

**OMAN WASTEWATER  
SERVICES COMPANY S.A.O.C**



**الشركة العمانية  
لخدمات الصرف الصحي ش.م.ع.م**

**OMAN WASTEWATER SERVICE COMPANY**

**ELECTRICAL STANDARD SPECIFICATION**

**SECTION 13**

**LIGHTING, EMERGENCY LIGHTING,  
ACCESSORIES AND GENERAL POWER**

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## A - LIGHTING

### 1-0 SCOPE

This Specification defines the requirements for lighting installations, to be installed within Oman Wastewater Services Company projects.

#### 1-1 **Design Criteria:**

- a) Lighting fittings shall be of first class quality, made by approved manufacturers and shall be suitable for trouble free operation on the system voltage at the site
- b) Lighting fittings shall be complete with internal wiring between lamp holder and termination point. Wiring shall be in silicone rubber insulated heat resistant flexible cables
- c) the Contractor shall be responsible for co-coordinating the light fitting installation with any other components of the ceiling systems
- d) all lighting fittings shall be complete with accessories and fixing hardware necessary for installation whether so detailed under fixture description or not
- e) outdoor lighting fittings shall be installed at mounting heights as specified or instructed on site by the Engineer
- f) all outdoor lighting fittings shall be suitably constructed and protected to withstand the corrosive atmosphere and high ambient temperatures of the site, whether indicated under the fittings description or not

### 2-0 STANDARDS SPECIFICATIONS:

The following standards shall apply:

BS 800: Limits and methods of measurement of radio interference characteristics of household electrical appliances, portable tools and similar electrical apparatus

BS 3677 : High pressure mercury vapour lamps

BS 4533 : Luminaires

BS 5225: Photometric data for luminaires

BS 60400: Lamp holders for tubular fluorescent lamps and starter holders

BS EN 60081: Tubular fluorescent lamps for general lighting service

BS EN 60238: Edison screw lamp holders

BS EN 60529: Degrees of protection provided by enclosures

BS EN 60662 :( IEC 662), High pressure sodium vapour lamps

BS EN 60947-1: General rules for low voltage switch gear and control gear

BS EN 61167: Metal halide lamps

### 3-0 PRODUCTS

#### 3-1 **Lamps:**

- a) Lamps shall be furnished and installed in all luminaires covered under the Contract
- b) Lamps used for temporary lighting services shall not be utilised in the final use in fixture units
- c) lamps for permanent installation shall not be placed in the fixtures until so directed by the Engineer, and this shall be accomplished directly before the building areas are ready for occupancy by the Employer
- d) lumen output of lamps shall be in accordance with BS EN 5225
- e) Generally, high output, low consumption, tri-phosphorus lamps shall be used, unless otherwise indicated.

##### 3-1.1 Fluorescent Lamps:

- Tubular fluorescent lamp shall comply with BS EN 60081
- Tube colour: cool white, unless otherwise indicated.
- Fittings shall comply with BS 800, for suppressing radio frequency interference.

##### 3-1.2 High Pressure Mercury Vapour Lamps:

- colour: deluxe white
- lumen output of lamps shall be in accordance with BS 3677
- burning position: universal.

##### 3-1.3 High Pressure Sodium Lamps

- wattage as indicated in the schedule of luminaires
- lamps with a high colour rendering index of 80 shall be used as indicated, suitable for indoor applications
- Lumen output of lamps shall be in accordance with BS EN 60662.

##### 3-1.4 5 Metal Halide Lamps

- wattage as indicated in the schedule of luminaires
- lumen output of lamps shall be in accordance with BS EN 61167

### 3-1.5 Control Gear For Fluorescent Lamps:

- high frequency electronic ballast not less than 25 kHz to IEC 928, unless specified otherwise
- when specified, conventional type low loss ballast with electronic starters shall be used and shall provide flicker free operation, as indicated in the Project

### 3-1.6 Lamp Holders:

- Lamp holders for fluorescent lamps shall be the spring loaded rotary type, to BS 6702.

## 3-2 Luminaires

- a) Luminaires shall be manufactured to BS 4533 with an appropriate IP classification to BS EN 60529.
- b) All lighting fittings shall be supplied complete with appropriate control gear where necessary,
- c) All the fittings shall have the same appearance, material, technical details and approximate dimensions.
- d) Luminaires shall be connected to the main circuit wiring with heat resistant flexible cables of a minimum conductor size of 1.5 mm<sup>2</sup> insulated with silicon rubber.
- e) Break joint rings shall be used in conjunction with batten holders, ceiling roses or back plates mounted onto a flush installation.
- f) Standard fluorescent luminaires shall have two suspension or fixing points.
- g) All lamp-holders for flexible pendants shall be of the all insulated skirted pattern with code grips and for batten or wall mounting shall be of similar pattern. All lamp holders shall be of the bayonet cap pattern.
- h) The glassware diffusers, shades and lamps shall not be fitted until all building work is complete.
- i) All fittings shall be easy to clean inside and outside, when mounted.
- j) Diffusers on fluorescent luminaires shall be poly-carbonate unless otherwise specified.

### **3-3 Termination/Earthing**

- a) Fused terminal blocks shall be fitted and be of sufficient capacity for the wiring involved.
- b) Each terminal shall be capable of accommodating two 2.5 mm<sup>2</sup> conductors.
- c) Connector strip terminals shall have a current rating not less than the rating of the circuit protective device and shall be encapsulated in self-extinguishing grade polyethylene.
- d) Where connector strips are provided in boxes behind heat producing appliances, porcelain connectors shall be used where temperatures in excess of 70 °C are likely.
- e) Conductors shall be clamped between metal surfaces such that no screws make direct contact with the conductor. The metal used in construction of the connector shall be at least 85 °C copper alloy such that good conductivity and electrolytic compatibility are maintained at all times.
- f) All light fittings shall be provided with an earthing terminal which shall be connected to the earth continuity lead of the final sub-circuit.
- g) The earthing of all pendant or semi-pendant fittings shall be by a separate core in the connecting flex or cable securely bonding the earth terminal on the fitting to the glanded joint of interconnecting cables. In no case shall pendant chains or conduit support tubes be used as a means of earthing.

### **3-4 Ceiling System:**

- a) In false ceilings, luminaires whether surface or recessed mounted shall not be supported by the false ceiling construction. Separate independent supporting systems shall be provided for each luminaire, comprising drop rods, chains or similar.
- b) Luminaires installed in false ceilings shall be connected to the lighting circuit using mechanically coupled plug-in ceiling roses.
- c) Luminaires shall be positioned to provide ease of access for maintenance, cleaning etc., while not impairing the distribution of light.
- d) The Contractor shall ensure that the luminaire manufacturer has the correct details of the ceiling system, including suspension, tiles, etc. He shall ensure that the luminaires are supplied with the correct trim, suspension system and are fully compatible with the ceiling system.

### 3-5 Noise and Interference

- a) The noise level from control gear, obtained from the average of sound pressure levels each measured at 2000 mm from the control gear in at least five positions (on each side and below), shall not exceed 30 dB Scale “A” (Noise Rating Number).

### 3-6 External Lighting:

- a) External lighting system shall consist of supply and installation of lighting columns, foundation and fixing of the columns, underground cabling, high pressure sodium vapour lamps or as specified, and control equipment as required
- b) contactor units, where specified incorporating a controlling photo-cell and time switch, shall be provided within the external lighting distribution board for the control of external lighting
- c) Underground lighting cabling shall be XLPE or PVC/SWA/PVC.
- d) Lighting columns shall be hot-dip galvanized steel of either tapered or tubular construction complete with luminaire fixing arms or brackets, as per design.
- e) all columns shall be externally painted with 2 coats of aluminium paints, internal surface including the studs inside the cable connecting box with red lead anticorrosive paints, the finishing shall be micaceous iron oxide paint pigmented with aluminium the column shall be equipped with auxiliary control gear and a 15 amp. single pole and neutral cut-out (with a three phase and neutral terminal block), two cable glands and two entry slots in the base of the pole for incoming and outgoing cables
- f) columns shall be provided with base plates having fixing holes and anchor bolts for foundations unless specified otherwise, the column length shall be 5m including buried part or 4m when plinth mounted. The diameter at the bottom shall not be less than 120 mm.
- g) All external lighting fittings shall be adequately earthed.
- h) Control gear shall form an integral part of the lighting fittings except where specified, or where this is not possible, it shall be totally enclosed in a housing to suit the installation location.
- i) All external fittings shall be dust-tight and waterproof to IP 65.

#### **4-0 INSTALLATION**

##### **4-1 Lighting Installation**

a) Terminations:

- General fluorescent fittings mounted direct to conduit outlet boxes shall have the circuit wiring run direct to the fittings terminal position. Flexible conduit pigtail shall be provided for all fixtures to J-boxes
- Terminations for recessed, or semi-recessed pattern fittings fitted in false ceilings, shall have the circuit wiring terminal above the ceiling, in a ceiling rose. Outlets shall be mounted adjacent to the fitting.

##### **4-2 Installation of Lamps**

- Generally install new lamps in all luminaires at substantial completion of work.

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## B - EMERGENCY LIGHTING

### 1-0 SCOPE:

This Specification defines the requirements for emergency lighting and accessories installations, to be installed within Oman Wastewater Services Company projects.

### 2-0 STANDARDS SPECIFICATIONS:

The following standards and documents shall be complied with:

- BS 4533 General requirements and tests
- BS 4533 Luminaires for emergency lighting
- BS 5225 Method of photometric measurement of battery operated emergency lighting luminaires
- BS 5266 Emergency lighting
- BS 7671 Requirements for electrical installations
- BS EN 60529 Degrees of protection provided by enclosures (IP code)
- OES

#### Warranty

- Battery units, luminaires and accessories shall be warranted for a minimum of 5 years by the manufacturer.
- The battery shall have minimum 10 years useful life.

### 3-0 PRODUCTS

#### 3-1 General

- Emergency lighting installations shall be complete with emergency batteries, chargers, luminaires and wiring, all as described in Specifications and as indicated on the Project Drawings, complying with BS 5266 Part 1.
- Non-maintained luminaires shall be supplied directly from the battery system.
- Maintained exit luminaires etc., shall be supplied from a separate supply via an independent transformer and shall only operate from batteries during mains failure.

- The operation of the system shall be such that on loss of one or all phases of the main electricity supply, a set of central batteries or individual battery packs shall provide power for 3 hours to illuminate emergency luminaires throughout the building. On restoration of the mains supply the batteries shall be charged by an integral charger such that the system supplies not less than 85 % of its rated voltage after a period of 12 hours.

### **3-2 Central Battery Units:**

#### **3-2.1 Battery chargers:**

- Battery chargers shall be installed in purpose-made metallic enclosures with an index of protection IP 31 in accordance with BS EN 60529 suitable for wall or floor mounting, depending on size
- Battery charger enclosures may house the system batteries providing the design of the enclosure ensures safe operation with the batteries specified. This arrangement should normally be restricted to smaller systems e.g. for circuit breaker tripping supplies for power supply to emergency lighting system, central battery units shall be wall or floor mounted as required, conforming to BS 4533 Section 102.22, and be of robust, high quality construction. Enclosures shall be metal, with hinged lockable doors and with suitable ventilation provided
- Battery charger shall operate from a 415 V, three phase or 240 V, 50 Hz single phase supply, unless otherwise specified
- battery charger shall be rated to supply trickle charge and any standing loading plus any additional recharging load that may be imposed
- Battery charger shall use an uncontrolled bridge as the input stage to minimize harmonic generation on the supply system. The characteristics of each charger shall match the requirements of the specific batteries selected and the duty cycle
- Battery charger shall be suitable for fully automatic charging of the appropriate battery and shall be provided with:

- § Mains 'ON' lamp
- § Main ON/OFF switch
- § Charge Ammeter Discharge Ammeter
- § Battery voltmeter
- § Test switch facilities
- § Contactor/relays to BS 5266 Part 3
- § fault protection
- § output current limitation

§ lamp indication for appropriate faults e.g. charger fail, low volts etc., with lamp colours in accordance with BS EN 60073

- g) Units shall be provided with composite output distribution boards of the sizes and types indicated on the Project Drawings
- g) Units shall be installed complete with all necessary fixings, maintenance equipment and instructions.

### 3-2.2 Batteries:

- a) Batteries shall be suitable for the discharge duty they will be required to perform. Batteries shall be of the lead acid, sealed re-combination type or Nickel Cadmium depending on the duty requirements. The contractor shall submit calculation to justify the Ampere-Hour capacity of the batteries for approval to the Engineer
- b) Battery system shall be provided with a suitably rated switch disconnect
- c) Batteries shall be mounted on suitable tiered galvanized steel shelving with moulded plastic trays to contain any leakage from the battery cells and, to allow safe easy access for maintenance
- d) Battery terminals shall be coated with the battery manufacturer's approved grease, and shrouded if not enclosed.

### 3-3 Self Contained Emergency Battery Packs

- a) Where a central emergency battery unit is not installed, individual emergency luminaries shall consist of individual power packs installed within or remote to the luminaries.
- b) Battery pack units shall consist of converter/inverter devices, with nickel-cadmium batteries to provide 3 hours operation under mains failure, unless the main supply is restored prior to this.
- c) Luminaries with self contained battery packs shall be connected to the 'live side' of the local lighting circuit and lamps shall operate automatically under mains failure conditions.

- d) Units shall have the capability of sustaining high temperature so that they can be accommodated in fittings with high internal temperatures. However, if the internal temperature of the fittings exceeds 50 °C, the battery unit shall be mounted remote to the luminaries. In the case of remote mounting, a purpose made remote mounting box shall be provided.
- e) Key operated switches shall be provided, at the locations indicated on the Project Drawings, for all self contained emergency pack unit luminaries, to control the operation of the luminaries manually for testing purposes. Test key switches shall be clearly labeled “Emergency Lighting”.

### **3-4 Luminaries and Lamps**

- a) Clauses relating to luminaries and lamps for Lighting shall also apply to emergency luminaries and lamps.
- b) Slave luminaries shall comply with BS 4533 and BS 5225 Part 3.
- c) Exit sign luminaries lettering shall be both in Arabic and English. The Arabic text shall be above the English text.
- d) Self contained emergency luminaries shall have a red light emitting diode installed on the luminaries so that the red light is visible.
- e) With the central battery unit system, emergency luminaries shall be installed with an engraved label fixed to the outer case of the luminaries, so that it is readily identified. The label shall detail the lamp wattage and rated voltage.
- f) Generally, marking of emergency luminaries shall comply with BS 5266 Part 1.
- g) The following illumination level shall be considered for designing the number of luminaries for emergency lighting: (refer to BS 5266, Part 1)
- h) Space to Height Ratio for luminaries shall be 4:1  
05 lux for vital positions:
- First aid and safety equipment
  - Exit doors

- Fire alarm call points
- Fire fighting equipment
- Exit and safety signs
- Changes of direction
- Corridor intersection
- Adjacent areas of final exit points

01 lux for normal working spaces:

- On the centerline of escape route
- Toilets
- Lift cars and moving ways
- Plant rooms
- Covered car parks

- i) Fluorescent lamps shall be provided for both slave and self contained type luminaire installations. The lamp wattage ratings shall be chosen from the following table:
- j) Slave: 4 watts or 8 watts
- k) Self contained: 8 watts, 18 watts, 36 watts or 58 watts

Total quantity of luminaries shall be calculated based on the illumination level requirement, the type of luminaries and lamp lumens.

## **4-0 INSTALLATION**

### **4-1 Wiring**

- a) Where the emergency lighting system installation is via a central battery unit, the wiring to emergency luminaries shall be carried out in MICC, PVC sheathed cables, unless specified otherwise.
- b) Where the emergency lighting scheme is self-contained emergency packs, the wiring system shall either be in MICC Cables as above or in PVC insulated single core wires in conduits.
- c) Generally, cables shall be 2.5 mm<sup>2</sup> cross-sectional area unless specified otherwise.
- d) The Contractor shall pay careful attention to cable routings so as to keep cable runs to the shortest possible length and ensure the overall volt drop on any circuit is within the tolerances of the luminaries connected and within the limits specified in the regulations.

#### 4-2 Installation of Batteries:

The manufacturer's recommendation/instructions shall always be followed.  
Insulated tools shall be used.  
Personnel erecting battery banks shall remove metallic objects from their person  
i.e. watches, rings etc.  
Eye and hand protection shall be provided.  
Batteries shall not be left on site for prolonged periods without being trickle  
charged to maintain their condition i.e. if delivery is some weeks before  
commissioning of the charger.  
Due care shall be observed when handling acidic substances.

#### 4-3 Luminaries and Lamps:

Luminaries and lamp installation shall comply with the requirements stipulated in  
LIGHTING section above.

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## C - ACCESSORIES AND GENERAL POWER

### 1-0 SCOPE:

The work of this Section is integral with the whole of the Project Documentation and is not intended to be interpreted outside that context.

### 2-0 STANDARDS SPECIFICATIONS:

The following standards and documents shall be complied with:

BS 88 HRC Fuses

BS 546 Specification Two pole and earthing-pin plugs, socket outlets and socket outlet adapters

BS 800 Specification for radio interference limits and measurements for household appliances, portable tools and other electrical equipment causing similar types of interference

BS 1363 13A Plugs, Switched and Un-switched Socket Outlets and connection units

BS 3456 Specifications for safety of household and similar electrical appliances

BS 3676 Part 1 Switches for household and similar fixed electrical installations

BS 4177 Cooker Control Units rated 30 Amp. and 45 Amp. 250 volts single phase supply

BS 4343 Industrial Plugs, Socket Outlets and Couplers

BS 4662 Boxes for enclosure of electrical Accessories

BS 5419 Fuse Switches and Switch Fuses

BS 5733 General requirements for electrical accessories

### 3-0 PRODUCTS

#### 3-1 General

All individual items of materials shall be of the same make throughout the Project unless specifically approved by the Engineer.

#### 3-2 Outlet Boxes:

- a) Galvanized one piece pressed steel, sizes and designs shall suit devices to be fitted
- b) In all hazardous areas specified and/or shown on drawings: explosion proof.
- c) Outlet boxes mounted externally or in damp locations shall be totally sealed to ensure water tightness.

### 3-3 Switches

#### Lighting Switches:

- a) To BS 3676
- b) To be rated 10, 15 or 20 amps depending on connected load,
- c) Quick make and break type
- d) Single pole, double pole, one way, two way or intermediate
- e) Surface mounted switches to be either poly-carbonate, or metallic
- f) Flush mounted switches to be of the grid fixing type.

#### Waterproof Switches:

- a) To be watertight IP 56 or as indicated in the Project Documentation
- b) To be made of poly-carbonate for indoor application in damp and wet areas.
- c) To be metallic suitable for AC-23A duty and have sunshades fitted where exposed to direct sunlight.

#### Switch Plates:

Where two or more switches are grouped together and connected to the same phase, multi-gang devices and common plates shall be used.

#### Double Pole Switches:

- a) The double pole switches shall be with neon indication lamps and shall be rated 20, 30 or 45 Amps.
- b) The face plate shall be of matt chrome, unless specified and shall be engraved 'WATER HEATER', 'WATER COOLER' etc. as required.

#### Push switches for lighting contactor control:

- a) Push to make momentary contact switch Suitable for inductive load
- b) Surface mounted type shall be either poly-carbonate, metallic, protected to IP 56
- c) Where two or more switches occur in one position they shall be contained in one case and each shall be appropriately labeled to indicate its function

Dimming Switches:

- a) Dimming switches shall be provided, complying with BS 5518
- b) Dimming switches shall be interference suppressed to conform with BS 800
- c) All dimmer units shall be sized to give a 40% margin above the connected load.
- d) Switches shall be certified for AC-23A duty

**3-4 Ceiling Roses:**

- a) Ceiling roses shall be of the all insulated type conforming to BS 67 with a white finish.
- b) Ceiling roses shall be provided with insulated terminals for the switched live, neutral and protective conductors; loop-in facilities shall be provided.
- c) Plug-in ceiling roses shall be used in large buildings, with extensive false ceiling systems, as detailed in the particular specification.

**3-5 Socket Outlets:**

General purpose Socket Outlets:

- a) To BS 1363
- b) 3 rectangular pin (2P+E) shuttered, with combined switch, rated 13A, 250 V
- c) To be supplied with plug complete with fuse

15A Socket Outlet:

- a) To BS 546
- b) 3 round pin (2 P + E) shuttered switched pattern complete with plugs.
- c) Neon indicator lamp, unless specified otherwise.

Weather proof Sockets:

- a) 13A Sockets: to BS 1363
- b) 3 rectangular pins, Un-switched type to be complete with weather proof
- c) plugs
- d) Plugs: 13 Amps
- e) Sockets: fused type with single pole cartridge fuse link of same rating as plug

- f) Sockets and plugs:
- § To have minimum IP 55 grade protection
  - § Housing parts: brass or pressure die-cast finished in grey hammered stove enamel
  - § plugs: cable grips shall have rubber compression rings, there shall be rubber gasket between plug and socket to ensure weather tightness.
- g) Sockets shall have screw on caps that close tight on socket when plugs are not inserted.

Socket Outlet Plates:

- a) Socket outlet face plates shall be finished.

Industrial Sockets:

- a) Combined Socket to be a combined unit comprising two sockets, rated 16A, 240V, 1 phase and 32A, 415V, 3 phase
- b) To be equipped with 16A SP and 32A TP MCBs,
- c) Three phase socket to be 5 pin type, single phase socket to be 3 pin type

Plugs and sockets for hazardous area:

- § To be suitable for zone 0, zone 1 or zone 2 applications, as relevant,
- § To conform to IEC 309-3
- § To be corrosion resistant
- § Ingress protection to IP 66.

**3-6 Shaver Socket Outlets**

- a) All shaver socket outlet units shall comply with BS 3456 and IEC 335.
- b) Shaver units shall be flush pattern with white moulded insert in matt chrome plate engraved 'Shaver Only' and be suitable for installation in bathrooms, incorporating a double wound isolating transformer to provide an earth free supply.
- c) Units shall incorporate primary winding circuit protection in the form of a self-resetting thermal overload device.
- d) Units shall incorporate an 'ON/OFF' switch with red neon indicator together with a selector switch for 20 VA load capacity at 240 Volts and 115 Volts

- e) Units shall incorporate two pin shuttered outlet configuration and have terminals to accept 2.5 mm<sup>2</sup> conductors.
- f) Unit outlet boxes shall be a minimum of 45 mm deep, rustproof by galvanising of equal finish and complete with a brass earthing stud secured to the back of the box.

### **3-7 Cooker Control Units**

- a) Cooker control units shall incorporate a 32 Amp. double pole switch and 13A, 3 pin switched socket outlet and neon indicator lights for both cooker and socket
- b) The cooker control unit shall be flush mounted.

### **3-8 Disconnect Switches and Switch Fuses**

- a) To be metal clad with front operated handles interlocked with switch fuse case to prevent opening switch in the “ON” position
- b) Switch shall have “ON/OFF” indication and provision for locking in “OFF” position
- c) utilisation category AC 23A

#### Fuse switch and switch fuses

- a) To BS 5419
- b) Fuses: to BS 88 bolted type, class Q1, certified for 415V and AC 80 Duty, rated as indicated
- c) Fused switch carriages: withdrawable type
- d) Fuse switches: ASTA certified to 50 KA.

#### Disconnect switches

- a) Same design as switch-fuses, with solid copper links in place of fuses
- b) Single pole and neutral, or triple pole and neutral
- c) Ratings, as indicated.

### **3-9 Fused Connection Units**

- a) 240 V fused connection units shall be switched, shall comply with BS 5733 and shall be fitted with a fuse complying with BS 1362 with a rating as specified.
- b) All fused connection unit shall be fitted with a neon indicator.
- c) Live contacts shall not be exposed under normal operating conditions when replacing a fuse.
- d) 240 V fuse connection units in plant areas, workshops etc., shall be surface mounted, metal clad and shall comply with BS 1363.
- e) The type of fused connection unit, particularly relating to the flex outlet, shall be authorized by the Engineer prior to the ordering of accessories.

### **3-10 Junction, Pull and Terminal Boxes**

- a) The Junction Box shall be completed with a terminal block suitable for connecting up to 10 mm<sup>2</sup> copper conductor (phase, neutral and earth) and an all insulated moulded white cover plate with removal covers.
- b) The cover plate shall be raised for connecting outgoing cable.

### **3-11 Timer**

- a) Timers shall be electronic type, unless specified otherwise.
- b) Timers shall be suitable for operation from supply voltage of 240V, 1-phase, 50HZ system.
- c) Timer output contacts shall be suitable for both a.c. and d.c. control circuits. The contacts shall be suitable for duty of AC-2 or DC-3 utilisation category.
- d) The rating of output contacts shall be co-ordinated with the application requirements.
- e) ON/OFF indicator shall be provided to monitor the circuit status.  
Timers shall be either:
  - Delay on energisation or
  - Delay on de-energisation type, as per the application requirements
- f) Timers shall be suitable for minimum 10 million operations.
- g) Degree of protection shall be minimum IP 20.

### 3-12 Time clocks

- a) Time clocks shall be suitable for operation from supply voltage of 240V, 1-phase, 50Hz system.
- b) Output contacts shall be suitable for both AC and DC control circuits. The rating of output contacts shall be co-coordinated with the application requirements.
- c) The no. of output contacts and the duration of contact closing shall be decided as per the application requirements.
- d) Time clocks shall be provided with a time dial setting for 24 hours and 7 days program.
- e) Each time clock shall be provided with a minimum running reserve energy for 1 day.
- f) Accuracy of clocks shall be better than 1 second per day.

## 4-0 INSTALLATION

### 4-1 Mounting Heights

Mounting heights shall comply with the following table:

Component/Equipment	Location or Function	Height (mm)
Lighting switches		1350
Socket outlets	Admin buildings	200
	Plant rooms	1200
	Kitchens	1350
	Above worktops	200
	External	1350
	Above fitments	150 above fitment
Cooker control units		1350
Cooker connection outlets		600
Distribution boards	Plant Rooms	1800
Room thermostats		1600
Room Heaters - Tubular	Plant Rooms	600
Room Heaters – Fan		2200
Telephone outlets		200
Fire alarm manual call points		1350
Bells or Buzzers		1900 – 2300

#### 4-2 Installation of Outlet Boxes

##### Location of Boxes:

- a) Determine exact location of boxes on site and obtain the Engineer's approval before commencing installation
- b) Make allowance for overhead pipes, ducts, variations in arrangement, thickness of finish, window trim, panelling and other construction when locating boxes.
- c) Fix outlet boxes securely
- d) Fix exposed outlet boxes to permanent inserts or lead anchors with machine screws.

#### 4-3 Installation of Switches

##### Lighting Switches:

- a) Located at the strike side of the door, approximately 150 mm from the edge of door frame
- b) Plates shall be installed with all four edges in continuous contact with finished wall
- c) Plates shall be installed with an alignment tolerance of 1.5 mm
- d) All switch assembly louvered plates shall have their earthing terminal connected to the earth terminal attached to the switch box by an insulated 2.5 mm<sup>2</sup> protective conductor.

#### 4-4 Installation of Junction, Pull and Terminal Boxes

##### Generally:

- a) Fix junction, pull and terminal boxes where indicated and where required to facilities pulling of wires and cables and connection of future appliances
- b) Locate boxes as inconspicuously as possible, but accessible after work is completed.

Pull Boxes:

Fix at maximum 10m spacing and to limit the number of bends in conduit to not more than two 90° bends.

**5-0 TESTING:**

- a) Test all switches, socket outlets etc. for correct polarity and continuity of conductors in the presence of and to the entire satisfaction of the Engineer.
- b) Carry out live phase to earth loop impedance tests at all switches and socket outlets with an approved earth loop impedance tester to the entire satisfaction of the Engineer.
- c) Ensure that all device plates have satisfactory earth continuity to the protective conductor system.
- d) Test all socket outlets for instantaneous tripping of associated distribution board current operated earth leakage circuit breaker using testing equipment, approved by the Engineer.