIONS

A visual inspection should be made to verify that the electrical equipment installed is correctly selected and erected in accordance with the FEWA Wiring Regulations and that there is no apparent damage. The visual inspection to be made as per the form in the [Appendix 18]

15.2.2 TESTING OF LOW VOLTAGE INSTALLATIONS

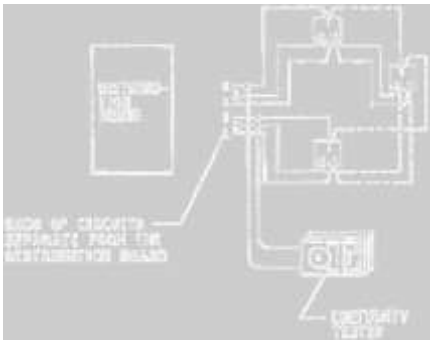
- Precautionary measures should be taken during testing and the method of tests should be such that no danger to persons or property can occur even if the circuit being tested is defective. Including locking off isolators and switches, safeguarding against contact with test voltages, replacement of test links and removal of tools after completion. The order of test sequence must be observed, in particular testing of Earth conductors (dangerous test voltages can appear on the installation metal work if Earth conductors are inadvertently disconnected or broken)

15.2.3 SEQUENCE OF TESTS TO BE MADE BEFORE SUPPLY IS CONNECTED

The following items, where relevant, are to be tested preferably during visit:

1. **Continuity of Protective Conductors including main and supplementary**

EQUIPOTENTIAL BONDING

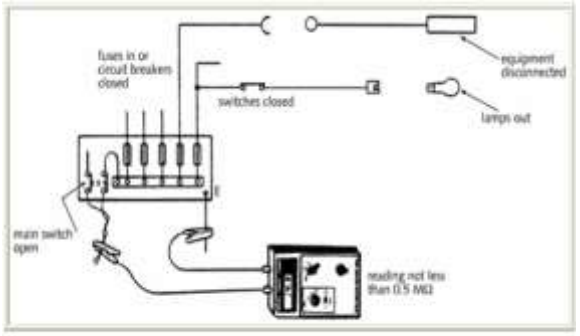


Every protective conductor, including all conductors and any extraneous conductive parts used for equipotential bonding should be tested for continuity. The test should be made by connecting together the neutral and protective conductors at the mains position and checking between earth and neutral at every outlet by a continuity tester, which should show a reading near zero.

2. **CONTINUITY OF RING CIRCUIT CONDUCTORS**

A. The ring circuit should be tested from the distribution board.

The ends of the two cables forming the phase conductor should be separated, and a continuity test should show a reading near zero between the two; the same tests to be made between the two cables that form the neutral conductor, and between the two cables that form the protective conductor.



Insulation test to earth

B. **The testing method in subparagraph** (a) Above is only applicable when the ring circuit has been inspected throughout, prior to the test, toascertain that no interconnection (multi-loops) exists on the ring circuit. Otherwise, the testing methods stipulated in Part 3 of the Guidance Note 3 to BS7671, should be adopted instead.

3) INSULATION RESISTANCE

An insulation resistance test shall be made at the incoming supply terminals of each and every distribution board and switch board to measure the outgoing circuits. This test shall be made and passed satisfactorily before any completed installation or alteration to an existing installation, is connected to the supply.
For these tests, a D.C. Voltage not less than twice voltage of the supply shall be applied for the measurement of insulation resistance, except that for tests made on the circuits which the voltage need not exceed 500 Volts D.C.
The following shall form the installation test at each and every distribution and switchboard:

1. Phase to phase insulation resistance.
2. Phase to neutral insulation resistance.
3. Phase to earth insulation resistance.
4. Neutral to earth insulation resistance.

These tests shall be carried out with fuse links in place, all circuit breakers closed, and all switches and main switch closed. The resultant insulation resistance for any of the above measurements shall not be less than the appropriate values given in Table below.
Where practicable, so that all parts of the wiring may be tested, all lamps shall be removed and all current using apparatus shall be disconnected and all local switches controlling lamps or apparatus shall be closed.

Circuit nominal voltage (Volts)	Test voltage DC (Volts)	Minimum insulation resistance (M□)
Extra-low voltage circuits when the circuit is supplied from a safety isolating transformer/SELV	250	0.25
Up to and including 500V with the exception of the above cases	500	0.5
Above 500 V up to 1000V	1000	1.0

4) POLARITY

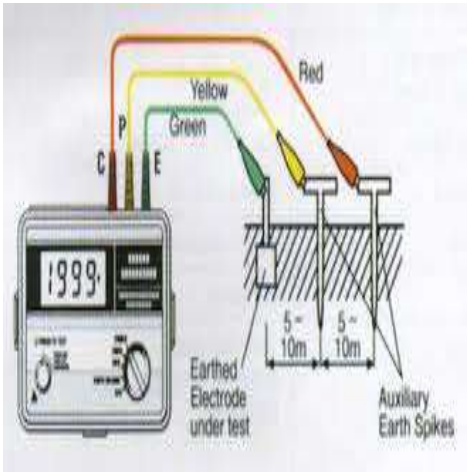
A test of polarity should be carried out to verify that:

- every fuse and single-pole control and protective device is connected in the phase conductor only;
- Every single-pole devices and lamp holders with an outer neutral (i.e Edison-type screw) contact are correctly connected.
- Wiring has been correctly connected to socket outlets and similar accessories.

- The test may be carried out with a long wander lead connected to the phase conductors at the distribution hoard and to one terminal of an ohmmeter or a continuity tester on its low resistance scale. The other connection of the device is equipped with a shorter lead which is connected in turn to switches, centre lamp holder contacts, phase sockets of socket outlets and so on. A very low resistance reading indicates correct polarity.
- To avoid the use of a long test lead, a temporary connection of phase to protective systems may be made at the mains position. A simple resistance test between phase and protective connections at each outlet will then verify polarity. In the unlikely event of the phase and protective conductor connections having been transposed at the outlet, correct polarity will still be shown by this method; this error must he overcome by visual verification.

4) **EARTH ELECTRODE RESISTANCE**

- A proprietary earth electrode test device should be used Auxiliary earth spikes should be applied at least 5m apart and 5 m distant from the electrode under test.
- An earth resistance value of less than 2 ohms is required for a Customer Earthed System.
- An additional number of electrodes may be required (or deeper electrodes) to achieve the required earth resistance value
- Due consideration should be given to future changes in soil condition (e.g. drying Out)
- Sufficient time should be allowed if special chemicals or salts are added to the ground to improve the earth resistance values.



15.2.4 MAINTENANCE, PERIODIC INSPECTION AND TESTING

- Maintenance, periodic inspection and testing of every installation shall be carried out to ensure safety and satisfactory performance. The frequency of periodic inspection and testing of an installation shall be determined by the type of installation, its use and operation, the frequency of maintenance and the external influences to which it is subjected. Industrial and commercial installations shall at least be inspected every 2 years by independent consumer/contractor. The consultant/Contractor or person responsible for the maintenance, inspection and testing shall report to FEWA. In writing, any defects found in related parts of the exiting installations and their rectification, together with a schedule of test results.
- Every installation shall be subject to periodic, random inspection by FEWA. The consumer shall arrange rectification of the defects, if any, notified by FEWA, at his own cost.

- The installation should also be periodically inspected by customer and a report on its condition obtained as prescribed in BS 7671 [Appendix 21]

INSPECTION AND TESTING OF ELECTRICAL INSTALLATIONS

- All electrical installations and equipment installed therein, shall be subject to FEWA's inspection, testing and final approval before connecting the electric supply. Contractors shall carryout inspection and testing of the entire electrical installation prior to requesting for FEWA inspection.
- Following specific inspection examples as appropriate to the type of installation shall be referred:

  a) **Distribution equipment**
    - Security of fixing
    - Insulation of live parts not damaged during erection
    - Adequacy/ security of barriers
    - Suitability of enclosures for IP and fire ratings
    - Enclosures not damaged during installation
    - Presence and effectiveness of obstacles
    - Presence of main switch(es), linked where required
    - Operation of main switch(es) (functional check)
    - Manual operation of circuit-breakers and RCDs/ ELCBs to prove functionality
    - Confirmation that integral test button/switch causes RCD(s) to trip when operated (functional check)
    - RCD(s) provided for fault protection, where specified
    - RCD(s) provided for additional protection, where specified
    - Confirmation overvoltage protection/ Surge protection device (SPDs) provided where specified.
    - RCD(s) provided for fault protection, where specified
    - RCD(s) provided for additional protection, where specified
    - Confirmation overvoltage protection/ Surge protection device (SPDs) provided where specified.
    - Confirmation of indication that SPD is functional
    - Presence of RCD quarterly test notice at or near the origin
    - Presence of diagrams, charts or schedules at or near each distribution board, where required
    - Presence of non-standard (mixed) cable colour warning notice at or near the appropriate distribution board, where required
    - Presence of alternative supply warning notice at or near

      1- The origin

      2- The meter position, if remote from origin

3- The distribution board to which the alternative/additional sources are connected
4- All points of isolation of all sources of supply

- Presence of next inspection recommendation label
- Presence of other required labelling
- Selection of protective device(s) and base(s); correct type and rating
- Single-pole protective devices in line conductors only
- Protection against mechanical damage where cables enter equipment
- Protection against electromagnetic effects where cables enter ferromagnetic enclosures
- Confirmation that all conductor connections, including connections to busbars, are correctly located in terminals and are tight and secure

b) Circuits

- Identification of conductors
- Cables correctly supported throughout
- Examination of cables for signs of mechanical damage during installation
- Examination of insulation of live parts, not damaged during erection
- Non-sheathed cables protected by enclosure in conduit, ducting or trunking
- Suitability of containment systems (including flexible conduit)
- Correct temperature rating of cable insulation
- Adequacy of cables for current carrying capacity with regard for the type and nature of installation.
- Adequacy of protective devices: type and fault current rating for fault protection
- Presence and adequacy of circuit protective conductors
- Coordination between conductors and overload protective devices
- Wiring systems and cable installation methods/practices with regard to the type and nature of installation and external influences
- Cables concealed under floors, above ceilings, in walls/partitions, adequately protected against damage.
- Provision of additional protection by RCDs/ ELCBs having rated residual operating current (In) not exceeding 30 mA
  1. For circuits used to supply mobile equipment not exceeding 32A rating
  2. for use outdoors
  3. For all socket-outlets of rating 20A or less, unless exempt
  4. For cables concealed in walls at a depth of less than 50 mm

5. For cables concealed in walls/partitions containing metal parts regard less of depth
- Provision of fire barriers, sealing arrangements so as to minimize the spread of fire
- Band II cables segregated/separated from Band I cables
- Cables segregated/separated from non-electrical services
- Termination of cables at enclosures
  1- Connections under no undue strain
  2- No basic insulation of a conductor visible outside enclosure
  3- Connections of live conductors adequately enclosed
  4- Adequately connected at point of entry to enclosure (glands, bushes etc.)
- Suitability of circuit accessories for external influences
- Circuit accessories not damaged during erection
- Single-pole devices for switching or protection in line conductors only
- Adequacy of connections, including CPCs, within accessories and at fixed and stationary equipment

c) Isolation and switching

- Isolators

1- Presence and location of appropriate devices
2- Capable of being secured in the OFF position
3- Correct operation verified (functional check)
4- The installation, circuit or part thereof that will be isolated clearly identified by location and/ or durable marking
5- Warning notice posted in situation where live parts cannot be isolated by the operation of a single device

- Switching off for mechanical maintenance
  1. Presence of appropriate devices
  2. Acceptable location - state if local or remote from equipment in question
  3. Capable of being secured in the OFF position
  4. Correct operation verified (functional check)
  5. The circuit or part thereof to be disconnected clearly identified by location and / or durable marking
- Emergency switching/stopping
  1. Presence of appropriate devices
  2. Readily accessible for operation where danger might occur
  3. Correct operation verified (functional check)

4. The installation, circuit or part thereof to be disconnected clearly identified by location and/or durable marking

1.13 MAINTENANCE, PERIODIC INSPECTION AND TESTING

- Functional switching
  1. Presence of appropriate devices
  2. Correct operation verified (functional check)

d) Current–Using Equipment (Permanently Connected)

- Suitability of equipment in terms of IP and fire ratings
- Enclosure not damaged/deteriorated during installation so as to impair safety
- Suitability for the environment and external influences
- Security of fixing
- Cable entry holes in ceilings above luminaires, sized or sealed so as to restrict the spread of fire
- Provision of under voltage protection, where specified
- Provision of overload protection, where specified
- Recessed luminaires (downlight)
- 1. Correct type of lamps fitted
- 2. Installed to minimize build-up of heat
- Adequacy of working space/accessibility to equipment

Appendices

Appendices

A1. Reference standards

All equipment, apparatus, materials and accessories complying with the updated relevant recommendations in the following standards/documents shall be deemed to satisfy the requirement of these Regulations, unless otherwise specified.

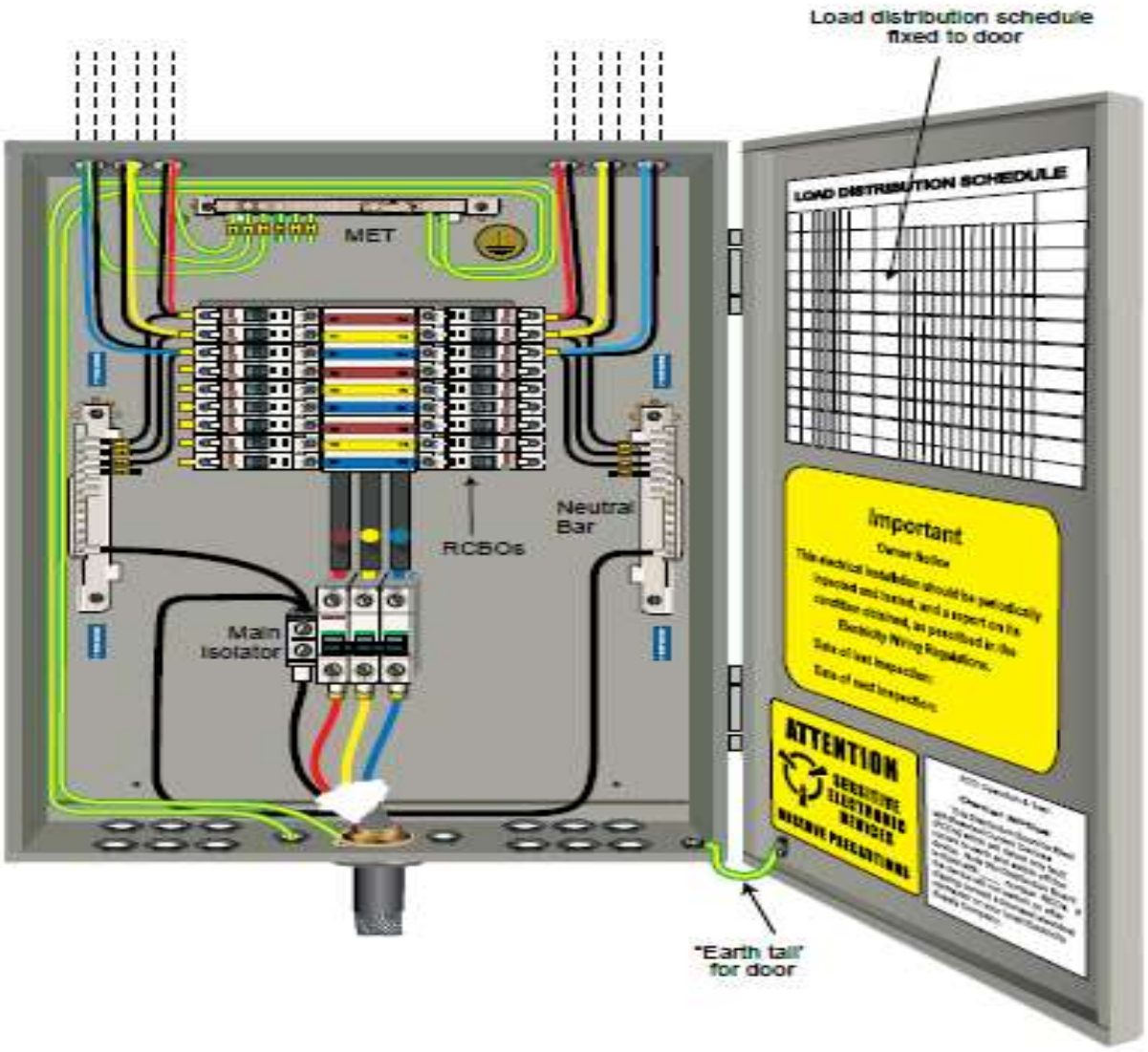
Components	BS	IEC
Cable		
PVC insulation (for power& lighting)	6004, 6346	502
PVC insulation (for switchgear & control wiring)	6231	227
Thermo-setting insulation	5467, 6234 , 7211	
Mineral insulation (copper –clad)	6207, 60702-1	702
Switchgear and control wiring	6231	
Flexible cables & cords (domestic)	6500, 50525-1:2011*, 50525-2-11:2011*, 50525-2-12:2011*, 50525-2-21:2011*, 50525-2-71:2011*	277
Flexible cables & cords (Industrial)	50525-1:2011*, 50525-2-11:2011*, 50525-2-21:2011*, 50525-2-51:2011*, 50525-2-83:2011*, 50525-3-21:2011*	245
Cable glands	6977, 6121	
Crimp connectors	61238	
Cable cleats	61914	
Conduits and conduit fittings		
Steel	4568, 60423*, 61386-21 50086*, 31	423,614
PVC	4607, 6053, 6099	423
Flexible Steel	61386-23	
Degree of protection	EN 60529	529
Distribution assemblies for construction site	4363	364-7-704
Earthing	7430, BS 951	364-5-54
Cable tray	61537*	

Trunking	4678	
Electrical Accessories		
General	5733	
Ceiling rose	67	
Cooker control units	4177	
Plugs & Socket-outlets	546, 1363, 4573	
Switches	60309	
Emergency Lighting	5266	
Hazardous areas	BS 5266	
Household appliances	EN 60335	
Isolating Transformer	61558	
Signs and discharge lighting	559	
lighting	60598	
Low voltage switchgear and control gear assemblies		
General	61439	61439
MCB & MCCB	60898*	898
RCCB/ELCB	BS 4293	
FUSES	88, 60269*	269
Busbar trunking system	61439-6*	61439-6
Neon Signs	BS 559	
Non combustibility test	BS 476	
Trunking, Ducting and fittings	BS 4678 1084	
Thermal classification of electrical insulation	BS 2757 85	
Solar PV system		
Thin-film terrestrial photovoltaic PV modules	61646* 61646	
Crystalline silicon terrestrial PV	61215* 61215	

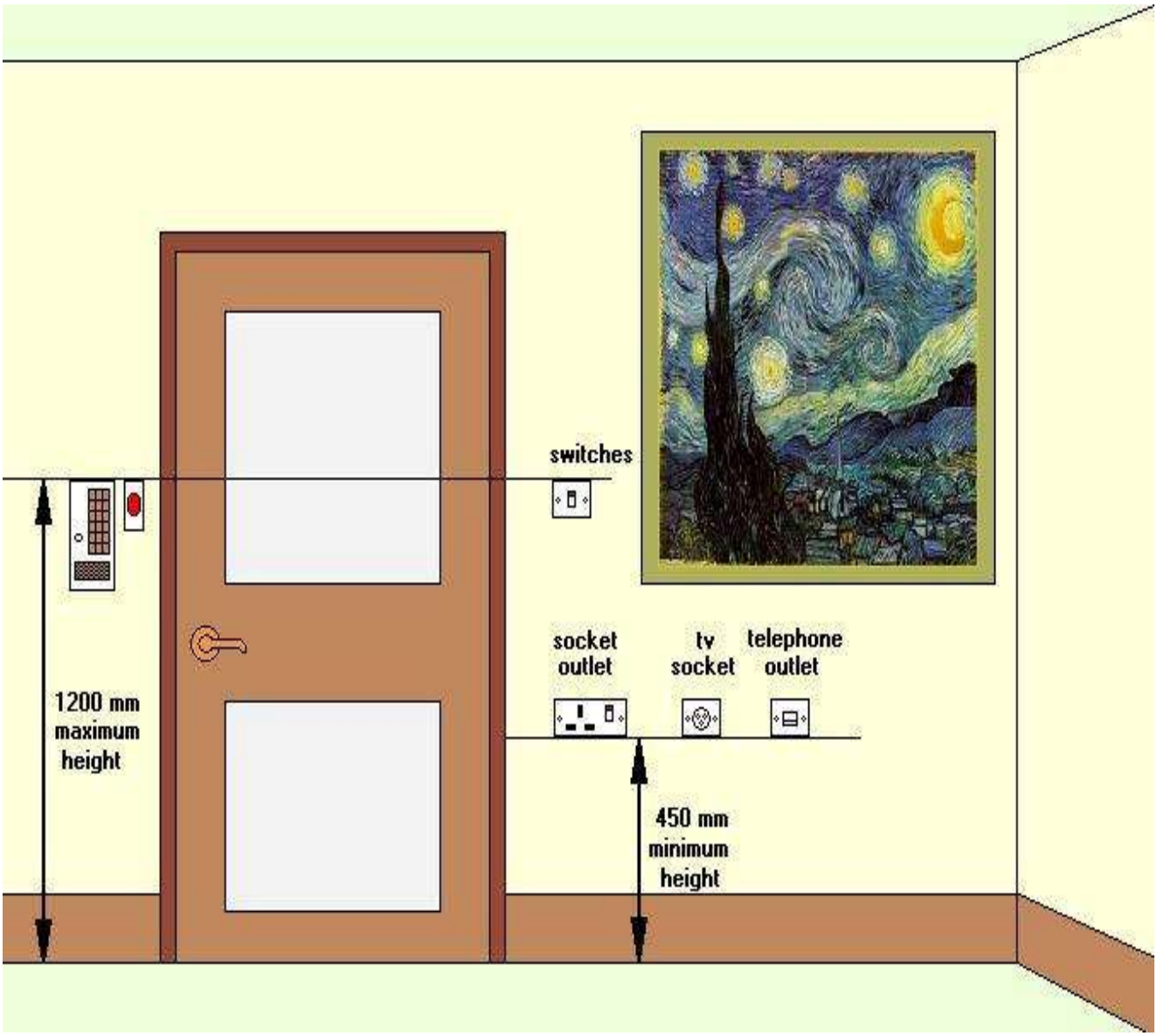
modules		
Solar PV modules safety qualification	61730-1 61730-2 61730-1, 61730-2	
Solar PV inverters degree of protection	60529* 60529	
Solar PV inverters protection class	60664-1* 60664-1	
Solar PV inverters characteristics of the utility interface	61727	
Solar PV inverters EMC Conformance	61000-6-1, 61000-6-2, 61000-6-3, 61000-6-4	
Solar PV inverters Harmonics Conformance	61000-3-2, 61000-3-3, 61000-3-11, 61000-3-12	
Solar PV inverters power converting equipment safety	62109* 62109	
Solar PV d.c. connectors	50521	
RCD Type B	62423, 62423	

A 2-a. (Labelling of Electrical Installation)

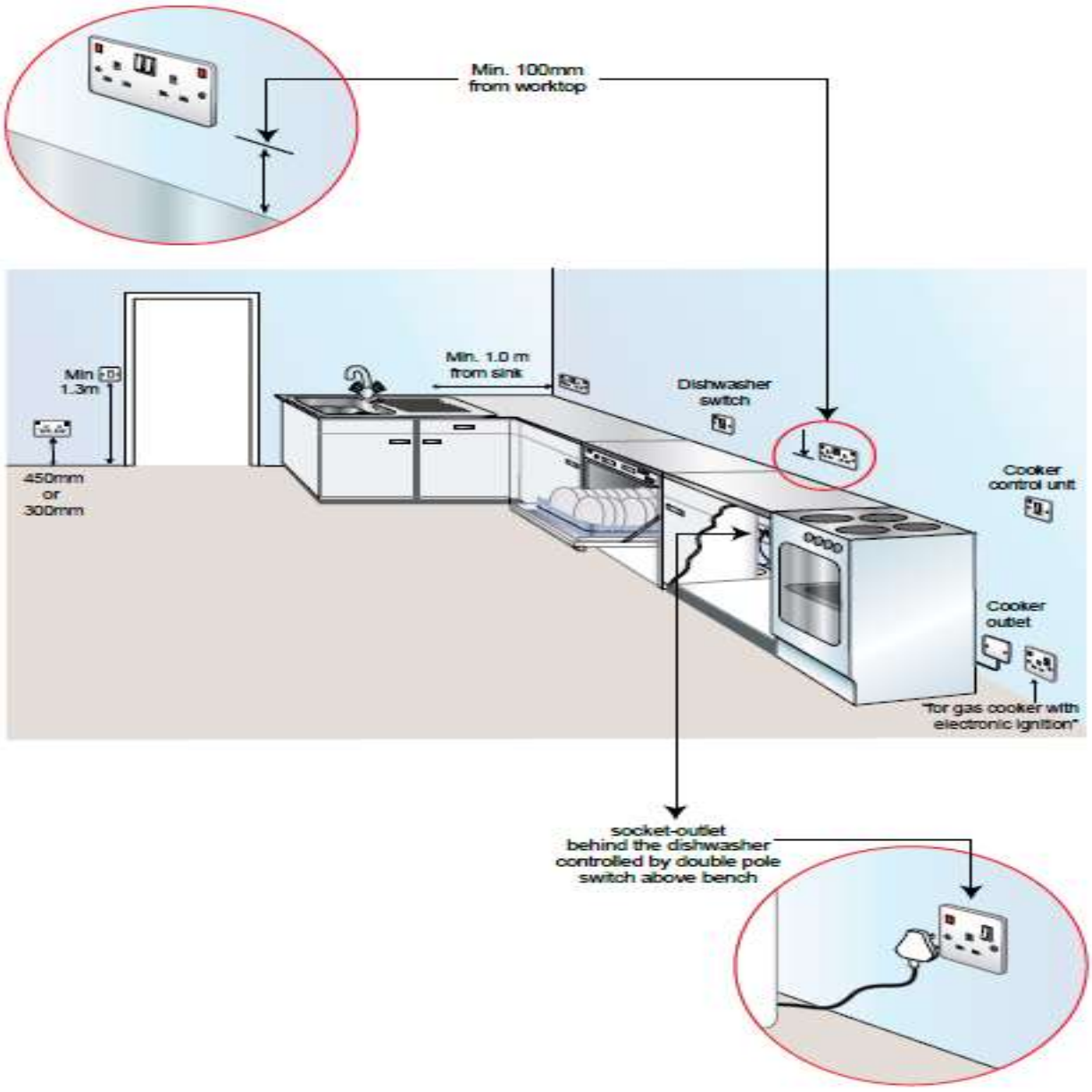
A2-b. (Load distribution schedule attached to final DB)



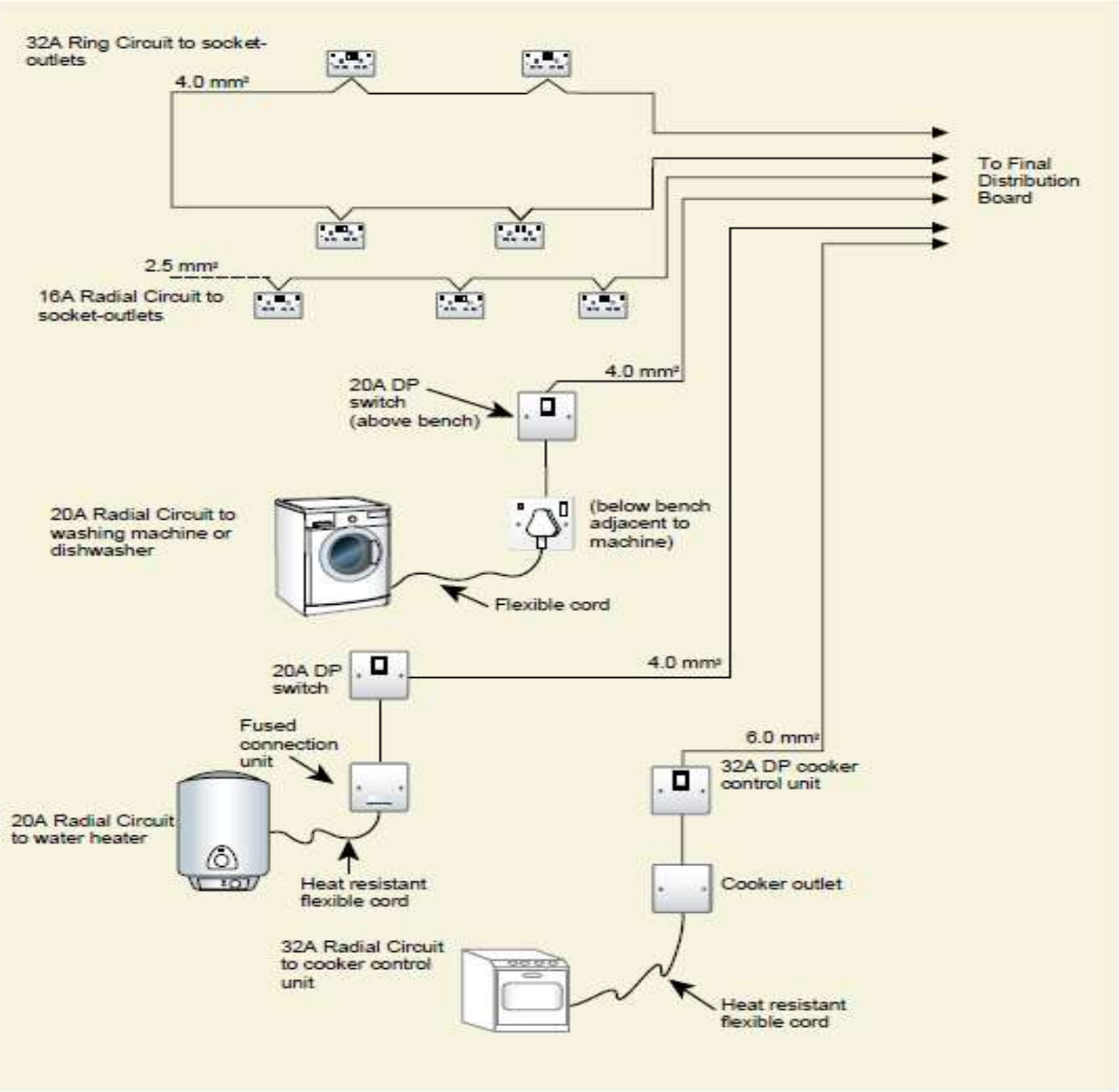
A -3a. (Service Arrangements)



Appendix -3b (Mounting height for Accessories and socket-outlets)



Appendix -3c (Cooker Control Unit)



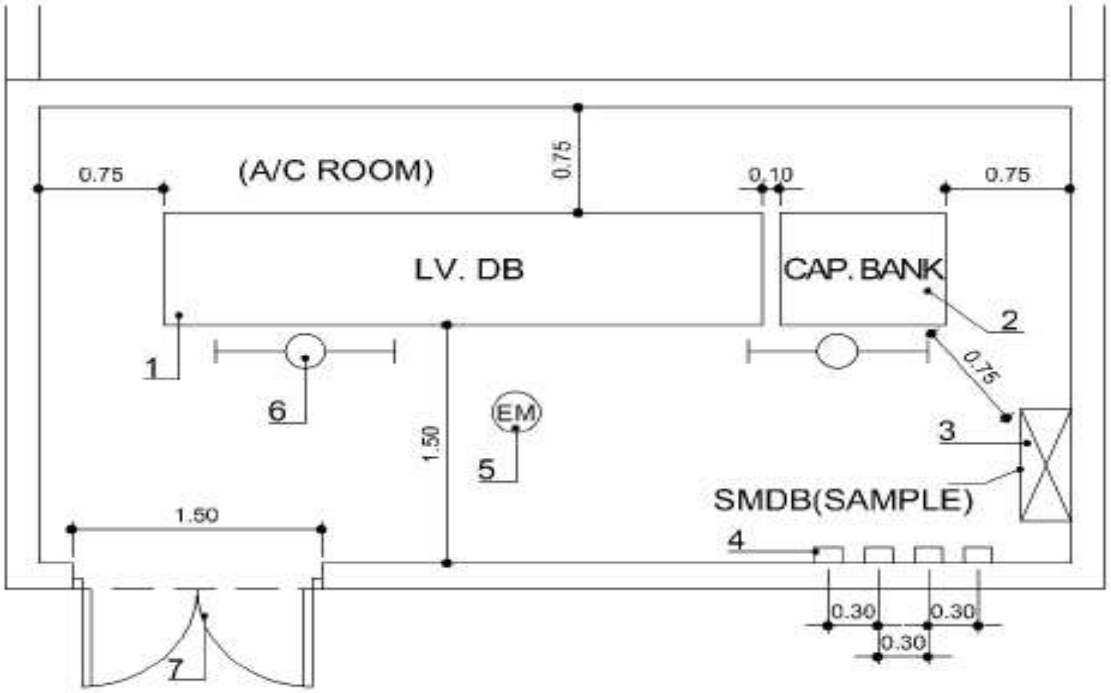
Note 1: heat resistant flexible cords to be sized to match the rating of the Circuit.

Note 2: for cookers with higher power ratings, sizing of the Circuit to be increased accordingly.

Note 3: for connection to fixed Appliances, either fused connection unit or socket-outlet may be provided.

Appendix -4a (Typical Electrical Services room with 1 No. cubicle type LV Switchboard)

TYPICAL ELECTRICAL SERVICES ROOM WITH 1 NO. CUBICLE TYPE LV. SWITCHBOARD / PANEL.



Description :

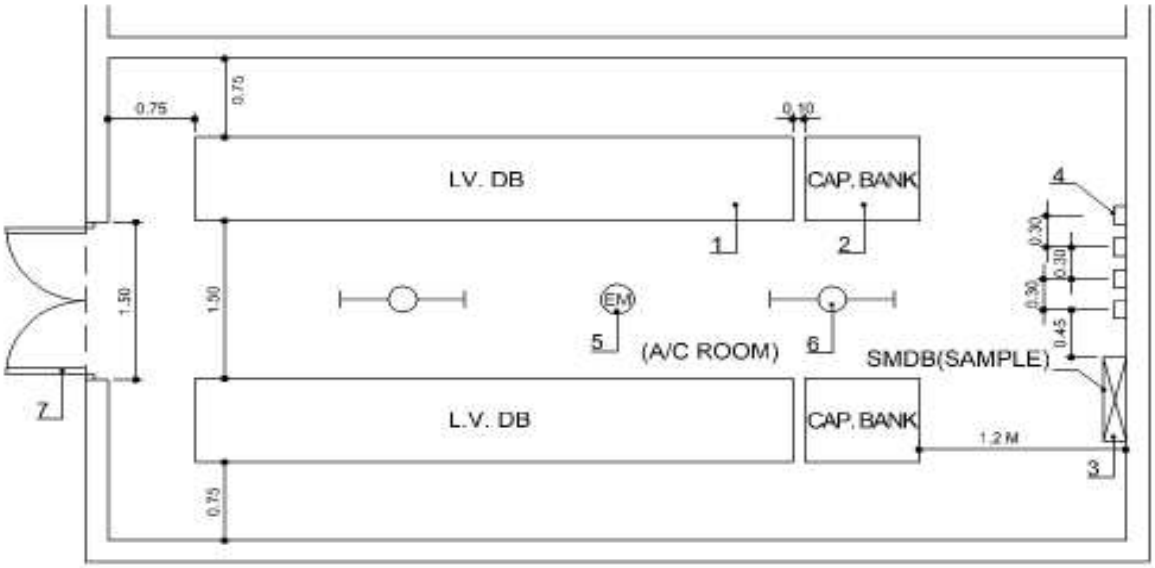
1) LV Switchboard / Panel.
2) Capacitor Bank.
3) Sub Main Distribution Board (Sample).
4) KWh meters.
5) Non-maintained, minimum 3 Hrs. rated, self contained emergency light.
6) Light fitting.
7) Non-combustible door.

Notes :

- All dimensions noted are in meters and not to scale.
- Minimum front clearance – 1.5 mtrs.
  Rear & side clearance – 0.75 mtrs.
- The minimum clear space shown at the sides and rear of the panel is for switchboards with rear access requirements only.

Appendix -4b (Typical Electrical Services room with 2 No. cubicle type LV Switchboard

TWO LV PANELS ARRANGEMENT IN LV SWITCH ROOM



Description :

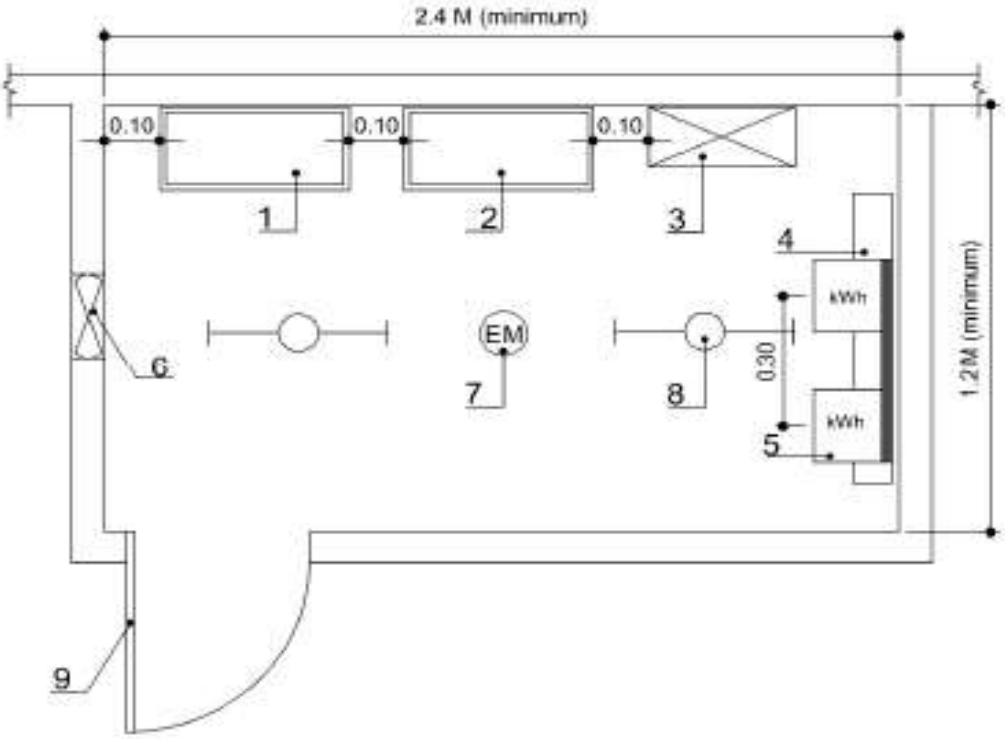
1) LV Switchboard / Panel.
2) Capacitor Bank.
3) Sub Main Distribution Board (Sample).
4) KWh meters.
5) Non-maintained, minimum 3 Hrs. rated, self contained emergency light.
6) Light fitting.
7) Non-combustible door.

Notes :

- All dimensions noted are in meters and not to scale.
- Minimum front clearance – 1.5 mtrs.
  Rear & side clearance – 0.75 mtrs.
- The minimum clear space shown at the sides and rear of the panel is for switchboards with rear access requirements only.

Appendix -4c (Typical Electrical Services room with 1 No. MDB)

TYPICAL ELECTRICAL SERVICE ROOM WITH 1 NO. MDB (MAX. 400 AMPS RATING)



Description :

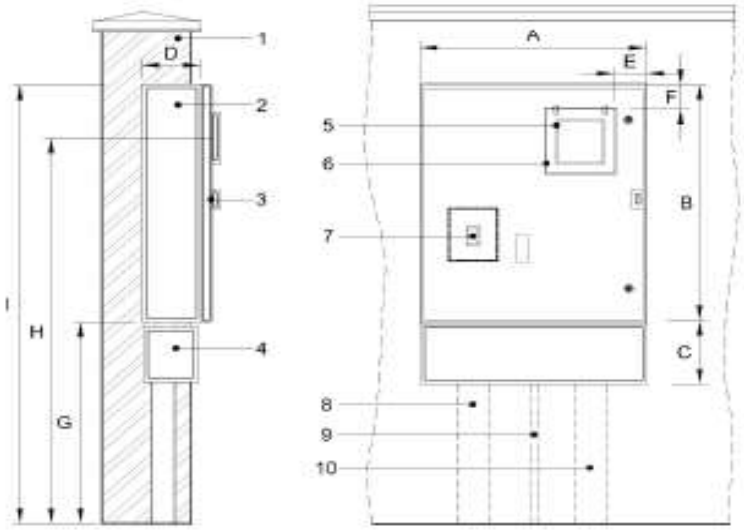
1) Main Meter.
2) Main Distribution Board.
3) Capacitor Bank.
4) PVC/GS trunking.
5) kWh meters.
6) Exhaust fan (for non–air conditioned room)
7) Non-maintained, minimum 3 Hrs. rated, self-contained emergency light
8) Light Fitting
9) Non-combustible door (Louvered type for non-air conditioned room)

Notes :

- All dimensions noted are in meters and not to scale
- Only minimum dimension permitted for electrical room is shown in the layout. Each electrical room shall be designed to accommodate the MDBs / SMDBs, kWh meters, etc. Prior approval shall be obtained for construction

Appendix -5 a (Typical arrangement of metering cabinet on compound wall)

TYPICAL ARRANGEMENT OF METERING CABINET ON COMPOUND WALL



Type of kWh Metering	Dimensions in cm								
	A	B	C	D	E	F	G	H	I
Direct Connected Metering (Up to 125Amps)	60	80	25	20	06	06	80 (Min.)	160 (Max.)	180 (Max.)
CT. Operated Metering (5A Meter & CT Ratio up to 400/5Amps)	80	100	30	25	08	08	80 (Min.)	160 (Max.)	180 (Max.)

Description :

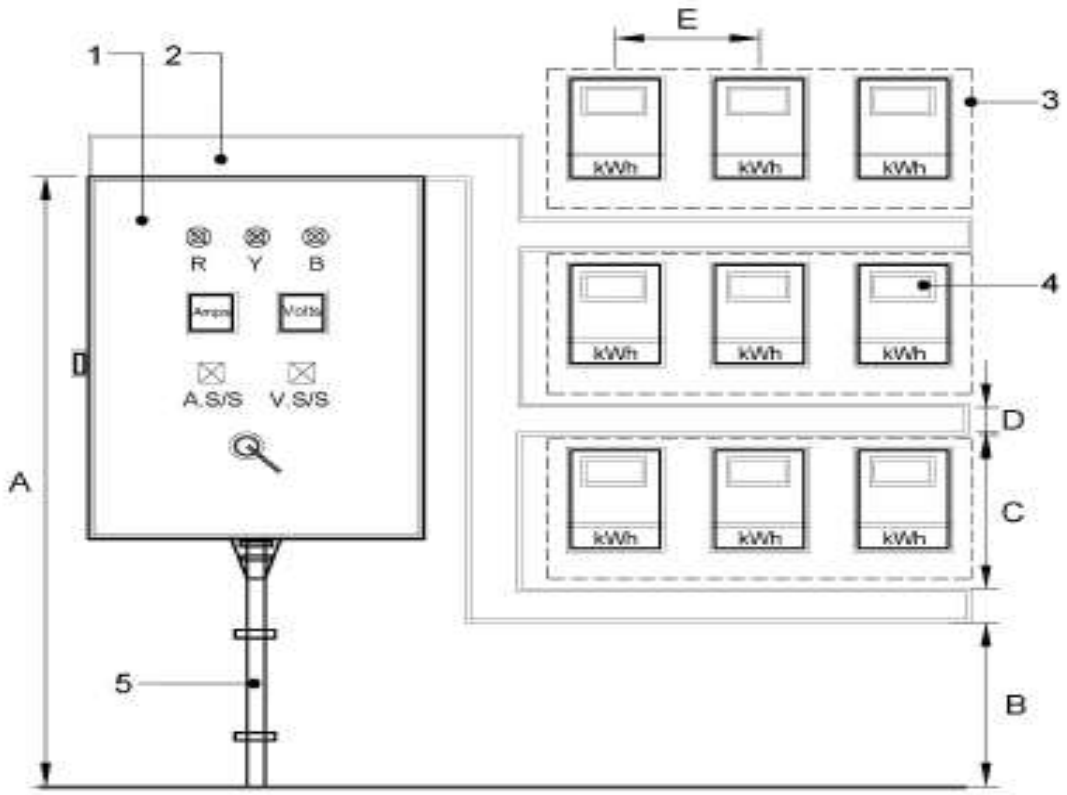
1) Compoundwall
2) Weather proof (IP 55) metering cabinet
3) Hinged door with provision for wire sealing & pad locking (hole size: min. 10mm dia.)
4) Cable (Gland) box
5) Transparent meter viewing window (min. 5mm thickness, size: 15cm x 15cm).
6) Protection cover with hinges on top (size: 20cm x 20cm)
7) Position of incomer breaker
8) 15 / 10 cm PVC pipe sleeve for service cable.
9) Conduit/s for earthing conductors (ECC)
10) 15 / 10 cm PVC pipe sleeve for load cable

Notes :

- CT operated metering: Provide sealable type VT fuses in sealable enclosure
- Minimum 2 mtr. Clearance shall be maintained between electricity and water service cabinets / points.

Appendix -5 b (Typical arrangement of KWh meter in Electrical Service Room)

TYPICAL ARRANGEMENT OF KWh METERS IN ELECTRIC SERVICES ROOM



Dimensions in cm				
A	B	C	D	E
180	60 (Min.)	50	10	30

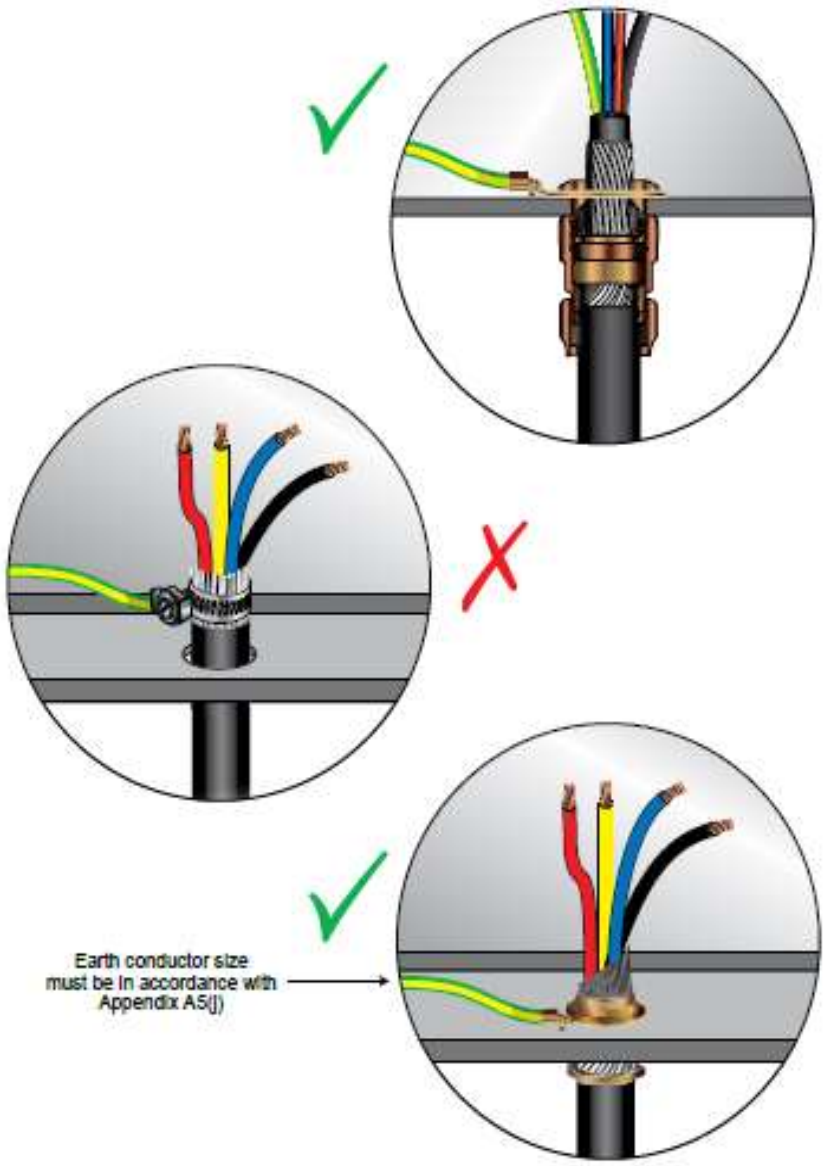
Description :

1) Main / Sub-main Distribution Board
2) PVC / GS trunking
3) Non-combustible type board / plate for fixing kWh meters
4) kWh Meter
5) Supply Cables

Notes :

- Layout indicates only the minimum space, maximum number of rows and arrangement, etc. of kWh meters.
- Earthing details, outgoing circuits & conduit terminations, etc. are not indicated.
- Minimum 2 mtr. clearance shall be maintained between electricity and water service cabinets / points.

Appendix -6 (Cable gland for Earthing of armoured cable)



Note: all glands should be mechanically and electrically sound, secured and tightened using the appropriate tools

Appendix -7 (Selection of Cables)

Recommended size of cables for use in fixed wiring installation for general purpose, and in normal situations

TABLE - 1

Single - Core PVC insulated, non-armoured, Stranded copper Conductors

Size of cables, in 'concealed' conduits		Max. rating of MCB/MCCB (Amps)	Max. Load current/demand (Amps)
2 x 1C, 1 Phase (mm2)	3/4 x 1C, 3 Phase (mm2)		
2.5	2.5	10/15	10/15
4	4	20	20
6	6	25	25
6	10	30	30
10	16	40	40
16	25	50	50
25	25	60	60
35	50	80	80
-	70	100	100
-	95	125	125
-	120	150/160	150/160

TABLE - 2

Multi core armoured PVC insulated, copper Conductors

Size of 1 No., 3/4 C PVC/SWA/PVC Cable installed in normal situations (mm2)	Max. rating of MCB/MCCB (Amps)	Max. Load current/demand (Amps)
2.5	10/15	10/15
4	20	20
6	30	30
10	40	40
16	50	50
25	60	60
35	80	80
50	100	100
70	125	125
65	160	160
120	180	180
150	200	200
185	250	250
240	300	300
300	350	350
400	400	400

TABLE - 3

Multi core armoured XLPE insulated, Copper Conductors

Size of 1 No., Cable installed in normal situations (mm2)	Max. rating of MCB/MCCB (Amps)	Max. Load current/demand (Amps)
10	50	50
16	60	60
25	80	80
35	100	100
50	125	125
70	160	160
95	200	200
120	225	225
150	250	250
185	300	300
240	350	350
300	400	400

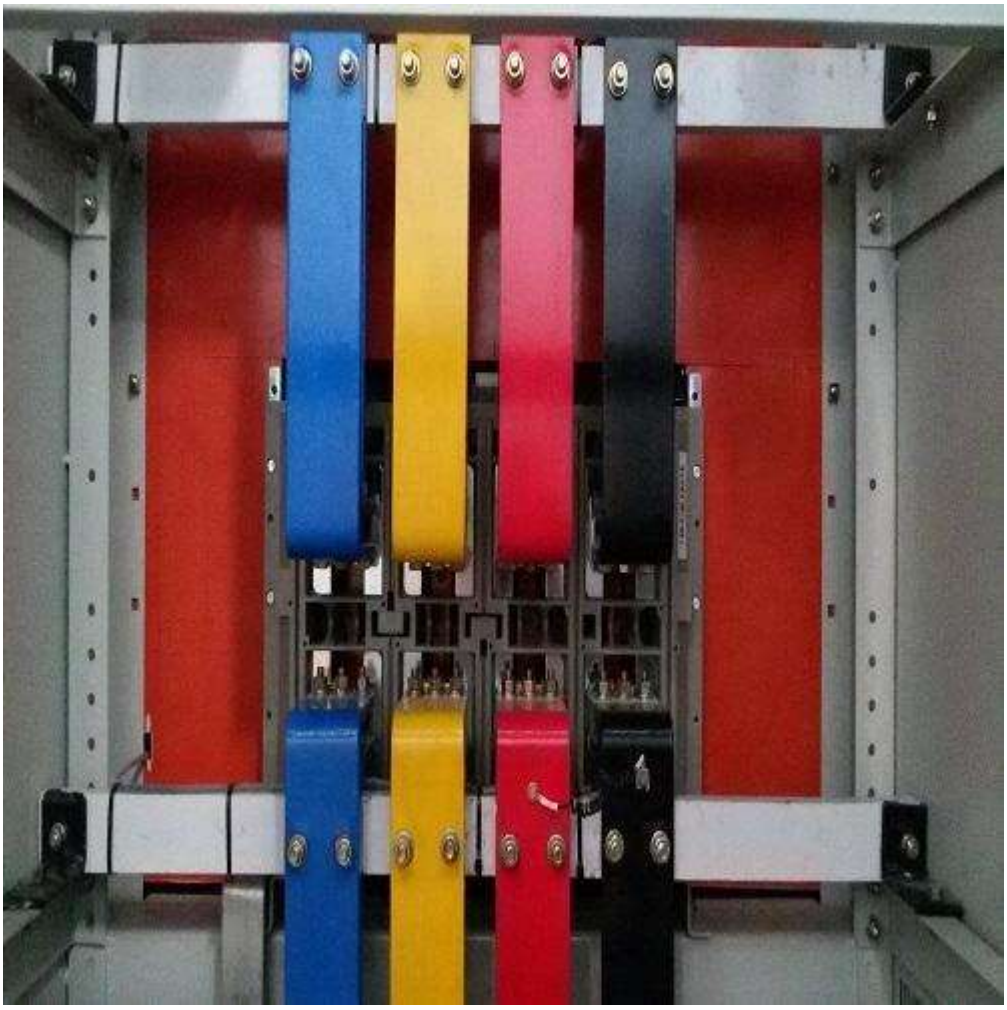
Common notes for Tables 1,2 & 3

1. Assess initial demand with safe diversity and anticipated demand in future, if any, as applicable to individual circuits, for selection of cable size, breakers rating, etc.
2. Assess individual fault levels and select MCBs/MCCBs accordingly.
3. Refer manufacturer's catalogues and select MCBs/MCCBs, cable sizes, etc. for specific applications, considering inductive/capacitive loads, laying conditions, voltage drop, correction factors, etc.

Appendix -8 (Colour Identification for Cables)

Conductor	Colour
Non-flexible fixed wiring and all three –phase cables:	
Phase -1	Red
Phase-2	Yellow
Phase-3	Blue
Neutral	Black
Earth Conductors	Green/ yellow
Functional Earth	Cream
Solar PV system d.c. cables	Black
Flexible Cables for single-phase Appliances :	
Phase-1	Brown
Neutral	Blue
Earth Conductors	Green/ yellow
Functional Earth	Cream

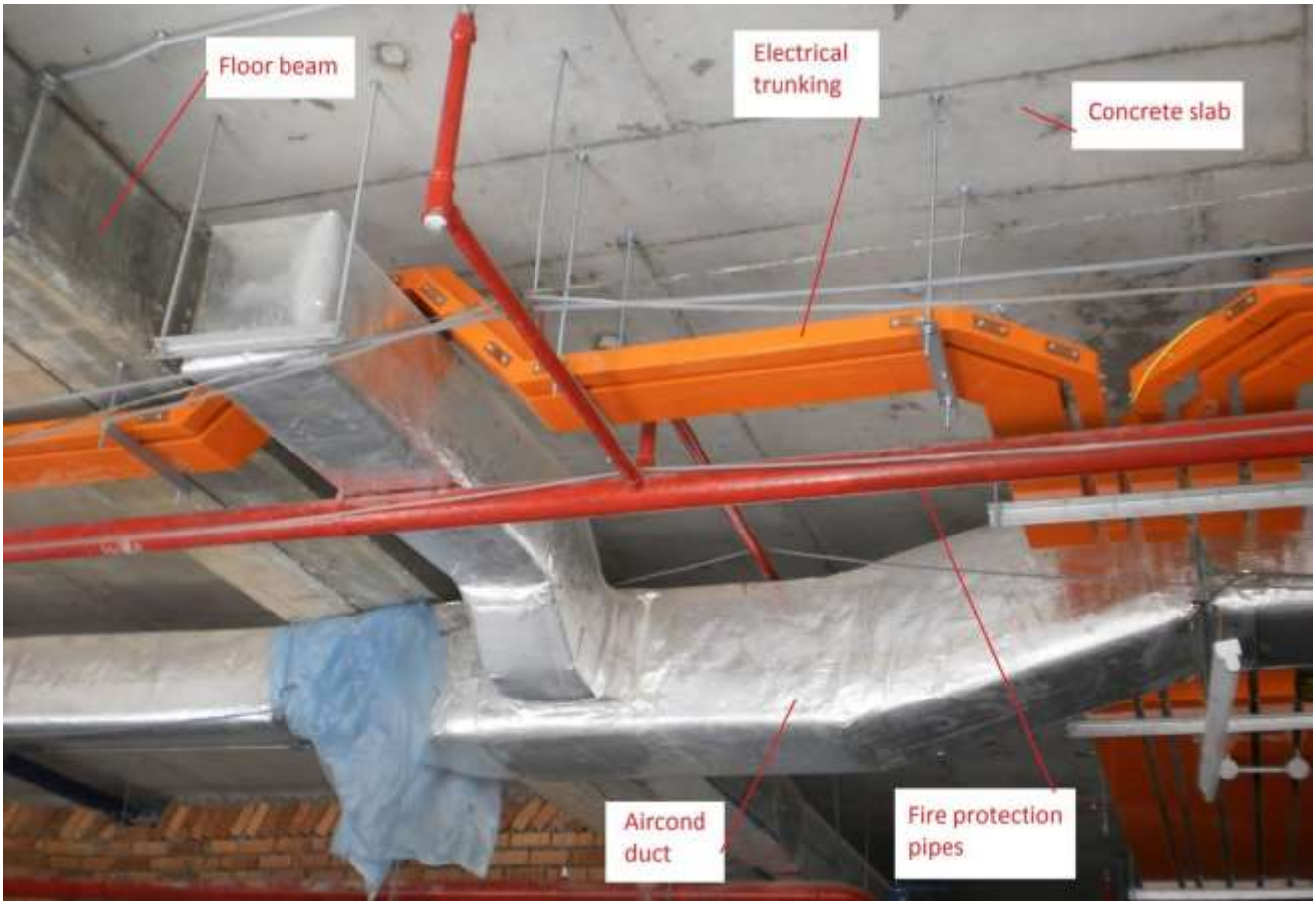
Appendix -9 (bus bar Colour Identification)



Appendix 10 (Bus Riser)

Typical busbar riser system including plug-in circuit breaker

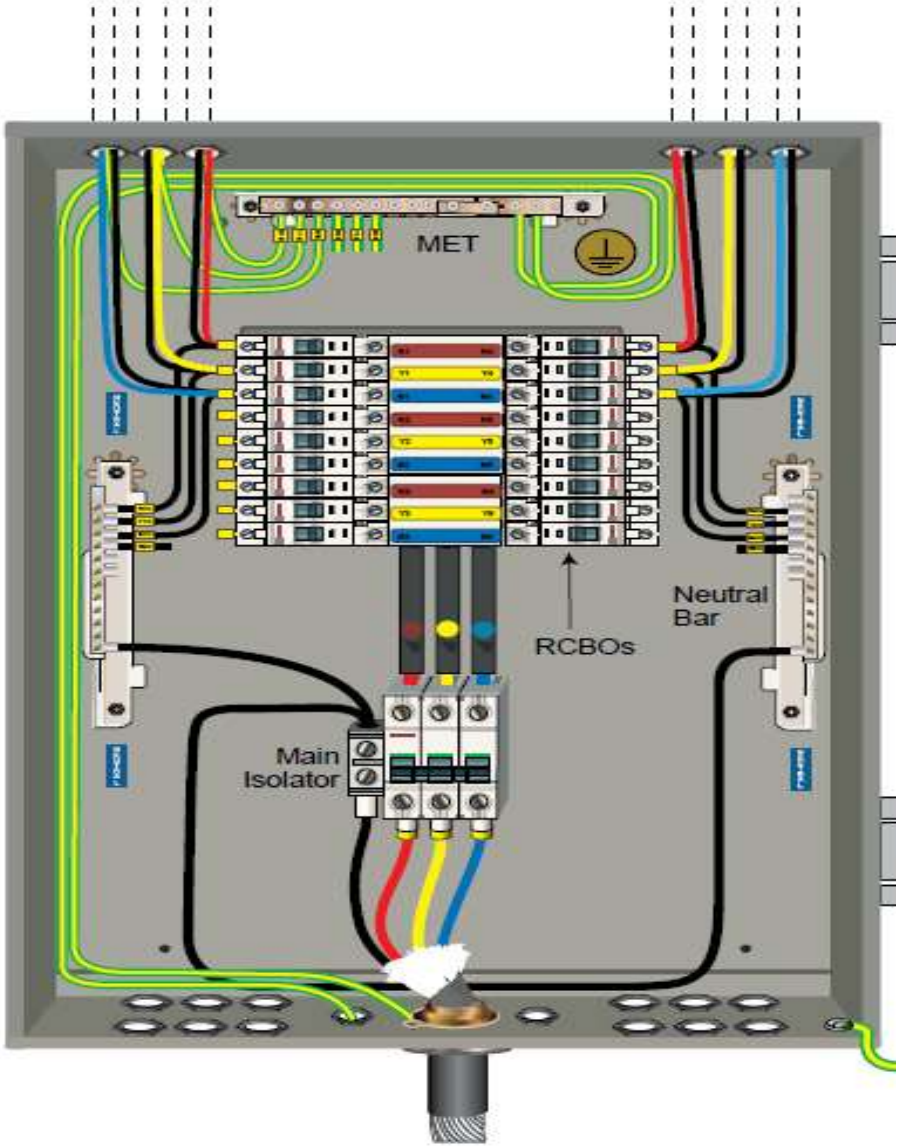
Appendix -11 (Electrical trunking running below soffit of concrete floor)



Appendix -12 (Surface conduit installation)

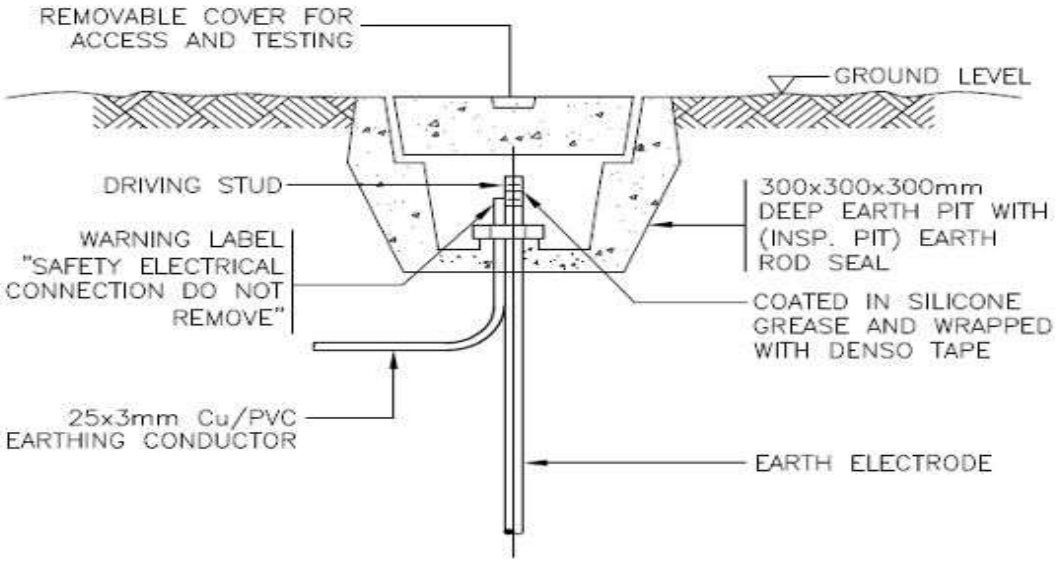
Appendix -13 (Cable Tray)

Appendix -14 (Main & Sub-Main Distribution Board)



Appendix -15 (Neon indicators)

Appendix -16 (Electrical grounding electrode and chamber)



TYPICAL DETAIL OF EARTHING PIT

Appendix -17 (Earth contuinty conductors (ECCS) & Equipotential bonding conductors)

Cross sectional area of phase/neutral conductor (S) (mm^2)	Minimum cross – sectional area of ECC (G/Y PVC insulated copper conductors) (mm^2)	Minimum cross – sectional area of equipotential bonding conductors (mm^2)
S <= 16	S (not less than 1.5)	S/2 (not less than 6)
16 < S <=35	16	10
S > 35	S/2	S/4 (need not exceed 25)

Note 1: for Main Earth Conductors between Earth Electrodes and the Main Earth Terminal of an Electrical Installation, S should be taken as the cross sectional area of the conductors of the incoming supply cable. For Circuit Earth Conductors S should be taken as the cross-sectional area of the Circuit phase conductors.
Note 2: Earth Conductors must always be insulated and a cross-sectional area of less than 1.5 mm2 must not be used unless they are an integral part of a sheathed cable (e.g. an Appliance flexible cord).
Note 3: Main Equipotential Bonding Conductors should be sized according to the live conductors of the incoming supply, but should not be less than 6 mm2.

Appendix -18 (Wiring Inspection form)

الهيئة الاتحادية للكهرباء والماء
Federal Electricity & Water Authority

Electricity Directorate – O&M Department	دائرة الكهرباء – إدارة التشغيل والصيانة
Form Name :Wiring Inspection Sheet	اسم النموذج .....

WIRING INSPECTION SHEET

Owner Name			
Application No.		Project Type	
Area		Contractor	

Inspection Items

Transformer Room

1.	Light units	☐	
2.	Emergency Light	☐	
3.	13 A Socket	☐	
4.	Checker Plate	☐	
5.	Ventilated Door	☐	

LV Electric Room

6.	Light	☐	
7.	Emergency Light	☐	
8.	13 A Socket	☐	
9.	Checker Plate	☐	
10.	Ventilated Door	☐	

Main & Sub Main Distribution Board

11.	Size of MDB incoming / outgoing Bus Bars	☐	19.	Back light sheet	☐
12.	Rating of incoming / outgoing breakers as per approved schedules	☐	20.	Labeling	☐
13.	Rating of breaking capacity as per approved schedules	☐	21.	Earthing MDB & SMDB (Body + Door)	☐
14.	Main cable size as per approved schedules	☐	22.	Meters & capacitor Bank CT Coils	☐
15.	Outgoing cable size as per approved schedules	☐	23.	Capacitor bank in separate cabinet	☐
16.	Earth wire size as per approved schedules	☐	24.	Total KVAR of capacitors as per approved schedules	☐
17.	Gland & Gland earthing	☐	25.	Capacitor bank fuse rating	☐
18.	Earth & neutral looping	☐	26.	Steps of capacitor bank	☐

Earth

27.	Six meters apart	❒
28.	Looping between earth rods	❒
29.	Graze & tape on the earth rode fitting	❒
30.	Earth resistant less than one Ohm	❒
31.	Size of earthing wire	❒

Sockets & Switches

39.	Color coding	❒
40.	Earthing	❒
41.	Size of wires as per approved	❒
42.	Water heater earthing legs	❒

Final DBS

32.	Rating of isolator, ELCB's as per approved schedules	❒
33.	Rating of breaking capacity as per approved schedules	❒
34.	Gland, Gland earthing & Door Earthing	❒
35.	Number of neutral section, referred to ELCB Section	❒
36.	Color coding of outgoing wires	❒
37.	Circuit labeling	❒
38.	Section numbering	❒

Meter

43.	Meters rating as per approved schedules	❒
44.	Type of breaker as per approved schedules	❒
45.	Asbestos sheet behind the meter	❒
46.	Height & number of meter rows	❒
47.	Size of meter wires	❒
48.	Rating of CTs of CT meter	❒
49.	Size of meter enclosure & view glass	❒
50.	Gland & earthing of meter enclosures	❒

Inspection Date	Inspector Name	Start Time	Finish Time	Need Re-inspection	Inspector Signatur
				❒Yes ❒No	
				❒Yes ❒No	
				❒Yes ❒No	

Remark:.....

Service Connection Supervisor / Engineer

.....

Appendix -19 (Wiring Completion Certificate & Test Report)

الهيئة الاتحادية للكهرباء والماء
Federal Electricity & Water Authority

شهادة إنجاز التمديدات وتقرير الفحص
Wiring Completion Certificate & Test Report

Area :	المنطقة :
No. :	الرقم :
Name :	الاسم :

This installation has been completed by M/S ..... on date .....
is accordance with the latest issue of FEWA regulations.
following Test figures have been obtained:
1-Between all poles connected together and earth .....
2-Between poles .....
3-Earth resistance .....
an effective earth electode / earth leakage circuit breaker has been installed .....
4-Polarity of all switches and socket outlets checked .....

أنا / نحن .....
قد قمت بإتمام التمديدات بتاريخ .....
وفق آخر إصدار من قانون وأنظمة التمديدات للهيئة الاتحادية للكهرباء والماء
وكانت نتائج الإختبارات كالتالي :
١ ـ ما بين أقطاب الأسلاك الموصلة ببعض و القطب الأرضي .....
٢ ـ ما بين أقطاب الأسلاك .....
٣ ـ المقاومة الأرضية .....
وقد تم تركيب القطب الأرضي / وقاطع التيار الكهربائي للتسرب الأرضي .....
٤ ـ أجري الفحص لتوصيل الخاص بالمفاتيح و المجوفات .....

The following apparatus are connected to the circuit indicate:

الأجهزة الكهربائية التالية موصلة إلى كل دائرة من دوائر التمديدات التالية :

	Phase A وجه أ	Phase B وجه ب	Phase C وجه ج	
Circuit No. (1)				دائرة رقم (1)
Circuit No. (2)				دائرة رقم (2)
Circuit No. (3)				دائرة رقم (3)
Circuit No. (4)				دائرة رقم (4)
Circuit No. (5)				دائرة رقم (5)
Circuit No. (6)				دائرة رقم (6)
Circuit No. (7)				دائرة رقم (7)
Circuit No. (8)				دائرة رقم (8)
Circuit No. (9)				دائرة رقم (9)
Circuit No. (10)				دائرة رقم (10)
Circuit No. (11)				دائرة رقم (11)
Circuit No. (12)				دائرة رقم (12)

Electrical Contractor ..... مقاول التمديدات الكهربائية
Electrical Contractor License No. ..... رقم رخصة مقاول التمديدات الكهربائية
Signature & Stamp of the Contractor ..... التوقيع و الختم

For official use only للاستعمال الرسمي فقط

Installation inspected on : ..... فحص التمديد بتاريخ .....
Inspector's Name : ..... اسم المفتش .....
Test to earth : ..... Ohm ..... أوم ..... نتيجة فحص الموصل الأرضي
Test between poles : ..... Mega Ohm ..... ميجا أوم ..... فحص توصيلات أقطاب الأسلاك
Inspector's Signature : ..... توقيع المفتش .....

APPROVED يعتمد

Contact Center: 800 3392
CS@fewa.gov.ae www.fewa.gov.ae

Appendix -20 (IP coding for ingress protection)

Ingress protection: IP codes			
First digit: protection against ingress by solid objects		**Second digit: protection against ingress of water**	
X	Not tested or not applicable	X	Totally protected against dust
0	No protection	0	No protection
1	Human hand or objects > 50mm	1	Vertically falling water
2	Human finger or objects > 12mm	2	Sprays of water < 15˚ from vertical
3	Objects > 2.5mm (e.g. tools or wires)	3	Sprays of water < 60˚ from vertical
4	Objects > 1.0mm (e.g. small wires)	4	Splashes of water (from any direction)
5	Limited protection against dust (to the extent that does not harm the equipment or impair safety)	5	Low pressure jets of water (from any direction)
6	Totally protected against dust	6	Strong jets of water (from any direction)
		7	Temporary immersion
		8	Total immersion

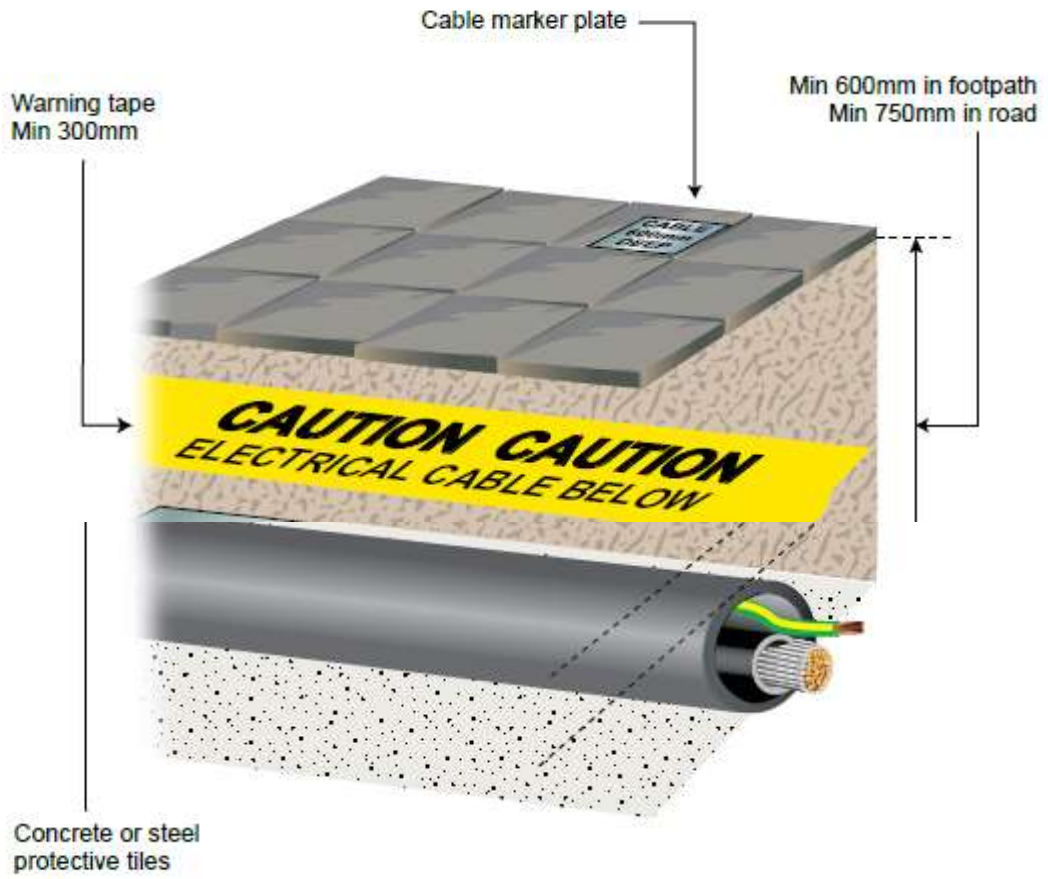
The IP coding system is specified in BS EN 60529: 1992 (adopted from IEC 529: 1989). The first digit specifies protection against ingress of foreign objects of varying size, ranging from human hands or fingers to fine dust particles. The second digit specifies protection against ingress of water, ranging from free falling water, to immersion in water.

BS EN 60529 does not specify protection against the risk of explosion, humidity or corrosive gases. If enclosures of equipment are drilled or knockouts removed, suitable measures should be taken to restore the equipment to the original IP rating.

Appendix -21 (Sequence of Periodic Testing)

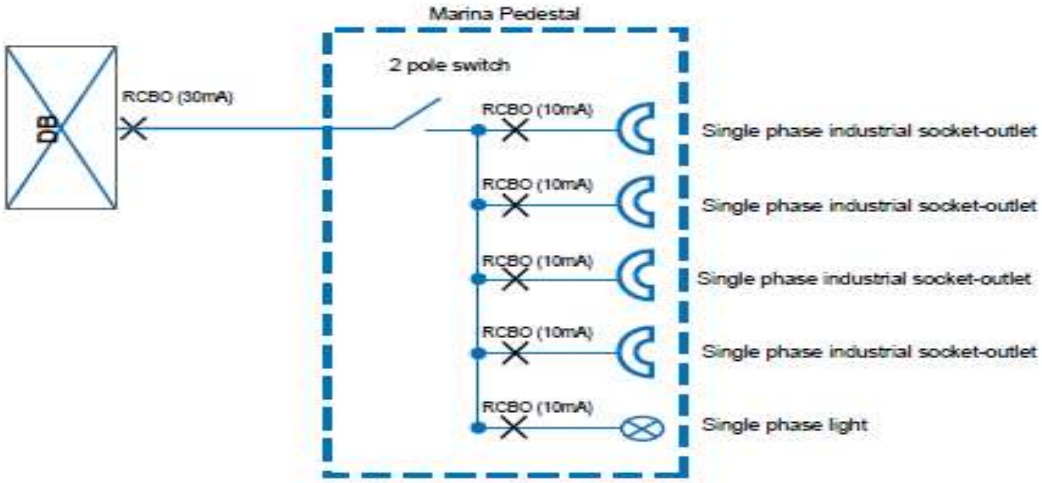
1	Continuity of protective conductors and earth equipotential Bonding
2	Polarity of Circuits
3	Earth Fault Loop Impedance and Prospective Fault
4	Insulation resistance
5	Operation of switches and isolators
6	Operation of residual current devices
Together with the ring final circuit conductors	
7	Continuity of Ring and Final Circuit conductors
8	Earth Electrode Resistance
9	Manual operation of circuit breakers
10	Electrical separation of circuits
11	Insulation resistance of non-conducting floors and walls

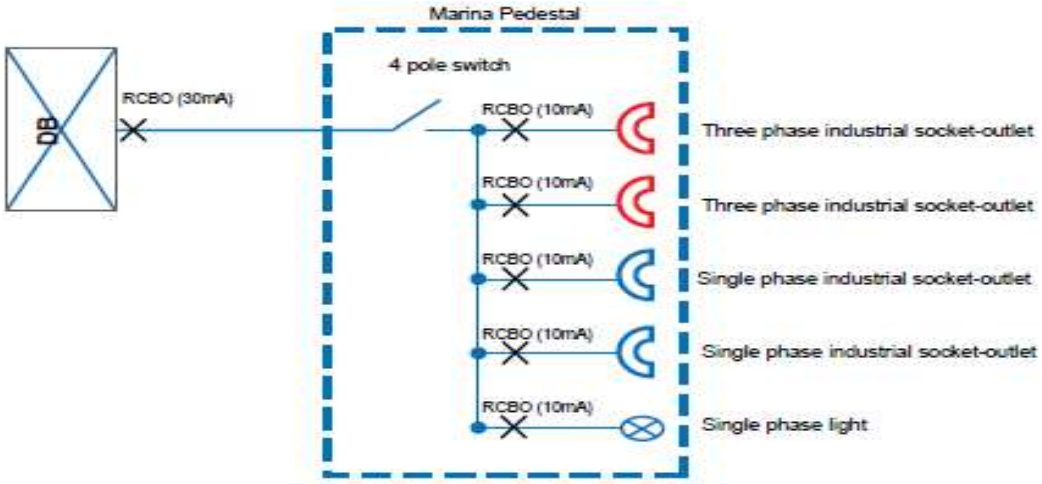
Appendix -22 (Protection of buried cables)



Appendix -23 (General Marinas Connection Arrangements)

Connection to mains supply (single phase and three phase)

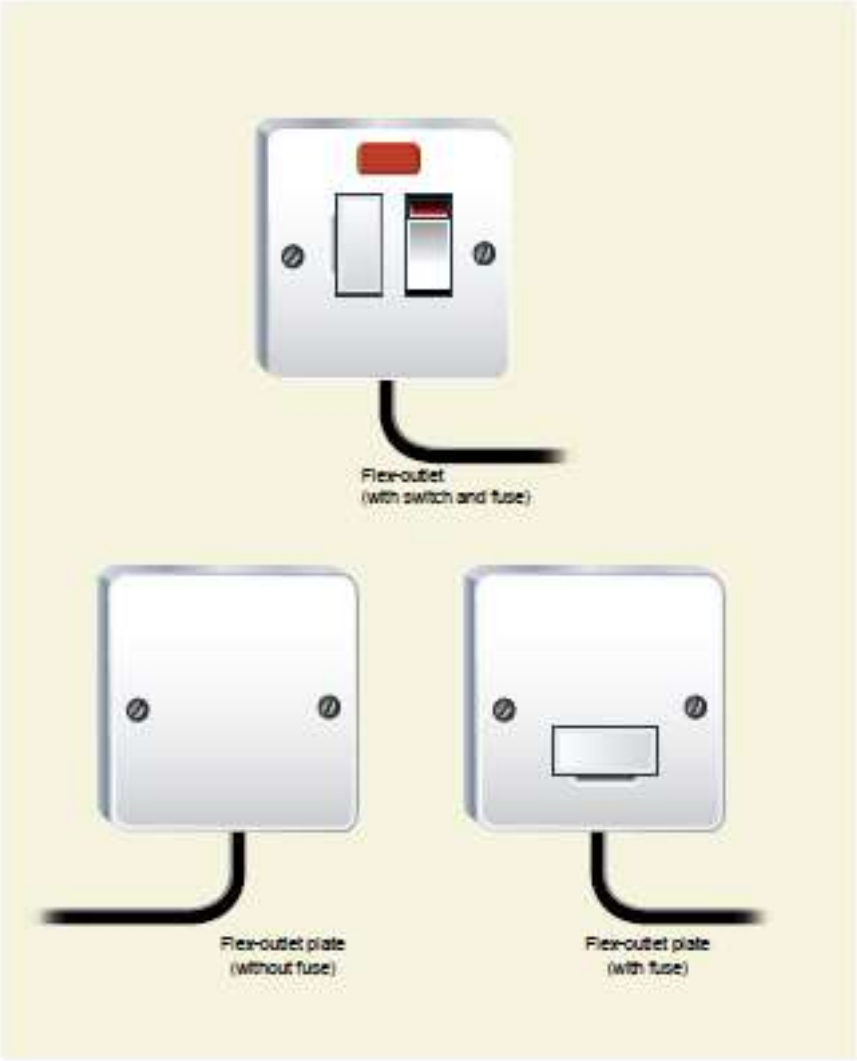




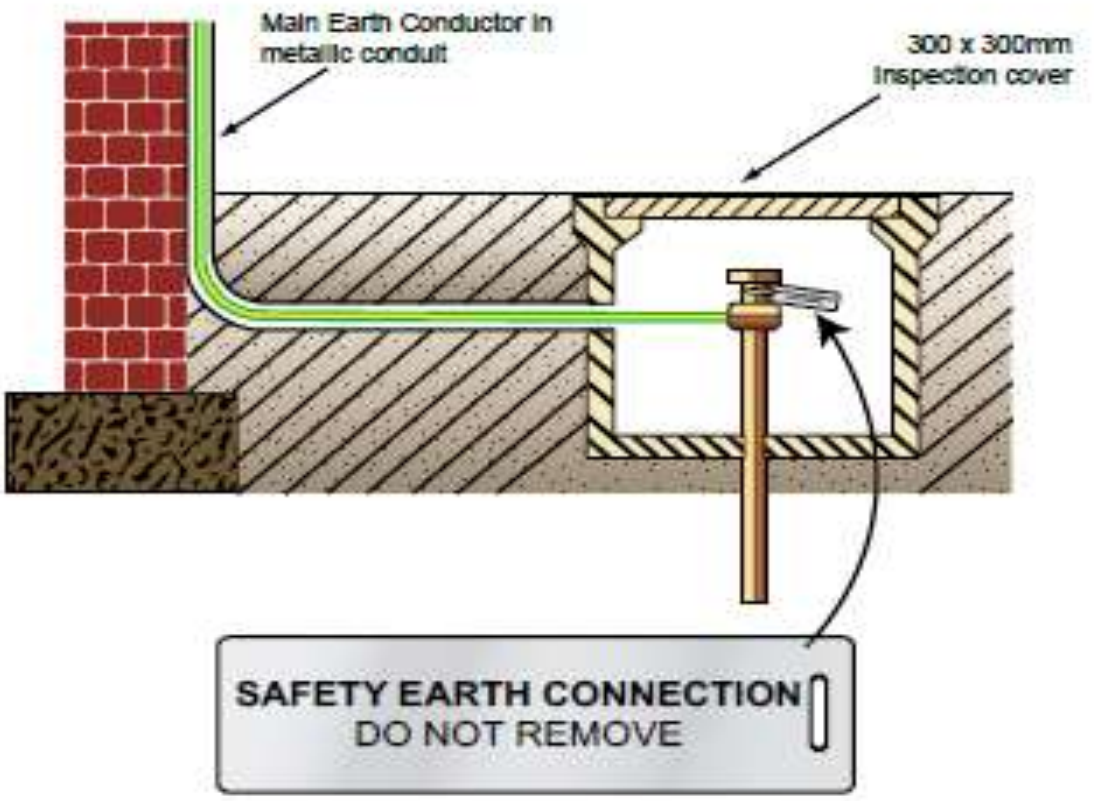
Note 1: protection can be provided by a combination of suitably rated MCBs and suitably rated RCDs.

Note 2: Earth Leakage Protection shall be effective for leakage currents of no greater than 30 mA, refer to clause 9.9.16.

Appendix -24 (Flex- outlet plate)



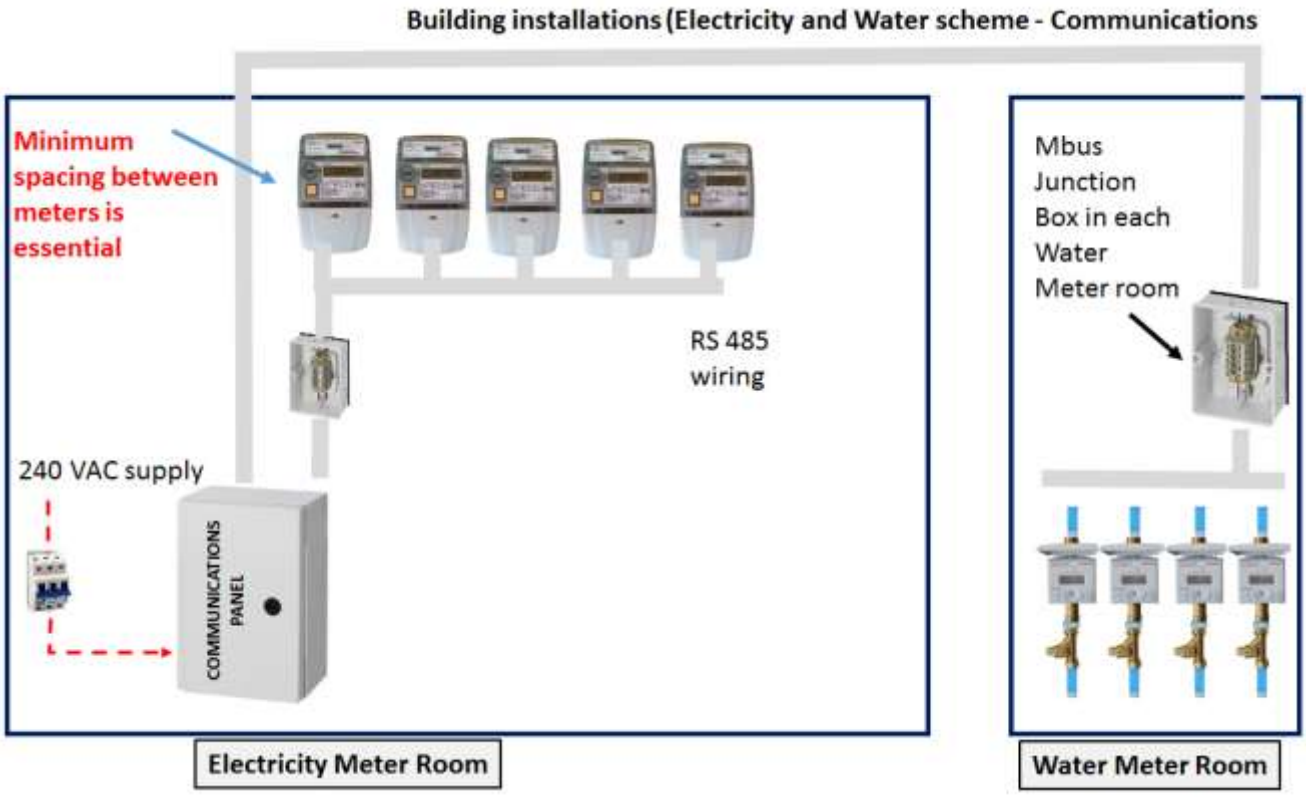
Appendix -25 (Earth Electrode pit and standard labels)



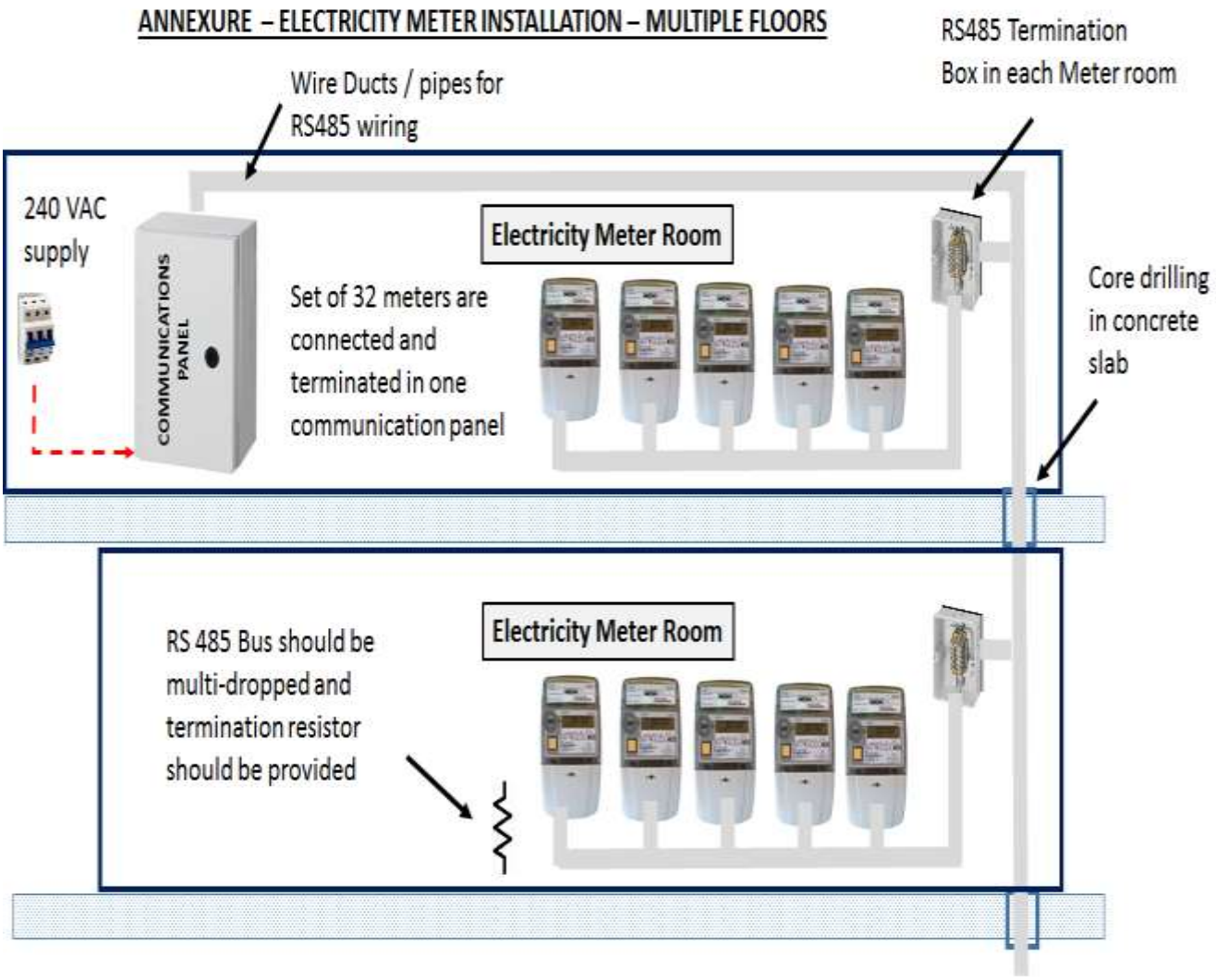
Standard safety label for Main Earth Connections

Standard safety label for main and supplementary bonding connections

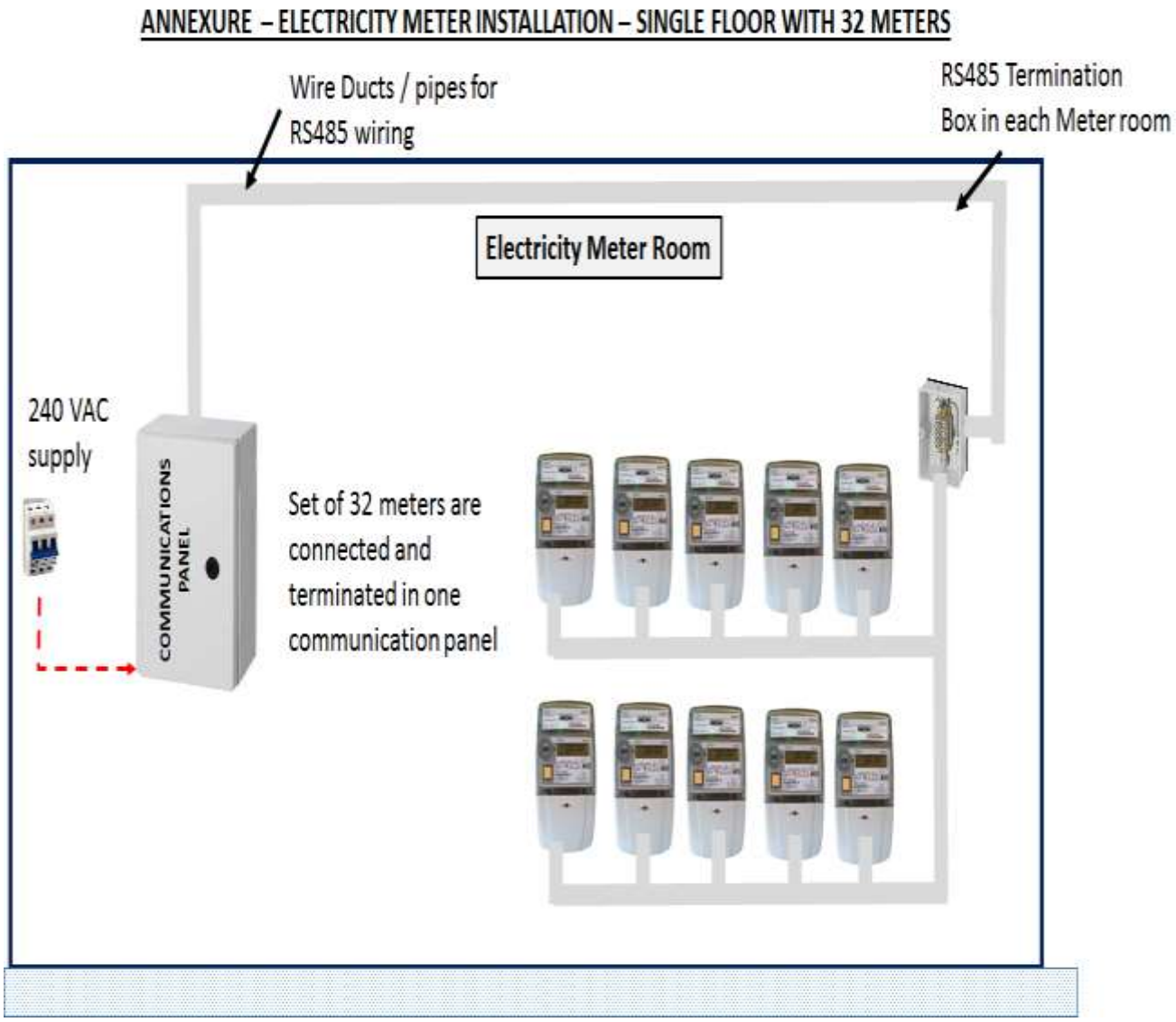
Appendix -26 (Smart Electricity Meter Installation with Communications)



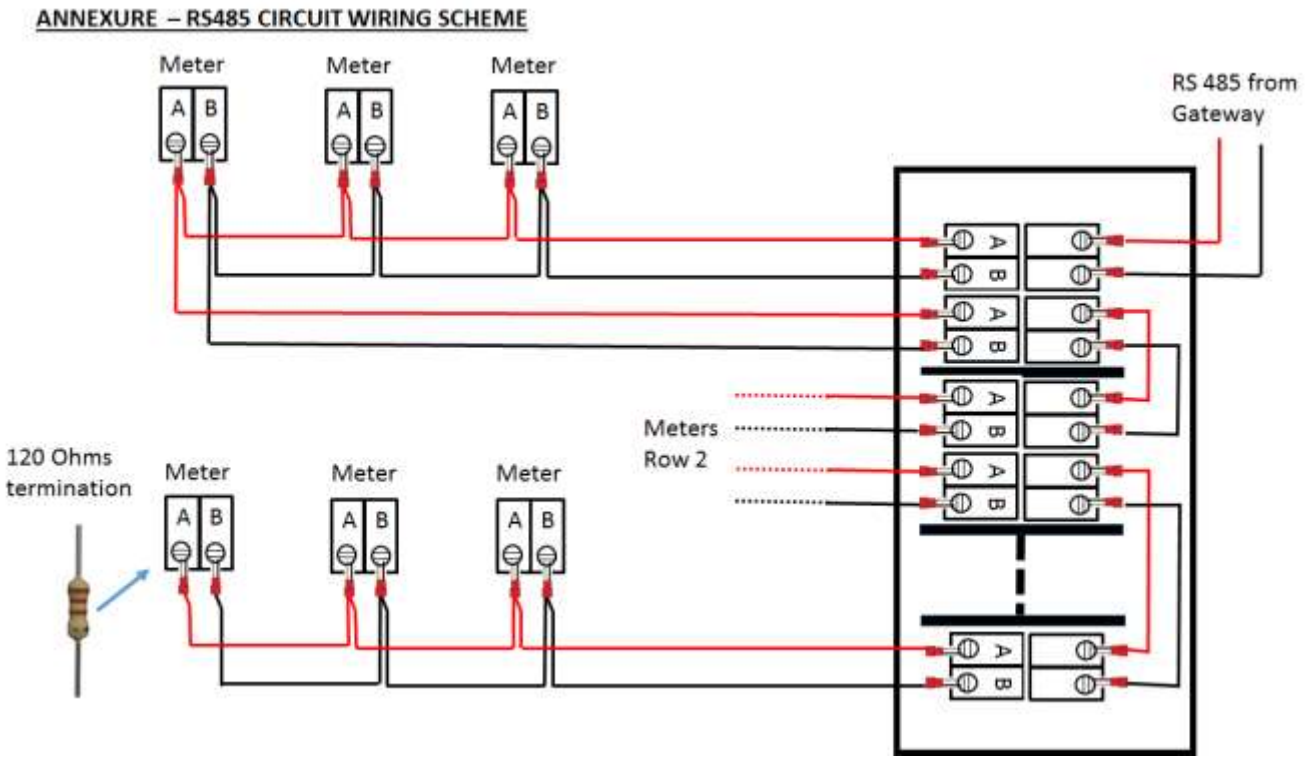
Appendix -27 (Smart Electricity Meter Installation with Communications)



Appendix -28 (Smart Electricity Meter Installation with Communications)



Appendix -29 (Smart Electricity Meter Installation with Communications)



Appendix -30 (Smart Electricity Meter Installation with Communications)