

## 12 ELECTRICAL INSTALLATIONS

### 12.1 General

- 12.1.1 The work shall be carried out strictly in accordance with the standard specifications and shall also conform to the requirements of Electricity Rules in force in ....., .....
- 12.1.2 All materials to be used in the Electrical Works shall be HAEGER or equivalent and shall bear the certification marks of local authorities. All materials shall be approved by the Consultant before use in the Works.
- 12.1.3 Earthing shall invariably be done in the presence of the Consultant or his representative.
- 12.1.4 All the conduits shall be continuously earthed. Check nuts shall be provided at the point where the conduct enters the I.C. box and junction box.
- 12.1.5 The Contractor shall arrange for the inspection of all Medium Pressure Installation by the Electrical inspector of the local electric supply authority from where the electricity connections has to be obtained, and see that they are passed by him.
- 12.1.6 The Contractor shall be responsible for all necessary permits, approvals, fees, and deposits etc., required for completing the Electrical works in accordance with the Contract.

### 12.1.7 Scope of work

- 12.1.7.1 The work consists of furnishing all tools, plants, labour, materials and equipment and performing the internal electrical Works comprising of:
- Light and power wiring
  - Fans and fixtures
  - Wires and Cables
  - Telephone System
  - Sub- Station Equipments:
  - Distribution Fuse gear
  - Earthing System
  - Lightning Protection System
  - Fire Alarm System
  - Air Conditioning System
  - Computer Network Cabling outlet work

### 12.1.8 Prequalification

- 12.1.8.1 The Electrification Work shall be carried out only by a licensed contractor authorized to under take such work under the .....

### 12.1.9 Qualification

- 12.1.9.1 A licensed Electrical Contractors should have the following qualifications:
- Must have in his employment a competent Electrical Engineer registered with .....
  - Must have in its employment an Electrical Consultant having certificate of competency who will exclusively supervise this work.
  - Must have necessary tools, plant and instruments.
  - Must have adequate experience of similar works.

- If a contractor does not possess the above qualifications he shall be allowed to sublet the Work to a competent Sub-Contractor provided an application for his prequalification is made to the engineer for his approval. Decision of the Engineer in this case shall be binding on the Contractor.

#### 12.1.10 Rules and Regulations

12.1.10.1 The installation in general shall be carried out in conformity with the Electricity Rules, 1937 (UK), and the latest edition of the Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers, London (I.E.). However, in case of conflict between these Specifications and the I.E. Regulations, these Specifications shall be followed.

#### 12.1.11 Standards

12.1.11.1 The latest relevant British Specifications, and I.E. recommendations shall be applicable and be followed for the equipment specified herein.

#### 12.1.12 Climatic Conditions

12.1.12.1 All equipment supplied shall withstand, without developing any defect, the following climatic conditions:-

12.1.13 Maximum Ambient Temperature	=	113° F or 45° C
12.1.14 Minimum Ambient Temperature	=	28° F or - 2.2° C
12.1.15 Maximum Humidity	=	98%

#### 12.1.16 Specifications

12.1.16.1 The Contractor shall furnish all material and equipment at site, confirming fully to the specifications given herein and to the accepted standards, the Institution of Electrical Engineers, London, and the .....

12.1.16.2 It is not the intent of these Specifications to include all details of design and construction of various material and equipment to be supplied under this contract.

12.1.16.3 The Contractor shall supply and install all material and equipment specified herein and also all installation and small material such as nuts, bolts, washers, shims angles, leveling material, insulation, tape, solder, etc. and all such required for complete installation as intended by the Specifications.

12.1.16.4 The contractor shall provide for all the required technical and non-technical personnel, skilled and non-skilled labour, construction equipment, transportation etc., as required for the completion of Work in strict accordance the Technical Specifications laid herein-after.

12.1.16.5 All material and equipment supplied by the Contractor shall be new and in all respects conforming to the high standard of engineering design and workmanship.

12.1.16.6 All material and equipment which have to be supplied and installed by the Contractor shall be passed/approved by the Consultant; even if the same is exactly in accordance with the Bill of Quantities and Drawings.

#### 12.1.17 Submittal

12.1.17.1 The Contractor, after the award of work, shall submit for approval of the Consultant all drawings and cuts of equipment, appliances, fixtures and accessories. Cuts, catalogues and drawings shall be clearly marked to indicate, the items furnished.

**12.1.18 Approval of Drawings and Data**

12.1.18.1 The Contractor shall provide detailed electrical drawings, wire diagrams, etc. for all electrical switchgear, fuse gear and all other systems etc. for the Consultant to review and approval. Three sets of equipment drawings shall be provided for obtaining approval.

**12.1.19 Drawings & Data**

12.1.19.1 Three sets of drawings and data (for each equipment) shall be furnished by the Contractor for the Consultant approval before commencement of work. The drawings to be supplied by the Contractor shall be as follows:-

**12.1.20 Electrical Drawings showing:-**

- Single-Line diagram
- Detailed wiring diagram
- All interconnections
- Relays, their locations, and internal wiring diagrams
- Other electrical devices including meters instruments and their wiring diagram

**12.1.21 Shop Drawings**

12.1.21.1 The design drawings do not show conduit routes and depict only the position of various fixtures and outlets. All the planning for the conduit routes shall be carried out, well in advance of the actual execution of work, by the Contractor to the satisfaction of the Consultant. For this purpose the Contractor shall prepare shop drawings and obtain prior approval of the Consultant. There prints of each shop drawings shall be submitted for obtaining approval.

12.1.21.2 No piece of work shall be allowed to be executed at site without the availability of these approved shop drawings. These shop drawings shall clearly depict the load balancing chart of each Distribution Board.

12.1.21.3 Time required for the preparation and approval of shop drawings shall be considered to have been included in the total time allowed for the completion of the work.

**12.1.22 Spare Parts list**

12.1.22.1 A list of spare parts required for the one year's operation (each equipment) where deemed necessary together with unit price of each part, shall be supplied by the contractor.

**12.1.23 Guarantee**

12.1.23.1 The Contractor shall furnish written guarantee in triplicate of the manufacturer for successful performance for each equipment. Such guarantee shall be for replacement which may be found defective in material or workmanship.

12.1.23.2 The guarantee shall cover a minimum period of 12 months effective from the date of completion certificate.

**12.1.24 As-Built Drawings**

12.1.24.1 The Contractor shall, during the progress of work keep a careful record of all changes and revisions where the actual installation differs from that shown on shop drawings. These changes and revisions shall be accurately carried out on the shop drawings and submitted to the Consultant for approval. After approval these drawings shall become the property of the Owner. These updated and approved

shop drawings depicting clearly all changes and revisions made on site shall be called As-Built Drawings.

- 12.1.24.2 Reproducible tracings of all these As-Built Drawings shall be handed over to the Consultant. Final payment will be withheld until the receipt of the approved As-Built Drawings.

#### 12.1.25 Test Reports

- 12.1.25.1 The Contractor shall be responsible for the submitting the test reports/certificates and get the installation inspected passed by the .....

### 12.2 Conduit and Conduit Accessoires

#### 12.2.1 Conduit Pipe

- 12.2.1.1 The conduit for the wiring of lights, socket outlets and other systems shall be made of PVC confirming to BSS 3505/1968 Class-D.

The conduit shall have following wall thickness and standard weights:

Pipe Size	Wt/100Rft.	Wall thickness
20mm dia	3.4 Kg	0.04 to 0.05
25mm dia	4.5 Kg	0.045 to 0.055

- 12.2.1.2 Steel conduit shall conform to BSS 31/latest. The conduit shall be enamelled with good quality non- cracking and non-flaking black paint.

#### 12.2.2 Conduit Accessories

- 12.2.2.1 The use of factory made round PVC junction boxes shall be used and should have nipples to receive PVC pipe with force fit, shall be used for ceiling outlets. The wall type junction box shall also be PVC.

- 12.2.2.2 Each junction box shall be provided with one piece cover which shall be fitted on the box with screws.

- 12.2.2.3 Conduit accessories such as switch boxes, socket outlet boxes, pull boxes and inspection boxes shall be made of PVC having dust tight covers. All boxes shall have required number of conduit entry holes. All the rectangular or square shaped boxes shall have nipples to receive PVC conduit force fit.

- 12.2.2.4 Manufactured smooth bends shall be used where conduit changes direction. Bending of Conduit by heating or otherwise shall be allowed only at special situations with the permission of the Consultant. Use of sharp 90 degree bends and tees is prohibited.

- 12.2.2.5 Bends shall have enlarged ends to receive the conduit without any reduction in the internal diameter of the PVC pipe.

- 12.2.2.6 All accessories e.g. boxes, coupling, bends, solid plugs, bushes, reducers, check nuts etc. shall be equal in quality to the specified conduit.

- 12.2.2.7 The drawings do not show conduit routes and all the planning for arranging conduit routes shall be carried out by the Contractor to the satisfaction of the Consultant.

- 12.2.2.8 The entire conduit system shall be essentially completed before the wiring pulling is taken in hand. Each conduit run shall be tested for continuity and obstructions. All obstructions shall be cleared in an approved manner. Water and moisture that

has entered any section of the conduit installation must be dried with suitable swabs to the satisfaction of the Consultant.

12.2.2.9 Adequate expansion joints shall be provided in all conduit runs passing across the expansion joints in the concrete slab of the buildings.

12.2.2.10 All the free ends of conduit shall be solidly plugged till such time as final and proper terminations are made.

### 12.3 Wires, Cables and Cords

#### 12.3.1 Wires & Cords

12.3.1.1 The wires & cords for the conduit wiring shall be single core, made of stranded copper conductors, PVC insulated, tested to B.S. 6004, 1975. The voltage grade shall be 300/500 volts or 450/750 V unless otherwise specified on Drawings and Bills of Quantities.

12.3.1.2 All the wire and cables shall be of the approved standard of .....

- For light or fan point wiring with 1.5 mm square or as specified in the BOQ.
- For light circuit wiring with 2.5 mm square or as specified in the BOQ.
- For power plug 15A wiring with 4 mm square or as specified in the BOQ.

#### 12.3.2 Installation Instructions

12.3.2.1 All wiring shall be continuous between terminations and use of connectors or joints is not allowed. Spur and tee connections are strictly prohibited.

12.3.2.2 Manufacturers recommended lubricant shall be allowed to facilitate pulling of wires. Use of any kind of oil and soap is prohibited.

### 12.4 Wiring Accessories

#### 12.4.1 Switches - GEWISS PLAYBUS or equivalent

12.4.1.1 Indoor switches controlling lights and fans shall be single pole, 5A, one or two way, suitable for 250V, 50 Hz. The body of the switches shall be made of moulded plastic, one/two/three/four gang with integral built in moulded plastic face plate.

12.4.1.2 Weatherproof switches shall conform to B.S. standard.

#### 12.4.2 Switch Socket Outlet Units - GEWISS PLAYBUS or equivalent

12.4.2.1 Switch & socket units shall be single, pole, 3 pin rated 5A. 15A or 20A or 250V or 50 Hz. These shall be moulded plastic type with white integral built-in face plate. Each socket shall have its control switch by the side of it on a common face plate. Thus the complete unit specified in BOQ shall be as switch and a socket outlet unit.

#### 12.4.3 Fans

12.4.3.1 All fans shall be capacitor type Deluxe models or equivalent and suitable for operation on 200/220 volts, 50 Hz, A.C Supply. All ceilings fans shall have five speed dimmers. The air displacement shall be adequate to 10,000 c.f.m for 48" (1219 mm) Sweep, and 12,000 c.f.m. for 56" (1423 mm) Sweep at maximum speed. The fan motor shall be capacitor type and bearings shall be groove type to give noiseless and quiet operation. The noise level relative to a frequency of range 1000 Hz should be within the limits of +3 dB.

#### 12.4.4 Dimmer

- 12.4.4.1 The dimmer shall be recessed type as required and shall be approved by the Consultant.

#### 12.4.5 Fan Hook

- 12.4.5.1 The fan hook shall be made of 12 dia mild 5/5 steel rod bent to shape of approved design. It should be in the form of a loop about 3-1/4" (87.5 mm) long and about 2" (50 mm) wide. The rod shall be bent to have at least 8" (200 mm) extension on both sides for tying to the reinforcement steel of the slab. All ceiling fan shall be of one make only.
- 12.4.5.2 The fan hook shall be installed in the RCC slab of the ceiling at the time of pouring concrete.

### 12.5 Light Fixtures

#### 12.5.1 General

- 12.5.1.1 The description of light fixtures is given in the Bills of Quantities, and stated on the Drawings, and all relevant material is described in this Section.
- 12.5.1.2 The determination of quality is based on certified photometric data covering the coefficient of utilization, light distribution curves, construction material, shape, finish, operation, etc.
- 12.5.1.3 The Contractor shall submit samples of each and every lighting fixture specified for approval of the Consultant.
- 12.5.1.4 The type of fixtures with manufacturer catalogue reference is given in Bill of Quantities.
- 12.5.1.5 The lighting fixtures shall be manufactured by ERCO or equivalent as approved by Consultant.

#### 12.5.2 Incandescent Light Fixture

- 12.5.2.1 The glass globes/ shades/ diffusers of the incandescent light fixtures shall be first class quality glass free from any air bubbles or voids. The glass shall generally be of opal white colour unless otherwise specified. The shape of the glass may be spherical, hemispherical, flattened bottom or tablet shaped as required.
- 12.5.2.2 Surface mounted fixture shall have stove enamelled sheet steel body. It may also be satin brass or aluminium anodised finish as required. The fixing holes shall match the outlet box. Wall bracket light fixtures shall have back plates with matching holes of the outlet box and decorative finish as required.
- 12.5.2.3 All the lighting fixtures shall be suitable for local climatic conditions.

#### 12.5.3 Fluorescent Light Fixture

- 12.5.3.1 All the light fixtures shall have lamps and electronic ballasts of the wattage specified. The fluorescent lamp shall be either 2 ft - 18 watts or 4 - 35 watts and the colour shall generally be day light, cool day light in the order of preference or as mentioned specifically.
- 12.5.3.2 The fluorescent lamps shall be Philips to BSS 1853 but having a minimum useful life of 5000 hours. The new generation of 26mm dia 18 watts and 36 watts energy efficient lamps shall be preferred.
- 12.5.3.3 The ballast shall be totally enclosed electronic type suitable for operation on 220 V, 50 Hz, single phase supply, a wiring diagram, wattage, voltage and current ratings shall be printed on the body of the ballasts. The power loss shall not more

than 10 watts for 36 watts ballast. The ballast shall be noiseless in operation without any whistling sound.

- 12.5.3.4 The manufacture shall be called upon to guarantee a trouble free life of 3 years, effective from the date of completion certificate.
- 12.5.3.5 The starters shall have radio-interference suppressers.
- 12.5.3.6 The internal wiring of the light fixtures shall be carried out at manufacturer's factory with heat resistance wires of size not less than 1.5 mm square.
- 12.5.3.7 The louvers of light fixtures shall be made of anodized aluminium and/or moulded plastic. The diffusers shall be made of Acrylic Perspex.
- 12.5.3.8 All the lighting fixtures shall be suitable for local climatic conditions.

#### 12.5.4 Installation Instructions

- 12.5.4.1 The light fitting shall be installed according to manufacturer's recommendations or as approved by the Consultant.
- 12.5.4.2 Flexible connecting wires from outlet box to the fixture shall be provided by the contractor; connector made of porcelain or thermoplastic material shall be provided and installed in the outlet boxes for connecting flexible wires to the point wires.
- 12.5.4.3 Outlet boxes or any openings in the ceilings and walls shall be covered with appropriately fabricated accessories to provide an architectural entity to conceal them.

#### 12.5.5 Main L.T. Switchboard

- 12.5.5.1 The L.T. switchboard shall be indoor type, free standing, free supporting, floor mounted, totally enclosed, sheet clad, dust and suitable for operation on 3 phase 4 wire system, 415 v, 50 Hz, AC supply.
- 12.5.5.2 The board shall be suitable for installation back to the wall and capable of front attendance. The switch board shall be designed to suit service conditions and ensure security and safety during operation, inspection, operation, cleaning and maintenance.
- 12.5.5.3 The switch board shall be designed and tested to IEC recommendations. Each panel shall withstand strain of 2000 volts insulation level for one minute power frequency test.
- 12.5.5.4 The L.T. switch board shall consist of the following:
  - ..... Unit incoming panel
  - KWh meters (To be approved and checked by .....)
  - Out going distribution feeders

#### 12.5.6 Distribution Feeder Panel

- 12.5.6.1 Single line diagram of the L.T. switch board shall be approved by the consultant and ..... before placing order for the switch board.

#### 12.5.7 Earthing

- 12.5.7.1 The switchboard shall be effectively earth by means of a copper strip of 25 mm x 3 mm (1" x 1/8") cross -section bolted to connections near the bottom of the switchboard.

### 12.5.8 Accessories

12.5.8.1 Designations labels, lifting lugs, foundation bolts, interconnecting nuts bolts, and washers, thimbles, lugs, levelling shims cable glands and/or cable end box for all the sizes of incoming and outgoing cable shall be supplied with the switchboard.

### 12.6 Testing

12.6.1 The following tests shall be conducted on each completed switchboard.

#### 12.6.1.1 Type Tests

- Temperature rise test
- Mechanical endurance test
- Making/Breaking Capacity test
- Routing Test
- High Voltage test
- The Switchboard shall be tested to British/Electricity Council Standard 41-5. Preference shall however, be given to Switchboards fabricated from all components manufactured by only one manufacturer.



**Installation Instruction**

12.6.2 All labour, equipments, tools and plants required to complete the installation shall be provided by the contractor. The Switchboard shall be fixed firmly on the floor in perfect line, plumb and level position.

12.6.3 All incoming and outgoing cable connections shall be made from the bottom including Earth connections.

**12.7 Distribution Board**

12.7.1 The distribution boards shall be free standing, cubical type or wall mounting type suitable for recessed mounting. Each distribution board (d.b.) shall be tropical in design, fully dust and vermin proof and liquid repellent.

**12.8 Lightning Protection System****12.8.1 General**

12.8.1.1 The Contractor shall be under obligation to supply all labour material, services and skilled supervision necessary. Shop drawing for the lightning system shall be submitted to the Consultant at least 4 weeks before commencing the work.

**12.8.2 Workmanship**

12.8.2.1 The installation shall be carried out by skilled and competent workmen so as to achieve high class workmanship.

**12.9 Telephone System****12.9.1 General**

12.9.1.1 The design drawings do not show conduit routes and depict only the position of various telephone outlets. All the planning for the conduit routes shall be carried out, well in advance of the actual execution of work, by the Contractor to the satisfaction of the Consultant. For this purpose the Contractor shall prepare shop drawings and obtain prior approval of the Consultant. Three prints of each shop drawings shall be submitted for obtaining approval before commencement of work.

12.9.1.2 No piece of work shall be allowed to be executed at site without the availability of these approved shops drawings. Time required for the preparation and approval of shop drawings shall be considered to have been included in the total time allowed for the completion of the work.

12.9.1.3 The contractor shall furnish and install the type of Telephone outlets approved by ..... All the floor mounted telephone boxes shall be concealed in a PVC box with open able cover for easy access.

12.9.1.4 Both ends of each set of conductors shall be properly identified with durable tags with the same identifications of both ends, at the outlet and the telephone terminal cabinets to facilitate the installations of the telephone instrument in the future and for trouble shouting purposes. Cable used shall be twisted and shielded 3 cables in the office area and the rest as shown in the drawing.

**12.10 Fire Alarm System****12.10.1 General**

12.11 The contractor shall be under obligation to, supply, install, test, commission and maintain for the period specified elsewhere, a fire alarm system as specified in the drawings, for this building.

### 12.11.1 Specifications

12.11.2 The system shall facilitate the detection of fires occurring in any part of the building by subsequent audible and visual indications. The system shall generally comprise of the following:

- Main Control Panel
- The control panel will be Perspex fronted panel and will display all screened labelling and indications by block LEDs mounted behind the front hinged cover. The control panel shall be mounted in pressed steel housing and provide the following functions and indications.
- Fully monitored two wire circuit for each sensor zone (24V D.C.) as required.
- Fully monitored two wire sounded circuit (24V D.C.) as required.
- Change over relay contacts each rated 5 amps 240V A.C. (Resistive load).
- Full test and isolate functions via a key-board located on the facia of the main termination housing to provide the following:-
- Ability to isolate sensor zones.
- Ability to isolate sounder zones.
- Ability to test automatically zones with an auto reset facility to enable a single person to carry out testing
- Full LED display of all functions comprising of:-
- System on, system fault, processor fault, alarm, zone supply fault, system supply fault, battery fault, charger/mains fault, sounder fault and sensor fault together with a test mode display which provides zone clears, zone open circuit and zone short circuit indication for individual sensor and sounder (bells) lines.
- Sequence of sounder operation- All sounder (bells) and relay out-put sequences shall be completely programmable to enable future changes to be carried out with only soft ware changes.
- The control panel shall provide the following functions and indications:-
- Twin LED display for system on, system fault, sounder fault, alarm, mains/charger fault, main processor fault, sensor fault, alarm silenced, battery fault, supply fault and earth fault.
- Also five dedicated control functions on illuminated push buttons which are key - isolated. These shall provide Evacuate, Buzzer Mute, Alarm silence, Lamp test and Reset controls.
- Battery charger - the battery charger shall be an integral part of the main fire alarm control panel cabinet and shall be capable of fully recharging the stand - by batteries after a main's failure within 12 hours. The capacity of the batteries shall be sufficient to supply the standing load for the least 24 hours and the maximum alarm load for one hour. The system shall be suitable for operation on 220v single phase or 415v, 3- phase 50 Hz supply.
- Mimic diagram showing all the floors shall be incorporated in the control panel.
- Sensors and Sounders

12.11.2.1 The main control panel as described in the foregoing shall be capable of working with the following devices having common specification as under:-

(a) Operating voltage	10-30 volts dc (two wire system)
(b) Ambient temperature	10 C to +80 C.
(c) Humidity range	20 to 90 RH

- (d) Altitude range Sea level to 6000 meters
- (e) Alarm mode Self latching producing a resistance of 680 ohms across the supply line.
- 12.11.2.2 Photocell (optical) smoke detectors- the units shall operate on light scattering principle. An internal infra-red light source shall be pulsed, with the light beam ranged so as to by-pass a receiving unit. The presence of smoke shall scatter the light beam, causing it to be reflected on to the receiving photocell. An evaluation circuit shall measure the amount of light and shall compare it to a reference. The detector shall trigger in to an alarm state when the amount of smoke exceeds a pre-set level. To ensure against false alarms several pulse readings shall be taken and compared before the detector shall be triggered into alarm. The detectors shall conform to b.s.s. 5446 part -1 and shall have the following specifications:-

(a) Quiescent Current	Less than 100 micro amps at 20 volts.
(b) Alarm Current	Maximum 60 mA
(c) Maximum Coverage	300 cubic meters
(d) Weight	250 grams approx.
(e) Diameter x Height	92 mm x 80 mm

- Manual stations - this unit also named call point shall be break glass type that do not require a hammer. The frangible glass is pressed hand to break the glass which shall activate the alarm. The call point shall conform to B.S. 5839 part-2.
- Alarm bells - the alarm bells shall be centrifugal type and the gong shall be 100 mm diameter or as specified. The unit shall be suitable for an input of 24 v dc. And shall provide a normal output of 94 db at 1 meter.
- Electronic sounders - the unit shall be primarily designed to operate on 24v.d.c. And arranged easily to generate a variety of sound signals: intermittent, continuous or warble tones.

#### 12.12 Wiring

- 12.12.1 The wiring for the fire alarm system shall be carried out in PVC conduit in accordance with instructions contained herein relevant section. 2x2.5 mm square or 4x2.5 mm square PVC heat resistance insulated single core cable 300/500 volts grade shall be pulled in 1" dia PVC conduit laid for the purpose. Any spurs and tee joints in the wiring are strictly prohibited. Instructions contained in section -E.2.2 and 2.3 shall be followed.

#### 12.12.2 Installation

- 12.12.3 The installation as a whole shall be tested and commissioned, in accordance with manufacturer's instructions, to the entire satisfaction of the Consultant.

#### 12.12.4 Shop Drawings

- 12.12.5 Shop drawing of the fire alarm system layout shall be submitted to the Consultant for approval.