

## **SECTION - 5**

# **TECHNICAL SPECIFICATION**

<b>Name of work:</b>	All in Maintenance Contract for Water Cooler installed at Minister Bungalow Site at Gandhinagar (For One Year) (2nd Attempt)
----------------------	--

## **Specifications for Electrical Works in Government Building Subject to the General condition of Contract in force (1986) General**

### **1. Wirings Rule:**

The installation generally shall be carried out in conformity with relevant Indian standard. Specification of and code of practices prevalent, Indian Electricity Rules, 1956 and Indian Electricity Act. 1910 as amended from time to time.

### **2. Definition:**

The definition of terms shall be in accordance with Indian standard code of Practice for Electrical wiring installation IS-732-1982 except for the definition of point in case of internal Electrical Installation. For definition of point wiring and measurement of Electrical works IS-5908-1970 shall be referred to.

### **3. Voltage and Frequency of supply:**

All current consuming devices shall be suitable for frequency of 50C/s and systems of voltage manual for unless otherwise specified.

### **4. Layout of wiring and its description:**

(I) the wiring shall be carried out as per schedule "Power" wiring must be in screwed conduit and shall be kept separate and distinct from lighting wiring. All wiring must be done on the distribution system with main and branch distribution boards at convenient centers and without isolated fuses. All conductors shall be run as far as possible along the walls and ceiling as to be easily accessible and capable of being thoroughly inspected. The balancing of circus will be arranged beforehand by the Ex. Engineer Electrical Division.

(ii) Within one month of the taking over the installation, the contractor shall supply to the Ex. Engineer Elect. Division a complete set of wiring diagrams of the same on drawings to be supplied when available by the Executive Engineer Electrical Division and to the satisfaction of the Ex. Engineer, Elect. Dept. and these wiring pains shall be "Drawings" within the meaning of the term as used in the General conditions of contract.

### **5. Conductors:**

All conductors unless otherwise specified shall not be less than 1.5 sq. mm. for point wiring and 2.5 sq. mm for mains conductors for power and lighting circuits shall be adequate size to carry the designed circuit load without exceeding the permissible thermal limits for the installation, and such sizes will be stipulated in specifications and or drawings.

### **6. Cables:**

6.1 All cables shall conform to relevant Indian Standards.

6.2 Conductors of all cables except the flexible cable shall be of aluminum. The smallest aluminum conductor for the final circuit shall have nominal cross sectional area of not less than 1.5 sq. mm. The minimum size of the aluminum conductors for power wiring shall be 4 sq. mm.

6.3.1 Conductors of flexible cables shall be of copper the minimum cross sectional area of such a cables shall be 14.0193 mm. the Flexible cable shall have uniform and adequate insulation.

6.3.2 Unless the flexible cables and conductors are protected by amount or though rubber of PVC Sheath, theses shall not be used in workshops and other places where they are liable to mechanical damage.

6.3.3 Core flexible cables shall be used for connecting single phase Appliances or phase, natural & earth connections.

### **7. Fall of Potential:**

The Cross sectional area of all conductors inside buildings shall be so proportioned to their lengths that the drop in voltage between main fuses and the farthest point or any lamp shall not exceed three percent of the voltage of the consumer's with all the consuming devices in use.

- 7.1 If the Cable Size is increased to avoid the voltage drop in circuit current rating of the cable shall be more than that for which circuit is designed. In each circuit or sub circuit or sub circuit every cable shall have current higher than the full load current.

8. **Ratings of lamps and fans socket outlets: Points and exhaust fans**

- 8.1 Incandescent lamps installed in residential and non-residential building shall be rated at 60 watts & 100 watts respectively.
- 8.2 Table fans and ceiling fans shall be rated at 60 watts, exhaust fan shall be rated at 100 watts and 1000 watts respectively for the purpose of load assessment unless actual values of the load are, know or specified.

9. **Tests:**

- 9.1 Before the installation is commissioned following tests shall be carried out.

- (1) Insulation Resistance Test.
- (2) Polarity Tests of Switches
- (3) Earth continuity tests
- (4) Earth electrodes Resistance test.

- 9.2.1.1 The insulation Resistance shall be measured between earth and the whole system of conductors or any section thereof with all fuses in place and all switches close, and except in earthed concentric wiring all lamps in position or both poles of installation otherwise electrically connected together. A direct current pressure of not less than the twice working pressure provided that it need not exceed. 500 volts for medium voltage circuits where the supply is derived from three wire D.D or a ploy phase A.C. system, the neutral pole of which is connected to earth either direct or through added resistance, the working pressure shall be deemed to be that which is maintained between the phase conductor and the neutral.

- 9.2.1.2 The insulation sentence shall also be measured between all conductors to one pole or phase conductor of the supply and all the conductors connected to the neutral or to the order pole or phase conductors of the supply with all lamps in position and switches in "OFF" position and its value shall be less than specified in sub-clause 9.2. 1.3

- 9.2.1.3 The insulation resistance in Mega-ohms measured as above shall not be less than 50 mega ohms divided by the number if outlet or when PVC insulated cables are used for wiring 12.5 mega ohms divided by number of outlets.

- 9.2.1.4 Where a whole installation is being tested a lower value than that given by the formula subject to a minimum of 1 mega ohm is acceptable.

- 9.2.1.5 A preliminary and similar test may be made before lamps, act. are installed and in this event the insulation resistance to earth should be not less than 100 mega ohms divided by the number of outlet or when PVC insulated cables are used for wiring 25 mega ohms divided by number of outlets.

- 9.2.1.6 The term "Outlet" includes every switch except that a switch except that a switch combined with a socket outlet appliance or lighting, fitting is regarded as one outlet.

- 9.2.1.7 Control rheostat heating and electric sign may, if required, be dis-connected from the circuit during the test, but in that event the insulation resistance between the case or frame work, and all live parts of each rheostat, appliance and sign, shall be not less than that specified in the relevant Indian Standard Specification or where there is no such specification shall be not less than half a mega ohm.

9.2 **Polarity Test:**

- 9.2.2.1 In a two wire installation a test shall be made to verify that all switches in every circuits have been fitted in the same conductor throughout & such conductor shall be labeled or marked for connection To the phase conductor or to the non-earthed conductor of the supply is fitted in a conductor which is labeled or marked for connection to one of the phase conductor of the supply.
- 9.2.2.2 In a three wire or a four wire installation a test shall be made to verify that every non-linked single pole switch is fitted in a conductor which is labeled or marked for connection to one of the phase conductor of the supply.
- 9.2.2.3 The installation shall be connected to the supply for testing. The terminate of all switches shall be tested by a test lamp one lead of which is connected to the earth. Glowing of test lamp to us full brilliance when the switch is in on position irrespective of appliance in position or not shall indicate that the switch is connected to the right polarity.
- 9.2.3 **Earth Continuity Test:**  
The earth continuity conductor including metal conduits and metallic envelops of cables in all cases shall be tested for electric continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit breaker measured form the connection with the earth electrode to any point in the earth continuity conductor in the completed installation shall not exceed one ohm.
- 9.2.3.1 **Earth Electrode Resistance Test:**  
Earth electrode Resistance test may be carried out by mugger Earth Testers containing a direct reading ohmmeter, a hand driven generator and auxiliary electrodes.
- 9.3 On completion of an electric installation (addition and alteration) a certificate shall be furnished by the contractor countersigned by the certified Supervisor under whose direction supervision the installation was carried out. This certificate shall be in the prescribed form as given in Appendix-B in addition to the test certificate required by Local Electrical Supply Authorities.
10. **Joint and looping back:**  
Unless with the sanction of Ex. Engineer, Electrical Divisions all joints in conductor shall be means of approved mechanical connectors in suitable and approved junction boxes but looping back system shall be preferable. in wiring unless otherwise specified phase and live conduct shall be looped at the switch box where a neutral conductor can be looped form light, fan or socket in non-residential buildings neutral and earth continuity wire shall be brought to each of 'the switch boards should be of adequate size to accommodate at least one number of 5 Amps, socket outlet and control switch in future.
11. **Switches:**  
Main Switchgears, Switch Board and their location:
- 11.1 All main switches (other hart loss of iron clad pattern) carrying current of 10 Amp. And above shall be twitted for back connections and shall be suitable protected.
- 11.2 AH switches and circuit breakers shall be constructed in accordance with the I.S. 4237-1967. General requirement for switchgear and control gear for voltage not exceeding 1000 volts and other relevant I.S. provided also that spring shall be either of phosphor bronze or if steel shall be copper or Nickel plated and that handle shall the so fastened that they do not tend to unscrew 01 become boss.
- 11.3 All main switches shall be either of metal cad enclosed pattern of any insulated enclosed pattern which shall be fixed at close proximity to the point of entry of supply.
- 11.4 Switch boards shall net be erected above gas, stoves, or within 2.5 mm of any washing unit in the washing rooms of laundries or in the bath rooms, lavatories, toilets or kitchens.
- 11.5 Switch boards, if unavoidably fixed in places likely to be exposed to weather, to drip or to abnormal moose

temperature the outlet casing shall be weather proof and shall be provided with glands or bushing of adopted to receive screwed" conduit according to the manner in which cables are run P/C and double flanged bushes shall be fitted in the holes of the switches for entry and exit of wires.

- 11.6 A Switch board net he installed so that its bottom is within 1.25 mm above the floor unless the front of the switch board completely enclosed by a door or the switch board is located in a position to which only authorized persons have access.
- 11.7 Switch boards shall be recessed in the wall if so specified in the schedule of work or in the special specification. The front shall be fitted with hinged panel of other suitable material such as Bakelite in wood frame with locking arrangement, the buts surface of door being flush with the walls. Ample room shall be provided at the back for connections and at the front between the switchgear mountings and the door.
- 11.8 Equipment's which are on the front of a switch board shall be so arranged that inadvertently personal contact with live parts in unlikely during the manipulation of switchgears. Changing of fuses or like operations.
- 11.9 No holes other than the holes by means of which the panel is fixed shall be drilled closer than 1.3 from any edge of the panel.
- 11.10 The various live parts, unless they are effectively screened by substantial barriers of non-hydroscopic, noninflammable insulating material, shall be so spaced that space shall not be maintained between such parts and earth.
- 11.11 The arrangement of gear shall be such that they shall be readily accessible and their connections to all instruments and apparatus shall also be traceable.
- 11.12 In every case in which switches and fuses are fitted on the same pile, these fuses shall be so arranged that the fuses are not alive when their respective switches are in the off position.
- 11.13 No fuses other than fuses in instrument circuit shall be fixed on the back of or behind a switch board panel of frame.
- 11.14 All the metal switchgears and switch boards shall be painted, prior to erection with one coat of antirust primer, After erection they shall be painted with two coats of approved enamel or aluminum paint as required on all sides wherever accessible.
- 11.15 All switch boards connected to medium voltage and above shall be provided with "Danger Notice Plate" conforming to relevant Indian Standards.

## 12. **Control at Point of Commencement of Supply:**

- 12.1 There shall be a linked man switchgear with fuse on each live conductor of the supply mains at the point of entry. The wiring throughout the installation shall be such that there is no break in the natural shall also be distinctly marked. In this connections Rule 32(2) of the Indian Electricity Rules, 1966 (See Appendix-A\_ shall also be referred.
- 12.2 The main switchgear shall be situated as near as practicable to be termination of services line and shall be easily accessible without the use of any external aid.
- 12.3 On the main switchgear, where the conductor of a two wire system or any earthier neutral conductor of a multi wise system or a conductor which is to be connected thereto, an indication of a permanent nature shall be provided to identify earthier neutral conductor. In this connection Rule 32(1) of Indian Electricity Rules, 1956 (see appendix 'A') shall be referred.

## 13. **Switch Board & Distribution Boards:**

I Metal clad switch gear shall preferably be mounted on any of the following types of Board.

### 13.1 **Hinged type Metal Board:**

There shall consist of a box made of sheet metal not less than 2 mm thick and shall be provided with a

hinged cover to enable the board to swing open for examination of the wiring at the back. The joints shall be welded. A teak wood board, thoroughly protected both inside and outside with good insulating varnish conforming to IS: 347-1952 specification for varnish shellac for General purpose and of not less than 6.5 mm thickness shall be provided at the back for attachment of incoming and outgoing cables. There shall be a clear distance of not less than 2.9 cm between the teak wood board and the cover, the distance being increased for larger boards in order that on closing of the cover, the insulation of the cables is not subjected to damage and no short length of cables is subjected to excessive twisting or bending in any case. The board shall be securely fixed to the wall by means of rag bolts, plugs or weed den Gut ties and shall be provided with a locking arrangement and an earthing stud. All wires passing through the metal board shall be bunched. Alternatively, hinged type metal boards shall be made of sheet covering mounted on channel or angle iron frame.

NOTE: Such type of boards is particularly suitable for small switch-boards for mounting metal-clad switchgear connected to supply at low voltages.

### 13.2 **Fixed type Metal Boards:**

These shall consist of an angle or Channel of iron frame fixed on the wall or on floor and supported on the wall at the top if necessary. There shall be a clear distance of one metre in front of the switch board. If there are attachments of base connections at the back of the switch board Rules 51(1)c) of Indian Electricity Rules, 1956 shall apply

NOTE: Such type of boards are particularly suitable for large switchboard for mounting large Number of switchgears or higher capacity metal clad switchgears of both.

### 13.3 **Teak wood Boards:**

For small installation connected to a single phase 230 volts supply teak wood boards may be caused as main boards or sub-boards. These shall be of seasoned teak or other durable wood with solid back impregnated with varnish of approved quality with all joints dovetailed.

13.4 In large size medium voltage installations, before proceeding with the actual construction of the boards proper drawing showing the detailed dimensions and design including the disposition of the mounting a which shall be symmetrically and neatly arranged for arriving at the overran dimensions shall be prepare and approved by the engineer-in-charge.

### 13.5 **Recessing of Boards:**

Where so specified the switch boards shall be recessed in the wall. The front shall be fitted with a hinged panel of teak wood or other suitable materials, such as bakelite, or with unbreakable glass doors in teak wood frame with locking arrangement, the other surface off the doors being flush with the walls, ample room shall be provided at the back for connection and at the front between the switchgear mountings.

### 13.6 **Arrangement of Apparatus:**

- a) Equipment which is on the front of a switch board shall be so arranged that inadvertently personal contact with live parts is unlikely during the manipulation of switches, changing of fuses or like operation.
- b) No apparatus shall project beyond any edge of panel. No fuse body shall be mounted within 2.5 cm of any edge of the panel and no hole other than holes by means of which the panel is fixed shall be drilled closer than 1.3 cm from any edge of the panel.
- c) The various live parts unless they are effectively screened by substantial barriers of non-hygroscopic, non-inflammable insulating material, shall be so spaced that an arc cannot maintain between such parts and earth.
- d) The arrangement of the gear shall be such that they shall be readily accessible and their connections to all instruments and apparatus shall be so spaced that an arc cannot maintain between such parts and

earth.

- e) The arrangement of the gear shall be such that they shall be readily accessible and their connection to all instruments and apparatus shall also be easily traceable.
- f) In every case in which switches and fuses are fitted on the same pole, these fuses shall be so arranged that the fuses are not alive when their respective switches are in the 'OFF' position.
- g) No fuses other than fuses instrument circuit shall be fixed on the back of or behind a switchboard panel or flame.

### 13.7 Marking of Apparatus:

- a) Where a board is connected to voltage higher than 250 volts, all the apparatus mounted on it shall be marked in the following colors to which the apparatus or its different terminal may have been connected.

Alternating Current	Direct Current
Three-phase-red	Three wire system-2 otherwise
Yellow & blue	Positive Red & negative Blue
Natural-black	Natural Black

Where fuse-wire three phase wiring is done, the neutral shall be in one color and the other three wires in another color

- b) Where a board has more than one switch shall be marked to indicate which section of the installation it controls)
- c) All markings required under the rule shall be clear permanent.

### 13.8 Main & Branch Distribution Board:

13.8.1 Main and branch distribution boards shall be any type mentioned in 13.1, 13.8.1. Main and branch distribution boards shall be of any type mentioned in 13.1

13.8.2 Main distribution boards shall be provided with a switch or air circuit breaker on each pole of each circuit, a fuse on the phase or live conductor and a link on the neutral or earthed conductor of each circuit. The switches shall always be linked.

#### 13.8.3 Branch Distribution Board:

13.8.3.1 Branch distribution boards shall be provided with a fuse of a miniature circuit breaker of both the (adequate rating-setting chosen on the live conductor of each circuit and the earthed neutral conductor shall be connected to a common line and be capable of being disconnected individually for testing purposes. At least one spare circuit of the same capacity shall be provided on each branch distribution board.

13.8.3.2 In residential installations, lights and fans may be wired on a common circuit such sub circuit shall not have [more than total after points of lights, fans and socket outlets/The load of such circuits shall be restricted to 800 watts. III a separate of a circuit is provided the number of fans in the circuit shall not exceed ten. Power sub-circuits shall be designed according to the load but in no case shall there be more than two outlets on each sub-circuits

13.8.3.3 In industrial and other similar installations requiring the use of group control of switching operation, circuits, for (socket outlets may be kept separate from fans and lights. Normally fans and lights may be wired on a common circuit, however, if need is let separate circuits may be provided for the two. The road on any law voltage sub circuit shall not (exceed 3000 Watts.) In case of new installation, all circuits and sub-circuits shall be designed by making provision of 20 (percent increase in load due to any future modification. Power sub-circuits shall be designed according to the load but in no case shall there be more than four outlets in each sub-circuits.

### 13.9 Installation of Distribution Boards:

13.9.1 The distribution fuse-boards shall be located as near as possible to the center of the load they are intended to control.

13.9.2 These shall be fixed on suitable stanchion or wall and shall be accessible for replacement of fuses.

13.9.3 These shall be of either metal-clad type, or damp situations, they shall be of the weather proof type and if installed where exposed to explosive dust, vapor or gas, they shall be of flame proof type

13.9.4 Where two or more distribution fuse boards feed low voltage these distribution boards shall be

(1) Fixed not less than 2 mm apart or

(2) Arranged so that it is not possible to open two at a time, namely they are interlocked and the metal case is marked Danger 415 volts or (3) installed in a room of enclosure accessible to only authorized person.

13.9.5 All distribution boards shall be marked lighting, power as the case may be and also marked with the voltage and number of phases of the supply Each shall be provided with a circuits list giving details of each circuit which it controls and the current rating of the circuit and size of fuse element.

13.9.6 Triple pole distribution boards shall not be generally used for final circuit distribution unless specification approval of Engineer-in-charge is obtained in special cases where use of Triple pole distribution boards are inevitable they shall be of H.R.C. fuse type only.

#### **13.10 Wiring and Distribution Board:**

13.10.1 In wiring a branch board, total load of the consuming devices shall be divided as far as possible, evenly between the numbers of ways of the boards leaving the spare circuit for future extension.

13.10.2 All connections between pieces of apparatus or between apparatus and terminal on a board shall be neatly arranged in a definite sequence following the arrangement of the apparatus mounted thereon, avoiding unnecessary crossing.

13.10.3 Cables shall be connected to a terminal only by soldered or welded or crimped lugs using suitable sleeve, lugs or ferrules unless the terminal is such a form that it is possible to securely clamp them without the cutting away of cable strands.

13.10.4 All bare conductor shall be rigidly fixed in such a manner that a clearance of at least 2.5 cms. is maintained between conductor of opposite polarity or phase and between the conductors any material other than insulating material.

13.10.5 If required a pilot lamp shall be fixed and connected through an independent single-pole switch and fuse to the bus-bars of the board.

13.10.6 In a hinged type board, the incoming and outgoing cables shall be fixed at one or more points according to the number of cables on the back of the board leaving suitable space in between cables and shall also, if possible be fixed at the corresponding points on the switch board panel. The cables between these points shall be arranged to form a "U" or "S" shaped loop which shall be of such length as to allow the switchboard panel to swing through an angle of not less than 90

#### **14. Capacity of Circuits:**

14.1 Lights and fans may be issued on a common circuits and such a circuit shall not have more than a total of ten points of lights, fan and socket outlets or a load of 800 watts whichever is less. The power circuits shall be designed with a maximum of two outlets per circuits generally when load is not known or specified. In non-residential buildings at important District centres however one outlet per circuit may be preferred. The circuit shall be designed based on the loading of the circuit where not specified the load shall be taken as 1 kw per outlet, where the load is more than 1 kw it should be controlled by a isolator switch or miniature circuit breeder.

**15. Passing Through walls and floors:**

15.1 Where conductors pass through walls one of the following methods shall be employed. Care shall be taken to see that wires pass very freely through protective pipe of box and that the wires pass through in a straight line without any twist of cross in wires, on other ends of such holes.

(a) A teak wood box extending through the whole thickness of the wall shall be buried in the wall and casings or conductors shall be carried so as to allow 1.3 cms air space on three sides, of the casing conductor.

(b) The conductor shall be caned either in a rigid steel conduit conforming to \*IS : 1653-1964 specification for Rigid Steel conduits of Electrical wiring (Revised) or a rigid non - metallic conduit conforming to \*IS : 2609-1963 specification of Rigid Non-Metallic conduits for Electrical Installations, or in a porcelain tube of such size which permits easy drawing in. The end of conduit shall be neatly bushed with porcelain, wood or other approved material.

(c) Insulated conductors while passing through floors shall be protected form mechanical injury by means of rigid steel conduit (see \*IS 1653-1964) to a height not less than 1.5 mm above the floors and flush with the ceiling below. This steel conduit shall be earthed and securely bushed.

15.2 Where a was tube passed outside a building so as to be exposed to weather the outer end shall be belt mounted and turned downwards and portly bushed on the open end.

**16. Fixing to Walls and Ceilings:** Plugs for ordinary walls or ceilings shall be of while seasoned teak or other approved hardwood not less than 5 cm long 2.5 cm square on his inner end and 2 cm square on the outer end. They shall be cemented into walls to within 7.5 mm of the surface, the remaining being finished according to the nature of the surface with plaster of lime punning.

16.1 Where owing to irregular crossing or other reasons the plugging of the walls or ceiling with wood plugs presents difficulties, the weed casing weed pattern, metal conduit or clear (as the case may be) shall be attached to the wall or ceiling in an approved manner in the case of new building wherever possible teak wood plugs shall be fixed in the walls before they are plastered.

16.2 To achieve neatness, plugging of walls or ceiling may be done by an approved type of asbestos metallic or a fiber fixing plug.

**17. Branch Switches:**

Where the supply is derived from a three-wire of four-wire source, and distribution is done on the two wire system all branch switches shall be placed in the outer or live conductor of the circuit and no single-phase switch of use shall be inserted in the middle wire, earth or earthed natural conductor of the circuit. Single

pole switches (Other than for multiple control) Carrying not more than 15 amperes any be of tumbler type which shall be 'ON' when the handle known is down.

18. **Fittings:**

Where conductors are required to be threaded through tubes or channels formed in the metal work of fittings these must be free from sharp angles or projecting edges and such size that will enable them to be wired with the conductors used for the final sub-circuits without removing the boarding taping or outer covering as far as possible all tubes and channels should be of sufficient size to permit 'Looping back' of wires cables and flexible cords other than those designed for high temperature shall not be used for wiring fittings except for portable fittings. All fittings must have not less than a half inch male nipple. Fittings and lamp holders for gas filled lamps shall be adequately ventilated.

- 18.1 Where light fitting is supported by one or more flexible cords the maximum weight to which the two flexible cords may be subjected shall be as follows.

Nominal cross Sectional Area cord mm <sup>2</sup>	No. & Dia in mm of wires.	Max. Permissible Weight
0.5	16/0.2	1.7
0.75	24/0.2	2.6
1.0	32/0.2	3.5
2.5	48/0.2	5.3
3.5	80/0.2	8.8
4	128/0.2	14.0

- 18.2 No inflammable shade shall form a part of light fitting unless such shade is well protected against all risks or fire. Celluloid shade or light fitting shall not be used under any circumstances.

18.3 **Fitting of wire:**

The use of fitting wire shall be restricted to the internal wiring and the lighting fittings. Where fitting wire is used for wiring, for the sub-circuit loads shall be terminated in a ceiling zone or connector from which they shall be carried into the fittings.

19. **Lamp Holders:**

Lamp holders for use on brackets and the like shall be in accordance with IS: 1258-1967 specification for Bayonet lamp holders and all those for use with flexible pendants shall be provided with cord grips. All lamp holders shall be provided with shade carriers. Where centre contact Edison screw lamp holders are used, the outer or screw contacts shall be connected to the middle wire, the neutral and the earthed conductor of the circuit.

20. **Outdoor Lamps:**

External and road lamps shall have weather proof fittings of approved design so as to effectively prevent the admission of moisture. An insulating distance piece of moisture proof materials shall be inserted in the fittings. Flexible cord and cord grip lamp holders shall not be used where exposed to weather in verandah and similar exposed situations where pendants are used, they shall be of fixed rod type

21. **Lamps:**

All incandescent lamps, unless otherwise required, shall be hung at a height of not less than 2.5 m above the floor level. They shall be in accordance with IS 418 : 1957 specification for Tungsten Filament General Service electric lamps

## **22. Fans, Regulators and Clamps**

### **22.1 Ceiling fans:**

Ceiling fans including their suspension shall conform to \*IS 374-1960 specification for electric ceiling fans and regulators (Revised) & to the following requirements

- (a) All ceiling fans shall be wired to ceiling rouses or to special connector boxes to which fans rod wires shall be connected and suspended from books or shackles with insulators between rod wires shall be connected and suspended from hooks or shackles with insulators between hooks and suspension rods. There shall be no joint in the suspension rod. but if joints be avoidable then such joints shall be screwed to special couplers of 5 cm minimum length and both ends of pipes shall touch together within couplers and shall in addition be secured by means of split pins alternatively the two pipes may be welded.
- (b) Fans clamps shall be of suitable design according to the nature of construction of ceiling on which these clamps are fitted in all cases fan clamps shall be fabricated from tested new metal of suitable sizes and they shall be as close fitting as possible Fan clamps for weed beams shall be of suitable flat iron fixed on two sides of the beam and according to the size and section of the beam one or two mid steel bolts passing through the beam shall hold both flat irons together Fan clamps for steel join shall be fabricated from tested flat iron to fit in rigidly at the bottom flange of the beam. Care shall he taken during form tested flat iron to fit in rigidly at the bottom flange of the beam. Care shall he taken during form tested flat iron to fit in rigidly to the bottom flange of the beam Care shall be taken during fabrication that the metal does not crack while hammering to shape. Other fan clamps shall be made to suit the position, but in all cases care shall be taken to see that they are rigid and safe.

Note: All tan clamps shall be so fabricated that fans revolve steadily.

- (c) Canopies on top and bottom of suspension rod shall effectively hide suspensions and connections to fan motors, respectively.
- (d) The lead-in wire shall be of nominal cross-sectional are a not less than 1.0 mm 2 with copper and 1.5 mm2 aluminum and shall be protected form abrasion.
- (e) Unless otherwise specified the clear distance between the ceiling fan and the floor shall be less than 2.75 m

### **22.2.0 Exhaust Fans:**

For fixing of an exhaust fan a circular hole shall be provided in wall to suit the size of the fan which shall be fixed by the means of rag-bolts embedded in the wall the hole shall be neatly plastered with cement and brought to the original finish of the wall. The exhaust fan shall be connected to exhaust fan point which be wired as neat to the hole as possible by means of a flexible cord, care being taken that the blades in the proper direction.

## **23. Attachment of fittings and accessories:**

- 23.1 In other than conduit wiring all ceiling crosses, brackets, pendants and accessories attached to watts or ceiling shall be mounted on substantial teak wood block twice Varnished after all fixing holes are made in them. Blocks shall be not less than 4 cms deep. Brass screws only shall be used for attaching finings and accessories to their base blocks.

## **24. Interchangeability:**

Similar part of all switches, lamp holder, distribution, fuse board, ceiling rouses, brackets, pendants, fans and all other fittings of same type shall be interchangeable in each installation.

## **25. Conduit Wiring System:**

- 25.1.1 Type and size of conduit - All conduit pipes shall be conforming to \*IS : 1653-1964, furnished with galvanized or stove enameled surface. All conduit accessories shall be of threaded type and under no

circumstances pin grip type or clamp type accessories be used. No steel conduit less than 16 mm in diameter shall be used. The number of insulated conductors that can be drawn into rigid steel conduit are given in Table II.

25.1.2 Bunching of cables - Unless otherwise specified, insulated conductors of AC supply and DG supply shall be bunched in separate conduits.

25.1.3 Conduit-Joints-Conduit pipes shall be joined by means of screwed couplers and screwed accessories only (\*IS : 2667-1964)

Specification for Fittings for Rigid Steel Conduits for Electrical Wiring. In long distance straight runs of conduit inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam-puts (in the latter case the bare threaded portion shall be treated with anti - corrosive preservative) shall be provided. Thread on conduit pipes in all cases shall be between 11 mm to 27 mm long sufficient to accommodate pipes to full thread portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges nor any or buries left to avoid damage to the insulation of conductors while pulling them through such pipes.

**Table-II Maximum Permissible Number of 250-V Grade Single core cables that can be drawn into rigid steel Conduit**  
(Clause 6.51 1)

Size of cable		Number and Diameter in		(No. of Cables Max)									
Nominal	Cross-sectional	mm of wires		16	20	25	32	40	50	63			
area		S	B	S	B	S	B	S	B	B	S	B S	B
1.0	1/1.12			5	4	7	5	12	10	20	14	-	
1.5	1/1.40	4	3	7	5	12	10	20	14	-	-	-	
2.5	1/1.80	3	2	6	5	10	8	16	12	-	-	-	
4	1/2.24	3	2	6	5	10	8	18	12	-	-	-	
6	(3/1.06*)												
	(7/0.85)												
10	1/2.80	2		3	2	6	5	10	8				
10	(7/1.06*)												
	1/3.55+	-	-	2	-	5	4	8	7	-	-		
16	7/1.40*	-	-	2	-	4	3	6	5	8	6	-	
	7/1.70	-	-	-	-	2	-	4	3	7	6	-25	
	7/2.24	-	-	-	-	-	-	2	-	4	3	-	-
35	-	-	-										
	7/2.50	-	-	-	-	-	-	2	-	5	4	6	5
50	7/3.00+	-	-	-	-	-	-	-	-	2	-	5	4
	6	5											
	19/1.80	-	-	-	-	-	-	-	-	2	-	5	4
	6	5											

\* For Cu. Conductors only

+ For Al Conductors only

Note-1 The cable shows the maximum capacity of capacity for the simultaneous drawing-in of cables. The table applies to 250 volts grade able the columns heads 'S' apply to runs of conduit which have table applies to 250 volts grade able the columns heads 'S' apply to runs of conduit which have distance not exceeding 4.2 SM between draw in boxes and which do not deflect from the straight by angle of more than 150.

- 25.1.4 **Protection against dampness** - in order to minimize condensation or seat in inside the tube, all outlets of conduit system, shall be property drained and ventilated, but in such a manner as to prevent the entry of insects as far as possible
- 25.1.5 **Protection of conduit against rust** - The outer surface of the conduit pipes including all bends, unions, tees 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 preservative or covered with approved plastic compound.
- 25.1.6 **Fixing of Conduit** - Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or any other approved plug with screws in an approved manner at an interval of not more than one meter but on either side of coppers or bends or similar fittings, saddles shall be fixed at a distance of 30 cm. from the center of such fittings.
- 25.1.7 **Bends in conduit** - All necessary bends in the system including diversion shall be done bending pipes, or by insuring suitable solid or inspection type normal bends, elbows or similar fittings or by fixing cast iron inspection boxes whichever is more suitable. Conduit fitting shall be avoided as far as possible. On conduit system exposed to weather, where necessary, said type fitting shall be used. Radius of such bends in conduit pipes shall be not less than 7.5 cm. No length of conduit shall have more than the equivalent of four quarter bends from outlet, the bends at the outlets not being counted.
- 25.1.8 **Outlets** - All outlets for fitting switches etc., shall be boxes, of suitable metal or any other approved outlet boxes for other surface mounting or flush mounting system.
- 28.1.6 **Conductors** - All conductors used in conduits wirings shall preferably be stranded. No single core cable nominal Cross - sectional area greater than 130 mm shall be enclosed in a conduit and used for alternating current.
- 28.1.7 **Erection and earthing of conduit** - The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit and permanently connected to earth conforming the requirements specified under pipe in a workman like manner for a perfect continuity between each wire and conduit. Gas or water pipes shall not be used as earth medium. If conduit pipes are liable to mechanical damage, they shall be adequately protected.
- 25.2 **Recessed Conduit wiring system with Rigid Steel conduits** - Recessed conduit wiring system comply with all the requirements for surface conduit wiring system specified in 6.5.2.1 to 6.5.2.4.
- 25.2.1 **Making of chase** - The chase in the wall shall be neatly made and be of ample dimensions to permit the conduit to be fixed in the manner desired In the case of buildings under construction chases shall be provided in the wall, ceiling etc., at the time of their construction and shall be filled up nearly after erection of conduit and brought to the original finish of the wall.
- 25.2.2 **Fixing of conduit in chase** - The conduit pipe shall be fixed by means of staples or by means of soft saddles not more than 60 cm apart. Fixing of standard bends or elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with a large radius which will permit easy drawing in of conductors. All threaded joints of rigid steel conduit shall be treated with some approved preservative compound to secure protection against rust.
- 25.2.3 **Inspection boxes** - Suitable inspection boxes shall be provided to permit periodical inspection and to facilitate removal of wires, if necessary. These shall be mounted flush with the wall Suitable ventilating holes shall be provided in the inspection box covers.
- 25.2.4 **Type of accessories to be used** - AM outlets such as switches and wall sockets, shall be either of flush mounting type or surface mounting type.

(a) **Flush mounting type** - All flush mounting outlets shall be of cast iron mild steel boxes with a cover of approved insulating material or shall be a box made of a suitable insulating material. The switches and other outlets shall be mounted on such boxes as would be approved. The metal box shall be efficiently earthed with conduit by an approved means of earth attachment.

(b) **Surface mounting type** - If surface mounting type outlet box is specified, it shall be of any be through flexible conduits of the same size as the rigid conduit.

### 25.3 Conduit Wiring System with Rigid Non-Metallic Conduits:

Rigid Non-Metallic conduits are used for surface recessed and concealed conduit wiring.

25.3.1 **Type and size** - All non-metallic conduits used shall conform to IS : 2509-1963adb shall be used with the corresponding accessories (See IS : 3419-1965) specification for Fittings for Rigid Non - Metallic Conduits).

25.3.2 **Bunching off cables** - Conductors of AC supply and DC supply shall be bunched in separate conduits. The number of insulated cables that may tie drawn into the conduits are In Table III. In this table space. Factor does not exceed 40 percent.

**Table-III MAXIMUM PERMISSIBLE NUMBER OF VOLTS GRADE SINGLE, GORE CABLE THAT MAY BE drawing INTO RIGID non-metallic conduits**

Size of cable Nominal Cross Sectional area mm <sup>2</sup>	Number 16 and	Size of Conduits (mm)					
		20	25	32	40	50	(Number of Cables Max)
1.0	1/1.12*		5	7	13	20	-
1.5	1/1.40		4	6	10	14	-
2.5	1/1.80		3	5	10	14	-
	3/1.06*						
4	1/2.24		2	3	6	10	14
	7/0.85*						
6	1/2.80		-	2	5	8	11
10	1/3.55*		-	-	4	7	9
	7/1.40*						
16	7/1.70		-	-	2	4	5
25	7/2.24		-	-	-	4	2
35	7/2.50		-	-	-	-	2
50	7/3.00*)-		-	-	-	2	3
	19/1.80						

\*For copper conductors only

\*For aluminum conductors only.

25.3.3 **Conduit joints** - shall be joined by means of screwed or plain couplers depending on whether the conduits are screwed or plain. Where there are long runs of straight conduit. Inspection type couplers shall be provided at intervals. For conduit fittings and accessories reference may be made to IS : 3419-1965.

25.3.4 **Fixing of conduits** - The provision of 25.1.6 shall apply except that the septum between saddles or

supports is recommended to be 60 cms for rigid non-metallic conduits.

- 25.3.5 **Bends in conduit** - wherever necessary, bends or diversions may be achieved by bending the conduits (See 6.5.3.9) or by employing normal bends, inspection bends, impaction boxes elbows or similar fittings.
- 25.3.6 Conduit fittings shall be avoided, as far as possible on outdoor system.
- 25.3.7 Outlets - All the outlets or fittings, switches, etc. shall be boxes of substantial construction. In Order to minimum is condensation or sweating inside in side 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, etc. as far as possible.
- 25.3.8 For use with recessed conduit wiring system the provisions of 6.5.2.1 to 6.5.2.4 shall apply
- 25.3.9 Heat may be used to soften conduit for bending and forming joints in case of plastic conduits. As the material softens when heated fitting of conduit in close proximity to hot surfaces should be avoided. Caution should be exercised in the use of the conduit in locations where the ambient temperature is 50°C or above Use of such conduits in place where ambient temperature is 60°C or above is prohibited.

#### **PVC INSULATED AND P.V.C. sheathed or T.R.S wiring SYSTEM**

##### **26.0 GENERAL**

This system of wiring is suitable for low pressure installation and shall not be used in places exposed to sun and rain nor in damp places. provided they are sheathed in the special approved protective covering and well protected to withstand dampness.

##### **26.1 Attachment to walls and ceiling:**

All cases on brick walls, stone or plastered walls and ceiling shall be run on well seasoned perfectly straight and well seasoned, perfectly straight and well varnished on four sides, teak wood or any approved hard wood battens not less than 10 mm thick, width of which shall be such as to suit total width of cables laid on the batten, prior to erection, these shall be painted with one coat of varnish or approved paint of color to match with surrounding. These battens shall be secured to wall and ceilings by flat head wood screws to faws plug or Phil plug at an interval not exceeding 75 cm. Wood plug can be used only with special approval of the Engineer in charge. The flat head wood screws shall be countersunk within wood batten and smoothed down

- 26.1.2 Where wiring is to be carried out along the face of the rolled steel joints a wooden batten adequate width shall first be laid on the same and dipped to it as inconspicuously as possible. The wiring should then be fixed to this batten shall be suitable bushed to prevent the abrasion of the cables.

- 26.1.3 Attachment to false ceiling: In no case, the open wiring shall be run above the false ceiling without the approval of Engineer-in-charge

- 26.20 Link clips: Only aluminum alloy clips/joint clips shall be used. The thickness shall be 0.32 mm (30 SWG) for lengths of 50 mm to 80 mm. The width shall not be less than 8 mm in all these cases. Link clips/joint clips shall be so arranged that one single clip shall not hold more than two core or three single core Cables of PVC insulated and PVC sheathed upto 2.5 sq. mm above while a single clip shall hold a single twin core or two single core cables. The clips shall be fixed on varnished wood batten with iron pins and space at interval of 15 cm between in the case of horizontal and vertical runs.

- 26.3.0 Bends in wiring: The wiring shall not be bent so as to form an abrupt right angle but must be rounded off at the corners to a radius not less than six times the overall diameter of the cable.

##### **26.4.0 Protection of wiring from Mechanical Damage:**

- 26.4.1 In cases where there are chances of any damage to wiring such wiring shall be drawn complying with all the requirements of conduit wiring system.
- 26.4.2 Such protective covering shall in all cases be fitted on all down drops within 1.5m from the floor. or from floor level upto the switch board whichever is less.
- 26.5.0 **Passing through floors:** All cables taken through floor shall be enclosed in heavy gauge steel conduit extending 1.5m above the floor or upto the switch board whenever is less and flush conduits or pipes shall be neatly bushed with porcelain wood or other approved material. The conduit pipes shall be security earthed.
- 26.6.0 **Passing through walls:** When conductors pass through walls, anyone of the following methods shall be employed. Care should be taken to see that Wires pass very freely through protective pipe or box and that wires pass through in a straight line without any twist or cross in wires on their ends of such holders.
- (a) A box of teak wood or approved hard wood extended through the hole thickness of the wall shall be buried In the wall and casings or conductors and casing or conductors shall be carried so as to allow 1.3 cm air space on the three sides of the casing of the conductor.
- (b) The conductors shall be carried in. an approved heavy huge solid drawn or lap weld conduit or in porcelain of such a size that it permits easy drawing in, the end of conduit shall be neatly bushed with porcelain, wood or other approved material.
- 26.6.1 Where a wall tube passed outside a building so as to be exposed to weather, the outer end shall be mounted natured downwards and property bushed or the open end, The conduit shall be neatly arranged so that the cables enter them without bending.
- 26.7.0 **Buried cables:** Tile HIS PVC sheathed cable shall not normally be burring directly in plaster. Where so specified in the special in the specification they may be taken in task wood channeling of ample capacity or conduit pipe boned In She wall.
- 26.8.0 **Stripping of outer covering:** While citing and stripping of the outer covering of the, care shall be taken that the sharp edge of the cutting instrument does not tough the inner insulation of the conductors. The protective outer covering of the cables shall be stripped off near connecting terminals as far as practicable. Care shall be taken to avoid hammering on link clips with any metal instrument after the cables are laid. Where junction boxes are provided, they shall be made moisture proof with a plastic compound.
- 27.0 **PAINTING WORK IN GENERAL:**
- 27.1 **Paints:** paints, oils varnishes etc. of approved make in original to the satisfaction of the Engineer -in charge shall only be used.
- 27.2 **Preparation of surface:** The surface shell be thoroughly cleaned and dusted before painting is started. The proposed surface shall be inspected by Engineer-in-charge or his authorized agent and shall have received the approval before painting is commenced.
- 27.3 **Application:** Paint shall be applied with brush. The paint shall be spread as smooth & event as possible particular care shall be paid to rivets, ruts belts and cover lapping Before drawing cut, it shall be continuously stared, in the sarolier containers with a smooth stick while it is being applied. Each coat shall be allowed to dry out sufficiently before a subsequent coat is applied
- 27.4 **Scope:** painting on old surface in in/door Situations will not include prier. coat except where specially motioned in the schedule of work or special specification. However, where rust has formed on iron and steel surfaces the spots win be painted with one anti-mil primer coat.
- 27.5 **Precautions:** All furniture fixtures, glazing floors, etc. shall be protected by covering, All stains smears, opashirig, dropping of every kind shall be removed. While painting of wiring etc. it shall be ensured that

painting of wall ceiling etc. is not spoiled in any way.

- 27.6 **Painting of conduit and accessories:** After installation surface of conduit pipes, fittings switch and regulator boxes, etc. shall be painted with two coats of approved enamel paint or aluminum paint as required to match the finish of surrounding wall, trussed, etc.

28. **Link clip:**

The clip for batten wiring shall be of Aluminum conforming to I.S. specification No. 2415-1975.

## **APPENDIX - 'A'**

Important Clauses of Indian Electricity Rules, 1956. Following clauses of Indian Electricity Rule, 1956 shall in particular be taken care of in the execution of electrical works.

Clause No. Subject to Authorization:

1. Construction, installation, protection, operation and maintenance of electric supply lines and apparatuses.
2. Cut-out on consumer's premises.
3. Identification of earthed and earthed neutral conductors and position of switches and cutouts therein.
4. Earthed terminal on consumer's premises.
5. Handling of electric supply lines and apparatus.
6. Distinction of circuits of different voltages.
7. Accidental charge.
8. Provisions applicable to protective, equipment.
9. Instruction for restoration of persons suffering form electric shock.
10. Precautions to be adopted by consumers, owners electrical contractors. Electrical workmen and suppliers.
11. Periodical inspection and testing of consumer's installation.
12. Precautions against leakage before connection
13. Supply to consumers.
14. Provisions applicable to medium high voltage installations.
15. Point of commencement of supply.
16. Precautions against failure of supply; Notice of failures.
17. Connection with earth, (low and Medium Voltage system.)
18. Use of energy at high and extra-high voltage system.
19. Connection with earth. (high & Extra-high voltage systage)
20. General conditions as to transformation and control of energy.  
All clauses under Chapter VIII on Overhead Lines.
21. Mode of entry.
22. Penalty for breaking seal.
23. Penalty for breach of rule 45.
24. Penalty for breach of rule 82.
25. Penalty for breach of rules

## APPENDIX - 'B'

### Form of Completion Certificate

I/We certify that the installation detailed below has been installed by me/us and tested and that to the best of my/our knowledge and belief, it complies with Indian Electricity Rules. 1956, as well as the C.P.W.D. General Specification for Electrician Works, 1972.  
Electrical Installation at Voltage and system of supply

(1) Particulars of works:

(a) Internal Electrical installation No. Total Load                      Type of system or wiring

(i) Light point

(ii) Fan point

(iii) Plug point

(a) 3 pin 5 Amp.

(b) 3 pin 15 Amp.

(b) others:

Description	HP/KW	Type of starting
(a) Motors: (i)		
(ii)		
(iii)		

(c) Other plants:

(d) If the work involves installation of over head line/or under ground cable:

(a) (i) Type & Description of overhead line.  
(ii) Total length & No. of spans,  
(iii) No. of street light & its description

(b) (i) Total length of underground cable & its size  
(ii) No. of joint.

End joint:  
Toe Join  
St. through joint:

2) Earthing:

(i) Description of earthing electrode  
(ii) No. of earth electrodes:  
(iii) Size of main earth lead:

3) Test Results:

(a) Insulation Resistance:  
(i) Insulation resistance of the whole system                      Megohms.  
of conductors to earth.  
(ii) Insulation resistance between the                      Megohms.  
Phase conductors and neutral.

Between phase R and neutral	Megohms
Between phase Y and neutral	Megohms
Between phase B and neutral	Megohms

(iii) Insulation resistance between the phase conductors in case of polyphase supply.  
Between phase R & phase Y                      Megohms  
Between phase Y & phase B                      Megohms  
Between phase B & phase R                      Megohms

(b) Polarity Test:  
Polarity of non linked single pole branches switches.

- (c) Earth continuity Test:  
maximum resistance between any point in the earth continuity conductor including metal conduits & main earthing lead.
- (d) Earth Electrode Resistance.  
Resistance of each electrode.
  - (i) Ohms
  - (ii) ohms
  - (iii) ohms
  - (iv) ohms
- (e) Lighting protective System:

Resistance of the whole of lighting protective system to earth before any bonding is effected with electrode and metal in/on the structure.

## SPECIFICATIONS

All Specification standard publication etc. specified mean the latest standards, publication etc. pertaining to electrical and should conform to the following wherever applicable.

- 1) The Electricity Act. 2003 with its amendments.
- 2) Indian Electricity Rules 1956 and its amendments.
- 3) Indian Electricity supply Act 1948.
- 4) The Factory Act, 1948 and its amendments.
- 5) Central Electricity Authority (Measures Relating to Safety and Electric Supply) Regulations, 2023
- 6) IS 732: 2019 Code of Practice for Electrical Wiring Installation (Fourth Revision)
- 7) IS/IEC 60947: Part 1 to 6- Low Voltage Switchgear and Control gears
- 8) IS 3043: 2018- Code of Practice for Earthing (Second Revision)
- 9) IS 1554: 1988 (Reaffirmed Year: 2020) PVC insulated (heavy duty) electric cables: Part 1 For working voltages up to and including 1100 V
- 10) IS 694: 2010 (Reaffirmed Year: 2020) Polyvinyl Chloride Insulated Unsheathed and Sheathed Cables/cords With Rigid and Flexible Conductor for Rated Voltages Up to And Including 1100 V
- 11) IS 5908: 1970 - Method of measurement of electrical installations in buildings
- 12) IS 9537 Part 1 to 8 Conduits for electrical installations
- 13) IS 1248: Part 1 to 9: 2021 Direct acting indicating analogue electrical measuring instruments and their accessories
- 14) IS 418: 2004 (Reaffirmed Year 2019) Tungsten Filament Lamp for Domestic and Similar General Lighting Purposes
- 15) IS 16103: Part 1 & 2: 2012 (Reaffirmed Year 2017) LED Modules for General Lighting Part 1 Safety Requirements & Part 2 Performance requirements
- 16) IS 374: 2019 Electric Ceiling Type Fans — Specification (Fourth Revision)
- 17) IS 14768: Part 1: 2000 Conduit Fittings for Electrical Installations Part 1: General Requirements
- 18) IS 3419: 1988 (Reaffirmed Year 2017) Fittings for Rigid Non-metallic Conduits
- 19) National Building Code of India, 2016
- 20) National Electrical code of India, 2023

## ANNEXURE-I

Abstract of the Wiring Rules of the Institution of Electrical Engineer  
(Referred to in the specification)  
Division (See clause 2 of the specification)

### Systems:

All electrical system in which all the conductor and apparatus are connected to a common source of supply.

- 1) Earthed: Effectually connected, to the general mass of the earth. Solidly earthed without the Intervention of a fuse, switch, circuit - breaker, resistor reactor or solenoid.
- 2) Un-insulated Conductor: A conductor without provision, by the Interposition of a dielectric or otherwise, for its insulation from earth.
- 3) Bare: Not covered with insulating material.
- 4) Dielectric: any material which offers high resistance to the passage of an electric current.
- 5) Bunch Conductor: When more than one conductor is contained within a single duct or groove or when they are run enclosed and spaced and not spaced apart from each other;
- 6) Points: In wiring as per IS: 5908 -1970 - Method of measurements of electrical installation in buildings.
- 7) Switch board: Assemblage of switchgear with or without instruments, but the term does not apply to a group of local switches in a final sub- circuit where each switch has its own insulating base.

Note : In the electricity (Factories Act) special regulations, 1908. and 1944 the term "Switchboard" includes "Distribution board."

- 8) Single pole switch: A switch suitable for closing and or opening a circuit on one phase or pole only.
- 9) Linked switches: A switch the blades of which are so linked mechanically as to make break all poles simultaneously or in a definite sequence.
- 10) Fuse Switch: A switch the moving part of which carries one or more fuses.
- 11) Three Wire System :
  - a) Outer Conductor: Those between which there is the greatest difference of potential. This use of the word outer must not be confused with the use of the word when applied to the external conductor of a concentric main.
  - b) Neutral Conductors: The term includes the neutral conductor of a 3 phase 4 wire system, the conductor of a single phase or d. c. installation which is earthed by the supply undertaking (or otherwise at the source of the supply) and the middle wire or common return conductor of a 3 wire d.c. or single phase a.c. system.
- 12) Semi enclosed machine: One in which the ventilating openings in the frame are covered with -
  - a) Girds expanded metal or wire gauze, with openings of less than 1/4 Inch but not less than so as to obstruct free ventilation
  - b) Wire gauge, in which the openings are less than 1/4 inch but not less than 3/32 inch (diameter or width):
  - c) Screens with smaller openings than the above.
- 13) **Totally - enclosed Machine:**

One in which the enclosing case and bearings are dust proof and which does not allow circulation of air between the inside and outside of the case.
- 14) **Pipe Ventilated Machine:** An enclosed machine in which, the frame is so arranged that the ventilating air may be conveyed to it through a pipe attached to the frame the ventilation opening maintained by the fanning action produced by the machine itself.

- 15) **Forced draught machine:** An enclosed machine in which the ventilating air supply is maintained by an independent fan external to the machine itself.
- 16) **Protected Machine:** One having end shall bearings and in which is free access to the interior without opening doors or removing covers.

## **SWICHES AND BREAKERS CIRCUIT**

(See clause II of Specifications)

- 17) **Switches and Circuits Breakers:**

Switches and circuit breakers (rules 2b. 36 and 37) whether fixed separately or combined with lamps, holders of fittings, must comply with the following requirements:

  - (a) Over threading must not take place at the point of contact or elsewhere, when the full current flows continuously.
  - (b) They must be so constructed or arranged that the contacts cannot accidentally close when left open.
  - (c) The basis must be of incombustible, nonconductor and moisture proof material.
  - (d) Circuit breaker as must be so arranged and placed that no combustible material is endangered by their action.
  - (e) Unless placed in an engine room or in a compartment arranged for the purpose, they must have their live parts covered. The covers must be of incombustible material and, must be either non-conducting or of rigid metal and clear of all internal machinery. For more than 6 amperes, at pressures exceeding 125 volts metal covers must be lined with insulating material.
  - (f) In positions where they are liable to injure or come into contact with goods, they must be further protected by an open fronted box or other suitable guard.
  - (g) Handles must be insulated so arranged that the hand cannot touch live metal, or be injured through and adjacent face blowing.
  - (h) Switches having a handle projecting through an opening in the cover, must not be used.

## GENERAL REQUIREMENTS

### 1.1 **Scope of works:**

The work covered by electrical specification consists supplying and installing, electrical wiring system complete in strict accordance with this specification and the applicable drawing and subject to the terms and conditions of the contract./It includes.

- (a) Conduit and wiring system for fans, lighting points bells, clocks sockets, etc. including fixing of lighting fixtures and fans etc. and miscellaneous points.
- (b) Conduit and wiring system for exhaust fans, power sockets etc.
- (c) Panel boards, distribution boards, switch fuse units.
- (d) Complete power and lighting cable systems.
- (e) Grounding system.
- (f) Conduits system.
- (g) Street lighting system.
- (h) Other miscellaneous electrical work.

### 1.2 **Completeness of Contract:**

Any work fittings accessories or apparatus which may not have been specifically mentioned in the specification but which are necessary in the equipment for efficient working of the plant should be deemed to be included in the contract and should be executed and provided by the contractors. All plant and apparatus should be complete in all the details, where such details, are mentioned in the specifications or not.

Three prints and one permanent negative of each of the finally approved drawings incorporating all the modifications proposed by the Department should be submitted. No modifications should be made in a drawing already approved by the Engineer-in-charge without his prior consent. Approval of the contractor's drawing will not relieve the contractor of any part of his obligation to meet all the requirements of the contract.

### 1.3 **Guarantee:**

The performance of all the equipment and the installation should be guaranteed as per tender conditions. All equipment must comply with the relevancy IS-BS specifications.

### 1.4 **Interchangeability:**

All corresponding parts of similar plant and equipment should be interchangeable in every way.

### 1.5 **Tools:**

All special tools required for dismantling and assembly of the equipment covered by the contract shall be supplied as obligation under the contract.

A list of to be supplied by the Contractor should be submitted along with the tender.

## **Specifications for Electrical Installation in Buildings**

### **1. GENERAL:**

1.1 These specifications relate to the electrical installations in the buildings of P.W.D. Electrical. The specifications cover general requirements to be fulfilled. These general specifications are supplemented by the specifications for the particular buildings separately attached.

1.2 These specifications are governed by the General conditions of the contract attached hereto.

### **1.3 APPLICABLE RULES AND REGULATIONS:**

1.3.1 Installation shall be carried out conformity with regulations for electrical equipment of buildings, published by the Institute of Electrical Engineers London (14th Edition 1966 and as amended upto date) herein after referred to as the I E. E. wiring regulations Where these specifications, or the special specifications for the particular building attached hereto are at variance with the I.E.E> regulation shall also comply with the requirements of the Indian Electricity Act, 1910 as amended upto date rules issued there under and also the regulations for the Electrical Association of India Where not specified otherwise, the installation should generally follow the Indian standard codes of practice and in their absence the relevant British Standard of practices. All the materials shall comply with the relevant Indian Standard of British Standard specifications

### **1.4 DEFINITIONS:**

1.4.1. The definitions of terms in the I.E.E. Regulations shall apply in general.

### **1.5 DRAWINGS:**

1.5.1. The preliminary drawings only indicate the general scheme of requirement. The exact position of all points, control switch boxes, runs of wiring and/or conduits joint boxes, inspection boxes, and sub-distribution boards, mains etc shall be got approved Engineer-in-charge. All circuits shall be clearly numbered in wiring diagrams and building plans. The detailed design of a switch-board, special fixture or any other part of the electric installation as may be called for by the engineer-in-charge shall also be supplied by the Contractor and should be got approved by the Engineer-in-charge. Three sets of completion drawings and wiring diagrams showing the instillations as executed shall be supplied by the contractor along with the completion certificate.

### **1.6 MATERIALS:**

All materials shall be new and of the best quality conforming to the relevant I.S.B.S. specifications. They must be the products of reliable manufacturers of many years or standings, All like parts of materials shall be interchangeable. In case of equipments such as circuit breakers; switch fuses etc. a descriptive and illustrated literature shall accompany the tender. The names of manufacturers' of various materials shall be furnished in proform in Appendix-1. Samples of materials wherever required should be deposited with the Engineer-in-charge. All materials shall be rust-proof or rendered rust proof by application of suitable paints. The supply of all equipment, switchgears etc. shall be complete with accessories. filings and mountings as may be required for their proper performance, and as specified in the relevant IS-BS Code of Practice and standards.

### **1.7 WORKMANSHIP:**

17.1. Good workmanship and neat finished appearance are the prerequisites for complying with the clauses. of these specifications. With a view to ensure fine workmanship the Tenderer shall employ licensed wiremen with an experience of not less than 5 years in the type of work they are engaged. The work should be done under supervisions of licensed Electrical Supervisors with good educational qualifications and

- considerable experience.
- 1.7.2 Tenderer shall furnish the names of Supervisor and their wiremen. who will be engaged in this work, with details of their experience.
- 1.8 **CO-OPERATIVE WITH CIVIL AND OTHER WORKS CONTRACTORS:**
- 1.8.1 The Tenderer after the award of the contract, shall co-operate with the civil and other contractors and shall coordinate his work of the other contractors with the least amount of dislocation and interference to the other works. Tenderer shall go through the drawings carefully and shall furnish the Engineer-in-charge with all the details of openings in the walls etc. they may be required for concealing any of the electrical equipment or accessories. Where the contractor fails to furnish such information as may be required for the purpose of concealing the equipment etc. they shall be made at his (Contractor) cost and expense. Any alteration to parts of the building shall be made good at the contractors expense and brought to the original shape finish and color.
- 1.9 **TESTING**
- The electrical contractor shall be completely responsible of the testing and commissioning of those installations covered by these specifications in compliance with the standard procedure, in obtaining permission of the Government Electrical Inspector. Any modification which is demanded by Government Electrical Inspector shall have to be carried out within the scope of the contract. The contractor shall submit four copies of drawings of installations as per regulations for shall be provided by the contractor for carrying out the installation work. All test shall be carried out in the presence of the Engineer-in-charge or his authorized representative and his approval obtained for the test results.
- 1.10 **TENDERER'S ABILITY**
- 1.11 In order to enable the Department to assess the ability of the Tenderer to execute the work, the Tenderer shall furnish evidence of his experience and capacity to carry out magnitude and nature.
- 1.12 **RATES:**
- 1.12.1. The rates of items shall include all traces, transport, loading and unloading charge and all such charges that may the market are not entertained Break up figure as required in the schedule of work shall also be furnished. As far as possible indigenous materials only shall be included for supply. Where It is unavoidable, imported items may be included and Tenderer should clearly indicate materials, quantity, rate and amount of these items.
- 1.13 **STORAGE SPACE:**
- ~~No covered storage space will be provided by the Department. The contractor has to make his own arrangement. However, the Department may give an open space near the place of execution where the contractor can build his own stores for executing the work.~~
- 1.14 **DEPARTURE FROM SPECIFICATIONS:**
- ~~The Tenderer should clearly indicate departure, if any from the specifications with reasons for the same.~~
- 1.15 EXTRA ITEMS: As per main tender Clause.
2. **TECHNICAL SPECIFICATION:**
- 2.1 **Supply System:**
- The wiring installation shall be suitable for 3 phase 4 wire, 415-440V 50Hz system of supply Color code of different phase shall be followed as per standard.
- 2.2 **Wiring for Light and Fans:**
- 2.2.2 Looping system to wiring shall be adopted. No joints shall be made at intermediate runs of cables and where they are unavoidable. such joints shall be through approved mechanical connections.
- 2.2.2 **Point wiring:**

Point wiring shall consist to the branch wiring from the board together with the controlling switch or push as far as and including the ceiling rose or any other approved connector or socket, outlets. In case of more than one light being controlled by one switch, the wiring up to the ceiling rose of the first light including the switch shall be considered as a Primary point. Loop wiring from light shall be considered as a 'Secondary' point and rates shall be quoted separately, including final connections to fixtures and plugs.

**2.2.3 Conductors:**

No conductor for final sub circuit wiring for light and socket outlets shall cross-section less than that of 2.5 sq.mm (copper)

**2.2.4 Loading:**

No final sub-circuit radiating from the fuse board of a sub-distribution board and wires with 25 sq. m. (Copper) cable shall carry more than 10 lights, fans or socket outlets or a connected load of 800 watts whichever is greater. The following wattages may be assumed for estimating the load on each sub-circuit unless otherwise known or specified.

Incandescent lamps	100 watts
Ceiling fans	60 watts
5-A Socket Outlets (lighting)	100 watts
4. ft. fluorescent tube	50 watts
5. ft. fluorescent. tubes	100 watts

In each sub-distribution board at least-one way preferably two ways shall be left spare for future requirement. A wiring diagram giving the exact Utilization of the ways shall be prepared and fixed in the sub-distribution board itself or any other easily accessible place. The ways of sub distribution boards shall be accordingly numbered.

**2.2.5 Local Control Switches (General):**

Local control switches for circuit carrying net less than 5-5 shall be piano type and shall conform to relevant IS Standards. The switch shall be 'ON' when the knob is in the down position. All local control switches shall be connected in the phase or live conductor only and in the natural conductor, switches shall be fixed in iron clad box and shall be so placed that the centre of the switch box is 1.3m from the finished floor level unless otherwise stated. All switch boxes shall be provided with 1 /8" thick Perspex cover fixed to the switch box with chromium plated counter sunk screws (brass).

**2.25A Switches (Two Way):**

- (a) Two way switches shall be piano type single pole, double throw, 250V, suitable for flush mounting and of 5A capacity as per the drawings. All switches shall be recessed in an embedded metal box.
- (b) Each box shall have suitable outlet for fixing conduits directly.
- (c) Each box shall have Perspex cover painted inside with the wall color, if required.
- (d) Each switch shall have suitable for the position in a stairway wiring. 2.2.5.B Switch Boxes (General)  
Electrical circuits shall be written suitable on the cover of all switched boxes, as approved by the Engineer-in charge (elect) whenever different phase are terminated in a switch box Bakelite partition shall be provided. Each cash shall be provided with a G.I. Earth stud nut and washers for earth connectors.

**2.2.6 Ceiling Rose:**

Ceiling rose shall be used on circuits having a normally exceeding 200V. Only one flexible cord shall be attached to a ceiling rose. Only 3-pin 5A socket outlet shall be provided in lighting circuits. All socket outlets be provided with a control switch and they shall be mounted in switch boxes in an approved manner.

**2.2.7 Fittings:**

These shall be of approved type as specified in the tender schedule. The subscripts leads should terminate in a ceiling rose or conductor in the fitting and internal connection made there from. Wherever these fitting are suspended they shall be done so through the conduits and ball and socket joint. All fittings shall be grounded by a G.I. conductor not less than 16 S.W.G.

**2.2.8 Flexible wiring:**

Flexible cords of not less than 23/0076 size be shall be used, The weight of suspension road shall be governed by I.E.F. Regulations.

**2.2.9. Ceiling Fans:**

All ceiling fans shall be wired to ceiling rose and suspended from a hook shackle or clamp and insulated from the same. All joints in the suspension, road shall be screwed and means of split pins. The fan clamps supplied by the Contractor shall be suitable for the ceiling or proof member as the case may be For concrete roofs, fan hooks shall be buried in concrete during concrete during construction in an approved manner and secure bound to the reinforcement.

**2.2.10 Conduits and Earthing:**

All conduits feeding lighting and circuits shall be provided with earth continuity G.I. conductor as specified for power wiring. All conduits shall be as specified for power wiring.

**2.3.1 Point wiring:**

Point wiring power shall be as defined under section 2.2.2 and shall include the switches and sockets.

**2.3.2. Loading:**

All distribution board for power wiring shall be not less than 15 A per way. Loading per way shall not exceed normally 100 watts. The following loads may be assumed if exact figure are not known.

3-Pin 15A      Outlets 1.000    Watts

3-Pin 5A        Outlets 100      Watts

**2.3.3 Wiring for Motors:**

2.3.3.1 Final sub-circuits loop in motors shall be connected to separate ways of the Distribution board even if the current in the sub-circuit is less then 15A. No looping is permissible.

2.3.3.2 All wiring shall be carried in H.G. conduit as specified in I.S. specification for gauge for different sizes of conduit. When the motor is resiliently mounted fixable with approved adopters shall be used for the last few feet. Where cables are used sufficient loop shall be left.

2.3.3.3 All switch fuse units controlling circuits feeding motor shall be provided with H.R.C. fuses or as specified:

2.3.3.4 The frame of every motor and its association contra gear shall be earthed by two separate and distinct connections to earth connector shall be capable of earing 3 times the rating of fuse or 1.1/2 time the setting or the circuit breakers but in no case than NO.8 S.W.G. or 7064" or equivalent cross section of copper. Where practicable, the earth connections shall be visible for periodical inspection. Gas or water pipes shall not be used for earth connections.

**2.3.3.5 Socket Outlets and Control Switches 5 A and 15A:**

All socket outlets shall be of 3 pin type, the third pin being connected to the earth stud of nearest distribution board by separate earthing wire: The socket shall conform to I.S.: 1293/1938,'single pole, piano type. Each socket plug shall be provided with a control switch of appropriate rating and as specified. The switch and socket shall be mounted inside the iron clad box provided with 1/8" Perspex cover as directed by the Engineer-in-charge or as specified in schedule of quantities. Inside switch box ample space shall be available around switches for connection wires to switches. All socket outlets for power shall be mounted at the skirting level otherwise specified or as directed by the Engineer-in-charge.

The three phase plug receptacles shall have their earth terminals connected by independent earth wires

to ring main strip on the building. In buildings where explosion proof fixtures are installed single phase plug receptacles as well as light points shall be connected to ring main ground bus installed in the building by separate earth wires of approved size.

Socket outlet shall have some provision not to receive the matching plug unless the grounding pin is in correct position. The grounding pin of the plug shall make the contact first and break the contact last at the time of inserting or removing the plug respectively.

The grounding terminal shall be connected to the enclosed metal body providing G.I.Stud, nut washers welded to the box.

Each unit shall be suitable for flush mounting as required and indicated in the applicable drawings.

Combination unit socket outlet and switch shall be complete with necessary internal wiring. The switch/socket shall be mounted on M.S. bracket enclosed in a box.

#### **2.4 Conduit Wiring:**

2.4.1 Where conduit wiring is adopted type and size of the conduit shall be as indicated in the drawing. The minimum of the conduit shall be 19 mm.

2.4.2 The contractor shall thoroughly study the structural of the buildings and wherever, necessary shall in consultation with Department's representatives at site, make suitable adjustments in the cable routings, earthing arrangements, and location boxes, fitting etc. with a view to avoid interference with any part of the building, structure, equipment or any other work in the building or to affect any improvement in the arrangement.

2.4.3 Protection of conduit against rust:

Conduit shall be given two coats of oxide paint before they are placed in position. All exposed conduit shall be painted after installation with the color as approved by the Engineer-in-charge. This does not apply to galvanized conduit.

2.4.3.A Protection against insects' and damp:

In Order to minimize condensation or sweating inside the conduit, system shall be properly drained and ventilated in such a manner as to prevent the entry of insects.

2.4.4. Conduit shall first be installed as a complete system without cables and shall be continuous from outlet to outlet from fitting to fitting and mechanically and electrically connected to all boxes and fittings.

#### **2.5. SPECIFICATION FOR POWER CONTROL AND TELEPHONE CABLES:**

##### **I. SCOPE:**

- i. The specifications cover the supply and medium voltage Power and control cables either in ground or trench depending on the conditions at site including accessories for the same. The work in general, consists of supplying, laying jointing terminating and connecting at. 1.1. KV APLSTS PVC power and control cables.
- ii. The contractor shall supply all accessories including jointing and terminating materials, compound, tapes supporting materials, cleats cable lugs, concrete base, bricks sand, cable-markers etc. as required to make the installation work including digging and filling of the trenches as required.

##### **II. SPECIFICATION:**

- i. All power cables to be supplied mentioned as 'APLSTS' in the Schedule should be mass impregnated, non draining, paper insulated lead sheathed, double steel tape armored and must comply with the latest IS1BS specifications.
- ii. All cabling materials such as cable compound, cable lugs, tapes shall be of approved quality acceptable to the type recommended by the manufacture of the cable for which it is used and approved by the Department.

- iii. Installation of all equipment shall also conform to the applicable. Codes and practice as per the IS and shall be executed to comply with the latest Indian Electrical rules as regards the safety, payability of equipment and other essential provisions specified therein.
- iv. Only approved make of cable shall be used. ICC and CCI will be preferred,
- v. The cables shall generally be laid as per is Code of practice.

### **III. GENERAL RULES CABLE LAYING:**

- i. Installation shall be carried out in a neat workmen like manner by skilled experienced and competent workmen in accordance with the standard practices.
- ii. Cables shall be laid preferably in one length to avoid joints. If straight joints are found-necessary, these can be introduced with prior approval of the Engineer-in-charge. The cost of the straight joint however, shall not be borne by the Department. But in no case joint shall be within the conduit G.I. pipe and duct.
- iii. Proper care should be exercised in handling the cable to avoid formation of kink etc. and should it become necessary a cable be bent to a radius not less than 20 times the overall diameter of the cable.
- iv. Method of installation, routing of cable etc. shall in every case be subject to the Department's approval and the contractors shall modify and or certificate no extra cost to the Department's any portions of the installation which do not meet with the Department's approval. All damages to the civil and other works on this account shall be made good by the contractor at no extra cost to the Department.  
The electrical contractor while notifying the building contractor for such work shall furnish the proper draws, duly explaining the work involved of indicate at suit actual work to be carried out as may be required by the building contractor. The electrical of any such work as the electrical work with this to the same has been completed.
- v. Where cables pass through hume pipes, contractor shall fix hard wood bushed round the cables at the ends of hume pipes. Where the cables pass through the floors or chambers and in such situation's the Engineer shall require, the contractor shall seal cable holes in a manner approved by Engineer-in-charge. Where cable. pass through roads mullahs. etc. cables must be protected by class 'A' Hume pipe of diameters not less than 6. (15cms).
- vi. The cable route shall be the shortest and these shall be minimum interference with built up areas, lawns etc.
- vii. Care shall be exercised for providing suitable props other service lines on earth at the time of excavation. Where cutting of a lawn inevitable it should be with the approval of the Engineers-in-charge.
- viii. Excavation of the trenches shall be executed with vertical sides and the trenches shall be kept as straight as possible. The exact location of each trench shall be settled by the Engineer-in-charge. On the site when the contract is in a position to commence each portion of the work.  
The trench shall be not less than 1/2 meter wide and 90 cms deep. If more, cables are to be laid, the width should be suitably increased.
- ix. After the cables are laid, the trench shall be filled in layers, each layer being well rammed by spraying. water and consolidated and sufficient allowance made for settlement. The extra earth over the trench should be removed from the place of trench to a place as decided by the Engineer-in-charge at site.
- x. Ends of cables shall be properly sealed to prevent entry of moisture prior to installation.
- xi. Where it is as specified as 1/2 core cables the 1/2 core shall be a natural conductor having reduced section.
- xii. For all multi core cables each core and tails shall be brought out, marked and or colored in an approved manner.
- xiii. Cables termination shall be done with suitable compression brass glands in the case of PVC cables and cast-iron trifurcating boxes in the case of APLSTS cables. The Armor should be connected to the right

main earth building with duplicate earth wires as per the relevant IS/BS specification.

The core insulation over each conductor shall however be retained throughout the run of the conductor up to the end where lugs shall be fitted thereon for connections. The lugs shall be fitted by means of approved solder and the such as aleap and Eyer NO.7 liberally used. The joint shall be mechanically strong and pressure tested.

## **2.6 DISTRIBUTION BOARDS AND PANELS:**

### **General Requirements :**

- 2.6.2 All distribution panels shall comply with IEE. Rules 60-61. A clear distance of 0.91 meter in front of the switch board shall be kept. Where bare connections of attachment are provided at the back of the switch board the space behind the panel shall begetter less than 0.299 meter or more than 0.762 main width there shall be a passage way from the further outstanding part of any attachment or conductor. If the space behind the switch board exceeds 0.70 main width there shall be a passage way from either end of the switch board clear to night of 1.928m width 0.299 m. All wiring connection shall be made neatly and securely.
- 2.6.3 For crocoites carrying more than 10 Amps, tinned cable sockets shall be used, all connections shall be so made as to form own diagram Circuit shall be clearly numbered to correspond-to wiring diagram. Names of the distribution boards shall be painted as directed by the Engineer-in-charge. All the which fuse units and isolators D.Bs. shall be complete with earthing studs lugs neutral bar ink. H.R.C. fuses and of approved make.
- 2.6.4 Skeleton type panels shall have a rigid frame work adequately braced and supporting frames adequately braced over which sheet metal shall be nearly secured. All switches distribution boards etc. shall be neatly arranged on the panels and all connections made from the back of switches. The panels shall be rendered dust and vermin-proof. The interior of the panels shall not be accessible to unauthorized persons.
- 2.6.5 The recess type boards shall be embedding wall in –a cupboard with a metal hinged door with locking arrangement. In all recessed conduit work all distribution boards shall be recessed. Where recessing is not possible, free-standing panel may be provided as approved by the Engineer-in-charge.
- 2.6.6 All individual components the switch fuse units D.Bs. etc. shall be connected by earth connected by earth continuity wire of appropriate size with the main earth bus of the D.B.etc. The panel switches of D.Bs. shall be earthed by the less than 2 distinctive paths to earth. Earthing of metallic parts of exposed metal shall not be affected through any structural metal work which houses the installation. Where metallic parts are not required to be earthed and are liable to become alive should the installation of the contractor become defective such metallic parts shall be separated by durable non conducting material from any structural work.
  - (a) Power panels shall be 3 phase, 4 wire, 415-230 volts for the distribution of 3 phase or single phase power loads. Lighting panels shall be 3 phase 4 wire 415/230 volts for single phase lighting load distribution on all 3 phase.
  - (b) All panels shall be done of protected front type with no mechanical or electrical defects.
  - (c) Bus bars shall be of electrolytic copper or aluminum as specified and the properly tinned sizes as indicated on applicable drawings as required.
  - (d) All knock outs for branch circuits entries shall be drilled and filled as required, for lighting panels the top and bottom cover plates shall be. removable type.
  - (e) Main disconnect device for all panel boards shall be of switches of disconnect type and of the size

as indicated shall be mounted directly below the panel or through a short thread conduit of required size.

- (f) The main disconnect for all panel boards shall have an entry suitable for PVC Armored cable from bottom.
- (g) All panel boards shall be provided with an earthing terminal and lug for connection to the grounding system.
- (h) Temperature rise of all electrical parts shall not be more than 300°C With full load amperes at room temperature.
- (i) All bars and supports of current carrying parts shall be of moisture resistant insulating material and shall not be adversely affected by arcing.
- (k) The locations of panels shown in the drawings are only tentative; panels may be located at a place approved by the Engineer-in-charge.
- (l) All civil works connected, with fixing such as grouting chasing and making good shall be the Tenderer responsibility.
- (m) Wires adequate capacity with proper size of lugs shall be used for inter connections.
- (n) Panel should be self-supported on angle channel iron frame work. It should be preferably of bolted construction in case bolted or grouted rigidly after leveling and alignment.
- (o) The cupboard and D. B. should be of such size so to be accommodated in the existing room as per I.E.E. rules and I.S. codes of practice for installations of Medium voltage switchgear.
- (p) Fabrication drawing showing the detailed dimensions and panels and its components indicating the frame work, earthing positioning of switches, 6 Bs. cable boxes, adopter chambers etc. shall be furnished to the Engineer-in-charge for his approval. All material to be got approved by the Engineer-in-charge.
- (q) The panel should be painted with anticorrosive paint suitable for humid and salty atmosphere on two coats to primer.

Switch Gears, power panels D. B. And S.F. Us. phase busbar, the Sizes of the bus bars shall be so selected that the current density in bar does not exceed 150 amps, per sq. m. for copper. The length of Bus-bar chamber should be as suitable length to fix all the switches etc. as per the prevailing standards, clear spacing of two adjacent buses shall be 1 1/2" minimum bar should be treated all along with color coated 11 KV grade PVC tape The maximum internal of support for each unsupported length shall exceed 600 mm.

The bus bar shall be of copper/aluminium and fabricated to the relevant standards specification. In case aluminium bus bar is used special with high conductivity aluminium bus bar alloy E 91 C frame conforming to E.S.S. 2898 shall be used. The current density shall not exceed 800A per sq. inch. Hylam barriers will be provided over the joints to prevent any short circuit.

The bus enclosing shall be made out not less than 16 gauge M. S. sheet construct on with angle iron support. All interconnections between bus bars S. F Us and O. Bs shall be of adequate size and details of such inter connection shall be furnished to the Engineer-in - charge for his approval.

The busbar shall be air insulated extensible type rectangular one. The bus bars chamber shall be dust tight by providing gaskets secured properly so as to render it vermin proof.

The combination fuse switch unit should comply with IS 4064 BSS61 and BBS 2510 wherever applicable. It should be suitable to accommodate High Rupturing capacity cartridge Fuse links complying with IS 2208 or BS 88 and having a certified rupturing capacity of not less than 35 MVA at 4440 volts (ACS duly Q The switch gear (panels, DBs, etc. shall be installed generally as per IS-Part -1 3072 and as specified and

shown in drawings.

All fuse switch units shall be provided with, non-deteriorating HRC fuse links complying with IS 2208-1962 and having rupturing capacity of 35 MVA at 415 volts or as specified.

All switches above 60 amps, rating shall be provided with suitable size adapted boxes. All switches mounted-on the top of the busbars shall be provided with detachable type reverse entry adapter boxes. Suitably engraved tables shall be provided for each circuits as well as for the board.

A meter's sector switches and LMH meter shall be provided where. Specifically mentioned. Small wiring for the inter-connecting shall be color coded and provided with numbered fuses for easy identification of circuits.

- (a) The distribution boards should be totally enclosed metal clad complying with B. S. 214. the M. S. sheet steel enclosures for recessed D. Bs. shall be of not less than 14 gauge.
- (b) The DB shall be with hinged door and the locking arrangements as approved by the Engineer-in-charge.
- (c) All the components shall be enclosed in the enclosure. The mounting of DB shall be got approved by the Engineer-in-charge before carrying out the installation.
- (d) The DBs shall have proper side-cut outs for conduits entry or cable entry as required and these shall be made on site
- (e) Adequate spacing shall be provided inside the D Bs. for easy removal of the fuses and carry out the interconnection.
- (f) A set of insulating beamers have to be provided between incoming breakers switches and fuses.

**Switch fuse Units:**

- (a) All the D.P.T.P. and T. PN. Switch fuse units shall be totally enclosed iron a clad quick make, quick break type to best Indian make conforming to the I.S. or S. 3185 specifications. All the switch fuse units shall have mechanical Interlock with a door so that the door cannot be opened when the swatches are in ON position. The switch should be of double be i>\ solution type to ensure safely.
- (b) Each T.P & T.PN switch fuse unit shall be earthed with two distinct each connections.
- (c) Suitable insulator shall be provided between phase.
- (d) There shall be suitable natural link in the fuse box.
- (e) All T.P and T.PN: switch fuse units snail be rated for 500 volts and D.P, (required for single phase supply) and S.PN. switches for 250 volts.
- (f) The H.HC. catndge fuse shall conform to U.S. 88 (1952).

The O.C.Bs. ACS shall be suitable for 400/440 volts 3 phase escapable of interrupting a fault MVA of not less than 31. The circuit breaker shall conform to the BSS-936 1940. BSS 3659 with such tripping arrangement as may as required under special specification is for the building. Efficient and fool - proof mechanical interlocking shall be provided for the safe operation and maintenance. The rate be inclusive of the first filling of oil.

**2.7 Instrumentation:**

Tile instruments and meters wherever necessary shall be housed in special sheet steel box located between switch fuses units and bus bar chambers. The instruments etc. shall be mounted on the hinged cover with heir dial flushed. All instruments shall have protective H. R.C. fuse links. All interconnections and small wiring shall be neatly dressed arranged and duly coloured 10r easy identification of circuits.

Meters shall be provided as required in the Schedule, Meters shall be dead head and be suitable

for 400/ 440 volt 3 phase 4 wire 50 c/cie (in balanced load) supply.

Each section switch shall be 3 point and of minimum 250 volts grade with silver tipped contact suitable for metering circuits, current transformers shall be of 5VA burden and commercial metering accuracy. Indication lamps shall be panel mounting type preferably of 250V grade. Every unit shall be prewired and interconnected to the system for its required indicating performance. Indicating lamps shall have independent circuit fuse.

**2.8 FIXING OF LIGHTING FIXTURES:**

1. Location of fixtures their manner of fixing mounting height etc. are indicated in relevant drawing. Actual location and levels shall however be arrived at site in co-ordination with other service etc. and prior approval of the Engineer-in-charge regarding the actual location Manner of fixing shall be obtained before the work is taken up in hand.
2. In all cases the contractor shall provide necessary interconnection wiring earthing painting etc. all necessary for complete installation. The contractor shall also test and commission the fixtures during completion of the work.
3. General arrangement of fixtures layout is indicated in drawings. Care shall be taken to see that all light fixtures are in a row in a room or particular area, are in absolute line and plump and are symmetrically disposed with respect to finished surfaces of walls, columns beams etc.
4. The inter-connections wiring from the light outlet point upto the fixture shall be carried out by means of flexible copper wire of section not less than 1.5 mm<sup>2</sup>.
5. All fixtures suspended by means of conduits shall be done with all and socket joints or as per approved design.

**2.9 Telephone system:**

1. Empty conduits shall be done recessed or exposed to surface along with pull boxes, junction boxes and telephone outlet boxes, in areas and location as indicated in the relevant drawing as per materials and methods as described in regard to conduits under section "Wiring in conduits" except the G.I. pull wires of gauge not less than 20 SWG shall be kept pulled through conduits in all sections so that in future telephone wires can be pulled easily.
2. Location shown on the drawing are proximate and final location shall be decided in the field by the Engineer-in - charge.

## **SPECIFICATION FOR EARTHING**

1. Installation of Earthing Plates:

All installation of earthing shall conform to Indian Electricity Rules, IS - 3043 latest edition and I.E.E. the copper earth plates should be tinned before installation. the earth plates of copper 60 cm x 60 cm x 3.515 mm thick size as mentioned in the schedule be in separate pits at least 150 cm to 300 cm. away from the building at a depth necessary to reach moist earth surface but with a minimum depth of 2.5 Meter from the finished ground Level up to the top vertical dodge of earth electrode. The earth plate shall be thoroughly cleaned to remove all dirt from the surface and be tinned property for electrical contact with the main ground. Each earth pit should be provided with 38 mm diameter GI pipe 2.5 meter long or more depending up to the depth of pit, put over the vertical edge of earth plate (with top end of pipe provided with a closed to coupler.) Alternative layers of salt and coke shall be provided surrounding the plate. The pits shall be filled when the plates are in position and with the approval of Engineer-in-charge.

To facilitate watering the pit, a concrete compartment should be made-with funnel with mesh and cover plate as per rules provide in ISI regulation. The masonry shall be 25 cm x 25cm x 25 cm (deep) with CI lid of 23 cm x 30 cm x30 cm size. After installation, the earthing resistance of each earth plate should be measured by resistance megger in the presence of Engineer-in-charge, three days after the completion of earthing work, and the value should conform to regulations.