

प्रकाश व्यवस्था के उत्पादन के लिए विनिर्देश

SPECIFICATION FOR LIGHTING INSTALLATION

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Abbreviations:

AC	:	Alternating Current
BIS	:	Bureau of Indian Standards
CCoE	:	Chief Controller of Explosives
CD	:	Compact Disc
CEA	:	Central Electricity Authority
CFL	:	Compact Fluorescent lamps
CIMFR	:	Central Institute of Mining and Fuel Research
DC	:	Direct Current
DG	:	Diesel Generator
DGMS	:	Director General Mines and Safety
ELCB	:	Earth Leakage Circuit Breaker
FFL	:	Finished Floor Level
FRP	:	Fibre Reinforced Plastic
GI	:	Galvanised Iron
HPMV	:	High Pressure Mercury Vapour
HPSV	:	High Pressure Sodium Vapour
HRC	:	High Rupturing Capacity
IP	:	Ingress Protection
IS	:	Indian Standards
JB	:	Junction Box
MCB	:	Miniature Circuit Breaker
MCCB	:	Moulded case circuit breaker
MDB	:	Main Distribution Board
MS	:	Mild Steel
PE	:	Polyethelene
PVC	:	Polyvinyl Chloride
TPN	:	Three Phase and Neutral

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	Mr. R. Mahajan (PEM)
	Mr. S.K. Dhawan (Inspection)

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1.0 SCOPE

This specification defines the requirements for the supply of equipment, materials, installation, testing and commissioning of the lighting system (lighting fixtures, lighting power distribution, telephone wiring etc.).

2.0 CODES AND STANDARDS

2.1 The work shall be carried out in the best workmanlike manner, in conformity with this specification EIL Installation Standards, and the relevant specifications/codes of practice of the Bureau of Indian Standards.

2.2 In addition to the above it shall be ensured that the installation conforms to the requirements of the following as applicable:

- a. Indian Electricity Act and Rules.
- b. Regulations laid down by CEA/Electrical Inspectorate.
- c. Regulations laid down by CCoE/DGMS (as applicable).
- d. The petroleum rules (Ministry of Industry Government of India).
- e. Any other regulations laid down by central/state/local authorities and Insurance agencies.

3.0 EQUIPMENT SPECIFICATIONS

All materials, fittings and appliances to be supplied by the contractor shall be new, unused and of the best quality and shall conform to the specifications given hereunder. These shall be manufactured in accordance with the latest revision of the specifications of Bureau of Indian Standards/International standards. In the absence of any specifications for a particular item, contractor shall bring material samples along with proven track record to site and get the same approved by Engineer-in-Charge/Owner before installation.

3.1 Lighting and Power Panels

3.1.1 Lighting and Power panels (general purpose panels for safe area) shall be made of 1.6mm thick sheet steel and shall be dust and vermin proof. All metal surfaces shall be cleaned free of rust, given a coat of red-oxide primer and finished with two coats of epoxy based paint of shade 632 of IS 5. Panels shall be indoor/outdoor type as specified. Indoor type panels shall have IP42 degree of protection and shall be suitable for surface or flush mounting on wall surface as specified. Lighting and power panels located outdoor shall be IP55 weather protected and shall also preferably have integral canopy for additional weather protection. The canopy shall be made of 2mm thick galvanized sheet steel or FRP where these are separate from the equipment.

3.1.2 Lighting and Power panels shall have TPN incoming feeder and single phase outgoing feeders. Lighting circuit feeders shall be rated for 10 amps and power circuit feeders shall have current rating of 16Amps. In power panels for window Air conditioning units, power circuit feeder shall be rated for 20 amps. Panels shall be equipped with phase and neutral bus bars of required current carrying capacity. The outgoing feeders shall be provided with single pole miniature circuit breakers (MCBs) for safe areas and double pole MCBs for hazardous areas. The incomer shall be with MCB and ELCB unit unless otherwise specified. Miniature circuit breakers shall be mounted in such a way that the operating levers project outside the front Bakelite cover plates for ease of operation. A hinged door to cover the operating knobs shall be provided. In addition, a circuit diagram indicating incomer details and outgoing details viz. Circuit number, circuit rating, and load connected and details of the load shall be pasted inside the panel. Also a laminated copy of the diagram shall be provided inside the panel in a suitably designed pocket. Two external earthing studs for connection to the plant earthing grid shall be provided on the panel. Further, the panel shall be provided with an earth

bus bar with terminal studs for connection to the third core of each outgoing circuit. Each circuit phase and neutral shall be given ferrule numbers. Complete wiring inside the panel, shall be neatly bunched with PVC tape and button. Sufficient terminals shall be provided in the terminal block so as to ensure that not more than one wire (core) is connected to a terminal. The panel shall have knock out holes or removable gland plate for the entry of incoming and outgoing conduits or cables. The panels shall be complete with requisite number of cable glands as specified.

- 3.1.3 The Main distribution board (MDB) where used, shall be made of 2mm thick sheet steel panel, dust and vermin proof similar in construction to Lighting and Power panels but with TPN MCCB or switch fuse incoming and TPN outgoings (MCB with ELCB units and MCB without ELCB unit as applicable) of required numbers as specified.
- 3.1.4 All MCBs shall be of M9 category as per IS 8828 and sensitivity of ELCBs shall be 100 mA-300 mA unless otherwise specified.
- 3.1.5 Wherever the size of incoming cable to lighting, power panels/MDB is more than 35 sq.mm a suitable cable adapter box shall be provided and attached to the panel. The incoming cable leads shall be connected to terminal block (bolted type terminals) of required size. This terminal block shall be connected to TPN incomer unit through separate PVC insulated copper conductor wires/bus bars. Sufficient space shall be provided (minimum 300mm) between gland plate and the bottom of terminal block for easy termination.

3.2 Lighting Fixtures

The types, makes and catalogue numbers of various types of lighting fixtures shall be as given in Fixture schedule job data sheet. HPMV/HPSV lighting fixtures shall be complete with ballast, starters and capacitor, as required. Control gears shall be integral or non-integral as specified in lighting layout drawings. Unless otherwise specified, all fixtures shall be supplied complete with lamps. Ballast for fixture shall be copper wound or electronic type. The fixtures shall be of high power factor type i.e. at least 0.9 or more.

3.3 Switches

Switches, manufactured in accordance with IS: 13947 shall be used for non hazardous areas. Switches in areas where concealed wiring has been adopted, shall be flush mounting piano type unless otherwise specified. For surface conduit wiring, piano type switches in surface mounted box shall be provided. Industrial Type switches (Weather protected) shall be used for outdoor areas. Modular switches along with required boxes shall be provided for indoor application in case shown in the layout.

3.4 Receptacles

Three pin type 5A/15A receptacles manufactured in accordance with IS: 1293 shall be used for non hazardous areas. The receptacles and the controlling ON/OFF switch shall be mounted in the same enclosure box but these shall be in separate units to facilitate replacement by parts. Flush mounting type receptacles shall be used in areas where concealed wiring has been adopted and surface type shall be used in other areas. For exhaust fans and wall mounted air circulators, socket and switch enclosures shall be separate. In buildings such as sub-station, DG. Shed, Workshop, maintenance shop etc. industrial type metal clad socket outlets and plugs shall be provided. These sockets shall be supplied complete with plugs. Modular type receptacles along with required boxes shall be provided for indoor application in case shown in the layout

3.5 Outlet Boxes

The outlet boxes used as point outlets shall be prefabricated type 65mm deep junction boxes. Outlet boxes custom fabricated for sockets, switches, fixtures and fan regulators etc. shall be made of MS sheet having minimum thickness of 1.6mm. Outlet boxes shall be galvanized/nickel plated after fabrication. These shall be complete with terminal block suitable for connection of wires up to 4 sq. mm. Front cover plate shall be of 3mm thick Bakelite / PE sheet. The colour shall suit the shade of the walls or shall be white if the shade of the walls is not finalised. The sheet shall extend at least 2 cm on all sides of outlet box. Cover plate shall be fixed by cadmium plated brass screws and cup washers. Outlet boxes shall be provided with adequate number of knock outs on all the sides for ease of wiring either with conduits or without conduits.

3.6 Conduit and Accessories

Conduits for Electrical installations shall conform to IS: 9537. The type of conduit (steel / GI/ PVC) shall be as specified on drawing. Black enameled steel or GI conduit shall be of 1.6mm thick and the minimum wall thickness of PVC conduit shall be 1.6mm. Generally PVC conduits shall be used in concealed wiring and for surface wiring GI conduit (in plant buildings) and black enameled steel conduit (in non plant buildings) shall be used.

3.7 Lighting Poles

Lighting poles shall be fabricated as per EIL installation standards enclosed with the specification from ERW steel tubular pipes of specified section, with joints, swaged together when hot and beveled on outside edges or hexagonal shape. Poles shall be coated with bituminous preservative solution on the ground portion of the outside surface. Remainder of the outside surface shall be given one coat of redoxide primer and finished with two coats of aluminium paint. The pole shall have a marshalling box near the bottom to contain HRC fuses, a neutral link, an earth stud and terminal block. FRP type lighting poles shall be provided in case shown in the layout.

3.8 Lighting Mast

3.8.1 Lighting masts (Lattice tower) where used, shall be fabricated as per EIL Standard Drawing enclosed with the tender/specification. They shall be complete with 2 nos. MS flats provided at the base plate for connection to the plant earthing grid. A ladder, platform, handrail, a weather protected TPN switch (at 1500mm from ground level) and a weather protected distribution board fabricated out of sheet steel shall be provided at the top of mast. The TPN Switch and the distribution board shall also have a canopy for additional weather protection. The TPN switch shall be suitable for looping one more lighting mast from the same incoming power supply. The distribution board shall have TPN bus bars of 30 Amps. rating and 12 Nos. outgoing circuits each with a 6A single pole MCB. The distribution board shall have cable entries from bottom. Necessary space provision and suitable mounting arrangement shall be made on top of the tower for mounting of ballast (choke) and condensers for all the circuits and the lighting fixtures. The masts shall be given one coat of red oxide primer and two coats of aluminium paint. Distribution board shall be fabricated out of 2mm thick sheet steel and shall be painted with two coats of enamel over a base coat of red oxide.

3.8.2 Unless otherwise specified the flood lighting high masts shall be telescopic type conforming to EIL specification and data sheet.

3.9 Wires

Wires shall be PVC insulated and shall be of 660 Volts grade as per IS694. Conductor shall be of stranded copper and size shall be minimum 1.5 Sq. mm for lighting, 2.5 Sq. mm for 15A power socket circuits and 4 sq. mm for split A/C power socket circuits. Red/Yellow/blue

wires for phases, black wire for neutral and green wire for earth shall be used (size of earth wire shall be same as for phase and neutral size). Wire size for air conditioning circuit feeders shall be as indicated in the panel schedule.

3.10 Ceiling fan/Exhaust fan

Ceiling fans shall be of 1200mm sweep unless otherwise specified with double ball bearing and regulator. The suspension down rod shall be sturdy mild steel rod of adequate diameter and of minimum length of 300mm with shackles suspension arrangement as per IS. For exhaust fans, the sweep dia. and air CFM shall be as specified in job specification. Exhaust fans for battery room shall be with anticorrosive blades suitable for use in acidic fumes.

3.11 Decorative switches and sockets

Decorative lighting switches and sockets where specified, shall be modular in design. All these items shall fit into the same frame with overall standard dimensions. Frames shall be suitable for surface and flush mounting in brick / concrete wall. The frames shall be suitable for conduit entry from all the sides. Switches and sockets shall match colors of the frame and cover plates to obtain a combination which shall match décor of the interiors of Control Room, Administrative buildings, offices rooms etc.

4.0 LIGHTING INSTALLATION

4.1 General

- 4.1.1 The lighting fixtures in the plant shall be fed from lighting panel. All outdoor lighting shall be group controlled manually or through synchronous timer or photocell. Lighting wiring between panel and lighting fixtures shall be done with PVC insulated 3-core (phase, neutral and earth) copper conductor armoured cable for hazardous areas. Wiring in the building shall be done by means of 3-core copper, conductor PVC insulated, un-armoured cables, or PVC insulated copper conductor wires in conduit/Metsec channel as specified. All joints of conductors in Switch boards/JBs Fittings shall be made only by means of approved mechanical connectors (nylon/PVC connectors). Bare twisted joints shall not be permitted anywhere in the wiring system.
- 4.1.2 The lighting layouts furnished by owner will indicate approximate locations of lighting fixtures. The electrical contractor shall determine, with approval of Engineer-in-Charge, the exact locations of each fixture in order to avoid interference with piping or other mechanical equipment and also with a view to obtain as much uniform illumination as practicable, and to avoid objectionable shadows. Conduits shall be laid out by the contractor to suit field conditions and as per directions of the Engineer-in-Charge.
- 4.1.3 On walkways, platforms and other outdoor area, lighting fixtures shall be located nearer to landing of stairs or ladders, gauges, flow meters, panel boards and other equipment to provide proper illumination.
- 4.1.4 The minimum height of any lighting fixture shall be preferably not less than 2.5 meters above the floor level.
- 4.1.5 All outdoor cable terminations to outdoor junction boxes, panels, socket outlets etc. shall be through bottom or from side. Top entries for cables shall be avoided to avoid water entry. All cable glands for outdoor terminations shall be double compression type and the gland shall be covered with PVC or rubber boot shroud. All unused cable entries shall be plugged with suitable blanking plugs.
- 4.1.6 Mounting height of equipment shall be as under:-

Top of Switch Box	:	1200 mm from FFL (Finished floor level)
Top of Lighting/Power Panel	:	1800mm from FFL
5/15 Amp. receptacle	:	300mm from FFL unless otherwise specified (1200 mm for process areas and industrial sheds)
Lighting fixture	:	As indicated in layout drawing
Exhaust fan	:	In the cutout provided / as indicated in Layout drawings.

4.1.7 Fixtures shall be firmly supported from the structures. Support clamps etc. may be bolted or welded to the existing steel work or metal inserts. In case of concrete structures, where metal inserts are not available, fixtures shall be suspended from concrete surfaces with the help of anchor fasteners. In such cases special care shall be taken to see that anchoring is firm. In places where ceiling fans are provided, lighting fixtures shall be suspended below the level of fan to avoid shadow effect.

4.1.8 Circuit cables in a group shall be cleated to structure by using galvanised strip clamps or cable run in cable trays wherever trays are available. Spacers and cleats shall be of required size to accommodate the cables. All hardware shall be galvanised or zinc passivated. Underground lighting cables (in paved areas) shall be taken in suitable GI sleeves buried at a minimum depth of 300mm from FFL. GI pipe sleeves shall be extended to 300mm above FFL. Exact termination/layout of GI pipes (for protection of cables) shall be decided at site as per site convenience in consultation with Engineer-in-charge.

4.1.9 Wiring for all outlet sockets shall be done with 3 cores of equal sizes for phase, neutral and earth. The terminals of switch sockets shall be suitable to receive the size of wire specified.

4.1.10 All lighting fixtures shall be provided with terminal block with required terminals suitable for connection of wire up to 2.5 sq. mm copper conductor.

4.1.11 The cable shall be straightened after unwinding it from the drum. All cables are clamped/laid in straight run without any sag and kink.

4.1.12 For location where fan points are shown, fan hooks with junction box shall be provided during concreting.

Where fan hooks and JBs. are provided separately JB shall be located within a distance of 300mm from hook for mounting of ceiling rose.

4.1.13 Industrial type plug sockets with 20A MCB or rating as per job specification shall be provided at a height of 500mm from FFL for window AC units.

Socket outlets and plugs for installation in Sub-station building, DG shed, workshop, and maintenance shop etc. shall be of industrial metal clad type.

4.1.14 Wiring for exhaust fans shall be terminated in receptacles as specified in layout drawing and the connection from receptacle to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires. Switch for exhaust fan shall be located in a separate switch board along with other switches.

4.2 Conduit System

4.2.1 Surface or concealed conduit system of wiring shall be adopted, as specified in the drawings. Required number of pull boxes shall be used at intervals to facilitate easy drawing of wires. Separate conduit shall be run for lighting and power circuits. Further, conduits for Normal lighting/Emergency lighting/DC critical lighting shall be separate. Conduit layout shall be decided at site as per site conditions. Drop conduits for switch boards shall be decided by

contractor as per wall locations shown in Architectural drawings. All exposed run of conduits on surface, shall be vertical or horizontal.

- 4.2.2 Only threaded type conduit fittings shall be used for metallic conduit system. Pin grip type or clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed.

Conduit shall be of minimum 25mm dia. Maximum number of wires permissible in a conduit shall be seven/nine for wire size of 2.5 sqmm/1.5 sq.mm. respectively.

- 4.2.3 The exposed outer surface of the conduit pipes, including all accessories forming part of the conduit system, shall be adequately protected against rusting. In all cases, bare threaded portion of conduit pipe shall not be exposed unless such bare threaded portion is treated with anti corrosive preservative or covered with approved plastic compound.
- 4.2.4 Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side. Where concealed wiring is done, junction boxes (65mm deep) shall be used so as to rest on shuttering properly. Conduits shall be laid above reinforcement. All conduit connections shall be properly screwed and Junction box covers shall be properly fitted so as to avoid entry of concrete slurry.
- 4.2.5 Conduit pipes shall be fixed by 1.6mm thick GI saddles on 3mm thick GI. saddle bars of required width in an approved manner at intervals of not more than 50cms for straight run. At places near junction boxes, bends, or similar fittings, saddle and bars shall be provided on either side.
- 4.2.6 Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. Pull wire (GI or steel) shall be provided inside conduit for the ease of wire pulling. The contractor shall coordinate his work with other agencies involved in the civil works in such a way, that the work of the other agencies is not hampered or delayed. Vertical conduit runs shall be made in wall before plastering is done so as to avoid chasing. Where chases are made for conduit run contractor shall fill these chases or any other openings made by them after completing the work and patch the surface. During installation, care shall be taken to see that proper covers are provided to prevent rusting of conduits. Locations of all point outlets, junction boxes shall be marked with brick powder or sand so that these are easily identified after shuttering removal. As built conduit layout drawing shall be submitted by contractor after completion of the work.
- 4.2.7 All junction boxes, bends and other accessories shall be of the same material as that of conduit and shall have the same protective coatings.
- 4.2.8 After erection, the entire conduit system shall be tested, for mechanical and electrical continuity and shall be permanently connected to earth by means of approved type of earthing clamps.

4.3 Hazardous Area Installation

- 4.3.1 Wiring in hazardous area shall be done by using minimum 2.5mm² copper conductor armoured cable. Circuit wiring feeding hazardous areas shall be controlled by two pole switches/MCBs (for phase as well as neutral isolation).
- 4.3.2 Correct type of lighting equipment (fixtures and JB's) with regard to hazardous protection as specified in the drawing shall be installed for the areas classified as Zone 1, Zone 2 etc.
- 4.3.3 The terminations in the junction boxes and the lighting fittings shall be done avoiding possibility of loose connections due to vibrations. After the terminations are made the cover of the junction boxes and the lighting fittings shall be closed properly with all bolts and hard

wares in correct position, retaining its explosion and weather protections. In fixtures having double cable entries, both the entries shall be used for looping in and looping out connection, thus minimising the use of a separate junction box. Wherever separate control gear boxes (CG box) are provided looping in and looping out connections shall be through CG box, thus avoiding the use of an additional junction box. All unused cable entries shall be sealed with suitable plugs.

- 4.3.4 Circuit cables shall be firmly cleated in a group along columns/ beam/ladders/side channels/platform using 1.6mm thick GI saddles on 25x3 mm GI saddle bar at intervals of 400mm to 500mm for straight run and on either side close to bending and at both termination ends as per the directions of Engineer-in-charge. Where required 3 or more of cables shall be taken in perforated 100mm cable tray after getting the approval of Engineer-in-charge. Cables shall not be routed along hand rails.

Where fire proofing column/structures are encountered, all cabling shall be taken in GI pipes of required size and both ends shall be sealed, well before fire proofing is done. Similarly equipment such as lighting fixture, control gear box, lighting/ power panels, field call stations, junction boxes etc. shall be installed on suitable steel mounting frame/distance bracket, thereby avoiding direct contact with the concrete used for fire proofing.

- 4.3.5 Cable glands for terminating cable on flameproof equipment shall be of double compression FLP type. Any material/equipment specified to be supplied by contractor for installation in hazardous areas, shall be tested by CIMFR and duly approved by CCoE or DGMS or any other applicable statutory authority. All indigenous FLP equipment shall also have valid BIS license as required by statutory authorities.

4.4 Building Lighting

- 4.4.1 The type of wiring system shall comprise surface/concealed conduit system or cable wiring as specified on layout drawings.
- 4.4.2 Mounting details of fixtures shall be indicated on the drawings. If specified on the drawings, a group of fluorescent lighting fixtures which are to be mounted end to end shall be fixed to mild steel cold rolled sections of 50mm x 50mm and of 1.2mm thick (Metsec channel). The entire assembly shall be fixed to the ceiling with necessary number of supports which may be by means of steel conduit or chromium plated chain link as required. The 'Metsec' Channel shall run continuous in suitable sections from one end to other end of wall. The complete channel shall be spray painted, with approved colour as per the directions of Engineer-in-Charge. All wires inside channel shall be neatly bunched by nylon tape and buttons.
- 4.4.3 Wiring in areas above false ceiling shall be done in Surface Conduit (25mm dia GI conduit) suitably clamped to the true ceiling. Vertical drops from true ceiling for panels, switches, receptacles etc. shall be taken in 25mm dia PVC conduit concealed in walls upto switchboards/panels. Lighting fixtures shall be supported from true ceiling. Exact location of fixtures shall be finalised in co-ordination with air-conditioning duct diffuser layout, panel's layout and false ceiling grid layout. To facilitate easy maintenance 'Looping back system' of wiring shall be followed throughout. Accordingly supply tapping's and other interconnections including for earthing are made only at fixture connector blocks or at switch boards. Required number of junction boxes shall be used at intervals for wire pulling and inspection.
- 4.4.4 All wires in conduit shall be colour coded as specified. Each circuit shall have independent phase neutral and earth wire. However when group of circuits are run in a single conduit the earth wire can be common.
- 4.4.5 Building conduit lighting system of wiring where measurement is done on point wiring basis generally consists of two parts. The first part is the circuit wiring which includes the work necessary from lighting panel up to switch box and from switch box to another switch box.

The second part is the point wiring which shall include the work necessary from tapping point in the switch box upto various fixtures or fan outlets/ceiling roses.

- 4.4.6 Switches for light fixtures/exhaust fans in battery room shall be provided outside the Battery room.
- 4.4.7 Lighting layouts for non-plant buildings (such as ware house, cement godown, gate house, workshop, service building, rest room, etc.) shall be prepared by installation contractor as defined in the scope of work.

The following basic data/document for preparation of layouts will be provided to the contractor.

- i) Architectural drawings
- ii) Illumination level required
- iii) Type of lighting fixture
- iv) Type of wiring (concealed/surface conduit/cable wiring etc.)

Based on the above input, contractor shall prepare and submit lighting layout drawings, panel schedules, conduit layout drawings for concealed wiring, design calculations wherever required, for review by purchaser before erection work is started. The lighting layout drawing shall show the location, type and mounting details of lighting fixtures, receptacles, junction boxes, layout of circuit indicating number of wires etc. The number of points in a circuit shall not exceed ten and the load in each circuit shall be less than 1000 Watts.

The panel schedule shall include rating of incoming and outgoing feeders, number of outlets, load for each outgoing circuit, etc.

All drawings shall be prepared preferably in A0 and A1 size. Panel schedules shall be in A4 size drawings. Final submission of drawings shall be in soft copies (CD form) and in bound volumes.

4.5 Street Lighting

- 4.5.1 Street lighting poles to be located on road side shall be installed at a minimum distance of 300mm from the edge of the walkway of the road (road berm). Size of wires from marshalling box upto fixture shall be 1.5mm²/2.5mm², copper conductor PVC insulated.
- 4.5.2 Each pole shall be earthed at two points by connecting to the plant earth grid as shown on Installation standards.
- 4.5.3 Street lighting fixture shall be mounted on steel tubular poles as per standard drawings. The foundation for the street lighting poles will be made by electrical contractor. Street lighting poles shall be supplied with a base plate.
- 4.5.4 The poles shall be numbered as per the drawings/ directions of Engineer Incharge.

4.6 Mast Lighting

- 4.6.1 The lattice structure masts shall be installed on concrete foundations with the base plate bolted on to the anchor bolts. The lattice structure shall be painted with a coat of primer and two coats of aluminium paint, the second coat to be given just before handing over to the owner. The masts shall be numbered as per drawings. The masts shall be connected to the plant earth grid at two points
- 4.6.2 The main feeder upto the distribution board of lighting mast shall be through PVC insulated armoured cable of size as specified in the respective drawing. Wiring from Distribution Board

to each flood-light fixture shall be by means of a 3-core 2.5sqmm, copper conductor PVC insulated armoured cable. All the cables shall be neatly clamped to the structure at intervals not exceeding 25 cms.

- 4.6.3 Exact orientation of flood lighting fixtures shall be decided at site to achieve optimum utility of these fixtures.

4.7 Telephone Wiring

Conduits for telephone wiring in buildings shall be of 1.6mm thickness. 25mm dia black enameled steel conduit/PVC as per IS 9537, installed on wall surface or concealed or as specified in job specification.

Conduit installation system shall comply with the requirements given in clause 4.2 'conduit system'. Required number of pull boxes shall be provided at interval for easy drawing of wires. The telephone wiring shall be done with 0.63mm dia annealed copper conductor PVC insulated 660V grade, twin flat wire, unless otherwise specified in job specification. One telephone socket outlet shall be provided for connection to telephone instrument.

5.0 TESTING AND COMMISSIONING

- 5.1 Lighting installation shall be tested and commissioned by installation contractor as per EIL specifications. Precommissioning checks and tests shall include but not be limited to the following:

- (i) The insulation resistance of each circuit without the lamps (load) being in place shall be measured and it should not be less than 500,000 ohms. (Between phases, phases to neutral, phase/neutral to Earth).
- (ii) Current and voltage of all the phases shall be measured at the lighting panel bus bars with all the circuits switched on with lamps. If required load shall be balanced on the three phases.
- (iii) The earth continuity for all socket outlets shall be checked. A fixed relative position of the phase and neutral connections inside the socket shall be established for all sockets.
- (iv) After inserting all the lamps and switching on all the circuits, minimum and maximum illumination level shall be measured in the area and recorded.
- (v) It shall be ensured that switch provided for ON/OFF control of point (light/fan/socket) is only on LIVE side.
- (vi) Operation of ELCB's shall be checked.

Contractor shall duly fill in all the above test results and submit the test reports to Engineer-in-Charge in triplicate.

- 5.2 All lighting layout drawings shall be marked by contractor for 'AS BUILT STATUS' and two sets of hard copies plus 1 set of soft copy in CD, shall be submitted to EIL.