

**SPECIFICATIONS FOR ELECTRICAL WORKS IN  
GOVERNMENT  
BUILDING SUBJECT TO THE GENERAL CONDITIONS OF  
CONTRACT IN FORCE  
(1986)  
GENERAL**

1. **Wiring Rules :**  
The installation generally shall be carried out in conformity with relevant Indian Standard Specifications 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-59008-1970 shall be referred to.
3. **Voltage and Frequency of Supply :**  
All current consuming devices shall be suitable for frequency of 50 C/s and system of voltage meant 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 centres 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 circuits will be arranged before hand by the Executive Engineer Electrical Division.
  - (ii) Within one month of the taking over the installation, the Contractor shall supply to the Executive 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 Executive Engineer, Elect. Dn, and these wiring plans 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 of 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 cable except the flexible cable shall be of aluminium. The smallest aluminium conductors for the final circuit shall have nominal cross sectional area of not less than 1.5 Sq. mm. The minimum size of the aluminium 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.

Signature of Contractor

Signature of Chief Officer

- 6.3.2 Unless the flexible cables and conductors are protected by armour or though rubber or PVC Sheath, these 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 for phase, neutral & 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 of any lump 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 the circuit is designed. In each circuit or sub circuit every cable shall have a current rating not less than that of the fuse which protects the circuit or sub circuit respectively for 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 buildings 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 according to their capacity.
- 8.3 5 Amp. socket outlet points and 15 Amp. sockets outlet points shall be rated at 100 watts and 1000 watts respectively for the purpose of load assessment unless value of the load are known 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 Electrode 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 closed, and except in earthed concentric wiring all lamps in position or both poles of the installation otherwise electrically connected together direct current pressure of not less than twice the working pressure provided that it need not exceed 500 volts for medium voltage circuits where the supply is derived that it need not exceed 500 volts for medium voltage circuits where the supply is derived from the three wire D.C. or a poly 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 resistance 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 other pole or phase conductors of the supply with all lamps in position and switches in 'OFF' position and its value shall be not less than that specified in Sub-Clause 9.2.1.3.
- 9.2.1.3 The insulation resistance in Megohms measured as above shall not be less than 50 Megohms divided by the number of outlet or when PVC insulated cables are used for wiring 12.5 Megohms 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 Megohm is acceptable.
- 9.2.1.5 A preliminary and similar test be made before lamps, etc. are installed and in this event the insulation resistance to earth should be not less than 100

Megohms divided by the number of outlet or when PVC insulated cables are used for wiring 25 Megohms divided by number of outlets.

**9.2.1.6** The term "Outlet" includes every 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 power appliance 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 Megohm.

**9.2.2 Polarity Test :**

**9.2.2.1** In a two wire installation a test shall be made to verify that all switches in every circuit have been fitted in the same conductor throughout & such conductor shall be labelled or marked for connection to the phase conductor or to the non-earthed 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 labelled 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 terminals of all switches shall be tested by a test lamp one lead of which is connected to the earth. Glowing of test lamp to its 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 envelopes 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 from 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 Megger Earth Testers containing a direct reading ohm-meter, a hand driven generator and auxiliary electrodes.

**9.3** On completion an electric installation (addition and alteration) a certificate shall be furnished by the Contractor countersigned by the certified Supervisor under whose direct supervision the installation was carried out. This certificate shall be in 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 Executive Engineer 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 conductor shall be looped at the switch box where as a neutral conductor can be looped from 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 Switchgear, Switch Board and their location :

- 11.1** All main switches (other than those of iron clad pattern) carrying current of 10 Amp. and above shall be fitted for back connections and shall be suitably protected.
- 11.2** All 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 be so fastened that they do not tend to unscrew or become loose.
- 11.3** All main switches shall be either of metal clad enclosed pattern or of any insulated enclosed pattern which shall be fixed at close proximity to the point of entry of supply.
- 11.4** Switch boards shall not be erected above gas, stoves, or sinks or within 2.5 m. 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 moist 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 PVC and double flanged bushes shall be fitted in the holes of the switches for entry and exit of wires.
- 11.6** A switch board not be installed so that its bottom is within 1.25 m. above the floor unless the front of the switch board is completely enclosed by a door or the switch board is located in a position to which only authorised 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 outer 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** Equipments which are on the front of a switch board shall be so arranged that inadvertently personal contact with live parts is 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 cms. from any edge of the panel.
- 11.10** The various live parts, unless they are effectively screened by substantial barriers of non-hygroscopic, non-inflammable 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 pole, 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 or 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 aluminium paint as required on all sides whenever accessible.

- 11.15** All switch board 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 main 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 neutral wire except in the form of a linked switchgear. The neutral shall also be distinctly marked. In this connection 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 service 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 an earthen neutral conductor of a multi-wire system or a conductor which is to be connected thereto, an indication of a permanent nature shall be provided to identify the earthen neutral conductor. In this connection Rule 32 (1) of Indian Electricity Rules, 1956 (See Appendix 'S') shall be referred.
- 13.0 Switch Board & Distribution Boards :** Metal clad switch gear shall preferably be mounted on any of the following types of Board.
- 13.1 Hinged type Metal Boards :** These 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 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 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 lag bolts, pulgs of wooden Gutties 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 mounted on channel or angle iron frame.
- Note :** *Such type of boards are 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 of 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 meter 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 or*

*switchgears of higher capacity metal clad  
switchgears or both.*

- 13.3 Teakwood Boards :** for small installations connected to a single phase 230 volts supply teak wood boards may be caused as main boards or sub-board. 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 actual construction of the boards, a proper drawing showing the detailed dimensions and design including the disposition of the mountings, which shall be symmetrically and neatly arranged for arriving at the overall dimensions, shall be prepared 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 hinged panel of teak wood or other suitable materials such as balelite, or with unbreakable glass doors in teak wood frame with locking arrangement, the other surface of the door 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 switch board shall be so arranged that inadvertent 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 cms 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 also be easily traceable.
  - (e) 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.
  - (f) No fuses other than fuses instrument circuit shall be fixed on the back of or behind a switch board panel or frame.
- 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 colours to indicate the different poles or phases to which the apparatus of its different terminals may have been connected.

<b>Alternating Current</b>	<b>Direct Current</b>
Three-phase-red	Three wire system-2 outer wires
Yellow & Blue	Positive red & Negative Blue
Natural-Black	Natural-Black

Where fuse-wire three phase wiring is done, the neutral shall be in one colour and the other three wires in another colour.
  - (b) Where a board has more than one switch, each such 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 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 or a miniature circuit breaker or both the adequate rating setting chosen on the live conductor of each circuit and the earthed neutral conductor shall be connected to a common link 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 of ten points of lights, fans and socket outlets. The load of such circuit shall be restricted to 800 watts. If a separate fan 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 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 centre of the load they are intended to control.

**13.9.2** These shall be of either metal-clad type, or all insulated type. But, if exposed to weather or damp situations, they shall be of the weather proof type and, if installed where exposed to explosive dust, vapour 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 m. 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 or enclosure accessible to only authorised persons.

**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 circuit 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 specific approval of Engineer-in-charge is obtained. In special cases where use of Tripole 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 number of ways of the boards leaving the spare circuit for future extension.
- 13.10.2 All connection between pieces of apparatus or between apparatus and terminals 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 be soldered or welded or crimped lugs using suitable sleeve, lugs or ferrules unless the terminal is of such a form that it is possible to securely clamp them without the cutting away of cable stands.
- 13.10.4 All bare conductor shall be rigidly fixed in such a manner that clearance of atleast 2.5 cms. is maintained between conductor of opposite polarity or phase and between the conductors and any material other than insulating material.
- 13.10.5 If required a pilot lamp shall be fixed and connected through on independent singlepole 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 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°.

#### **14.0 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 isolater switch or miniature circuit breaker.

#### **15.0 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 or box and that the wires pass through in a straight line without any twist or cross in wires, on either 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 carried 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 : 2509-1963 specification for 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 from mechanical injury by means of rigid steel conduit (see "IS 1653-1964) to height not less than 1.5 m. above the floors and flush with the ceiling below. This steel conduit shall be earthed and securely bushed.



**15.2** Where a wall tube passes outside a building so as to be exposed to weather, the outer end shall be belt mounted and thinned down wards, and properly bushed on the open end.

**16.0 Fixing to Walls and Ceilings :**

Plugs for ordinary walls or ceilings shall be of well seasoned teak or other approved hardwood not less than 5 cm long 2.5 c. square on the 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 plaster or 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 wood casing, wood batten, metal conduit or cleat (as the case may be) shall be attached to the wall or ceiling in an approved 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, meatilic or a fibre fixing plug.

**17.0 Branch Switches :**

Where the supply is derived from a three-wire or 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 or fuse shall be inserted in the middle wire, earth or earthed neutral conductor of the circuit, Single-pole switches (other than for multiple control) carrying not more than 15 amperes may be of tumbler type which shall be 'ON' when the handle is down.

**18.0 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 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 vented.

**18.1** Where light fitting is supported by one or more flexible cords, the maximum weight to which the twin flexible cords may be subjected shall be as follows :

<b>Nominal cross sectional Area of cord.</b>	<b>No. &amp; Dia in mm of wires.</b>	<b>Max Permissible weight Kg.</b>
<b>mm<sup>2</sup></b>		
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

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

**8.3 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, the sub-circuit loads shall be terminated in a ceiling zone or connector from which they shall be carried into the fitting.

**9.0 Lamp Holders :**

Lamp holders for use on brackets and the like shall be in accordance with "IS : 1258-1967, specification of Bayonet lampholder and all those for use flexible pendants shall be provided with cord grips. All lampholders shall be provided with shade carriers. Where centre contact Edison screw lampholders 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 lampholders shall not be used where exposed to weather. In verandahs and similar exposed situations where pendants are used, they shall be of fixed rod type.

**21.0 Lamps :**

All incandescent lamps, unless otherwise required and suitably protected, 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.

**22.0 Fans, Regulators and Clamps :**

**22.1.0 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 roses or to special connector boxes, to which fan 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 unavoidable 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) Fan 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 reinforced concrete roofs shall be buried with the casting and due care shall be taken that they shall serve the purpose. Fan clamps for wood 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 mild steel bolts passing through the beam shall hold both flat irons together. Fan clamps for steel joist shall be fabricated from tested flat iron to fit 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 fan 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 nominal cross-sectional area not less than 1.0 mm<sup>2</sup> with copper and 1.5 mm<sup>2</sup> with aluminium and shall be protected from abrasion.

(e) Unless otherwise specified, the clear distance between the ceiling fan and the floor shall not be less than 2.75 m.

**22.2.0 Exhaust Fans :**

For fixing of an exhaust fan, a circular hole shall be provided in the wall to suit the size of the frame which shall be fixed by means of lag-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 shall be wired as neat to the holes as possible by means of a flexible cord, care being taken that the blades rotate in the proper direction.

**23.0 Attachment of fittings and accessories :**

**23.1** In other than conduit wiring, all ceiling crosses, brackets, pendants and accessories attached to walls or ceilings 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 only shall be used for attaching fittings and accessories to their base blocks.

**24.0 Interchangeability :**

Similar part of all switches, lampholders, distribution fuse-boards ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

**25.0 Conduit Wiring System :**

**25.1.1** Type and size of conduit - All conduit pipes shall be conforming to \*Is : 1653-1964, furnished with galvanised or stove enamelled 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 DC supply shall be bunched in separate conduits.

**25.1.3 Conduit - joints** : conduit pipes shall be joined by means of screwed couplers accessories only (\*IS L 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 of full threaded portion of couplers or accessories Cut ends of conduit pipes shall have no sharp edges nor any of burrs 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 6.5.1.1)**

Size of cable		Size of conduit (mm.)												
Nominal	No. and	16	:	20	:	25	:	32	:	40	:	50	:	63
Crossect-	Dia. in	:	:	:	:	(No. of cables, Max)	:	:	:	:	:	:	:	:
ional area.	mm of wires	:	:	:	:	:	:	:	:	:	:	:	:	:
	S	B	S	B	S	B	S	B	S	B	S	B	S	B
1.0	1/1.12 5	4	7	5	13	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	18	12	-	-	-	-	-	-
4	1/2.24 3	2	4	3	7	6	12	10	-	-	-	-	-	-
	(3/1.06*)													
	(7/0.85)													
6	1/2.80 2	-	3	2	6	5	10	8						
	(7/1.06*)													
10	1/3.55+	-	-	2	5	4	8	7	-	-	-	-	-	-
	7/1.40*	-	-	2	-	4	3	6	5	8	6	-	-	-
16	7/1.70 -	-	-	-	2	-	4	3	7	6	-	-	-	-
25	7/2.24 -	-	-	-	-	-	3	2	5	4	7	6	9	7
35	7/2.50 -	-	-	-	-	-	2	-	4	3	7	5	8	6
50	7/3.00+	-	-	-	-	-	-	-	-	2	-	5	4	6
	19/1.80	-	-	-	-	-	-	-	-	2	-	5	4	6

**For Cu. Conductors only. + For Al. conductor only.**

**NOTE 1** *The cable shows the maximum capacity of conditions for the simultaneous drawing-in of cables. The table applies to 250 volts grade cable. The columns headed 'S' apply to runs of conduit which have distance not exceeding 4.25 M between draw in boxes, and which do not deflect from the straight by angle of more than 15°. The columns headed 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15°.*

**NOTE 2** *In case of inspection type draw-in box has been provided and if the cables is first drawn through one straight conduit, then through the drawn box, and then through the second straight conduit, such systems may be considered as that of a straight conduit even if the conduit deflects through the straight by more than 15°.*

**25.1.4 Protection against dampness** - In order to minimise condensation or sweating inside the tube, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects as far as possible.

**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 metre but on either side of couplers bends or similar fittings. Saddles shall be fixed at a distance of 30 cm. from the centre of such fittings.
- 25.1.7 Bends in conduit** - All necessary bends in the system including diversion shall be done by bending pipes or inserting 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, solid 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.
- 25.1.9 Conductor** - All conductor used in conduits wiring shall preferably be stranded. No single-core cable or nominal Cross-sectional area greater than 130 mm<sup>2</sup> shall be enclosed in a conduit and used for alternating current.
- 25.1.10 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 after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirements specified under 7 by means of special approved type earthing clamp efficiently fastened to conduit 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 shall comply with all the requirements for surface conduit wiring system specified in 6.5.1.1 to 6.5.1.10 and addition, conform to the requirements 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 neatly after erection of conduit and brought to the original finish or the wall.
- 25.2.2 Fixing of conduit in chase** - The conduit pipe shall be fixed by means of staples or by means of 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** - All outlets such as switches and wall sockets, may 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 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 approved insulating material and outlet mounted in an approved manner.
- 25.2.5** When crossing through expansion joints in buildings, the conduit sections across the joint may 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 : 2509-1963-The conduit may be either threaded type or plain type as specified in IS : 2509-6913\* and 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 be drawn into the conduits are given in Table III. In this table space factor does not exceed 40 percent.

**TABLE - III**  
**MAXIMUM PERMISSIBLE NUMBER OF 250 VOLTS GRADE SINGLE -**  
**CORE CABLE THAT MAY BE DRAWN INTO RIGID NON-METALLIC CONDUITS**

Size of cable		Size of conduit (mm.)					
Nominal	No. &	16	20	25	32	40	50
Cross Sectional	Diameter						
Area	in mm. of						
	wires						
mm <sup>2</sup>							
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	-
	7/1.06*						
10	1/3.55+	-	-	4	7	9	-
	7/1.40*						
16	7/1.70*	-	-	2	4	5	15
25	7/2.24	-	-	-	2	2	6
35	7/2.50	-	-	-	-	2	5
50	7/300+	-	-	-	-	2	3
	19/1.80						

\* For copper conductors only.

+ For aluminium conductors only.

- 25.3.3 Conduit joints** - Conduit joints shall be jointed 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 spacing 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, inspection 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 for fittings, switches, etc., shall be boxes of substantial construction. In order to minimise condensation or sweating inside the conduit, all outlets of conduit system shall be properly drained and ventilated, but in such a manner as to prevent the entry of insects, 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 of 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 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 :**

- 26.1.1** All cables on brick walls, stone or plastered walls ceiling shall be run on well seasoned, perfectly straight and well varnished on four sides, teak wood or any approved hardwood battens not less than 10 mm finished thick, width of which shall be such as to suit total width of cables laid on the battens, prior to erection, these shall be painted with one coat of varnish or approved paint of colour to match with surrounding. These battens shall be secured to wall and ceilings by flat head wood screws to raws plug or phill 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 counter within wood batten and smoothed down with file.
- 26.1.2** Where wiring is to be carried out along the face of the rolled steel joists, a wooden batten of 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 backing in the ordinary way. Where wiring passes through structural steel work, the hole shall be suitably 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.

- 26.2.0 Link dips :** Only aluminium alloy clips/joint clips shall be used. The thickness shall be 0.32 mm (30 SWG) for lengths of 25 mm to 40 mm and 40 mm (28 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 TRS of PVC insulated and PVC sheathed upto 2.5 sw. 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 switch iron pins and spaced at interval of 15 cm both in the case of horizontal and vertical runs.
- 26.3.0 Bends in wiring :** The wiring shall not in any circumstances be bent so as to form an abrupt right angle but must be rounded off at the corners to 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 the all the requirements of conduit wiring system.
- 26.4.2** Such protective covering shall in all cases be fitted on all down drops within 1.5 m. 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 1.5 m. above the floor or upto the switch board, whichever is less and flush with the ceiling below or by means of any approved type of metallic covering. The ends of all conduits or pipes shall be neatly bushed with porcelain wood or other approved material. The conduit pipes, shall be securely earthed.
- 26.6.0 Passing through walls:** When conductors pass through walls, any one 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 either ends of such holes.
- (a) A box of teak wood or approved hard wood extending through the hole thickness of the wall shall be buried in the wall and casings or conductors shall be carried so as to allow 1.3 cm air space on the three sides of the casing or conductor.
- (b) The conductors shall be carried in an approved heavy gauge solid drawn or lap weld conduit or in a porcelain tube of such a size that it permits easy drawing in, the ends conduit shall be neatly bushed with porcelain, wood or other approved material.
- 26.6.1** Where a wall tube passes outside a building so as to be exposed to weather, the outer end shall be mounted and turned downwards and properly bushed on the open end. The conduit shall be neatly arranged so that the cables enter them without bending.
- 26.7.0 Buried cables:** The TRS or PVC sheathed cable shall not normally be buried directly in plaster. Where so specified in the special specification they may be taken in teak wood channeling of ample capacity or conduit pipe buried in the wall.
- 26.8.0 Stripping of outer covering -** While cutting and stripping of the outer covering of the cable care shall be taken that the sharp edge of the cutting instrument does not touch the inner insulation of the conductors. The protective outer covering of the cables shall be stripped off near connecting terminal and this protective covering shall be maintained upto

the close proximity of 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 shall be thoroughly cleaned and dusted before painting is started. The proposed surface shall be inspected by Engineer-in-charge or his authorised 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 & even as possible. Particular care shall be paid to rivets, nuts, bolts and cover lapping. Before drawing cut, it shall be continuously stirred in the smaller 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 indoor situations will not include primer coat except where specially mentioned in the schedule of work or special specification. However, where rust has formed on iron and steel surfaces the spots will be painted with one anti-rust primer coat.

**27.5 Precautions :** All furniture fixtures glazing floors, etc., shall be protected by covering. All stains, smears, splashings, 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 aluminium paint as required to match the finish of surrounding wall trusser, etc.

**28 Link clip :**

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