**SECTION D 5 – Internal Electrification Works**

**Table of Contents**

[TECHNICAL SPECIFICATIONS 500](#_Toc512886476)

[C.14.1 INTERNAL ELECTRICAL WORKS 500](#_Toc512886477)

[C.14.2 LIGHTING FIXTURES WORKS 517](#_Toc512886478)

[C.14.3 UPS POWER SUPPLY & DISTRIBUTION SYSTEM 519](#_Toc512886479)

[C.14.4 EARTHING SYSTEM AND GROUND FAULT PROTECTION 531](#_Toc512886480)

[C.14.5 CABLE TRAY & LADDER SPECIFICATION 538](#_Toc512886481)

[C.14.6 BUSDUCT/ RISING MAINS (SANDWICH CONSTRUCTION) 543](#_Toc512886482)

[C.14.7 LIGHTNING PROTECTION SYSTEM AND SPDs 546](#_Toc512886483)

[C.14.8 LIFT/ ELEVATOR 552](#_Toc512886484)

[C.14.9 Energy Conservation Measures:- 561](#_Toc512886485)

[C.14.10 Sensor:- 561](#_Toc512886486)

**SECTION D 5 – Internal Electrification Works**

# TECHNICAL SPECIFICATIONS

## INTERNAL ELECTRICAL WORKS

**1.1 GENERAL**

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications.

* + - 1. General Specifications for Electrical Works.(Part –I)Internal Work - 2013.
      2. General Specifications for Electrical Works Part II External - 1995.
      3. General Specifications for Electrical Works (Part-III-LIFTS & Escalators) - 2003
      4. General Specifications for Electrical Works Part IV Sub Station – 2013.
      5. General Specifications for Electrical Works Part VII D.G. Sets - 2013.
      6. General Specifications for Electrical Works Part VIII Gas Based Fire Extinguishing System - 2013.

#### **1.2 WIRING SYSTEM:**

1. **SCOPE:**

The scope of work under this section covers installation and wiring for lights, fans, exhaust fans, call bells, fan coil units, geysers and power sockets etc., The wiring shall generally be done using FRLS PVC insulated copper conductor wires in M.S./PVC conduits as called for including providing switches, sockets, plug tops, electronic fan regulators, outlet boxes etc.

1. **STANDARDS:**

The following latest standards and rules shall be applicable:

IS : 732 Code of practice for electrical wiring installation (System voltage not Exceeding 1100 V).

IS : 1646 Code of practice for fire safety of buildings (General) Electrical installation.

IS : 9537 Conduits for Electrical installations (Part 1-4)

IS : 2667 Fittings for rigid steel conduits for electrical wiring.

IS : 3480 Flexible steel conduits for electrical wiring.

IS : 3837 Accessories for rigid steel conduit for electrical wiring.

IS : 694 PVC insulated cables.

IS : 6946 Flexible (Pliable) non-metallic conduits for electrical installation.

IS : 1293 Plugs and sockets outlets of rated voltage upto and including 250V.

IS : 8130 Specifications for conduits for electrical installation.

IS : 3854 Switches for domestic and similar purposes.

IS : 3419 Fittings for rigid non-metallic conduits.

IS : 4648 Guide for electrical layout in residential building.

IS : 4649 Adopters for flexible steel conduits.

IS : 5133 Boxes for enclosures of the Electrical.

IS : 4615 Switch socket outlets.

IS : 8884 Code of practice for installation of Electric bells and call system.

IS: 2551 Electric Danger notice plates.

IS : 3646 Code of practice for interior illumination.

IS: 371 Ceiling Roses.

IS : 302 General and safety requirements for household and similar electrical appliances.

IS : 3043 Code of practice for earthing.

IS : 5216 Guide for safety procedures and practices in electrical work. Indian Electricity Act and Rules.

Regulations for the electrical equipment in buildings issued by the concerned Electrical Authorities.

All standards and codes mean the latest.

#### **1.3 WIRING FOR LIGHTS, CEILING FANS, EXHAUST FAN AND CALL BELL POINTS:**

a) A point wiring shall consist of the wiring from the switch board together with a switch as required, including providing conduit & accessories, connector, ceiling rose., with suitable termination. The item will also include looping between switch boards of the same circuit. A point wiring shall include, in addition, the earth continuity conductor/wire from the switch board to the light fitting & fans & all other such non- current carrying metals shall be earthed. No tee jointing or looping of wires shall be done any anywhere except at a switch box or a light fitting. No joint shall be permitted above false ceiling.

The point wiring shall be carried out in the under mentioned manner:

* Design, Supply, installation, fixing of conduits and Steel wire / G.I. pull wire with necessary accessories, junction/pull/ inspection/switch boxes and outlet boxes etc.
* Supplying and drawing of wires of required size including earth continuity FRLS PVC insulated wire.
* Supply, installation and connection of modular type switches, sockets, cover plates, switch plates & fixing fan regulator, lamp holder, ceiling rose etc.
* The point shall be complete with the loop wiring from the switch board to the switch board of same circuit.

#### b) WIRING FOR LIGHTING FIXTURES

* The lighting in common areas, basements, common corridors, stair cases, service rooms and outdoor and façade areas etc. to be powered.
* This wiring will be linear basis and not on conventional point basis.
* The power wiring to Lighting Controllers will be done by three (1P+1N+1E) number FRPVC insulated wires of appropriate size from Distribution Board in MS/PVC Conduits. In this system, no switches will be required to control the lights.
* The Circuit Main:

The circuit main for lights/fan/6A sockets (where 6 A sockets connected to light circuit) shall include the wiring from the MCB distribution boards up to the first switch/light point/fan point.

The scope of work shall include the following:

* Supply and wiring in concealed/surface conduit from DB's to first switch/light/fan point.
* Providing FRLS PVC insulated copper conductor earth wire.
* Providing Steel/G.I. fish wire (pull wire) in the conduit.
* Termination of wires in DB's & switches using proper tinned copper lugs of soldering/crimping type.
* Providing necessary pull/junction boxes where necessary.
* Identification of circuits shall be done with ferrule nos.

#### **1.4 SYSTEM OF WIRING:**

Unless otherwise mentioned on the drawings, the system of internal wiring shall be as follows:

The system of wiring shall consist of single core, FRLS PVC insulated, 1100 Volt grade, stranded copper conductor wires/cables laid through concealed PVC and exposed to surface shall be MS conduits.

#### a) GENERAL:

Prior to laying and fixing of conduits and light outlet boxes, contractor shall carefully examine the layout drawings and prepare detailed shop drawings, indicating the exact location of light outlets, with distances marked, conduit routing, with sizes, No. of wires run in each conduit, control switch location etc. The contractor shall obtain the approval of all shop drawings by the Owner/PMC prior to the installation of conduits. Any discrepancy noticed in the design drawings shall be brought to the notice of the Engineer- In-Charge. Any suggestions or modifications suggested by the contractor shall have the approval of Owner/PMC before execution.

#### **1.5 CONDUITS:**

1. Type of Conduit

Unless otherwise specified all conduits for concealed/ surface/exposed installation including conduits running above false ceiling shall be of medium protection with stove enameled MS conduits. All conduits installed below ground level or in the damp/wet area shall be `A' Class G.I. pipes. All conduits for fire alarm system on surface shall be of MS conduits and concealed shall be FRLS PVC conduit.

1. PVC Conduits:

If specified to be provided in any special area the Nonmetallic conduits and accessories shall conform to IS 9537 (part 3), IS 3419 and each conduit shall bear the ISI Mark. PVC conduits shall be medium class as per IS:9537 ( Part-3) round. The conduit shall be plain end type as specified in IS:9537 (Part-3). The conduits internal surface shall be smooth. Only approved quality factory made bends/accessories shall be used unless otherwise stated. Minimum size of conduits shall be 20 mm diameter a n d wall thickness shall be as per IS:9537 ( Part-3) for medium class.

1. Metal Conduits:

Conduits and Accessories shall conform to IS:9537 (Part-2). Solid drawn, screwed steel conduits protected by black stove enamel shall be used. Where conduits for buried wiring are passing underground they shall be of galvanized steel conduit. Joints between conduits and accessories shall be securely made to ensure earth continuity. No steel conduit less than 20 mm in diameter shall be used. Conduits shall be solid drawn, lap welded, with minimum wall thickness of 1.6 mm for conduits up to and including 32 mm diameter and 2 mm wall thickness for conduits above 32 mm diameter.

The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer & ISI Mark (Engraved Markings) or painted markings.

Conduit accessories such as bends, coupling etc., shall be conforming to relevant Indian Standard Specifications.

The number of 1100 volt grade PVC insulated copper conductor wires that may be drawn in the conduits of various size shall be as per following Table.

**TABLE - I**

**Maximum number of PVC insulated 650/1100 V grade Aluminum/copper conductor cable conforming to IS: 694 – 1990**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Nominal Cross- Sectional area of conductor in sq.mm** | **20mm** | | **25mm** | | **32mm** | | **38mm** | | **51mm** | | **64mm** | |
| **S** | **B** | **S** | **B** | **S** | **B** | **S** | **B** | **S** | **B** | **S** | **B** |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| 1.50 | 5 | 4 | 10 | 8 | 18 | 12 | - | - | - | - | - | - |
| 2.50 | 5 | 3 | 8 | 6 | 12 | 10 | - | - | - | - | - | - |
| 4 | 3 | 2 | 6 | 5 | 10 | 8 | - | - | - | - | - | - |
| 6 | 2 | - | 5 | 4 | 8 | 7 | - | - | - | - | - | - |
| 10 | 2 | - | 4 | 3 | 6 | 5 | 8 | 6 | - | - | - | - |
| 16 | - | - | 2 | 2 | 3 | 3 | 6 | 5 | 10 | 7 | 12 | 8 |
| 25 | - | - | - | - | 3 | 2 | 5 | 3 | 8 | 6 | 9 | 7 |
| 35 | - | - | - | - | - | - | 3 | 2 | 6 | 5 | 8 | 6 |
| 50 | - | - | - | - | - | - | - | - | 5 | 3 | 6 | 5 |
| 70 | - | - | - | - | - | - | - | - | 4 | 3 | 5 | 4 |

**NOTE:**

1. The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
2. The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.
3. Conduit sizes are the nominal external diameters

#### CONDUIT ACCESSORIES:

* 1. PVC Conduit Bends & Collars:

If PVC conduits are used, then the PVC conduit bends & collars shall preferably be of the same make as of conduit. This shall conform to IS 9537/3412 with ISI Mark where necessary bends or diversion may be achieved by means of using bends and or circular inspection boxes with adequate and suitable inlet and outlet termination. In case of recessed installation system, the bends shall be properly secured & flush with the finished wall surface. Elbows shall not be used. No bends shall have radius less than 2 1/2 times the outside diameter of the conduit. Readymade factory bends shall be used where required.

* 1. M.S. Conduit Bends & Collars:

The MS conduit bends and collars shall be of MS black enameled coated having internal threading for screwed joints of the conduits. The bends and collars shall conform to IS 2667 & having ISI mark. The conduit bends & collars shall preferably be of the same make as of conduit. The minimum radius of conduit bend shall be 2 1/2 times the outer diameter of the conduit pipe. Where necessary conduit bends with inspection door shall be used, only factory made readymade bends shall be used.

* 1. PVC/Inspection/Junction/Pull Boxes:

The Inspection/pull box/junction boxes where used with PVC conduit installation shall be of heavy gauge PVC & conform to IS specification and shall match with the conduit sizes. The box shall be of round/square rectangular shape with conduit stub projection for termination of conduit. The box shall be minimum 50mm deep and the size of box shall be suitable to pull/make necessary joints of wires inside the boxes. Extra deep boxes are preferred. The boxes shall have flush type cover. The colour of plate shall match the colour of paint of the surface where installed. The boxes shall have concealed screwed socket for fixing the ceiling rose.

* 1. M.S. Conduit/Junction/Pull/Inspection Boxes:

The boxes for junction/pull/inspection boxes to be used with M.S. conduit installation shall be heavy gauge black enameled M.S. boxes. These boxes shall be manufactured in conformity with ISI specification and to match the type of conduit used. The boxes shall be of round/square or rectangular shape and shall have minimum 50mm depth. The box shall have threaded stub projection to terminate M.S. conduits. The boxes shall have concealed screwed sockets for fixing the ceiling rose or cover plate.

#### SWITCH OUTLET & SOCKET OUTLET BOXES :

1. Concealed Type outlet Boxes

The concealed outlet boxes for switches, sockets, power outlets, telephone outlet, fan regulator etc., shall be modular type and of same make as of switches/sockets etc. to match the exact requirement of combination of outlets. The boxes shall be fabricated out of heavy gauge CRCA cold rolled carbon alloy sheet steel with zinc plating (G.I). The size of boxes should match the type of outlet/switch plate to be mounted on the box. The adequate No. & size of knockout holes shall be provided to terminate the conduits in the box. These boxes shall be standard factory made product of same make as of switch plates & sockets. Separate screwed earth terminal shall be provided in the box for earthing. The outlet box shall be of minimum depth of 50mm. Boxes shall be suitable for grid mounting type of accessories. Long screw shall be provided to take care of the extra plaster thickness to mount the switch plates. Provision shall be made in the box & switch plate to have the minor adjustment of alignment of switch plate to plumb level.

1. Surface Type Boxes:

The boxes for mounting switches, sockets and other wiring devices shall be either moulded plastic or heavy gauge CRCA sheet steel painted to match the colour of wall. The box shall be suitable to terminate the M.S. surface conduit into the box. The size and shape of box shall match the exact type and combination of switch plates, receptacles & wiring devices.

Deep boxes shall be used to facilitate easy termination of conduit & wires/cables. Separate screwed earth terminal shall be provided in the box for earthing.

1. Light Outlet Boxes :

For concealed PVC conduit installation the light outlet box shall be of PVC

(round/square) with knock out holes, conduit projection suitable to terminate the conduit to the box. The box shall be made of heavy gauge PVC & the sample to have the approval of Owner/PMC before use. The boxes shall have concealed screwed socket to fix the ceiling rose. The boxes shall be minimum 50 mm deep. For surface conduit installation the light outlet box shall be of black enameled M.S. boxes. The boxes shall have threaded stub projection having internal threading to terminate the conduit of different sizes. The boxes shall be minimum 50mm deep.

1. Ceiling Fan Hook Boxes:

The ceiling fan hook box shall be fabricated of 2mm thick M.S. with adequately sized M.S. rod/hook to fix the ceiling fan. The hook shall be concealed within the fan hook box. The side extensions of rod shall be sufficiently long enough to provide adequate anchorage in the concrete. The size of the box shall be such that it should be totally covered by the plastic canopy of the ceiling fan. The box shall have anticorrosive primer coating.

#### COVER PLATES FOR SWITCHES & OUTLETS

Switches/socket/wiring devices plates shall be the same product as of switches/sockets/wiring devices. This shall be of best quality moulded plastic grid mounting type device plates/frames and shall match with the type of switches/sockets & boxes.

#### COVER PLATES FOR INSPECTION/JUNCTION/PULL BOXES

The cover plate for PVC boxes shall be minimum 3mm thick of perspex/formica sheet cover. For M.S. boxes cover plate shall be black enameled M.S. plates. The shape of the plate shall match that of the box.

#### RECEPTACLES

The sockets shall conform to IS 1293. Each socket shall be provided with control

switch of appropriate rating. The sockets shall be moulded type rated for 250 volts and of full 6 Amp or 16 Amp capacity as mentioned on the drawings.

The 6/16 Amps sockets shall be multipin (6 pin) automatic shutter type suitable for plugging 6 Amps/16 Amps tops. The shutter shall open when the earth pin of the plug top inserts in the socket. Where called for the 16 Amps socket shall have indicating lamp. The socket outlets & switches shall be of grid mounting type. Where called for sockets shall be provided with three pin plug top suitable to the socket & of the same make as of socket. The socket outlets installed outside the building/open to sky or in damp/wet areas shall of weather proof water tight type.

#### INDUSTRIAL TYPE SOCKETS

The socket outlets single phase or three phase installed in basement area, kitchen etc., shall be three pin or 5 pin industrial type with MCB (Single phase or three phase) control.

The socket & MCBs shall be mounted in a sheet steel enclosure and shall be the standard factory made product.

1. CONDUCTORS:

All PVC insulated Copper conductor wires shall conform in all respects to standards as listed under sub-head 'Regulations and Standards' and shall be of 1100V Grade.

* 1. FRLS PVC insulated wires (for light & small power wiring)
     1. For all internal wiring FRLS PVC insulated cables of 1100V grade, single core shall be used.

The conductors shall be plain annealed copper conductors complying with relevant IS standard.

The conductors shall be circular stranded copper conductor.

* + 1. The minimum number and diameter of wires for circular stranded conductor shall meet the requirements set out in the relevant Indian Standards.
    2. The insulation shall be PVC compound complying with the requirements of relevant ISS. It shall be applied by an extrusion process and shall form a compact homogeneous body.

The thickness of PVC insulation shall be as set out in the relevant standards.

* + 1. The cores of all cables shall be identified by colors in accordance with the following sequence.

Single phase - Red

Three phase - Red, Yellow, Blue

Neutral - Black

Earth - Green or Green/Yellow.

A means of identifying the manufacturer shall be provided throughout the length of cable.

1. Wire Sizes:

Unless otherwise specified in the drawings the size of the cable/wires used for internal wiring shall be as follows:

1. Light Point wiring for Single & two points - 1.5 Sq mm.

2. Light Point wiring for more than two points - 2.5 Sq mm.

3. Light Plug Wiring - 1.5 Sq mm.

4. Power Plug (16 Amp Socket outlet) - 4 Sq mm.

5. Power Plug (20/30 Amp MCB) - 6 Sq mm

6. Circuit Wiring from DB to First Switch - 2.5 Sq mm

For wiring of higher capacity out lets, size of wires will be decided keeping in view load and distance from DB.

The size of earth continuity conductor shall be same as phase wire.

#### INSTALLATION OF CONDUIT:

1. Concealed Conduit System :

Unless otherwise Specified all wiring shall be in heavy gauge black enameled MS conduit embedded in wall, or ceiling and concealed in the false ceiling as specified in case of PVC conduit the size of the conduit shall be selected in conformity with I.S. code and as specified. Factory made conduit bends and accessories shall be used. PVC Conduit shall be joined using coupler as supplied by the conduit supplier. The conduit in ceiling slab shall be straight as far as possible. Before the conduits are laid in the ceiling, the position of the outlet points, controls, junction boxes shall be set out clearly as per the dimensions and to minimize off-sets and bends. Before the reinforcement r o d s are kept in position electrical contractor should mark in paint the position of outlet points and conduit drop on the shuttering. When the outlet boxes are kept in position & before pouring the concrete, all outlet boxes shall be filled with paper to avoid entry of concrete inside the box. Conduits in ceiling shall be bonded to the reinforcement rods with Steel wire bonding wire at intervals not more than 1000mm, to secure them in position. PVC deep light outlet / pull boxes shall be provided as required. The conduit in ceiling slab shall be laid above the first layer of reinforcement rods to avoid cracks in the ceiling surface. In general the conduit shall not be laid directly on the shuttering surface to avoid cracks in the ceiling surface.

1. Conduits Concealed in the wall shall be secured rigidly by means of steel hooks / staples at min. 750 mm intervals. Before conduit is concealed in the walls, all chases, grooves shall be neatly made to proper required dimensions using electrically/manually operated groove cutting tools to accommodate number of conduits. The outlet boxes for control switches, inspection and draw boxes shall be fixed as and when conduits are being fixed. The recessing of conduits in walls shall be so arranged as to allow at least 12mm plaster cover on the same. All grooves, chases etc. shall be refilled with 1:4 cement mortar and finished up to wall surface before plastering of walls is taken up by the general civil contractor. Horizontal chase in walls are not allowed. Where, unavoidable prior permission of Owner/PMC shall be obtained before making any chasing. Where conduits pass through expansion joints in the building, adequate expansion fitting or other approved devices shall be used to take care of the relative movement. Whenever the conduits terminate into Control Boxes, distribution boards etc. conduits shall be rigidly connected to the boxes/boards with check nuts on either side of the entry. After conduits, junction boxes, outlet boxes etc. are fixed in position, their outlets shall be properly plugged with PVC stoppers or any other suitable material so that water, mortar, vermin or any other materials do not enter into the conduit system. All conduit ends terminating into an outlet shall be provided with bushes of PVC or rubber after the conduit ends are properly filed to remove burrs and sharp edges. Necessary G.I./Steel wire pull wires shall be inserted into the conduit for drawing wires before concreting. Insulated earth wires shall be run in each conduit originating from the panel board upto the Light, Socket and Switch boxes. If the Contractor forgets to install any conduit/ boxes etc., before the plastering/ painting work is done by other agencies, he may be permitted to install the same with prior permission of Owner/PMC and he shall be liable to make good the wall, floor, ceiling etc.
2. Conduits shall be so arranged as to facilitate easy drawing of wires through them. Entire conduit layout shall be done in such a way as to avoid additional junction boxes other than light points. The wiring shall be done in a looping manner. All the looping shall be done in either switch boxes or outlet box. Joints in junction or pull boxes are strictly not allowed.
3. All conduits shall be installed so as to avoid touching of steam and hot water pipes. Conduits shall be installed in such a way that the junction and pull boxes shall always be accessible for repairs and maintenance work. The location of junction/pull boxes shall be marked on the shop drawings and approved by the Owner/PMC.

A separation of 200mm shall be maintained between electrical conduits and hot water lines in the building.

1. No run of conduit shall exceed ten meters between adjacent draw in points nor shall it contain more than two right angle bends, or other deviation from the straight line.
2. Caution shall be exercised in using the PVC conduits in location where ambient temperature is 50- degrees Celsius or above. Use of PVC conduits in places where ambient temperature is more than 60-degree C is prohibited.

The entire conduit system including boxes shall be thoroughly cleaned after completion of installations and before drawing of wires. Conduit system shall be erect and straight as far as possible. Traps where water may accumulate from condensation are to be avoided and if unavoidable, suitable provision for draining the water shall be made.

All jointing method shall be subject to the approval of the Owner/PMC

1. Separate conduits shall be provided for the following system.
   * Lighting wiring
   * 16 Amp power outlets.
   * Telephone Owner/PMC Intercom system.
   * Fire Alarm system.
   * Cable TV system.
   * Computer data cabling system.
   * Equipment wiring/Cabling.
2. Conduit Joints

Conduits shall be joined by means of plain couplers. Where there are long runs of straight conduit, pull/inspection boxes shall be provided at intervals, as approved by the Engineer- In-Charge. The conduits shall be thoroughly cleaned before making the joints. In case of plain coupler joints, proper jointing material like vinyl solvent cement (gray in color) or any material as recommended by the manufacturer shall be used.

1. Bends in Conduit

Wherever necessary, long bends or diversions may be achieved by bending the conduits or by employing normal bends. No bends shall have radius less than 2.5 times outside diameter of the conduit. Heat may be used to soften the PVC conduit for bending, but while applying heat to the conduit, the conduit shall be filled with sand to avoid any damage to the conduit. Kinks in the conduit bends shall not be acceptable.

1. Bunching of Cables:

Cables of AC supply of different phase shall be bunched in separate conduits. The number of insulated wires/cables that may be drawn into the conduits shall be as per CPWD specification. The space factor does not exceed 40%. However, in any case conduits having lesser than 20 mm diameter shall not be used.

#### Open/Surface Conduit System:

* 1. Wherever specifically called for, surface conduit system shall be adopted. All conduits shall be of rigid MS. pipe. All conduits and its accessories shall be of threaded type. Conduits shall run in square and Symmetrical lines. Before the conduits are installed, the exact route shall be marked at the site and approval of the Owner/PMC shall be obtained. Conduits shall be fixed by heavy gauge PVC saddles, secured by suitable rawl plugs, at an interval of not more than 1 meter. Wherever, couplers, bends, or similar fittings are used saddles shall be provided at either side at a distance of 300 mm from the centre of such fittings. Conduits shall be joined by means of screwed couplers and screwed accessories only. In long distance straight runs of conduit, inspection type couplers /junction boxes shall be provided. Threading shall be long enough to accommodate pipe to the full threaded portion of the couplers and accessories. Cut ends of conduits shall have no sharp edges nor any burrs left to avoid damage to insulation of wires.
  2. Bends in conduit runs shall be done by using pipe bending machine. Sharp bends shall be accomplished by introducing solid bends, inspection bends or PVC inspection boxes. Radius of solid bends shall not be less than 75mm. Not less than 90 degree bend shall be used in a conduit run from outlet to outlet.
  3. Wherever conduits terminate into control boxes, outlet boxes, distribution boards etc., they shall be rigidly connected to the box with check nuts on either side of the entry.
  4. Steel wire /fish wire shall be drawn in each conduit.
  5. Separate PVC insulated copper conductor earth wire shall be drawn in each conduit.
  6. Draw boxes shall be located at convenient location for easy drawing of wires.
  7. Every mains and submains shall run in an independent conduit with an independent earth wire of specified capacity along the entire length of conduit.
  8. The conduit to be installed shall be of ample cross section area to facilitate the drawing of wires. The diameter of the conduit shall be selected in this specifications. But in no case it shall be less than 20 mm diameter.
  9. Entire conduit layout shall be done such as to avoid additional junctions boxes other than for outlet points. Conduits shall be free from sharp edge and burrs. Conduits shall be laid in a neat and organized manner as directed and approved by the Owner/PMC. Conduit runs shall be planned so as not to conflict with any other services pipe, lines/duct.
  10. The conduit shall be painted with two coats of enamel paint, color as approved by the Owner/PMC after installation.
  11. If required, connection between PVC and steel conduits shall be through a junction box.

Direct connection between PVC and steel conduits are not allowed.

* 1. Where exposed conduits are suspended from the structure, they shall be clamped firmly and rigidly to hangers of design to be approved by the Owner/PMC Where hanger supports are to be anchored to reinforced concrete, appropriate inserts and necessary devices for their fixing shall be left in position at the time of concreting, making holes and opening in the concrete will generally not be allowed. Where inserts are not provided, contractor shall use only anchor fasteners. In case, it is unavoidable, prior permission of the Owner/PMC shall be obtained to make any openings in the concrete surface.
  2. Conduit Joints:

Conduit pipes shall be joined by means of screwed couplers and screwed accessories, as per IS : 2667. The threads shall be free from grease or oil.

In long distanced straight runs of conduit, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and lock nuts shall be provided. The bare threaded portion shall be treated with anti-corrosive paints. Threads on conduit pipes in all cases shall be between 11mm or 27mm long, sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any burrs left, to avoid damage to the insulation of conductors while pulling them through such pipes. Brass female bushes shall be used in each conduit termination in a switch box, outlet box, electrical panel or any other box.

Conduit shall be secure in each outlet box, switch box, electrical panel or any other box by means of one G.I. hexagonal lock nut and bush, outside and inside the box.

At each building expansion joints, approved oil tight double wire wound flexible steel conduit or any other approved method shall be used. This shall be united on both sides with the rigid conduits by suitable union.

Conduits installed in the plant room for mechanical equipment shall be properly clamped with the mechanical supports, but in no case, it shall be fixed with the body of the equipment. The connection of conduit to the mechanical equipment shall be through oil tight double wire wound flexible steel conduit. In any case the length of the flexible conduit shall not exceed one meter. The flexible conduit shall be properly clamped with the body of the equipment. They shall not in any case be clamped to any cover or any removable parts of the equipment.

k.14)) Bends of Conduits:

All necessary bends in the system including diversion shall be done by bending pipes or by inserting suitable solid or circular inspection type normal box or similar fittings. Conduit fittings shall be avoided as far as possible on conduit system exposed to weather, where necessary, solid type fittings shall be used. Radius of such bends in conduit pipes shall be not less than 75mm.

No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted.

* 1. Protection against Dampness:

In order to minimize condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, as far as possible.

* 1. Protection of Conduit Against Rust:

The outer surface of the conduits including bends, junction boxes, etc., forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases, no bare/ threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive coating or covered with approved plastic compound.

All screwed and socket connections shall be adequately made fully water tight by the use of proper joining material i.e. white lead for metal conduits.

* 1. Bunching of Cables:

Unless otherwise specified, insulated conductors of different phases shall be bunched in separate conduit. Wires carrying current shall be so bunched in the conduit that the outgoing and return wires are drawn in to the same conduit. Wires originating from two different phases shall not be run in the same conduit.

#### WIRING

Power wiring shall be distinctly separate from lighting wiring. Each circuit phase wire from the distribution boards should be followed with a separate neutral wire of the same size as the circuit wire.

1. Drawing of Conductors:
   1. The drawing and jointing of PVC insulated copper wire and cables shall be executed with due regard to the following precautions. While drawing wires through conduits, care shall be taken to avoid scratches and kinks which causes breakage of conductors. There shall be no sharp bends.
   2. Insulation shall be shaved off like sharpening of a pencil and it shall not be removed by cutting it square.
   3. Strands of wires shall not be cut for connecting terminals. The terminals shall have sufficient cross sectional area to take all strands and shall be soldered. Connecting brass screws shall have flat ends. All looped joints shall be soldered and connected through block/connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross sectional areas exceeding 10 sq. mm. shall always be provided with cable sockets. At all bolted terminals, brass flat washer of large area and approved steel spring shall be used. Brass nuts and bolts shall be used for all connections.
   4. Only certified wiremen and cable jointers shall be employed to do jointing work. All wires and cables shall bear the manufacturer's label and shall be brought to site in original packing. For all internal wiring, PVC insulated wires of 1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in loop system and no joints shall be allowed in the length of the conductors. If the use of joints connections are unavoidable due to any specific reason, prior permission, in writing, shall be obtained from the Owner/PMC. No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire, is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of wire. Before the wires are drawn into the conduits, the conduits shall be thoroughly cleaned of moisture, dust, dirt or any other obstruction by forcing compressed air through the conduits. The minimum size of PVC insulated conductor wires for all sub- circuit wiring for light points shall be 2.5 sq. mm.
2. Joints:

All joints shall be made at main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. No joints shall be made in conduits and in junction boxes. Conductors shall be continuous from outlet to inlet.

#### MAINS AND SUB-MAINS:

Mains and sub-mains cable or wires where called for shall be of the rated capacity. Every main and sub-main wire shall be drawn into an independent adequate size conduit. An independent earth wire of the proper rating shall be provided for every single phase sub main. For every 3- phase sub main, 2 nos. earth wires of proper rating shall be provided along with the sub main. The earth wires shall be fixed to conduits by means of clips at not more than 1000 mm distance.

Where mains and sub- main cables are connected to switchgear, sufficient extra lengths of cable shall be provided to facilitate easy connections and maintenance.

#### LOAD BALANCING:

Load balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

#### COLOUR CODE OF CONDUCTORS:

Colour code shall be maintained for the entire wiring installation: red, yellow, blue for three phases, black for neutral, green/yellow green for earthing.

The control wire from light control switches to the light/ fan points shall be the same colour as that of the phase/ circuit wires feeding that particular loop.

#### EARTHING:

All earthing system shall be in accordance with IS 3043 code of practice for earthing. The type and size of earthing wire shall be as specified under the heading of cables. Each conduit originating from the DB to various outlets shall have one earth wire (PVC insulated copper conductor green colour wire).

#### TESTING OF INSTALLATION:

Before a completed installation is put into service, the following tests shall be complied with.

#### INSULATION RESISTANCE:

The insulation resistance shall be measured by applying 500 volt megger with allfuses in places, circuit breaker and all switches closed.

The insulation resistance in mega ohms of an installation, measured shall not be less than 50 mega ohms divided by the number of points on the circuit.

The insulation resistance shall be measured between Earth to Phase Earth to Neutral Phase to Neutral

#### EARTH CONTINUITY PATH:

The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker, measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.

#### POLARITY OF SINGLE POLE SWITCHES:

A test shall be made to verify that every non linked, single pole switch is connected to one of the phase of the supply system.

#### COMPLETION CERTIFICATES:

All the above tests shall be carried out in presence of Consultants/Employer/Owner/PMC and the results shall be recorded in a prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be re-tested. The completed test results forms shall be submitted to the Owner/PMC for approval.

On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

#### TABLE - II

**Girder Clips or Clamps**

**Size of Conduit Width Thickness**

i) 20 mm - - - - 19 mm 0.9mm (20 SWG)

ii) 25 mm - - - - 19 mm 0.9mm (20 SWG)

iii) 32 mm & above - - - 25 mm 1.2mm (18 SWG)

#### SPECIFICATION OF LIGHT/POWER CIRCUIT/DB’S

**a)**. **CAPACITY OF LIGHT AND POWER CIRCUIT**

* + - 1. Lighting circuit shall not have more than 10 switch controlled/group points of light, fan, socket outlet or connected load of 800 W whichever is less.
      2. Power circuit shall be designed based on load where specified, otherwise the norm of one KW per circuit is to be followed.
      3. Not more than 2 power outlet shall be connected in one power circuit in the case of buildings.
      4. Power outlets in common areas like security hold, concourse, arrival/departure and passenger areas shall be two power out let per circuit. One outlet shall be looped from other outlet.

In the case of pictographs and signages, these shall be connected as a group control point from the nearest light point and classified as group control point.

#### b) DISTRIBUTION BOARDS

Distribution Board shall be double door type with extended loose wire box at the top and suitable for flush installation. All distribution boards shall be of three phase (415 Volts) or single phase (240 volts) type with incoming isolator or MCB and/or ELCB as in indicative Items. Distribution boards shall contain plug in or bolted type miniature circuit breaker mounted on bus bars. Miniature circuit breakers shall be quick make & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection. MCB shall conform with IS 8828-1978. Bus bars shall be of electrolytic copper. Neutral bus bars shall be provided with the same number of terminals as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. Phase barrier shall be fitted and all live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

Distribution Board with single phase outgoings requirement shall be Horizontal type. Distribution Board installed in indoor dry locations shall conform to IP-42. Distribution Board installed in outdoor and & wet locations shall conform to IP- 65.

Miniature Circuit Breakers for lighting circuits shall generally be of "B" series whereas the circuits feeding discharge lamps (HPMV or HPSV), halogen lamps, all power outlet points, equipment/ machinery shall be of "C" series (Motor circuit) types. All miniature circuit breakers shall be of 10 KA rated rupturing capacity.

Distribution board shall be provided with isolator or MCB and/or earth leakage circuit breaker as mentioned in drawings and Indicative items. Earth leakage circuit breaker shall be current operated type and of sensitivity not less than 100mA unless otherwise stated. ELCB shall be mounted within distribution board box. Distribution board box, Isolator, MCB used shall be of one/same manufacturer. Standard size DB Box manufactured by approved manufacturer shall be used. In case, size specified in Indicative items is not standard size of manufacturer, next standard size distribution board box shall be used with incoming and outgoing MCB as specified in Indicative items. Additional cutout/space for outgoing MCB shall be plugged with blank plates.

#### 1.8 EARTHING:

1. SCOPE:

All the non-current carrying metal parts of electrical installation shall be earthed as per IS:3043.

All equipment, metal conduits, rising main cable armour, switch gear, distribution boards, meters, all other metal parts forming part of the work shall be bonded together and connected by two separate and distinct conductors to earth electrodes. Earthing shall be in conformity with the provisions of Rules 32, 61, 62, 67 and 68 of IER 1956.

1. G.I.PIPE EARTH STATION :

G.I. pipe shall be of medium class, 40 mm dia and 4.5 m length. Galvanizing shall conform to relevant Indian Standards. G.I. pipe electrode shall be cut tapered at the bottom and provided with holes of 12 mm dia drilled not less than 7.5 cm from each other up to 2 M of length from bottom. The pipe electrode shall be as far as practicable embedded below permanent moisture level. Except where rock is encountered, pipes shall be driven to a depth of at least 4.5 mtr. Where rock is encountered at a depth of less than 2.5mtr the electrode may be buried inclined to the vertical and the inclinations shall not be more than 30 deg from the vertical. The pipe electrode shall be made of one piece. Earth leads to the electrode shall be laid in a heavy duty GI pipe and connected to the pipe electrode with brass bolts.

## LIGHTING FIXTURES WORKS

**2.1 SCOPE** :

Scope of work under this section shall include supply inspection/testing at suppliers/manufacturer's premises, receiving at site, safe storage, transportation from point of storage to point of erection, erection and commissioning of light fittings, fixtures and accessories for back of the house area including all necessary supports, brackets, down rods and painting etc. as required.

#### GENERAL CONDITIONS

1. The luminaire specification shall be read in conjunction with drawings and associated sketches and Indicative items that are pertinent to the specialist lighting design scheme. Drawings will supersede in case there is conflict between technical specifications and drawings
2. All equipment supplied shall comply with the relevant requirements, and be capable of installation in accordance with the manufacturers’ instructions, the current edition of the local wiring regulations and all statutory and local authority requirements.

#### PROTECTION

* 1. All equipment shall be supplied with adequate means of protection to ensure its preservation during transport to site and any subsequent storage prior to installation.
  2. All vulnerable finished parts liable to scratching or other abrasion during handling and installation shall be further protected by a removable film applied prior to dispatch.
  3. Notwithstanding the above, the contractor shall remain responsible for ensuring compliance with relevant standards, the accuracy of the information shown on his drawings at all times and for ensuring that the equipment shown fulfils the requirements of this specification.
  4. Electrical supply connections shall be designed to facilitate the easy installation of the luminaires.
  5. All lighting fixture shall be independently earthed with minimum 1.0 sq,mm multi stranded copper wire and further shall be connected to building earthing system.

#### SAMPLE APPROVAL

* 1. One working sample is to be supplied in working order complete system, and 3m electrical cable terminated in a plug suitable for connection to the local distribution system for each type of luminaire specified.
  2. All samples are returnable and shall not be included in the fixture count for the project.

#### COMMISSIONING

The Contractor shall focus all adjustable light fixtures under the direction of the Engineer- In-Charge. All access equipment shall be provided by the Contractor.

1. **STANDARDS**

All fixtures would comply with latest Indian standards

#### LIGHT FITTINGS-GENERAL REQUIREMENTS:

* 1. Fittings shall be designed for continuous trouble free operation under atmospheric conditions without reduction in LED life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather - proof and rain proof. IP44 for wall brackets, IP65 for semi-outdoor areas, IP67 for ground buried up lights and IP68 for cove lights
  2. All hardwires used in the fitting shall be suitably plated or anodized and passivated.

#### LIGHTING FIXTURES INSTALLATION:

1. The light fixtures and fittings shall be assembled and installed in position complete and ready for service, in accordance with details, drawings, manufacturer's instructions and to the satisfaction of the Owner/PMC. Pendent fixtures specified with overall stem lengths are subject to change and shall be checked with conditions on the job and installed as directed. All suspended fixtures shall be mounted rigid and fixed in position in accordance with drawings, instructions and to the approval of the Owner/PMC. Fixtures shall be suspended true to alignment, plumb level and capable of resisting all lateral and vertical forces and shall be fixed as required.
2. All suspended light fixtures, fans etc., shall be provided with concealed suspension arrangement in the concrete slab/roof members. It is the duty of the Contractor to make these provisions at the appropriate stage of construction. Exhaust fans shall be fixed at location shown on drawings. They shall be wired to a plug socket outlet at a convenient location near the fan. All switch and outlet boxes, for fans and light fittings shall bebonded to earth. The recessed type fixtures shall not be supported into the false ceiling frame work. This shall have independent support from the socket of ceiling using conduit down rods/steel chain with provision for adjusting the level of fitting. Wires shall be connected to all fixtures through connector blocks. Wires brought out from junction boxes shall be encased in flexible pipes for connecting to fixtures concealed in suspended ceiling. The flexible pipes shall be check-nuted to the junction box with a brass bush. Double checknut at the fixture and flexible pipes, wherever used shall be of approved quality by the Owner/PMC.

## UPS POWER SUPPLY & DISTRIBUTION SYSTEM

**3.1 General**

* This specification covers the design, supply, delivery, installation, testing and commissioning of a continuous duty, as per the required designed capacity to be worked out by the contractor, uninterruptible power supply system in N+1 configuration complete with maintenance-free sealed battery banks. The uninterruptible power supply system, hereafter referred to as the UPS system, shall operate in conjunction with the existing power distribution system, which consists of main supply from Distribution Transformer and back up supply from DG sets installed in the complex. In the event of an emergency it shall be able to supply, independently and automatically, clean and regulated, uninterruptible power for computer equipments and other critical loads, for a minimum period of thirty minutes/fifteen minutes. Only “ true -on-line” technology, also called voltage, frequency independent operation ,with by-pass (VFI as per IEC 62040-3 ,revised standards), are desirable, and shall accordingly be confirmed by the suppliers.
* UPS shall utilize a rack-mounted N+1 redundant, scalable array architecture. The system power train shall be comprised of 50kVA / 45kW power modules (rating of power modules may vary from vendor to vendor).
* Each hot-swappable / trained user replaceable 50kVA / 45kW power module shall contain a fully rated power factor corrected input rectifier/boost converter, a fully rated output inverter, battery charging circuit and fiels replaceable fans. Power module fans shall be variable speed controlled and capable of maintaining the system in the event of single fan failure.
* The UPS system and all associated equipments and components shall be manufactured in accordance with the IEC 62040 standards. (revised, to date).
* The UPS manufacturers shall be ISO 9001:2000 certified and shall have a sufficient experience in the design, manufacture, installation and testing of UPS system ,during the last ten years.
  1. **Environmental conditions**

1.) The UPS system shall be capable of withstanding any combination of the following environmental conditions, without mechanical damage or degradation of operating characteristics:

* Ambient temperature(maximum) : 45°C

(minimum) : 0 °C

* Relative humidity (maximum) : 95%

(minimum) : 60%

* Altitude up to : 1000m

2.) Audible Noise: - Noise generated by the UPS system, under any condition of normal operation ,shall not exceed an allowable sound pressure level of 75 dBA at 1 meter, according to EN27779(revised).

**3.3 System description**

1. The UPS system shall consist of the following major equipments

a) Rectifier

b) Static inverter

c) No-break static transfer switch

d) maintenance by pass switch

e) Battery bank

f) Main control panel with Mimic and touch Screen LCD display

1. The UPS system shall be able to operate in any of the following modes:

a) On-line mode:- During on-line operation mode, the UPS system shall be equipped to provide precise regulated and transient-free power to the computer equipment/connected loads. The mains supply provides power to the input converter. The input converter shall provide regulated DC power to the inverter and also, , supply the power to the battery charger to maintain the batteries in a fully charged condition . The Inverter shall convert the DC power into the regulated Ac .power for the system.

b) ECO mode:- When the load does not require highest level of protection, the UPS shall be in an energy saving mode. This mode shall be fully programmable to adapt it to the load and customer needs. When ECO mode is activated, the UPS switches to bypass, as a function of the actual mains system.

In case of a mains imperfection (out of tolerances) the UPS shall return to on-line mode.

c) Battery mode:- Upon failure of the mains supply, input power for the inverter shall automatically be supplied from the connected batteries. When the mains is restored, or the standby generating set supply is ready, input power for the inverter and for recharging the batteries shall ,automatically ,be supplied by the rectifier.

If the input does not return, the UPS shall, automatically, shut itself down in an orderly manner when the discharge limit of the batteries is reached.

d) By-pass mode:- Upon the failure of static inverter, the no-break static transfer switch shall activate ,automatically ,to isolate the faulty inverter and at the same time maintain a continuous supply to the system load. The automatic transfer mode shall also operate in the event of system overloading, or if irregular or undesirable output load is detected. In this case, the system shall, automatically, return to the original on-line mode of operation if the unbalancing is cleared.

e) Manual by-pass mode:- If the UPS system needs to be isolated for service or maintenance, the maintenance by-pass shall transfer the load from inverter to the mains ,without interruption and vice versa.

**3.4 Electrical characteristics**

1. General:-

UPS output Power ratings , 4 wire plus earth, at 0.9 power factor:\_

2. Input characteristics-

a) Input voltage : 304 - 470V

b) frequency : 50 – 60 Hz

c) Power factor : ≥ 0.99

d) Current distortion : ≤ 5% at full load

3. Output characteristics:-

a) Output voltage : 400 / 415V

b) Frequency : 50Hz, ± 0.01% if free running

: ± 5% with mains synch. (adjustable)

c) Power factor : 0.9

d) THD- linear load : < 1%

e) Recovery time : <20 msec.

f) Inverter overload : 125% for 10 min.

capability : 150% for 60 sec.

g) Crest factor : > 3:1 (as per:\_EN-50091)

acceptance

**3.5 Input Rectifier**

1. General:- the input rectifier converts the utility voltage into a regulated DC voltage. The Rectifier supplies power to the inverter. The Rectifier shall also draw power factor corrected and distortion free power from mains.

2. Capacity:- the Rectifier shall have sufficient capacity to support a fully loaded inverter and at the same time maintain the batteries in a fully charged condition.

**3.6 Battery Charging operation**

1. If the batteries are fully discharged, the Battery Charger shall recharge the batteries to 90% of fully charged condition ,preferably ,within ten to twelve(10-12) hours and at the same time supply full load current to the system. UPS supplier shall specify the time required for fully charging the batteries, as and when the Batteries get fully discharged.

2. Current and Voltage Limit:- the rectifier/charger output current and voltage shall be set to the battery supplier's recommendations and shall be adjustable at site.

**3.7** **Inverter**

1. General:- the conversion of DC to AC must be accomplished by power transistors of the IGBT type. Failure of any component of power system shall not interrupt the AC output. Instead it shall disconnect itself from the configuration while transferring the load to the static transfer switch and activate an alarm.

2. Output:- the inverter output voltage shall be controlled by software in DSP /

FPGA software (software generated sine wave).

3. The waveform shall be fed through a filter circuit. The inverter shall be able to handle short-circuit conditions without any damage to any of its components.

1. Frequency Control:- The output frequency of the inverter shall be controlled by an oscillator, which can be operated as a free running unit or in synchronized operation with a separate AC source.

5. If the external synchronizing source deviates from the pre-set frequency by ± 5% (adjustable), the oscillator shall automatically revert to free-running, and the microprocessor controlled accuracy shall be ± 0.1%.

**3.8 Electronic by-pass switch**

1. The electronic by-pass shall consist of a static SCR-switch, used to provide an uninterruptible transfer of the load to the utility. In case of variation in the output voltage., the electronic bypass switch shall return the load, automatically, to the UPS , when the malfunctioning, or overloading is cleared.
2. The electronic by-pass switch shall consist of processor controlled thyristors.
3. The electronic by-pass switch shall be activated manually by a switch/push button to test bypass operation. The switching time from inverter to reserve (bypass) and vice-versa shall be of negligible duration. In case of non-synchronization, this test should get discontinued automatically.

.

**3.9 Maintenance by-pass**

1. The maintenance by-pass shall be based on a manually operated switch which shall allow the electrical isolation of the UPS from the load while still supplying the load with power directly from the utility.

3.10 **Battery / battery test**

1. The battery bank shall provide the UPS system with a stored energy source. The battery bank shall be designed for standby power service. The cells shall be completely sealed and maintenance free.
2. The ampere-hour rating of the batteries shall be sufficient to stand the inverter for the standby period of 30 minutes with the inverter operating at full rated load at 0.7 power factor

3. Tenderer shall submit full technical data of the batteries, ampere hour rating offered in the tender and shall provide calculation to show the AH required and the ratings there of. An aging factor of 1.25 shall be considered while calculating AH rating of Battery.

4 The. Tenderer shall also specify the recommended voltage per cell for float charging or recharging.

5. The designed life span of the battery shall not be less than 3 years and only battery with proven field applications of not less than 3 years shall be accepted.

6. The batteries shall be mounted on/in shelves/cabinets/racks.

7. The UPS must be provided with an automatic battery test system.

8. The end of discharge voltage of the batteries must be load dependent in order to prevent deep discharging of the batteries whilst utilizing their maximum available capacity.

9 The Batteries shall conform to IS-1652(revised) or equivalent IEC standards.

**3.11 Instrumentation**

1. A touch screen Graphic Liquid Crystal Display (LCD) shall be provided.

2. The UPS system main control panel with LCD shall include the following measurement particulars:-

* Mains voltage and frequency, and the current delivered by the mains.
* Output voltage and output frequency, and the current delivered by the UPS.
* Battery voltage and current.
* Output Power

3. The UPS system main control panel with LCD shall include the following indications or controls also:

* Inverter ON / OFF.
* (manual) transfer to bypass.
* (manual) transfer to Inverter.

4. On the system Mimic panel, a mimic diagram with a common audible alarm and indications shall be available for any of the following conditions :-

* Mains ON
* Mains Fail
* Rectifier ON
* Rectifier Fail
* Inverter ON
* Inverter Fail
* Battery Low
* Load on Inverter
* Load on bypass source.

5. In addition, following conditions shall be displayed on alpha-numeric display:-

* Mains within limits
* By-pass line within limits
* Inverter operating
* Inverter By-pass line synchronized
* Load on Inverter
* Load on By-pass line
* Manual bypass On
* Mains out of limits
* Bypass line out of limits.
* Inverter Off
* Overload.
* Emergency Power Off
* End discharge battery voltage (battery low)
* Battery Charger failure

6. The UPS panel must be able to store up to 500 alarm or events

**3.12 Mechanical Design**

1. Enclosure:- The UPS system shall be housed in free standing steel cabinet.

2. Colour:- The UPS cabinet colour shall be Black.

3. Ventilation:- Mechanical venting , as required, shall be specified/detailed out.

4. Cable Entry:- Input to the system and outgoing cables shall be from the bottom / top.

5 Modular construction:-

The UPS shall be modular in construction consists of hot-swapable Power moules.

6. Power Connections:- Adequate space for termination shall be provided for incoming and outgoing cables. The cables for interconnecting the UPS and battery racks shall be supplied by the UPS supplier..

7. Protection:- The equipment shall meet the requirements of protection class IP20., as per IEC 60529(revised).

**3.13 Acceptance**

1. The tenderer shall submit detailed acceptance test procedures and checklist which shall be designed to verify the full compliance of the installed system with these specifications.

2. The acceptance test shall be carried out by contractor's engineer and witnessed by the Consultants/Employer/Owner/PMC

3. Copies of the test report and commissioning certificate stating that the system has been installed and commissioned to the requirements of the specifications, shall be submitted to the end-user on handing over the commissioned system.

**3.14 Documentation**

1. All documentation shall be written in good, simple and concise English using accepted technical terms, symbols and nomenclatures.

2. The final edition of the handing-over document shall cover installation, commissioning, operation and maintenance aspects of the system.

**3.15 Maintenance**

1. The tenderer shall be responsible for the maintenance of the system after the expiring of the warranty period. In the tender submission, the tenderer shall include a maintenance agreement for the subsequent maintenance of the system for consideration by the end-user.

2. The agreement shall include comprehensive maintenance proposed for five year for up-keeping of the system.

3. The tenderer shall submit a checklist of items to be carried out for the regular maintenance.

**3.16 Standards**

Standard codes of practice(revised up to \_date) to be followed are:\_

IS---732\_\_\_89Elect Installations)

IEC\_62040\_3 (Performance and test requirements)

IEC\_62040\_1& 3 (UPS)

IEC 60529\_\_\_\_(Degree of enclosure protection)

**3.17. SPECIFIED INBUILT FEATURES:**

- To withstand input variations

- High over load capacity, as specified

- Overall Efficiency: ≥ 96%

- Front Panel touch screen LCD display

- Digital controls, using latest processor like DSP / FPGA.

- Inbuilt arrangement for load sharing/load transfer ,if one of the Module is removed for maintenance/repairs, without affecting the operations.

- Solid state type, of online double conversion VFI technology,

- Inbuilt arrangement for automatic cut-off of Batteries while discharging to ensure that the voltage of a Battery cell does not go down beyond 1.75 volts and cause expensive brake-downs. The system should have automatic, as well as, manual testing arrangement at regular intervals.

- Protection against single phasing and Phase reversal shall be inbuilt.

**3.18 SHOP DRAWINGS**

Dimensioned shop drawings shall be prepared by the successful tenderer and submitted to the Consultants for comments/approval.

**TO BE FILLED BY THE CONTRACTOR WITH SUBMITTAL FOR APPROVAL**

##### **TECHNICAL SPECIFICATIONS FOR UPS SYSTEM**

|  |  |  |
| --- | --- | --- |
| **1** | **General Particulars** |  |
|  |  |  |
| **2** | **APPLICABLE STANDARDS** |  |
|  |  |  |
| **3** | **CRCA SHEET :** |  |
| 3.1 | Thickness of sheet |  |
|  |  |  |
| **4** | **DEGREE OF PROTECTION :** |  |
| 4.1 | Conforming to |  |
|  |  |  |
| **5** | **EXTERNAL :** |  |
| 5.1 | Overall dimensions |  |
| 5.2 | Max height |  |
| 5.3 | Max width |  |
| 5.4 | Max length |  |
| 5.5 | Max weight |  |
|  |  |  |
| **6** | **PAINTING** |  |
| 6.1 | Processing done |  |
| 6.2 | Shade no |  |
| 6.3 | Primer deposits thickness |  |
| 6.4 | Final powder coating / painting thickness |  |
|  |  |  |
| **7** | **DESIGN BASED ON** |  |
| 7.1 | Climatic conditions |  |
| 7.2 | Ambient Temperature :- |  |
|  | a) Max. |  |
|  | b) Min. |  |
| 7.3 | Relative humidity :- |  |
|  | a) Max. |  |
|  | b) Min. |  |
| 7.4 | Venting required |  |
|  |  |  |
| **8** | **AUDIBALE NOISE** |  |
| 8.1 | Max – DBA at – 01 meters |  |
|  |  |  |
| **9** | **WARRENTY** |  |
| 9.1 | From the date of installation, testing, commissioning |  |
|  |  |  |
| **10** | **MAX OVERALL EFFICIENCY (IN PERCENTAGE) AT FULL LOAD** |  |
| 10.1 | At specified conditions |  |
|  |  |  |
| **11** | **PROTECTION PROVIDED** |  |
| 11.1 | Output overload / short circuit |  |
| 11.2 | Over temperature |  |
| 11.3 | Low Battery |  |
|  |  |  |
| **12** | **POWER MODULES** |  |
| 12.1 | No. of Modules(in N+1 form) |  |
| 12.2 | Rating of each Module |  |
| 12.3 | Weather Modules are hot-swapable |  |
| 12.4 | Dimensions of each Module |  |
|  |  |  |
| **13** | **INPUT** |  |
| 13.1 | Voltage |  |
| 13.2 | Voltage tolerance |  |
| 13.3 | 3 Phase / 4 Wire? |  |
| 13.4 | Input frequency |  |
| 13.5 | Synchronization range to bypass |  |
| 13.6 | Power factor |  |
| 13.7 | Input THDI |  |
|  |  |  |
| **14** | **OUTPUT** |  |
| 14.1 | Capacity :- |  |
|  | a) KVA |  |
|  | b) KW |  |
| 14.2 | Frequency |  |
| 14.3 | Frequency stability |  |
| 14.4 | 3 Phase / 4 Wire? |  |
| 14.5 | Waveform |  |
| 14.6 | Rated voltage |  |
| 14.7 | Steady state voltage regulation |  |
| 14.8 | Voltage distortion with linear load |  |
| 14.9 | Crest factor |  |
|  |  |  |
| **15** | **UPS OPERATION MODES** |  |
| 15.1 | On-line |  |
| 15.2 | Power save |  |
|  |  |  |
| **16** | **BATTERY BANK** |  |
| 16.1 | Type of batteries |  |
| 16.2 | No. of batteries |  |
| 16.3 | Make |  |
| 16.4 | Voltage |  |
| 16.5 | No. of cells / batteries |  |
| 16.6 | VAH offered |  |
| 16.7 | Life (Years) |  |
| 16.8 | Conforming to |  |
| 16.9 | Back-up time |  |
| 16.10 | Overall Dimensions |  |
|  |  |  |
| **17** | **OTHER FEATURES** |  |
| 17.1 | In-built Manual Bypass Switch |  |
| 17.2 | Digital controls, using latest processor DSP / FPGA |  |
| 17.3 | Provision for remote monitoring |  |
| 17.4 | Input phase sequence protection |  |
| 17.5 | Touch screen LCD on front door |  |
| 17.6 | Battery test feature |  |

**GTP of UPS System:-**

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Model** | **RM 500** |
|  |
|  | **Capacity of UPS** | **500kVA / 450kW** |
|  | **TECHNOLOGY** | **DOUBLE CONVERSION TRUE ONLINE TOPOLOGY** |
| **(I)** | **Input** |  |
| 1 | Phase | 3Ph+N+PE 380 / 400 / 415 V (line-line) 220V/230V/240V (line-neutral) |
| 2 | Voltage range | 304V to 478V |
| 3 | Frequency range | 40-70Hz |
| 4 | THDi | <4% |
| 5 | Power Factor | >0.99 |
| **(II)** | **Output** |  |
| 1 | Voltage | 380 / 400 / 415 V (line-line Nominal), 220V/230V/240V(line-neutral Nominal), Selectable |
| 2 | Voltage regulation | 1% to balanced load; 1.5% to 100% unbalanced load |
| 3 | THDu | <1% (linear load) <5.5% (non-linear load) |
| 4 | Power Factor | 0.9 |
| 5 | Frequency | 50Hz / 60Hz |
| 6 | Frequency Variation (in Free-running mode) | ±0.01% |
| 7 | Phase tolorence | 120°±0.5° (balance and unalance load) |
| 8 | Crest Factor | 3:1 |
| 9 | Overload capacity | <102%, long time |
| 110%, transfer to bypass after 60minutes |
| 125%, transfer to bypass after 10 minutes |
| 150%, transfer to bypass after 1 mintute |
| >150%, transfer to bypass after 200ms |
| **(III)** | **DC Link** |  |
| 1 | Battery Voltage | 480V to 528V DC nominal |
| 2 | Charge power | 20% of system power |
| 3 | Low Battery Cut-off | Adjustable from 1.7V/ Cell to 1.8V/ Cell |
| **(IV)** | **System** |  |
| 1 | Overall efficiency in normal mode | 96% max |
| 2 | Overall efficiency in ECO mode | 99.00% |
| 3 | Efficiency in Battery mode | 96.00% |
| 4 | Display | 10.4” touched colourful LCD + LED |
| 5 | Degree of Protection | IP20 |
| 6 | Interface : Standard | RS-232, RS-485, EPO, Dry contacts |
| 7 | Interface : Optional | SNMP |
| 8 | Temperature range of operation | 0 – 40°C |
| 9 | Relative Humidity | 0 – 95% (non-condensing) |
| 10 | Audible Noise | 72dB(from 1m distance) |
| **(V)** | **Physical Parameters** |  |
| 1 | Maximum dimensions (WxDxH) in mm: Module Overall | 510x700x178 |
| 1300x1100x2000 |
| 2 | Module Weight in kg(approx.) | 45kg |
| Weight of Cabinet in kg(approx.) | 450kg |

## EARTHING SYSTEM AND GROUND FAULT PROTECTION

#### **4.1** EARTHING

1. **SCOPE**

This Section covers the essential requirements of earthing system components and their installation. For details not covered in these specifications, IS Code of Practice on Earthing (IS: 3043-1987) as per relevant Indian Electricity Rules 1956 Amended upto date, shall conform to CPWD General specifications for Electrical works (part-I-Internal) 1994 and in the regulations of the local Electrical Supply Authority shall be referred to.

#### APPLICATION

The electrical distribution system is with earthed neutral (i.e. neutral earthed at the Transformer / Generator). In addition to the neutral earthing, provision is made for Body earthing to the metallic body of equipments and non-current carrying metallic components in the sub-station, as well as in the internal/external electrical installations such as for Transformers, HT/LT Panel, Capacitor Panels & DG Sets etc. through a common grid formed in the Substation building. Earthing requirements are laid down in Indian Electricity Rules, 1956, as amended from time to time, and in the Regulations of the Electricity Supply Authority concerned. These shall be complied with.

Each equipment shall be connected with two independent earth conductors to earth bar located in respective area. Each earth bar shall be connected to Earth Grid by two independent earth conductors. Earthing Grid shall be directly connected by two independent earth electrodes. Earthing shall be 600 x 600 x 3mm thick with copper earth plate.

#### MATERIALS

The material of earth and earth conductor shall be as specified in specifications and approval of Owner/PMC

#### EARTH ELECTRODES

The type of earth electrode shall be any of the following: -

b.2.1) Plate/ Pipe earth electrode as specified in INDICATIVE ITEMS.

**b2.2) Electrode materials and dimensions** The materials and minimum sizes of earth electrodes shall be as specified.

#### EARTHING CONDUCTOR

The earthing conductor (protective conductor from earth electrode upto the main earthing terminal/ earth bus, as the case may be) shall be of the same material as the electrode, viz. GI or copper and in the form of wire or strip as specified. The size of earthing conductor shall be as specified.

#### NEUTRAL EARTHING OF EQUIPMENT

Neutral terminals of Transformers shall be earthed independently. Each neutral terminal shall be earthed with two independent earth electrodes. Earth electrode shall be 600 x 600 x 3mm thick copper plate. Copper Strip as earth conductor laid in ground shall be protected for mechanical injury & by providing GI Pipe of required dia as specified.

#### PLATE EARTH ELECTRODE

Earthing shall be provided with copper/GI plate electrode as mentioned in Indicative Items of following.

|  |  |  |
| --- | --- | --- |
| i. | Copper Plate Electrode. : | 600mm x 600mm x 3mm thick |
| ii | GI Plate Electrode. : | 600mm x 600mm x 6mm thick |

The electrode shall be buried in ground with its faces vertical and not less than Three(3) metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cast iron MS frame with cover having locking arrangement shall be provided at top of chamber. Earth electrode may not effect the column footing or foundation of the building. In such cases electrode may be further away from the building.

#### ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride, calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

#### HARDWARE ITEMS

All hardware items used for connecting the earthing conductor with the electrode shall be of GI in the case of GI pipe and GI plate earth electrodes, and in case of copper plate electrodes.

#### LOCATION OF EARTH ELECTRODES

Normally an earth electrode shall not be located closer than 1.5 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases electrodes may be located further away from the building, with the prior approval of the Owner/PMC.

The location of the earth electrode will be such that the soil has a reasonable chance of remaining moist as far as possible. Entrances, pavements and roadways, should be avoided for locating earth electrodes.

#### INSTALLATION

* 1. **Electrodes**
     1. Various types of electrodes
        1. Pipe electrode shall be buried in the ground vertically with its top at not less than 20 cm below the ground level. The installation shall be carried out as shown in drawing.
        2. In locations where the full length of pipe electrode is not possible to be installed due to meeting a water level, hard soil or rock, the electrode may be reduced length, provided the required earth resistance result is achieved with or without additional electrodes, or any alternative method of earthing may be adopted, with the prior approval of the Owner/PMC. Pipe electrodes may also be installed in horizontal formation in such exceptional cases.
        3. Plate electrode shall be buried in ground with its faces vertical, and its top not less than 3 m below the ground level. The installation shall be carried out as shown in drawing.
        4. When more than one electrode (plate/pipe) is to be installed, a separation of not less than 2 m shall be maintained between two adjacent electrodes.

#### Artificial treatment of soil

When artificial treatment of soil is to be resorted to, the electrode shall be surrounded by charcoal/coke and salt and as indicated in enclosed drawings. In such cases, excavation for earth electrode shall be increased as per the dimensions.

#### Watering arrangement

* 1. In the case of plate earth electrodes, a watering pipe of 20mm dia. medium class

G.I. pipe shall be provided and attached to the electrodes and a funnel with mesh shall be provided on the top of this pipe for watering the earth.

* 1. In the case of pipe electrodes, a 40 mm X 20 mm reducer shall be used for fixing the funnel with mesh.
  2. The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30 cm X 30 cm X 30 cm.
  3. A cast iron/MS frame with MS cover of 6 mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.

#### Earthing conductor (Main earthing lead)

* 1. In the case of plate earth electrode, the earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.
  2. In the case of pipe earth electrode, wire type earthing conductor shall be secured as indicated in drawing using a through bolt, nuts and washers and terminating socket.
  3. The earthing conductor from the electrode up to the building shall be protected from mechanical injury by a medium class, 15 mm dia. GI pipe in the case of wire, and by a minimum of 40 mm dia, medium class GI pipe in the case of strip. The protection pipe in ground shall be buried at least 30cm deep (to be increased to 60 cm in case of road crossing and pavements). The portion within the building shall be fixed on walls.
  4. The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switch board by: Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and, Bolt, nut and washer in case of strip conductor.

#### Earth bus and main earthing terminal

In all installations, main earthing terminal shall be provided at the main switchboard. This may be in the form of earth stud or single earth bar depending on the type of the switchboard.

A ring earth bus shall be provided in the substation building, switch room, and various panels shall be connected to that earth ring.

Following conductors shall be terminated on to the main earthing terminal.

1. Earth connection from electric supply company (where provided)
2. Earthing conductor from electrode.
3. Protective conductors.
4. Equi-potential bonding conductors.

#### Protective (Loop earthing/ earth continuity) conductor

Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/terminal of the upstream switch board by protective conductors.

Two protective conductors shall be provided for a switchboard carrying a (3) Three-phase switchgear thereon.

#### i.4 ) Earth Resistance

The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 5 ohms as measured by an approved earth testing apparatus.

Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode(s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by the Owner/PMC.

#### Marking

Earth bars/terminals at all switch boards shall be marked permanently, as "E".

Main earthing terminal shall be marked "SAFETY EARTH - DO NOT DISCONNECT".

#### MEASUREMENT OF EARTH ELECTRODE RESISTANCE

* + 1. Two auxiliary earth electrodes, besides the test electrode, are placed at suitable distance from the test electrode. A measured current is passed between the electrode ‘A’ to be tested and an auxiliary current electrode ‘C’ and the potential difference between the electrode ‘A’ and auxiliary potential ‘B’ is measured. The resistance of the test electrode ‘a’ is then given by

R= V/I

Where,

R- Resistance of the test electrode in ohms

V- Reading of the voltmeter in volts

I-Reading of the ammeter in amps

* + 1. Stray currents flowing in the soil may produce serious errors in the measurement of earth resistance. To eliminate this, hand driven generator is used.

If the frequency of the supply of hand driven generator coincides with the frequency of stray current, there will be wandering of instrument pointer. An increase or decrease of generator speed will cause this to disappear.

* + 1. At the time of test, the test electrode shall be separated from the earthing system.
    2. The auxiliary electrodes shall be of 13mm diameter mild steel rod driven up to 1 m into the ground.
    3. All the three electrodes shall be so placed that they are independent of the resistance area of each other. If the test electrode is in the form of a rod, pipe or plate, the auxiliary current electrode C shall be placed at least 30m away from it and the auxiliary potential electrode’ B’ shall be placed mid-way between them.
    4. Unless three consecutive readings of test electrode resistance agree, the test shall be repeated by increasing the distance between electrodes A and C up to 50m, and each time placing the electrode B mid-way between them.
    5. On These principles, “ Megger Earth Tester” containing a direct reading ohm-meter, a hand driven generator and auxiliary electrodes are manufactured for direct reading of earth resistance of electrodes.

#### ELECTROLYTIC MAINTENANCE FREE EARTHING

The effective earthing connection surface should be smooth & free from paints and oxide coatings

#### Types & Technical Specifications (Long Life Maintenance Free Earthing Solution)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Type** | **Soil** | **Warranty (years)** | **Current Capacity** | **Electrode Details** | | | **TF Qty (Bags)** | **Test Well Cover** |
| **Length**  **(feet)** | **Outer Dia. (inch)** | **Thickness**  **(mm)** |
| Electrolytic Maintenance Free Earthing | Non Rocky | 30 | 1kA/ 9Sec | 10 | 2 | 2 | 3 | Poly-plastic |

* 1. The specifications with performance warranty and technical spec details shown in the tables.
  2. The ground rod shall be filled from the factory with non-hazardous metallic salts to form the electrolytic process and enhance the grounding performance.

#### Environment Friendly Backfill Material

* 1. Non-corrosive, electrically conductive and ground enhancing backfill should lower the contact resistance to earth by up to 63 % when used in conjunction with copper grounding equipment.

1). Excavation

1. Bore a hole into the earth (minimum diameter 6"). Hole should be bored to allow installed unit to be as close to vertical as possible
2. A 14" hole must be provided for the cover box.
3. Depth of hole must be 6" deeper than the vertical length of the system.
4. Top vent ports must be left open to the atmosphere for continuous air circulation by using the protective test well provided.
5. Plate Type Earthing (Cu/GI), Crow Foot Earthing and Cu Claded rod earthing, the mixing procedure of Backfill will be same as like in the electrolytic Earthing.

#### Installation

1. Remove sealing tapes from the bottom of unit only. Tapes must be saved and made available to the electrical inspector to verify removal and proper installation. Do NOT remove the green and white “Bury to Here” marker from the top of the unit.
2. Position the unit in the hole. Use green and white “Bury to Here” marker as a guide to depth in which unit shall be buried. Three bags of are included with each 10' electrode.
3. Pour around electrode in augured hole. Do not mound backfill past green and white marker.
4. Place box with cover over the top of the electrode so that the cover is at grade level. Use backfill to stabilize box around the electrode. This keeps the breather holes free of obstruction and debris. Top of box should not contact the top of the electrode.
5. Remove top sealing tape ONLY after backfill is complete. This prevents soil from blocking the vent ports.

#### d) Connection

1. Connect grounding conductor to ground rod pigtail exothermally.
2. Bury grounding conductor 30inch below grade.

## CABLE TRAY & LADDER SPECIFICATION

* 1. **General Requirement:-**

GI Cable Tray shall be Perforated/ Ladder systems are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/ Instrumentation/ Communication systems.

#### Design and Fabrication of Cable Trays / Ladders:-

The GI cable trays / ladders shall be fabricated according to the design specified by IEC 61537 and should be tested for Safe Working Load (SWL). The relevant details of SWL and the load chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Safe Working Load (SWL) with a span length up to 5 meters | | | | | |
| Description | Side | Height | Width | (in | Span length (in meters) |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | (in mm) | mm) | 1.5m | 2m | 2.5m | 3m | 4m | 5m |
| Permitted Load (in kg/meter) | | | | | |
| Perforated tray | 60 | 100-500 | 150 | 100 | 50 | - | - | - |
| 85 | 100-500 | 175 | 110 | 50 | - | - | - |
| 100 | 150-500 | 185 | 130 | 75 | 60 | - | - |
| Cable Ladder | 60 | 200 - 600 |  | 225 | 150 | 110 | 45 | - |
| 110 | 200 - 600 |  | 310 | - | 140 | 65 | 50 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Safe Working Load (SWL) with a span length up to 10 meters | | | | | | | | | |
| Description | Side Height (in mm) | Width (in mm) | Span length (in meters) | | | | | | |
| 4m | 5m | 6m | 7m | 8m | 9m | 10m |
| Permitted Load (in kg/meter) | | | | | | |
| Perforated Cable Tray for long span distance | 110 | 200 - 300 | 160 | 110 | 75 | - | 20 | - | - |
| 400 - 600 | 200 | 150 | 100 | - | 40 | - | - |
| 160 | 200 - 300 | 230 | 180 | 140 | 100 | 70 | - | - |
| 400 - 600 | 250 | 200 | 160 | 130 | 100 | - | - |
| Cable Ladder for long span distance | 110 | 200 - 300 | 160 | 110 | 80 | 40 | - | - | - |
| 400 - 600 | 210 | 150 | 100 | 70 | - | - | - |
| 160 | 200 - 300 | 230 | 180 | 140 | 100 | 70 | - | - |
| 400 - 600 | 250 | 200 | 160 | 130 | 100 | - | - |
| 200 | 200 - 600 | - | - | 300 | 250 | 200 | 140 | 100 |

Fabrication of Tray / Ladder and accessories at site and welding is not permitted. In unavoidable circumstances, If any cut or holes are made in the trays/ Ladder/ accessories, zinc spray need to be applied over the surface. The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plastic END caps. Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections.

Cables shall run in cable tray/ladder mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures using mounting accessories

#### **CABLE TRAY:-**

The cable tray and all accessories shall be fabricated from sheet steel and has to be galvanized against corrosion confirming to EN10346 / ISO1461-1999 for installations in indoor and outdoor applications respectively. The cable trays shall be supplied in standard lengths of 3000 mm and the width of the tray shall be as follows.

Width: 100, 150, 200, 300, 400, 500.

All the cable tray accessories like Bend’s, TEES’s, Cross over’s etc. should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories. etc. are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturer’s catalogue. For locally fabricated and non-tested tray, thickness should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter

#### CABLE LADDER:

The cable Ladder and all accessories shall be fabricated from sheet steel and has to be galvanized against corrosion confirming to EN10346 / ISO 1461-1999 for installations in indoor and outdoor applications respectively. The cable ladders shall be supplied in standard lengths of 3000 mm and the width of the ladder shall be as follows.

Width: 200 to 600 mm in multiples of 100 mm

Maximum rung spacing in the ladder shall be 300mm. The rung’s should be made of C profiles suitable to fix cables by special metal clamps according to the drawing. The ladder shall be of riveted and foldable type for easy transportation and to avoid damage during transportation and storage. All the ladder accessories like Bend’s , TEES’s, Cross over’s etc. should be designed in accordance with IEC 61537 and shall be factory fabricated . The accessories shall be made from the same material as of the ladder and modular type, it should be connected with the ladder by using fasteners. The details of ladders, fittings and accessories. etc. are shown in the enclosed drawing.

For Cable Ladders designed, tested and confirming to IEC 61537, thickness of cable Ladder should be according to the manufacturer’s catalogue. For locally fabricated and non-tested Ladder, thickness should be 2.5 mm up to span length of 1.5 to 2 meter, 3 mm for span length between 2.5 to 4 meter and 3 to 4 mm for span length between 5 and 10 meter

#### COVER FOR CABLE TRAYS / LADDERS:-

Cover for trays/ladders to protect the cable insulation from falling objects, water droplets, harmful effects of ultraviolet rays and accumulation of dust. The cover shall be Galvanized sheet steel. The cover for the cable trays shall be of snap fit type.

**Steel Wire Rope Hangers& Supports:**

Wire Hangers shall be used to suspend all static Electrical services.

Wire Hangers should consist of a pre-formed wire rope sling with a range of end fixings to fit various substrates and service fixings, these include a ferruled loop, permanently fixed threaded M6 (or M8, M10) stud, permanently fixed nipple end with toggle, at one end or hook or eyelet, cladding hook, barrel, wedge anchor, eyebolt anchor or any other end fixture type or size as per manufacturers recommendation and design. The end fixings and the wire must be of the same manufacturer with several options available. The system should be secured and tensioned with a Hanger self-locking lock at the other end comprising of a single piece housing; the wedge inside the lock housing should be having serrated teeth & made up of sintered steel and springs used, if any, should be made up of stainless-steel. **Once the grip is locked for safety purpose unlocking should only be done by using a separate setting key and should not be an integral part of the self-locking grip for safety purpose.** Only wire and/or supports supplied and/or approved, shall be used with the system.

1. Wire Hangers should have been independently tested by Lloyds Register. APAVE, TUV, CSA, Chiltern International fire, ADCAS, Intertek, ECA, and SMACNA, approved by ULC and CSA and comply with the requirements of DW/144 and BSRIA – wire Rope Suspension systems. Wire rope should be manufactured to BSEN 12385: 2002
2. The contractor shall select the correct specification of wire hanger to use for supporting each particular service from table 1 below. Each size is designated with a maximum safe working load limit (which incorporates a 5:1 safety factor).

The correct specification of wire hanger required is determined using the following formula.

**Weight per meter of object suspended (kg) X distance between suspension points (m) = weight loading per Hanger suspension point (kg).**

Where the installed wire rope is not vertical then the working load limit shall be reduced in accordance with the recommendations give in the manufacturer’s handbook.

The contractor shall select the correct length of wire rope required to support the service. Lengths from 1-10m lengths. Specials can be made, check with manufacturer. No in–line joints should be made in the rope.

Table – 1

|  |  |  |
| --- | --- | --- |
| **Wire Hanger Safe Working Loads** | | |
| **Size** | **Minimum breaking load of Wire Rope** | **Working load limit (kg/lbs)** |
| No. 1 | 80kg/176 lbs | 0-10 kg / 0-22 lbs |
| No. 2 | 260kg/572 lbs | 10-45 kg / 23-100 lbs |
| No. 3 | 580kg/1276 lbs | 45-90 kg / 101-200 lbs |
| No. 4 | 1500kg/3300 lbs | 90-225 kg / 210-495 lbs |
| No. 5 | 2160kg/4752 lbs | 225-325 kg / 496-715 lbs |
| No. 6 | 2500kg/5500 lbs | 325-500 kg / 715-1100 lbs |

The standard range of Hanger Kits should contain galvanized high tensile steel wire rope or stainless-steel wire rope as per the application, the minimum specification is as above and should be manufactured to BS 302 (1987), BSEN12385. **Comply with manufacturer's load ratings and recommended installation procedures.** Note the testing is done to the minimum breaking load of the wire thus giving a minimum safety factor of 5: 1.

1.0 **Supports can be provided for: Busbar, Cable Ladder, Cable Tray, Cable Basket, Channel, Trunking, Light Rafts, Luminaires, Secondary Supports, Safety Lines, High Bay/Low Bay Lights, Electrical Cables, CCTV and Catenary Supports:** Y-Fit solution shall be used to a maximum width of 500mm Cable Tray. For Tray over 500mm cradle support method or independent supports must be taken as appropriate based on load. Any other solution can be used based on manufacturer’s recommendation on site conditions after prior approval.

**2.0 Catenary Supports**: Refer to manufacturer’s recommendations on Catenary supports with C-clip, special care should be taken with tensioning of the wire and angles at which the installation of services are made**.**

1. Stainless Steel Supports should be available for food, chemical and High Corrosion areas near coastlines.

Refer to manufacturers catalogue and installation guide for further technical information. **Comply with manufacturer's load ratings and recommended installation procedures.**

**All supporting system to be provided by same manufacturer.**

1. **Scope**

The scope covers MS cable trays and cable tray accessories.

**2.0 Standards**

(IS. specifications shall be adhered to)

**3.0 Specifications**

Material: Hot rolled plain sheets of tested quality “O” grade as per IS **1079.**

Thickness of material: **2.0 mm**

Cable loading on tray: **50** Kg/MTR

Span between cable tray supports: **1.5** meters to  **2.0**  Mtrs.

Surface finish: Hot dip galvanising iron as per IS **2629,** minimum **70** microns thickness

Length of cable trays: **2.5** Meters

Width of Cable trays: (outside to outside width to be taken)

a) Ladder type - Bolted/welded construction **300** mm/450mm/600mm (depending on number of cables to be laid)

b) Perforated cable trays (Same as above)

**4.0 Sizes of Cable Trays:**

a) Ladder type - Bolted/welded construction

Side rail

\* Flange width **15** mm

\* Depth **70** mm

\* Two coupler holes of **10**mm diameter required on each side of side rail

\* Rungs

\* Channel section: **20** x **40** x **20** mm

\* Slot size on rungs: **20** x **10** mm (oblong holes)

\* Interval between rungs not more than **250m**m

b) Perforated type construction

\* Flange width : **30**mm

\* Slot size : **20** x **10** mm (oblong)

**5.0 Sizes of Coupler Plates:**

a) Ladder type - Bolted/welded construction

Size: **90** x **45** mm

Thickness of material: **2/2.5** mm

Slot size: **20** x **10**mm oblong holes - Two numbers

Round holes **10**mm diameter Two numbers

Finish: Hot dip galvanised as per IS:**2629**

b) Perforated type construction:

Size: **210**mm x **25**mm

Thickness of material: **3**mm

Slot size: Oblong holes **20** x **10** mm - **2** numbers

Round holes **10**mm diameter - Two numbers

Finish: Hot dip galvanised as per IS:**2629**

**6.0** **Hardware for coupler plate:** (Electro galvanised)

a) Hexagonal Head Bolts - **4** Nos.

b) Plain washers **- 8** Nos.

c) Hexagonal nuts - **4** Nos.

Number of coupler plates per cable tray - Two numbers.

**7.0 Cable tray Accessories:**

Material: Hot rolled plain sheets of tested quality “O” grade as per IS: **1079**

Finish: Hot dip galvanised as per IS:**2629**

Minimum bending Radius - **450**mm

Tees, Horizontal/vertical elbows, cross and reducers for both ladder type - welded/bolted and perforated construction shall be as per standard manufacturers drawings.

**8.0 Erection**

Cable trays shall be erected on walls, trenches (if necessary) by **drilling holes in the wall by power drilling machine**. Cable Tray shall be fixed to wall by providing proper size Anchor expandable type bolt and nut arrangement.

Proper type of cable tray accessories shall be selected depending on the site condition.

## BUSDUCT/ RISING MAINS (SANDWICH CONSTRUCTION)

**1.** **Scope**:

The specification covers design, manufacturing, supply, installation, testing and commissioning of Sandwich type busbar trunking for use as feeder busbars for interconnection between separate electrical equipment / load centers, and for use as plug-in busbar risers.

**2.** **System details:**

The busbar shall be suitable for operation in a 1000V system, with frequency of 50 Hz having 100% neutral and internal earth.

**3. Standards & Type Test Certification.**

The busbar shall be designed and manufactured in accordance with the following international standards for busbar trunking:

* IS 8623 Part 2 : Particular requirements of busbar trunking systems
* IEC 61439 –6 : Particular requirements of busbar trunking systems
* IEC 60529 : Degree of protection

The bus duct shall be type tested in confirmation to above standards from a independent national recognized test house within last Five years for Short circuit , temperature rise & Degree of Protection & Resonance , Seismic withstand test for Zone V as per Latest IS/ IEC.

**4. Design & Construction requirements – Sandwich busbars**

**General:** The busbars shall be of sandwich construction, non-ventilated design. It shall be possible to mount the busbar system in any orientation, without affecting the current rating.

**Busbars::** The busbars shall of high conductivity Aluminum bars with conductivity > 60%.

The maximum hotspot temperature rise at any point in the bus duct at continuous rated load shall not exceed 45 deg.C above a maximum ambient temperature of 45 deg.C in any position.

Busduct system shall be terminated by end enclosure.

Unless otherwise highlighted, full size neutral of the same cross-sectional area as the phase conductor shall be provided for all rating of the busbar system.

Where an earth conductor is required, it shall be a separate, integral earth conductor, of the same high conductivity material as the phase conductors.

**Insulation:**

The busbars shall be insulated throughout their length by epoxy coating / Polyester / Mylar. The insulation material used shall be of Class F / Class H . The insulation must comply to UL 94 V-O.It shall be Halogen Free.

**Housing:**

The housing shall be made of 1.6 mm galvanized sheet steel/Aluminium , with an epoxy powder coated paint finish. The housing shall be profiled, to provide higher strength and efficient heat dissipation. The width of the housing shall preferably be the same for all ratings of busbars, in order to provide interchangeability of tap off boxes.

**Joints:**

The joints between sections shall be made so as to provide flexibility during installation and expansion / contraction of busbar during operation. The joints shall be of the single bolt type

The joint construction must have the following features.

* Heat expansion of at least 3mm per joint.
* The joint insulation must be of one piece molded design and not have any cut edges which can absorb moisture.
* The joint construction must allow a +/- 14mm adjustment at the time of installation, for ease of adjusting to site measurement variations.
* The joint bolt must be insulated with a bolt insulator. The bolt insulator must be of molded one piece.
* The joint system must be designed in a way that the installer cannot insert the busduct length too far and damage the bolt insulator.
* The busbar ends shall not have holes or slots at the joints – the electrical continuity shall be through pressure plates, achieving a high area of joint cross section and expansion capability.
* It shall be possible to install and remove the joints without disturbing the busbar run.

**Tap off units:**

Where specified, tap off locations shall be provided for insertion of plug in tap off units. The tap off locations shall be covered by hinged plates.

Tap off unit’s safety features:

* When the door cover is open, it should not be possible to turn the MCCB “ON”.
* The door shall be provided with a lock and keys.
* When the lever is in ‘on’ position, even with the key unlocked, the operator should not be able to remove the box or open the tap off location cover.
* During insertion, the earth conductor shall make contact first before the phase conductors. This should follow the sequence of first in last out concept.
* The tap off unit handle can be attached to at the front or left or right side of the box, depending on the site situation and as per approved drawings.
* When the box is open the live conductors shall be safe guarded by a transparent insulator plate which allows for visible inspection but does not allow touching of the live conductors.
* In the event of a MCCB requiring maintenance or changing, the mechanical interlocking must allow easy access by removing only the front plate and not interrupting the adjacent linkages.
* For IP65 bus-trunking, the tap off unit arrangement also must be covered through 1.6 mm thick GI Sheet canopy.
* The tap off boxes will be suitable for accommodating MCCBs or other accessories, as required. The tap off units should allow the flexibility of accommodating different, reputed MCCB makes, to be mutually agreed depending on the tender requirements.

**Accessories:**

Bus trunking system shall be complete with all accessories like bends, busduct, expansion joints, flexible connections etc to suit site requirements. Rising main in addition shall be complete with tap off points, end feed units, end covers, thrust pads and spring hangers at each floor. Bus trunking systems shall be complete in all respects. All accessories shall be quoted along with the unit rate of straight length of the busduct and rising mains.

**Thrust Pads**

Thrust Pads shall be provided in the raising main systems for necessary support to the rising mains and to prevent busbar expansion in down ward direction.

**5. INSTALLATION**

* Installation of the Rising Main shall be carried out as per manufacturer’s instruction.
* For Bus Duct horizontal runs, a horizontal expansion units shall be provided at every 40 m if required by design and at expansion joints of the building structure and the system shall be supported at every 1.5 m or as per the site conditions.
* Annular space around Rising Mains and/or Bus Ducts while crossing floors and walls shall be filled up by sealing material made available by Owner/PMC in accordance with manufacturer’s instructions.

**6. TESTING AT SITE**

* `Physical check including checking damage/crake in any components, tightness of bolts and connections etc.
* Insulation test after installation according to manufacturer’s test procedures.
* Testing earth continuity.

## LIGHTNING PROTECTION SYSTEM AND SPDs

The comprehensive Lightning protection plan - consist both External Lightning Protection and Internal surge protection as per the guideline of IS/IEC 62305 standard and NBC 2016

**1.0 Scope:**

New standard IS/IEC 62305 supersedes old IS 2309:1989 standard for lightning protection This Section covers necessary requirement of protection of structure from external lightning using new Indian standard IS / IEC 62305, following the various methods and internal lightning protection using surge protection, as defined in the said standard. Please refer IS/IEC 62305 for detail.

**2.0 Standard - Brief:**

A. New standard define & mentions the requirement for Lightning protection via its four chapters i.e.

• IS/IEC 62305-1:2010, Protection against lightning – Part 1: General Principles

• IS/IEC 62305-2:2010, Protection against lightning – Part 2: Risk management

• IS/IEC 62305-3:2010, Protection against lightning – Part 3: Physical damage to structures and life hazard

• IS/IEC 62305-4:2010, Protection against lightning – Part 4: Electrical and electronic systems in structures.

B. Before designing, it is essential to determine the risk involved as per IS/IEC 62305-2, in the structure and depending on the risk involved, level of protection is determined which is basis of designing as per IS/IEC 62305-3.

C. The design shall be made according to IS/IEC 62305-3 using any or combination of three methods, as per defined lightning protection level: -

⇒ Rolling sphere method

⇒ Mesh method

⇒ Protective angle method

The designing is based on level of protection of individual building / structure determined by Risk assessment. It differentiates between four classes of lightning protection system. A Class I lightning protection system provides the maximum protection and a Class IV, by comparison, the least.

D. Separation distance shall be considered while designing the ELP as per IEC 62305-3 which is essential to avoid creepage flashover. It can be achieved either by maintaining physical separation distance or by use of special cable - High voltage insulated (HVI) cable, as a down conductor to compensate the need of the separation distance, as per IS/IEC 62305 & NBC 2016.

E. Generally, in new construction buildings, it is recommended to use reinforced down conductor and earthing. As per clause E.4.3.1 of IS/IEC 62305-3:2010, It is to be ensured for continuity and maximum overall resistance of 0,2 ohm shall be achieved and can be checked by measuring the resistance between the air-termination system and a ground plate (grounding bus-bar / grounding termination) at ground level.

F. Lightning Protection components shall be tested for natural weathering and exposure to corrosion in i.e Salt Mist Treatment test according to EN 60068-2-52 and Humid Sulphurous atmosphere treatment test according to BS EN ISO 6988.

G. Special measure has to be taken for building above 60m, while designing Lightning protection, to protect the building above against side flashes.

Metal compatibility shall be ensured to avoid corrosion and contact resistance at connection point.

External Lightning Protection (ELP):

The design shall be made according to IS/IEC 62305-3 using any or combination of three method - Rolling sphere, Angle of protection and Mesh method as per defined lightning protection level and same shall be approved by consultant for zone of protection.

**3.0** Lightning Protection components shall be tested for natural weathering and exposure to corrosion in i.e. Salt Mist Treatment test according to EN 60068-2-52 and Humid Sulphurous atmosphere treatment test according to BS EN ISO 6988. Metal compatibility shall be ensured to avoid corrosion and contact resistance at connection point.

Risk Analysis: The design shall be accompanied with proper Risk Analysis as per IS/IEC 62305-2 to determine level of protection required for particular structure which will be basis of design.

External Lightning Protection comprises of below listed items: All components shall meet the requirement of IEC 62305 standard.

1. Air terminal: It shall be made of Aluminum or it's alloy, complying to EN 62561-2. It shall be mounted in such a way that as far as possible drilling shall be avoided on roof top. The terminal shall withstand wind velocity of 145KM/hour. The length of the Air-terminal rod varies from 1mtr to 4mtr or even higher on special occasion, depending on design to finalize Bill of Material.

Fixing Accessories- suitable fixing accessories used with Air-terminal to withstand Lightning current and suitable clamp complying to EN 62561-1 for connecting Air terminal with roof conductor.

1. Down conductor: Preferably round conductor (long length, minimum joints) shall be made of Aluminum or it's alloy or GI or Copper or Stainless Steel, min dia 8 mm, complying to complying to EN 62561-2. Wherever, it is not possible to maintain the separation distance, special islaoted cable (like HVI) can be used to avoid separation distance.

Separation distance:

It is necessary to maintain separation distance of down conductors as per IS/IEC 62305-3, to prevent dangerous flashover between the parts of the external lightning protection system and conductive parts inside the structure (electrical / electronic equipment, pipes, ventilation ducts, etc.) resulting from a direct lightning strike. In case separation is not possible, Special conductors / cable (HVI Cable), according to EN 62305-3 & NBC 2016, may be used for discharging the lightning current to earth while maintaining a sufficient separation distance. High-voltage-resistant insulated down conductor for keeping the separation distance from conductive parts Natural components made of conductive materials, which will always remain in/on the structure and will not be modified (e.g. interconnected steel-reinforcement, metal framework of the structure, etc.) may be used as parts of an LPS. The reinforcing rods of walls or concrete columns and steel structural frames may be used as natural down-conductors.

As per clause E.4.3.1 of IS/IEC 62305-3:2010, It is to be ensured for continuity and maximum overall resistance of 0,2 ohm shall be achieved and can be checked by measuring the resistance between the air-termination system and a ground plate (grounding bus-bar / grounding termination) at ground level.

1. Roof Conductor: Preferably round conductor (long length, minimum joints) shall be made of Aluminum or it's alloy or GI or Copper or Stainless Steel, min dia 8 mm, complying to EN 62561-2

Fixing Accessories- suitable fixing accessories to be considered to support Roof conductor @ 1 meter as per IS/IEC 62305-3.

1. Clamp for support to conductor: The conductor shall be made of Stainless Steel/GI and shall be supported with the structure at every 1 mtr, as far as drilling shall be avoided on roof top. The clamps shall be tested for natural weathering and exposure to corrosion in i.e. Salt Mist Treatment test according to EN 60068-2-52 and Humid Sulphurous Atmosphere treatment test according to BS EN ISO 6988. In special application, if drilling is not possible, special adhesive clamp is recommended to hold roof conductor on roof / shed.
2. Test clamps: It shall be made of Stainless Steel/GI and shall be used for every down conductor at 1meter (approx) above to ground level (connection / disconnection purpose).
3. Earthing system: Each down conductor shall be terminated to either earth electrode or ring earth, Earth electrode shall be 3/4" dia, 10 feet long, UL listed, min 254-micron copper coating over mild steel, -Each earth electrode shall be supported with RoHS certified, low resistivity (≤0.2ohm mtr) Ground Enhancement Material (min22.6Kg), performs in all soil condition, increases the contact area with earth electrode. The final resistance using one rod or ring, shall be ≤ 10 Ω.
4. GI Strip for Earthing : The strip used for connecting down conductor from test link to earth Electrode. Metal: Galvanized Iron, Size: 25X6, Coating of Galvanization: Min 86 micron.
5. Equi-potential bond: All metal (natural conductor) components shall be bonded together with roof/down conductor for equi-potential bonding.
6. Quantity: to be determined for each and individual building / structure as per IS/IEC 62305-2 & 3.
7. Lightning Flash Recorder:The Lightning system shall be installed complete with the Lightning flash recorder/counter with digital recording.

The Lightning flash recorder, complying to EN 62561-6, shall consist of a mechanical 3 digit display which will register all Lightning discharges with a sensitivity of up to 100KA 10/350 µs Lightning impulse current.

The Lightning flash recorder shall be housed in IP 65 rated enclosure and will operate without reliance on batteries or an external power source.

It shall be installed on the most direct down conductor, at height of about 2 meter above ground level or as per user guideline.

**4.0** Internal Lightning Protection

The Internal Surge Protection Device shall be selected as per zone of protection described in IEC 62305, 61643-11/12/21, 60364-4/5. Depending on Zone concept of provided in IEC 62305 – 1 & 4.

LPZ -OB & LPZ 1: At Mains entry point (Main LT Panel): Type 1 + 2, i.e.

SPD Combined Arrester with Integrated Backup Fuse.

LPZ1 & LPZ 2: Sub distribution panel at each floor will be used with Type 2 SPD i.e

SPD with integrated fuse - for each Sub Distribution Panel

CCTV control room Panel + Server room Panel + IT building panel will be used with Type 2 SPD i.e Type 2 SPD guard for each Panel

All data network will be protected using suitable Surge Protection Device.

**4.1 Power Line Protection**

Main Distribution Board shall have Type 1 SPD to discharge Lightning current surges for 415 V AC, 3 phase 4 wire (TT) configuration. UPS / Sub Distribution Board shall have Type 2 SPD to discharge switching surges for 415 V AC, 3 phase 4 wire (TT) configuration. Server and sensitive equipments shall have Type 3 SPD at their power input to discharge switching surges.

Type 1, Type 2 and Type 3 devices shall be from same manufacturer to achieve the co-ordination

Type 1 SPD (with inbuild Fuse) - at Main LT Panel

a) The device shall be non-exhausting metal encapsulated, spark gap based technology.

b) The device shall be tested as per latest and valid IEC 61643-11:2011 or EN 61643-11:2012 standards.

c) The device shall be rated for 255 V (Uc) between L-N and N-E.

d) The SPD should be tested for Temporary overvoltage and it shall with stand 440 V / 120 minutes.

e) The device shall be capable to discharge Lightning current (10/350µs) of 25kA (L-N) and 100kA(N-E).

f) The device shall have voltage protection level of device shall be ≤ 1.5 KV including inbuilt fuse for L-N.

g) The device shall have Follow current extinguishing capability [L-N]/[N-PE] : 100 kArms / 100 Arms

h) The device shall have follow current limitation/Selectivity resulting in no tripping of a 20 A gL/gG fuse up to 50 kArms between L-N.

i) The device shall have built in fuse and operation of SPD shall be independent of Line current for L-N SPD. The short circuit with stand capability of the device shall be 100 KArms for L-N SPD.

j) The device shall have mechanical indication for both the states (green for ‘healthy’ and red for failure) on L-N and N-PE connected SPD.

k) The device shall be certified by KEMA or VDE as per IEC 61643-11:2011 or or EN 61643-11:2012.

Type 2 SPD (with inbuid Fuse) - at Each Sub Distribution Panel – for Load current more than 125A:

a) The device shall be single shield high duty discharge capacity Zinc Oxide Varistor between L-N and single shield high discharge capacity spark gap between N-Earth.

b) he device shall be suitable for 3 phase 4 wire (TT) OR 1 Phase 2 wire system with nominal voltage parameters of 230 Vac ±10% between L-N and 415 Vac ±10% between L-L

c) The device shall be capable to discharge 12 KA (10/350 µs, lightning current) between N-PE and 40 KA (8/20 µs switching surges)

d) Voltage Protection level of device shall be ≤ 1.5 KV including built in fuse (for L-N SPD).

e) The device shall have built in fuse and operation of SPD shall be independent of Line current for L-N SPD.

f) The device shall have mechanical indication for both the states (green for ‘ok’ and red for failure) on all modules (L-N and N-PE)

g) The device shall have pluggable option to change cartridge without disconnection.

h) The device shall be tested for Vibration and Shock as per EN 60068-2

i) The device shall be certified by KEMA as per IEC 61643-11:2011 or EN 61643-11:2012.

Note: it is important select proper Type 1 and Type 2 SPDs to ensure achieve co-ordination.

Type 2 SPD: For CCTV Control Room Panel, Server room panel & IT room panel (for load current less than 125A)

a) The device shall be single shield high duty discharge capacity Zinc Oxide Varistor between L-N and single shield high discharge capacity spark gap between N-E.

1. The device shall be suitable for 3 phase 4 wire (TT) OR 1 Phase 2 wire system with nominal voltage parameters of 230 Vac ± 10% between L-N and 415 Vac ±10% between L-L
2. The device shall be capable to discharge 12 KA (10/350 µs, lightning current) between N-PE and 40 KA (8/20 µs switching surges)
3. Voltage Protection level of device shall be ≤ 1.5 KV
4. The device shall have mechanical indication for both the states (green for ‘s’ and red for failure) on all modules (L-N and N-PE)
5. The device shall have pluggable option to change cartridge without disconnection.

g) The device shall be tested for Vibration and Shock as per EN 60068-2.

h) The device shall be certified by KEMA as per IEC 61643-11:2011 or EN 61643-11:2012.

**4.2** Data Line Protection:

Telephone line at MDF Shall consist of Lightning current protector directly coordinated with fine suppressor Lightning current arrestor shall be expandable to a combined lightning current and surge arrester by means of coarse and fine suppressor protective plug.

The integrated disconnection block contacts allow for testing, measuring and patching with plugged-in protection. The three-pole gas discharge tubes have a fail-safe function with visual fault indication.

Fault indication: Visual color change

Nominal voltage: 180 V DC

Max Continuous Operating Voltage: 180 V DC

Max Continuous Operating Voltage: 127 V AC

D1 total 10/350 µs (Iimp) 5KA

D1 per line 10/350 µs (Iimp) 2.5 KA

C2 total Nominal Discharge (In) (8/20 µs) 10 KA

Voltage protection level: ≤500 V

Shall comply IEC 61643-21 and approved by third party like EACRF Protection:

Protection for UHF/VHF co-axial cable with “N” termination:

Lightning current arrester: SPD class TYPE 1, for coaxial 50 Ohm antenna systems, shall be tested acc. to EN 61643-21, suitable for remote supply, exchangeable gas discharge tube.

Max. continuous operating voltage (d.c.): 180 V

D1 Lightning impulse current (10/350 µs): 5 kA

C2 Nominal discharge current (8/20 µs): 20 kA

Frequency range: 0-2.5 GHz

**4.3** CCTV:

The IP based camera shall be installed with suitable surge protection device for communication interface over POE at both the ends.

General Specification of SPD:

a) The device shall be capable to discharge lightning impulse current (at 10/350µs) of 0.5KA & 10 KA total nominal discharge current (at 8/20µs).

b) The device shall be suitable for maximum continuous DC voltage of 48V.

c) Voltage Protection level (line to line / line to ground) of device shall be ≤ 700V.

d) The device shall be enclosed within Zinc die cast material.

e) The device shall be DIN rail mounted adopter type with sockets.

f) The device shall comply to IEC 61643-21/ EN 61643-21 and shall be UL approved.

g) Cut-off frequency shall be minimum 100 MHz.

**4.4** Earthing system:

In general, a low earthing resistance is recommended. The recommended value of the overall earth resistance of 1 Ω is fairly conservative in the case of structures in which direct equi-potential bonding is applied. The resistance value shall be as low as possible in every case but especially in the case of structures endangered by explosive material. (Refer to IS/IEC 62305-3 Clause E.5.4.1).

Above ground metal piping in the process/valve area (subject to non Cathodically protected) shall be earthed (Refer IEC 62305-3, Annex ‘D’ Para D.5)

From the viewpoint of lightning protection, a single integrated structure earth-termination system is preferable and is suitable for all purposes (i.e. lightning protection, power systems and telecommunication systems). By interconnecting the earthing system of a number of structures, a meshed earthing system is obtained. This will give low impedance between buildings and has significant LEMP protection advantages.

Thus, different earthing systems like lightning protection earthing, electrical earthing, safety earthing, electronics earthing etc. shall be interconnected. And places where direct interconnection is non-permissible then use of isolating spark gaps (ISG) is recommended to create equi-potential bonding throughout the earthing system at the event of lightning.

ISG shall be complying to IEC 62561-3, used at the places where direct interconnection is non-permissible to create equi-potential bonding throughout the earthing system at the event of lightning with lightning impulse current (10/350 µsec / Iimp) up to 100 KA and rated impulse sparkover voltage of ≤1.25 KV with IP 67 degree of protection.

## LIFT/ ELEVATOR

**1.0 General**

This specification covers manufacture, testing as may be necessary before dispatch, delivery at site, all preparatory work, assembly and installations, commissioning putting into operation of Lifts.

**2.0** **Location**

2.1 Gems & Jewellery Park, Mahape, Navi Mumbai

2.2 The work shall be executed as per CPWD General Specifications for Electrical Works (Part III Lifts & Escalators – 2003/ up to date) as per relevant IS and as per directions of Owner/PMC.

**3.0** **Data, Manual and Drawings by Contractor**

3.1 The contractor shall submit the following drawings for approval of Owner/PMC before commencement of installation.

All general arrangement drawings.

Details of foundations for the equipment, load data, location etc. of various assembled equipment as may be needed generally by other agencies for purpose of their work. The data will include breaking load on guides, reaction of buffers on lift pits reaction on support points in machine room, lilt well etc.

Complete layout dimensions for every unit / group of units with dimensions required for erection purposes.

Any other drawing / information not specifically mentioned above but deemed to be necessary for the job by the contractor.

3.2 The contractor should furnish well in advance No. of copies (as mentioned in SCC) of detailed instructions and manuals of manufactures for all items of equipment’s regarding installation, adjustments operation and maintenance i/c preventive maintenance & trouble shooting together with all the relevant data sheets, spare parts catalogues and workshop procedure for repairs, assembly and adjustments etc.

**4.0** **Extent of work**

4.1 The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning as per the requirement of NBCC. The term complete installation shall not only mean major items of the plant and equipment’s covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation will all layout charts whether or not those have been mentioned in details.

**5.0** **Inspection and Testing:**

5.1 Initial and final inspection / testing shall be carried out as per CPWD General Specification for Electrical (Part III-Lifts & Escalators’2003).

5.2 Tests at manufacturer’s premises will be witnessed by Owner/PMC.

5.3 Environmental test certificate for Controller & Automatic Rescue Devices should be furnished from any accredited laboratory of Government / Autonomous bodies to prove to tropocalisation for the environment conditions as per rules of Govt.

5.4 Copies of all documents of routine and type test certificate of the equipment, carried out at the manufacturers premises shall be furnished to the Owner/PMC.

After completion of the work in all respects the contractor shall offer the installation for testing and operation for carrying out joint inspection and will be carried out as per CPWD General Specification for Electrical (Part III Lifts & Escalators’ 2003.)

**6.0** **Running in Period:**

After satisfactory final inspection, the contractor shall demonstrate the trouble free running of the installation for a period of not less than 30 days before the overtaking each lift. During this period, the lifts shall be kept either in automatic or manual mode. After the lift-installation has operated without any major breakdown for 30 days, the installation shall be taken after getting approval by the NBCC. During this period i.e. 30 days, the lift shall be deemed to have run trouble- free, if the numbers of breakdowns are not more than four calls (excluding false calls and leveling defects).

**7.0** **Compliance with Regulations and Indian Standards.**

All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:

1. Factories Act.
2. Indian Electricity Rules
3. I.S & B.S Standards as applicable
4. Workmen’s compensation Act
5. Statutory norms prescribed by local bodies like CEA, NDMC etc.

**8.0** **Painting**

This shall include painting of entire exposed iron work compete in the installations. All equipment’s works shall be painted at the works before dispatch to the site.

**9.0** **Training**

The scope of works includes on job technical training of two persons at site.

**10.0 Maintenance**

10.1 Sufficient trained and experienced staff shall be made available to meet any exigency of work during the guarantee period of as specified in SCC.

10.2 The maintenance, routine as well as preventive for as per manufactures recommendation shall be carried out and the record of the same shall have to be maintained.

10.3 Lift shall be provided with 5 years of operational licence and other approval related to the lift installation, operation and maintenance upto 5 years.

**11.0** **TECHNICAL PARTICULARS**

**PARTICULARS OF DETAILS**

1. **General:**
2. Name of Manufacture
3. Country of Manufacture
4. Capacities (Persons/Weight).
5. Service
6. Speed of Travel
7. Height of Travel
8. No. of Floors served
9. No. of openings
10. Position of counterweight
11. Type of leveling method.
12. **Machine:**
13. Position of Machine
14. Motor
15. Electric supply particulars for which it is suitable for operation.
16. **Brake**
17. Type
18. **Car and Doors:**
19. Outside dimensions of car
20. Inside clear dimensions
21. Construction of car
22. Design / type of enclosure of car
23. Details of flooring
24. Attachment and fitting inside the car
25. Car Doors:
    1. Size
    2. Operation
    3. Construction, Design & finish
    4. Landing Doors
    5. Size
    6. Operation
    7. Construction, design & finish
26. **Safety Devices:**
27. Car safety-type
28. Counter weight safety-type
29. Door inter locks in car-type
30. Door locks in landing-type.

**12.0** **WORKS TO BE DONE BY THE CONTRACTOR**

12.1 In addition to the manufacture supply, installation, testing and commissioning of the equipment’s following works shall be deemed to be included within the scope of the work to be done by the contractor.

1. All minor building works necessary for installation of equipment’s such as making of openings in walls/floors, either of RCC or brick masonry etc. and restoring them to original condition and finish. The scope of minor building work includes all grouting of foundation, concrete pads to be formed or made as base for supporting R.S. Joists etc. grouting and anchoring of all the boards, clamps, supports foundation bolts, installation in position of R.S. Joists in machine room, lift well, or in the pit. Such works shall exclude cutting of marble work and construction of partition wall where involved.
2. Supply of necessary R.S. Joists or angle iron support brackets etc. for installation of the lift either in machine room or at other places as may be necessary including their installations in position.
3. All electrical works, except bringing in main connection and earth conception to machine room terminated on suitable switch fuse unit/board. All electrical works including inter connection from this switch/board and loop earthing from the earth bar to be provided in the machine room shall be done by the contractor.
4. Responsibility to ensure safety of all materials against pilferage and damage till the installation is handed over to the NBCC.
5. All scaffolding as may be necessary in the lift well during erection work and subsequently removal.
6. Temporary barricades with caution boards at each landing to prevent accident during execution of work.

Supply and installation of landing facia plates made of steel, car apron plates, sill support angles with necessary clamps, foundations bolts supports etc. as necessary in connection with the installation of the lift.

Steel ladder to be provided for access to lift pit wherever required under regulations.

12.2 Information to be supplied by the contractor before execution:

The contractor shall provide his programme / bar chart for submission of preliminary drawings, manufacturing of equipment’s, installation, testing, commissioning and handing. This should be correlated with the building completion programme. The contractor shall be required to submit the following drawings and information for approval of the NBCC before execution the work:-

All general arrangement drawings

Details of foundations for equipment’s, load data, locations etc. of carious assembled equipment’s as may be needed by other agencies for purpose their work. The date will include breaking load on guides, reactions of but on lift pits, reaction on support points in machine room, lift well etc.

Compete layout dimension for every unit/group of units with dimensions required for erection purpose.

Any other drawing / information not specifically mentioned above but deemed to be necessary for the job by the contractor.

**13. SPECIAL CONDITIONS FOR THE ELECTRICAL WORKS (GENERAL)**

The work shall be carried out strictly in conformity with (1) code of practice for electrical wiring and fittings in Govt. buildings (2) the Indian standard specification (3) the departmental specification, if the work carried out does not comply with the code of practice and departmental specifications and if the workmanship is unsatisfactory it will be binding the contractor to redo the job without any extra cost and pay penalty as decided by the department.

* The work should be carried out under the direct supervision of persons holding a certificate of competency for the type of work involved.
* After completion of work a plan of building should be prepared indicating the location of various main and sub-boards and all the fitting together with a circuit diagram duly numbered (in the diagram). The final bill will not be paid till the above and the diagram submitted and approved after verification.
* The contractor will be responsible for any defects noticed for either improper work man ship or defective materials supplied by him for one calendar year from the date of final completion of work.
* Lugs should be provided for all earth connections.
* The contractor himself should arrange for the transportation of men and material to their work spot.
* All civil works and patch works indicated for providing electrical installations should be well finished to the satisfaction of the civil authorities. A certificate from them should be obtained to the effect that the civil and patch work done is to the satisfaction civil authorities. It will be the responsibility of the electrical contractor to obtain such certificate from the civil engineer. Unless such certificate is produced this office will have right to withheld the bill.
* Concerting to the pole and providing independent earthing should be done in presence of departmental staff.
* The distribution board with switch controls shall be separate in each floor for normal supply and essential supply.
* The lighting circuits shall be provided with separate conductor to enable to connect the normal lighting and essential lighting with linking to any of the above system to ensure to switch over to essential supply in the order to have minimum to avoid inconvenience to the staff working.
* The control for the luminary to be provided in the hall for both to be connected to the normal supply and essential supply shall be separate and away from the each system.
* For the points to be connected to essential supply a separate conduit system is to be laid as enumerated in the above conditions includes circuit a main of any system.
* The location for the D. B’s and switch controls for essential supply will be decided during the course of execution where the circuit conduit way have to be terminated.

1. **Specification:**  The supply and erection of lift should be inconformity of standards as per I.S.I specifications.
2. **Scaffolding:**  Scaffolding to the required extent has to be erected by the firm at their cost.
3. **Steel:** The rate quoted should also include necessary steel required for still support angles, hitch beams, buffer supports channels and bearing plates etc. The department will not be responsible for any mishaps during execution of equipment.
4. **Minor civil works :** Doing all minor works comprising of cutting holes and making good, quide rail brackets and landing batton fixtures, frames for collapsible gates and civil works, associated with the laying of the stills at each entrances and on the landing buffer supports channels and other works ancillary to the erection work in lift making groom and all other civil works will have to be carried out by the firm only to the satisfaction of the departmental officer and the company will responsible for any defects in the said works that might be noticed at later dates.
5. **Transport & Storage:** The materials will have to be delivered at site and stored at the cost of the firm. The safety of the material will be firm’s responsibility till the equipment is handed over duly commissioned. Any damage or loss of the material stored will be to the account of tenderer. Any repairs or replacement etc., needed to the materials so stored should be done at the cost of tenderer till the lift is handed over in satisfactory operation condition after testing and commissioning. All the expenses should be borne by the company. However, storage facilities will be provided free of cost.
6. **Earthing:** Necessary earthing is to be provided by the firm in confirmation to the relevant I.S.I specifications.
7. Other conditions will be as per APSS (Manual AP detailed standard specifications)???

15.0

**Brief Specification for All Elevators:**

All Elevators with following minor civil works required for installation of lift such as scoffolding, grouting, concreting and masonry work including all accessories.

**Common For Passenger Elevator:-**

1. Type and capacity : 20 Passenger

2. Speed Approx: 3.0 meter/second

3. Power Supply : 415V 3 Phase 50 cycles AC

4. Auxiliary power : Single phase 220 V 50 cycles A.C.

5. Type of Drive: Variable Voltage Frequency Drive (V3F).

6. Location of Machine Room: Machine room less

7. Travel in Mtrs: Varaible On Avg 150 Mts.

9. Control: Selective collective control with simplex.

10. Lift Door Opening Size = 1100 x 2400 mm

11. Car door : SS Mirror finish.

12. Landing Door : SS Mirror Finish

13. Electric light/fan : LED / Suitable fan

14. No. of entrances : - Location - Front.

15. Car entrance : Center opening power doors with SS No. 4

16. Landing entrance : Center opening power doors with SS No. 4

17. Indicators car & landings: 7 Segment 25mm digital direction and indicators in car and at all landings.

18. Special features/other features : Automatic Rescue Device.

19. Call register type KDS-50 Micro pushbutton for Car and landing.

20. 3-Way Intercom

21. Manual Cranking operation

22. Integral shaft for gear and motor

23. Emergency Stop Button

24. CVT/Built Voltage Stabilizer (Constant Voltage Transformer)

25. Pit ladder and ballustrade

26. Flooring : Granite flooring with 19mm recess (as per approval).

27. Emergency cabin lighting and alarm.

28. FRD/Fire Man Drive (Fire Rescue Device)

29. Controls: Resolve Micro Processor based simplex full collective control with or without attendant operation.

30. Door Safety: PANA 40-Full ray curtain for car door safety.

31. Load weighing device with indicator & bypass function.

32. Lift Announcement System (LAS)

33. Safety gears & over speed Governor.

33. Infra red door safety device.

35. Civil works: All minor civil works such as scaffolding, making holes, grouting, concreting etc.

36. Provision for connectivity of CCTV.

**Passenger Elevator:-**

Details to be discussed.

## Energy Conservation Measures:-

* The total voltage drop from supply point (Transformer) to the final point (LT Panels, light and socket etc.) of supply shall not greater than 4% of rated voltage (415V) during running condition.
* All light fixtures shall be LED type.
* All external area lights shall be controlled with Timer/day light sensor.
* Solar street light fittings shall be consider with standalone with battery charger. Minimum 20% street light pole shall have color back up.
* Occupancy sensors shall be considered in conference /meeting room, wash room area.
* Automatic power factor correction relay considred to maintain the power factor minimum 0.95.
* Use of capacitors at load centers to improve voltage & PF to reduce distribution losses.
* Low loss energy efficiency dry type transformers shall be considered.
* Use of insulation on roof top to reduce air conditioning load.
* Use of high efficiency motors.
* Use of VFD for hydro-pneumatic system for water supply & necessary chilled water system.
* Optimization of the operation of the equipments there BMS.
* Lighting power densities as per energy analysis report by GRIHA

## Sensor:-

**1. INTRODUCTION**

The work covered in this section is subject to all of the requirements in the General Conditions of the Specifications. System Integrator shall coordinate all of the work in this section with all of the trades covered in other sections of the specification to provide a complete and operable system.

**2. EQUIPMENT QUALIFICATION**

Products shall be manufactured by an ISO 9002 certified manufacturing facility

IEC 60669-2-1 / CE / Rohs compliant

**3. SYSTEM DESCRIPTION**

The objective of this section is to ensure the proper installation of the occupancy sensor based lighting control system so that lighting is turned off automatically if the daylight set point level is reached, or after reasonable time delay when a room or area is vacated by the last person to occupy said room or area.

The Occupancy Sensor system shall sense the presence of human activity within the desired space and fully control the “On” / “Off” function of the lights.

Time Delay settings shall be factory set at 15 minutes and the daylight set point 500 lux for ceiling mount and 300 lux for wall corner sensors.

To increase energy saving, in manual-on mode the Walk-Through mode is useful when a room is momentarily occupied. If the person leaves the room within 30 seconds, the sensor will turn the light off 3 minutes after the initial detection.

Sensors can provide audible alerts as a warning before the load turns OFF.

- Audible alert: at 1 min, 30 sec, and 10 sec before time delay elapses the motion sensor can produce an audible sound for an extinction warning.

With infrared commissioning tool , lot of parameter can be customized as the time delay, the daylight set point, sensor sensitivity, daylight calibration, the walk-through or and the re-trigger mode, the audible alert.

Installer, in accordance with manufacturer’s recommendation, shall determine final sensor location. All sensors shall have adjustable factory calibrated sensitivity for maximum performance.

The installing system integrator shall be responsible for a complete and functional system in accordance with all applicable local and national codes.

The occupancy sensor based lighting control shall accommodate all conditions of space utilization and all irregular work hours and habits.

The supplier’s obligation shall include repair or replacement, and testing without charge to the owner, all or any parts of equipment which are found to be damaged, defective or non-conforming and returned to the supplier.

4. SUBMITTALS

Manufacturer shall substantiate conformance to this specification by supplying the necessary documents, performance data and wiring diagrams.

System Integrator shall submit a lighting plan clearly showing proper product, location and orientation of each sensor.

System Integrator shall submit any interconnection diagrams per major subsystem showing proper wiring.

Manufacturer/System Integrator shall submit standard catalog literature which includes performance specifications indicating compliance to the specification. Catalog sheets must clearly state load restrictions.

5. SPECIFIC REQUIREMENTS

5.1 PRODUCTS

* Sensors shall be capable of detection of occupancy at desktop level up to 15 m2, and gross motion up to 150 m2.
* Sensors shall accommodate all loads 8.5A/10A at 100-240 volts; and shall have 360˚ coverage capability.
* At all moment the load can be turned ON and OFF, buy using push button or commissioning tool.
* Sensors should support Off Time delay in the range of 0 secs-59 mins & any changes required in off delay time or daylight set point to be modified with handheld Infrared remote.
* Sensors products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor’s longevity.
* Sensors shall have no leakage current to load, in manual or in Auto mode for safety purposes and shall have voltage drop protection.
* Sensors shall provide a field selectable option to convert sensor operation from automatic-on to manual-on.
* Passive infrared sensors shall utilize Pulse Count Processing and Detection Signature Processing to respond only to those signals caused by human motion.
* Passive infrared sensors shall provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line).
* Passive infrared sensors shall have a multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
* Where specified, passive infrared, ultrasonic and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.
* Dual technology sensors shall be wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas.
* Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.
* Dual technology sensors parameters can be customized with the infrared commissioning tool to detect initial occupancy by using passive infrared only, ultrasonic only, passive infrared or ultrasonic, or passive infrared and ultrasonic.
* Dual technology sensors parameters can be customized with the infrared commissioning tool for the re-trigger mode by using passive infrared only, ultrasonic only, passive infrared or ultrasonic, or passive infrared and ultrasonic.
* Dual technology sensors parameters can be customized with the infrared commissioning tool to maintain initial occupancy by using passive infrared only, ultrasonic only, passive infrared or ultrasonic, or passive infrared and ultrasonic.
* Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
* Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.
* All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
* Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.
* All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.
* In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.
* All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
* Sensors shall have an operating temperature range of -5°C - +45°C.
* To ensure complete protection from weather elements and exposure, outdoor sensors shall be manufactured with precision double-shot tooling and contain internal silicon gaskets.