



**BHARAT HEAVY ELECTRICALS LIMITED**  
**COMPONENT FABRICATION PLANT**  
**RUDRAPUR**

**TENDER FOR ELECTRICAL SERVICES TO NEW  
PRODUCTION SHOP , BAY EXTENSION, FG SHED,  
ADMINISTRATIVE BUILDING MATERIAL & BOI STORE  
ETC.AT RUDRAPUR**

**Tender Enquiry No: BHE/RU/PROJ/ ES**  
**DATED :27/10/2010**

**SECTION V**

**TECHNICAL SPECIFICATIONS**

**BHARAT HEAVY ELECTRICALS LIMITED**  
**(A GOVERNMENT OF INDIA UNDERTAKING)**  
**COMPONENT FABRICATION PLANT**  
**RUDRAPUR, DISTT. U.S.NAGAR -263153**  
**(UTTARAKHAND)-INDIA**

## TECHNICAL SPECIFICATIONS

### INDEX

SL.NO.	CONTENTS
1	PART A TECHNICAL SPECIFICATIONS-General
2	PART B TECHNICAL SPECIFICATIONS-CONDUIT WIRING
3	PART C TECHNICAL SPECIFICATIONS-CABLE LAYING
4	PART D TECHNICAL SPECIFICATIONS-ELECTRICAL FITTINGS
5	PART E TECHNICAL SPECIFICATIONS-CIRCUIT BREAKERS
6	PART F TECHNICAL SPECIFICATIONS-EARTHING
7	PART G TESTING
8	PART H ACCEPTABLE MAKES OF MATERIALS & APPENDIX –‘A’

## **PART -A**

### **TECHNICAL SPECIFICATIONS – GENERAL**

- 1.1 These specifications indicate the General requirements for internal electrical work including wiring system, panel boards, cable laying, earthing protection and other related works.
- 1.2 These specifications are drawn to indicate essential requirements and precautions to be taken regarding internal electrical installation for ensuring efficient, safe, economical and practicable use of electrical materials and equipment, in conformity with statutory regulations and easy maintainability of the installations.
- 1.3 Complete work shall be carried out conforming to the provisions of Indian Electricity Act and relevant Indian standard Specifications (BIS). Wherever these regulations are supplemented by the State Electricity Dept., Electricity Undertakings/Boards, Factory inspector and the Safety Engineering Dept. of BHEL, the installation shall also comply with these requirements. Wherever the specifications given in this booklet differs from those of the statutory regulations, these specifications shall be followed.
- 1.4 Location of panel boards, distribution boards, switch boards, light fittings, cable routes, conduit routes, earth pits etc. shall be marked at site and approval of Engineer-in-charge obtained before proceeding with the installation work.
- 1.5 Rated Power, Voltage and frequency of supply of current consuming devices and materials used in installation shall be suitable for the power and frequency of the supply to which these are to be connected.

## **PART-B**

### **TECHNICAL SPECIFICATIONS FOR CONDUIT WIRING**

#### **2.1 For all industrial premises, conduit system of wiring shall be provided.**

##### **2.2 Point Wiring:**

**2.2.1** Point wiring shall include all works necessary for complete wiring of a switch circuit of any length from the tapping point on the distribution circuit to the following through the switch:

- a) Ceiling rose or connector (in the case of ceiling/exhaust fan point).
- b) Ceiling rose (in the case of pendant except stiff pendant point).
- c) Back plate (in the case of stiff pendants and fittings with down rods)
- d) Socket and Outlets (in the case of socket outlets points)
- e) Lamp Holder (in the case of wall brackets, batten points, bulk head and similar fittings).
- f) Call Bell/ Buzzer (in this case the works Via the switch shall be red as "Via ceiling rose, socket outlet or bell push where no ceiling rose/socket outlets is provided").

**2.2.2** The following shall be deemed to be included in the point wiring:

- a) Switch.
- b) Ceiling rose or connector as required
- c) Any special and suitable M. S. box for neatly housing the connector and covering the fan hook in case of fan point.
- d) Bushed conduit or porcelain where cable pas through walls, floors etc.
- e) Earth wire from the distribution boards to all current carrying apparatus through switch boards, M. S. Boxes etc.
- f) All metal blocks, boards, covers and M. S. Boxes, sunk or surface mounted including those required for mounting fan regulators but excluding those for fixing the distribution switch boards.
- g) All fixing accessories such as clips, nails, screws, phil plug, rawl plug etc. as required.
- h) Connection to ceiling rose, connector socket outlets, Lamp holders, Switch, fan regulator etc.
- i) Looping in the same switch board and inter connections between Points on the same circuit.

##### **2.3 System of Wiring:**

**2.3.1** The wiring shall be carried out as per the system specified in the tender Schedule. Power wiring shall be kept separate and distinct from lighting and fan wiring. All conductors shall run as far as possible along the walls and ceiling so as to be easily accessible and capable

of being thoroughly inspected. In all types of wiring due consideration shall be given for neatness, good appearance and safety.

2.3.2 The balancing of circuits in 3 wires on poly phase installation shall be arranged to the satisfaction of Engineer-in-charge. In large/important rooms light fans and socket outlet points shall be distributed over more than one circuit as directed by the Engineer-in-charge.

## **2.4 Flexible Cable:**

2.4.1 Conductor of flexible cable shall be of copper. The minimum permissible size of conductor for flexible cable shall be 1.5 mm<sup>2</sup>. Unless the flexible cables and conduits are protected by armour PVC sheaths, these shall not be used in workshops and other places where they are liable to mechanical damage.

2.4.1 Three core flexible cables shall be used for connecting single phase appliance.

## **2.5 Rating of lamps, fans etc. :**

2.5.1 For the purposes of connected load calculations, incandescent installations for residential and non residential building shall be rated at 100 W

2.5.2 Table fans shall be rated at 50/60W. Exhaust fans shall be rated according to their capacity.

2.5.3 **5 Amp** socket outlet point and 15 Amp socket outlet point shall be rated at 100W and 1000W respectively, unless the actual values of loads are known or specified.

## **2.6 Joints and loop back :**

2.6.1.1 Unless otherwise specified, the wiring shall be done in the 'Looping system'. Phase or light conductor shall be looped at the circuit box and neutral connected shall be looped from the light, fan or socket outlet. In non residential buildings neutral conductor and earth continuity wire shall be brought to each circuit board, circuit switch in rooms and halls. These shall be terminated inside the switch board and shall be of adequate sizes to accommodate minimum of 1 No. 5 Amps socket outlet and control switch in future.

2.6.2 Wherever wires are to be connected together, mechanical connector of adequate ratings shall be made use of. Under no circumstances

twisted joints shall be allowed.

## **2.7 Control at point of entry of supply.**

2.7.1 There shall be a linked main switch gear with fuse on each light conductor of the supply mains at the points of entry. The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switch gear.

2.7.2 The neutral shall be distinctly marked.

2.7.3 The main switch gear shall be situated as near as practical to the termination of service line and shall be easily accessible without the use of any external aid.

2.7.4 On the main switch gear, where the conductors include earth conductor of a 2 wire system or on earthed neutral conductor of a multi wire system or a conductor which is to be connected thereto, the permanent indication shall be provided to identify the earthed neutral conductor ( **Rule 32 (i) of Indian Electricity Rules 1956 refers** ).

## **2.8 Switch Boards:**

2.8.1 Metal clad switch gear shall be mounted on wall, columns etc. by suitable mechanical means so as to ensure firm mechanical supports.

2.8.2 Hinged type boards shall consist of a box made of sheet metal clad, switch gear, distribution boards etc.

2.8.3 Hinged metal boards shall consist of a box made of sheet metal of 6 SWG gauge thick and shall be provided with hinged cover to enable board to be swung open for the examination of the wiring at the back. The joint shall be substantially welded.

2.8.4 All wires passing through metal boards shall be bushed.

2.8.5 No apparatus shall project beyond any edge of the panel. No fuse body shall be mounted within 2.5 cms of any edge of the panel.

2.8.6 Fixed type metal boards shall be provided for large switch boards where number of switch gears and/or higher capacity metal clad switch gears are to be mounted.

2.8.7 Fixed type metal boards shall consist of an angle or channel iron frame fixed on the wall or on the floor and supported on the wall at the

top. There shall be a clear distance of one meter in front of the switch board. The working distance of one meter behind the switch board is preferable.

2.8.8 The detailed design and drawings for metal boards and angle iron frame work including the disposition of the various mounting, which shall be systematically and neatly arranged for arriving at the overall dimensions shall be prepared and submitted before hand for approval of the Engineer-in-charge.

2.8.9 In case of convenience power outlets in industrial premises of 15/30 Amps the boxes shall be made out of sheet metal 16 gauge and of size 300 x 250 mm. The socket outlet shall be of Reyrolle type two pin and earth. A 30 Amps switch, double pole metal clad shall be provided for the socket outlet. For the socket outlets, protective cover with connecting chain shall also be provided.

2.8.10 In case of commercial and residential buildings or wherever specifically indicated power outlets with flush type 15 Amps socket outlet and 15 Amps control switch shall be provided.

## **2.9 Marking of Apparatus:**

2.9.1 When a board is connected to voltage higher than 250 volts, all the terminals or leads of the apparatus mounted on it shall be marked in the following colours to indicate the different poles or phase to which apparatus or its different terminals may have been connected.

### **Alternating Current**

Three phases-**Red, Blue, Yellow**

Neutral - **Black**

Earth - **Green**

2.9.2 Where a board has more than one switch gear, each such switch gear shall be marked to indicate which section of the installation it controls. The main switchgear shall also be suitably marked. Where there is more than one switch board in the building, each such switch board shall be marked to indicate which section of the installation and building it controls.

2.9.3 All marking required under this rule shall be clear and permanent.

2.9.4 In the cable boxes for all the switchgears, the size and number of

cables connected to it shall be suitably marked.

2.9.5 All distribution boards shall be marked 'lighting' or 'power' & essential lighting / power as the case may be and also marked with the voltage supply and number of phases of the supply. Each distribution board 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 the fuse element.

#### 2.9.6 Capacity of Circuits:

2.9.7 Lights and fans may be wired on a common circuit. Such circuit shall not have more than a total of 8 points of light, fan and socket outlets or a load of **800 watts**, whichever is less.

2.9.8 The power circuits shall be designed with one outlet per circuit unless otherwise specified, The circuits shall be designed based on the loading of the circuit. Where not specified, the load shall be taken as **3000 watts** per circuit..

#### 2.11 Bunching of cables:

2.11.1 Cables carrying direct current may be bunched whatever their polarity, but cable carrying alternating current, if installed in metal conduit shall always be bunched so that the outgoing and return cables are drawn into the same conduit.

#### 2.12 Outlets:

2.12.1 The switch or regulator boxes shall be made of metal on all sides. In case of office buildings Hylam sheets/bakelite sheets of 3 mm thickness and white colour finish may be used for the front side of the box. In Industrial buildings, the front side of the boxes shall also be of mild steel. In case of cast iron boxes, wall thickness shall be atleast 3 mm and in the case of welded mild steel sheet boxes the fabrication shall be carried out from 16 gauge sheet steel. The edges of the M.S. Boxes shall be folded inside to support bakelite/hylam sheet. In no case M. S. Boxes with corner pieces welded for supporting the hylam sheet shall be provided.

2.12.2 In case of M.S. Cover for the front side of the switch boards, all the four edges of these cover shall be folded inside for a depth of atleast 4 mm.

2.12.3 Clear depth of the box shall not be less than 50 mm and this shall be increased suitable to accommodate mounting of fans regulator in flush pattern.



2.12.4 Only a portion of the M.S. Boxes shall be sunk in the wall, the other portion being projected out for suitable entry of conduit pipes into the box.

2.12.5 Control switches shall be connected in the phase conductors only and shall be 'ON' when knob is down. Switches shall be fixed in sheet steel boxed with cover plates as specified. Chromium plated brass screws shall be used for fixing of switches.

2.12.6 Power Point wiring shall be distinctly separated for light Point wiring. Conduits and wires should be as per BOQ.

#### **2.19 Recessed conduit wiring system:**

2.19.1 Recessed conduit wiring system shall comply with all the requirements of surface conduit wiring and in addition shall also comply with following requirements.

##### **2.19.2 Making of chase**

The chase in the wall shall be neatly made and of ample dimensions to permit the flexing of conduit pipe in an approved manner. In case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick masonry work, special care shall be taken to fix the conduit and accessories in position alongwith the building work. In case of new construction the scope of work under the electrical contractor shall be responsible for providing chase in the wall, fixing up the conduits and finishing of the wall complete. However, final painting after plastering will be carried out by the agency.

##### **2.19.4 Inspection boxes:**

Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection to facilitate replacement of wires, if necessary. These shall be mounted flush with the suitable ventilating holes shall be provided in the inspection box covers.

##### **2.19.5 Types of accessories to be used:**

All outlets such as switches, wall sockets etc. may be either flush mounting type or surface mounting type as specified. The outlet box shall be efficiently earthed with conduit by an approved means of earth attachment.

To facilitate drawing of wire in the conduit G.I. fish wire of 10 SWG shall be provided along with laying of recessed conduit.

## **2.20 Wires:**

- 2.20.1 All wires shall be PVC insulated single core copper or aluminium as specified and shall be any 660 volts grade.
- 2.20.2 Wires of single strand is permissible upto 2.5 sq. mm size. Beyond this size wires with stranded conductors only be used.
- 2.20.3 All wiring termination shall be with crimped lugs except in case of termination on piano type switches and piano type sockets outlets.
- 2.20.4 Conduits buried in concrete structure shall be put in position and securely fastened to the reinforcement and got approved by the Engineer-in-charge before the concrete is poured. Proper care shall be taken to ensure that the conduits are neither dislocated nor chocked at the time of pouring the concrete. Suitable fish wires shall be drawn in all conduits before they are embedded.
- 2.20.5 No conduit shall be buried in concrete or plastered unless the work has been inspected and inspected and approved by the Engineer-incharge.

## **PART- C**

### **TECHNICAL SPECIFICATIONS FOR CABLE LAYING**

- 3.1 All cable shall be PVC insulated, sheathed and steel armoured with an outer PVC protective sheath. Cables shall have high conductivity stranded aluminium conductors and cores shall be colour coded as per Indian Standards.
- 3.2 All cables shall be without any kinks or visible damage.
- 3.3 Cables shall be laid in the routes marked in the drawings. Where the route is not marked, the contractor shall mark it out on the drawings and also on the basis of actual site measurements.
- 3.4 All cables shall be properly terminated with glands, tinned copper lugs and cables identification tags and shall be properly crimped or soldered with lugs as directed.
- 3.5 All the indoor cables shall be laid on walls, ceilings, inside shafts, with suitable supports. Distance between supports shall not be more than 50 cms.
- 3.6 Cables shall be laid indoors by using 3 mm thick M.S. spacers with G.I. saddles and screws.
- 3.7 Cables laid directly in existing trenches shall be properly supported by M.S. Clamps.
- 3.8 Straight through joints shall not be permitted where the route length does not exceed one full drum length. In case of routes where the length exceeds one full drum length, minimum number of straight through joints as approved by the Engineer-in-charge shall be provided. However, no separate payment will be made for such straight through joints.
- 3.9 Cables shall be tested before laying and after laying but definitely before connecting up to the switch gears.

3.10 After the cable installation is complete, the entire installation shall be tested with 500 V insulation resistance tester and following reading established.

- (i) Continuity on all phases
- (ii) Insulation resistances between conductors, conductors and ground.

All test readings shall be recorded and handed over to Engineer-in-Charge.

3.11 In case of High Tension cables the insulation test shall be carried out using 2000 V meggar. In addition to this pressure test shall be carried out on the H.R. Cables as specified in IS:1255 – Code of Practice for installation & maintenance of paper insulated power cables.

**PART-D**  
**TECHNICAL SPECIFICATIONS FOR ELECTRICAL FITTINGS,  
FIXTURES AND FANS**

**4.1 Fluorescent Light Fittings :**

- 4.1.1 All fixtures shall be complete with accessories and fixing necessary for installation completed in all respects.
- 4.1.2 Fixtures shall be installed at mounting heights as detailed on the drawings or instructed at site by the Engineer-in-charge.
- 4.1.3 Fixtures and/or fixture outlets boxes shall be provided with hangars to adequately support the weight of the fixture. Design of hangars and method of fastening shall be as approved by Engineer-in-charge unless otherwise specified in the drawings and tender specifications.
- 4.1.4 Pendant fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Provision for adjustment of height during installation shall be made.
- 4.1.15 Detailed catalogue and technical data for all fixtures or wherever desired by the Engineer-in-charge, Sample fixtures shall be submitted for approval to the Engineer-in-charge before orders for the fixtures are placed. Shop drawings for non-standard fixture types shall be submitted for approval to the Engineer-in-charge.
- 4.1.16 Recessed fixtures shall be constructed so that all components are replaceable without removing housing from the ceiling.
- 4.1.17 Lamp shall be supplied and installed in all lighting fixtures provided under this contract. Lamps used for temporary lighting service shall not be used in the final lamping of fixtures. Lamps shall be of wattage and type as shown on the drawings. Wherever not shown, the details shall be ascertained from the Engineer-in-charge before procurement. Lamps for permanent installation shall not be placed in the fixtures until so directed by the Engineer-in-charge and this shall however be

accomplished immediately before the building portions are ready for occupation.

4.1.18 Rate quoted against pole item shall include for excavation, concrete foundation, pole earthing studs, arm for fitting, fixing bracket for control gear, pole cap etc. all complete.

4.1.19 Poles shall be erected absolutely vertical.

4.1.20 All buried portions of the poles shall be given a primer coat and two coats of bituminous paint. All exposed portions shall be given one primer coat and two coats of aluminium paint before erection. In addition, one more coat of aluminium paint shall be given after the fittings are erected and work completed.

4.1.21 Fans, Regulators and Clamps :

4.1.22 Ceiling fans including their suspension shall conform to relevant ISS with secondary safety device incorporated against free fall of fans from their hooks.

4.1.23 All ceiling fans shall be wired to ceiling roses or to special connector boxes and suspended from hooks or shackles. There shall be no joints in the suspension rod.

4.2 Mode of Measurements :

4.2.1 each lamp, fixtures, shall be measured as a unit complete with all accessories, lamps, mounting, wiring, connection, earthing etc. all complete.

4.2.2 Each street light pole shall be measured as a separate unit complete including excavation, erection of pole, pole cap, bracket etc. all as specified and in conformity with the drawing and specifications.

4.2.3 Exhaust fan and ceiling fans shall be measured as a complete unit including fixing up and connecting the fans, regulator, earthing arrangement, blanking opening in the wall, in case of exhaust fan etc

**PART-E**  
**TECHNICAL SPECIFICATIONS FOR CIRCUIT BREAKERS,**  
**PANEL BOARDS AND DISTRIBUTION BOARDS**

**5.1 Switch Fuse Units :**

- 5.1.1 Switch fuse units shall have quick-make, quick break silver plated preferably double break contacts with operating mechanism suitable for rotary operation in the case of cubicle mounting. All Switches shall be rated according to the Schedule of work or drawings and shall withstand the system fault current. Cam operated rotary switches with adequate terminal adaptors upto 25A are acceptable but for all higher rating switch fuse units shall be heavy duty type conforming to I.S.4047.
- 5.1.2 The switches should be at easily accessible height and the highest switch operating handle should not be over 1.50 M from floor level.
- 5.1.3 All the interconnections shall be solid copper links and shall be taped properly as per the colour code.
- 5.1.4 Engraved plastic labels shall be provided indicating the feeder details, capacity and cable sizes.
- 5.1.5 'DANGER' sign board shall be fixed on the front cover.
- 5.1.6 The complete frame and bus bar shall be painted to match the switches.
- 5.1.7 Arrangements for terminating earth strip shall be provided on the frame.
- 5.1.8 Cable entry boxes shall be provided for all incoming and outgoing cables.
- 5.1.9 The panel shall be grouted in the floor with all the necessary

hardwares.

5.2.0 The sub-panels should be mounted on suitable M.S. frames and job includes grouting the same on the wall/ floor with all the necessary hardware.

5.2. 1.12 **Bus bar** chamber shall be completely compartmentalized openings made at top and bottom for switches shall be blocked with bakelite sheets and bushed openings provided for interconnecting leads

## **PART-F**

### **TECHNICAL SPECIFICATION - FOR EARTHING**

#### **6.1 EARTHING :**

6.1.1 Normally an earth pit shall not be situated less than 1.5 mtrs. from any building. Care shall be taken that the excavations for earthing may not affect the footing of the foundations of the buildings.

6.1.2 The earthing lead shall be securely bolted and soldered to plate. The lead shall be connected by means of cable socket with bolts & nuts.

6.1.3 The earthing lead shall be suitably protected from mechanical injury.

6.1.4 No earth electrodes installed shall have a greater ohmic resistance than one ohm as measured by an approved earth testing apparatus.

6.1.5 The twin strips of size 25 mm x 3 mm of aluminium or G.I. strip shall be connected from earth station to nearest switch gear.

6.1.6 The cost towards provision and erection of earth station shall include all labour for excavation in soft soil/ hard rock/ concrete apron, back filling of the excavated portion, resurfacing to the original finish including provision of all materials, sundries, consumables and test link.

6.1.7 The entire work shall be carried out conforming to IS 3043-1966.

#### **6.2 SUB EARTHING :**

6.2.1 From main panel, earthing conductor in twin shall be laid alongwith the cables for continuous earthing. Sizes of earth wire shall be as specified in the schedule of quantities upto the distribution board.

6.2.2 The earth conductors shall be earthed at both ends using properly



sized lugs, either by crimping or soldering. Twisted joints are not allowed anywhere in the earthing system.

6.2.3 The earth conductors shall be properly fastened to the cables throughout the run.

6.2.4 All the conduits either surface or concealed shall be laid with 12 SWG bare aluminium earth conductors along the run of conduits.

6.2.5 The copper earthing clamps shall be fastened at threaded joints to ensure proper earthing and all the threaded joints shall be painted with black bituminous paint.

## **PART-G**

### **TECHNICAL SPECIFICATION FOR TESTING**

#### **7.1 General**

On completion of an installation the following tests shall be carried out:-

1. Insulation Resistance Test.
2. Polarity Test.
3. Earth continuity Test.
4. Earth Electrode Resistance Test.

##### **7.1.1 Insulation Resistance**

7.1.1.1 The insulation resistance shall be measured by applying between earth and the whole system of conductors of 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, a 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 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.

7.1.1.2 The insulation resistance shall also be measured between all conductors connected 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 not be less than 50 Meg Ohms divided by the number of outlets .

7.1.1.3 Where an entire installation is being tested, a lower value than that

given by the formula, subject to a minimum of 1 Mega Ohm is acceptable.

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

7.1.1.5 The term "outlet" includes every point along with every switch except that a switch combined with a socket outlet, appliance or lighting fitting is regarded as one outlet.

7.1.1.6 Control rheostats, heating and power appliances and electric signs may, if required, be disconnected 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 India Standard Specification or where there is no such specification shall be not less than half a mega ohm.

#### **7.1.2 Polarity test of switch:**

7.1.2.1 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 and such conductor shall be labelled or marked for connection to phase conductor or to the non earthed conductor of the supply.

7.1.2.2 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.

7.1.2.3 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.

#### **7.1.3 Testing of earth continuity path :**

7.1.3.1 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.

#### 7.1.4 Measurement of earth electrode resistance :

- 7.1.4.1 Two auxiliary earth electrodes besides the test electrode are placed at suitable distance from the tests electrode (see figure). A measured current is passed between the electrode 'A' to be tested and an auxiliary current electrode 'C' and the potential difference between the electrode 'A' and auxiliary potential electrode 'B' is measured. The resistance of the test electrode 'A' is then given by –

$$R = \frac{V}{I}$$

Where,

R - Resistance of the test electrode in ohms.

V - Reading of the voltmeter in volts.

I - Reading of the ammeter in amps.

*CURRENT* 

*SOURCE*

X + 1 m

A= Test Electrode

B= Potential Electrode

C= Current Electrode

- 7.1.4.2 (a) Stray currents flowing in the soil may produce serious errors in measurement of earth resistance. To eliminate this, hand driven generator is used.

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

- 7.1.4.3 At the time of test, the test electrode shall be separated from the earthing system.

- 7.1.4.4 The auxiliary electrodes shall be of 13 mm diameter mild steel rod driven upto 1 m into the ground.

- 7.1.4.5 All the three electrodes shall be so placed that they will be independent of the resistance area of each other.
- 7.1.4.6 If the test electrode is in the form of rod, pipe or plate, the auxiliary current electrode "C" shall be placed at least 30m away from it and the auxiliary potential electrode 'B' shall be placed mid way between them.
- 7.1.4.7 Unless three consecutive readings of test electrode resistance agree the test shall be repeated by increasing the distance between electrodes A and C upto 50 m and each time placing the electrode 'B' midway between them.
- 7.1.4.8 On these principles "Megger Earth Tester" containing a direct reading ohm meter, a hand driven generator and auxiliary electrodes are manufactured for direct reading on earth resistance of electrodes.
- 7.1.5 On completion of an electric installation a certificate shall be furnished by the contractor countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as given in Appendix 'A', in addition to the test certificate required by the local Electric Supply Authorities.

## **PART-H ACCEPTED MAKES OF MATERIALS**

### **ACCEPTABLE MAKES OF MATERIALS**

1. L.T. ACB	Siemens / L&T / GE / C & S
2. MCCB/ELCB/RCCB	Siemens/ L& T/ Crompton/ GE
3. MCBs & MCB Boards	Siemens/ GE/ MDS
4 L.T. SDU / FSU / SFU	Siemens/ L&T./ GE / Hevell's
5 L.T. Isolator	Siemens/L & T /GEC
6 Change over switches	C&S / HPL / Hevell's / L&T
7 Rotary/Selector switches	Siemens/ L & T/ Kaycee/Switchtron
8. CTs & PTs	TELK/ Kappa/ Siemens/ / BEACON
9. Motor Starters	Siemens/ L&T/ BCH
10. Air break Contactors	Siemens/ L&T/ BCH / Telemechanique
11. Overload relays	Siemens / L & T/ BCH
12. Time delay relay	Siemens/ BCH/ L&T/ EE
13. Single phase Preventer	Siemens/ L & T/ BCH
14. Push button & Indication Lamps	Siemens/ L & T / Technic
15. Measuring Instruments	AE/ MECO/ IMP/ ENERCON/ ALACRITY
16. Protective Relays	E.E / EMCO/
17. Cables	Universal/Premier/ Polycab/ Hevells
18. PVC insulated copper wires	Finolex/ Hevell's/ Polycab/ Anchor
19. Copper Lugs	Dowell / Comet / Uma
20. Telephone cables	Delton/ HCL
21. Fuse & Fuse Distribution Boards	E.E/ Siemens/ L & T/Hevell's
22. Bus bar trunking & tap off units	E. E /GEC/L&T
23. Light/ Street Light fittings	Philips/ GEC/ Crompton/ Bajaj
24. Voltage stabilisers	Auto Elec/ Aplab/ Keltron
25. Sodium vapour light fittings	Philips/ GEC/ Crompton
26. Ceiling/Pedestal/Wall Mounting fans	GEC/ Usha/ Bajaj/ Khaitan/Hevell's

27. Pedestal fans (Heavy duty)	Almonard/ Crompton /GE
28. Exhaust fans	GEC/ Crompton/ Usha/ Bajaj/ Khaitan
29. Industrial Plug & sockets	Crompton/ BCH/ Legrand
30 MCB Distribution Board	MDS/ Legrand/Siemens / BCH
31. Cable tray	MEK/ Indiana
32.PVC Conduit pipes & accessories	BEC/ Universal/ Polypack
33. Cable sockets/Glands	Dowels / Lotus/ Braco / Comet / Jainson
34. Electronic choke/Ballast	Opal/ Philips/ Taurus/ Intelux
35. Electronic fan Regulator	Rider/ Anchor / Usha/Bajaj
36. Bakelite fuse cut-outs	EE/ Standard /L&T
37. Bulk Head Fittings	CEALITE / CROMPTON/Bajaj
38. 3-Pin Socket(5/6/15A)	Anchor/Arkaylite/
39.Piano Switch(5/6/15 A)	Anchor/Arkaylite/
40.Compact fluorescent light(CFL)	Philips/Orpat/Hevell's
41.Tube Light/Fixture with reflector	Philips/Bajaj/CG/ECE
42.Lighting Fixture	Philips/Bajaj/Hevell's
43. M.H.LAMP	Hevell's/Philips/Bajaj

## **A P P E N D I X 'A'**

### **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 IS:732 – Code of practice of Electrical wiring Installations (system voltage not exceeding 650 volts)

Electrical Installation at \_\_\_\_\_

Voltage & system of supply \_\_\_\_\_

#### **1. Particulars of Works :**

##### **(a) Internal Electrical Installation**

No. Total Load Type of system of 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) If the work involves installation of over headline and/ or under ground cable.

[a] Overhead Line

(i) Type & description of overhead line

(ii) Total length and No. of spans

(iii) No. of street light and its description.

[b] Underground Cable

- (i) Total length of underground cable & its size.
- (ii) No. of joints
  - End Joint :
  - Tee Joint :
  - St. through Joint :

**Earthing :**

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

**Test Results :**

- (a) Insulation Resistance
  - (i) Insulation resistance of the whole system of conductors to earth .... Megohms
  - (ii) Insulation resistance between the phase

**Conductor & neutral -**

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

**(iii) Insulation resistance between the phases Conductors in case of poly phase supply**

Between phase R and phase Y .... Megohms  
Between phase Y and phase B .... Megohms  
Between phase B and phase R .... Megohms

**(b) Polarity Test**

Polarity of non linked single pole branch switches.

- (c) Earth continuity test
  - Maximum resistance between any point in the earth continuity conductor including metal conduits and main earthing lead ..... Ohms
- (d) Earth Electrode Resistance
  - (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 earth electrode and met-1 in/on the structure ... Ohms

**Signature of the Supervisor**  
**Name and address**

**Signature of Contractor**  
**Name and address**

