

[EQ. TO SOR 2025-2026 CAT-III]

3. TECHNICAL SPECIFICATIONS  
FOR  
ERECTION, TESTING & COMMISSIONING  
OF ELECTRICAL INSTALLATIONS

## ERECTION, TESTING & COMMISSIONING OF ELECTRICAL INSTALLATIONS

### 1.0

#### SCOPE OF WORK

- 1.1 The intent of this specification is to define the requirements for the installation, testing and commissioning of the electrical system like H.T VCB panel, transformer, L.T. panels, Cables, earthing network, Internal and External lighting, Light fixtures etc.. Requirement of this project shall be as specified in bill of quantities / approved drawings / general specifications or as per the battery limits fixed by the owner / consultant.

### 2.0

#### STANDARDS

- 2.1
1. The work shall be carried out in the best workman like manner in conformity with this specification, the relevant specification / codes of practice of the Indian Standards Institution, approved drawings and the instructions issued by the authorised representative, from time to time. Some of the relevant Indian Standards are listed elsewhere in this tender document.
  2. In addition to the standards mentioned in 2.1, all works shall also conform to the requirement of the following :
  3. Indian Electricity Act and Rules framed there under.
  4. Fire Insurance Regulations.
  5. Regulations laid down by the Chief Electrical Inspector of the State / State Electricity Board / Union Territory.
  6. Regulations laid down by the Factory Inspector of the State / Union Territory.
  7. Any other regulations laid down by the local authorities.
  8. Installation & operation manuals of original manufacturers of equipment.

### 3.0

#### ERECTION

- 3.1 The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. Equipment shall not be removed from packing cases unless the floor has been made ready for installing them. The cases shall be opened in presence of the client / consultant or his authorised representative. The empty packing cases shall be returned to the stores and any document if found with the equipment shall be handed over to the client's representative. Any damage or shortage noticed shall be reported to the client / consultant in writing immediately after opening of packing cases.

#### 3.2 ONAN TYPE TRANSFORMER

##### 1. Erection

Transformer complete with radiators, bushings, conservator and miscellaneous accessories shall be thoroughly inspected and any damage noticed shall be reported to the client / consultant. Before erection of transformer, the level of rails on foundation shall be checked and minor corrections if necessary shall be carried out. After the completion of erection, necessary stoppers shall be provided at the wheels. All loosely supplied fittings / accessories shall be cleaned and mounted on the transformer and connections made. After completely assembling & installation, the transformer shall be cleaned and touched up with a paint supplied by the manufacturer applied wherever necessary. All cover bolts shall be checked for proper tightness. (The foundation of transformer and rail fixing will be made by some other agency).

## 2. Testing

Winding insulation resistance shall be measured from primary and secondary to ground and between primary and secondary.

Test the operation of thermister type sensor relay in accordance with the manufacturer's instructions.

Check the polarity of terminals and the phase sequence.

Proforma for transformer tests :

## 3. Proforma for transformer tests :

- Transformer name plate.
- Insulation resistance test with 1000 V meagre.
  - a) between primary to earth
  - b) between secondary to earth
  - c) between primary and secondary
- Operation of the tap changer.
  - Operation of the tap at tap No. 1
  - Operation of the tap at tap No. 2
  - Operation of the tap at tap No. 3
  - Operation of the tap at tap No. 4
  - Operation of the tap at tap No. 5
- Polarity marking and phase sequence.
- Earth resistance: Body & Neutral tank.

[This proforma shall be jointly signed by the CLIENT/ CONSULTANT and the contractor in duplicate].

## 3.3 POWER CONTROL CENTER / MOTOR CONTROL CENTER, DISTRIBUTION BOARDS

### 1. Erection

Electrical panels and bus duct shall be delivered in convenient shipping section by the manufacturer. The contractor shall make his own arrangement for safe transportation of all the items to the erection site and also carry out complete loading / unloading during transportation. The contractor shall be responsible for final assembly and interconnection of busbars / wiring. Foundation channel shall be grouted in the flooring by the contractor. Switchgear shall be aligned and levelled on their base channels and bolted to them as per the instructions of the client / consultant. The earth bus shall be made continuous throughout the length. Loosely supplied relays and instruments shall be mounted and connected on the switchgear. The contacts of the drawout circuit breaker shall be checked for proper alignment and interchangeability.

After erection, the switchboard shall be inspected for dust and vermin proof. Any hole which might allow dust or vermin etc. to enter the panel shall be plugged suitably at no extra cost. If the instrument transformers are supplied separately, they shall be erected as per the direction of the client / consultant. The contractor shall fix the cable glands after drilling the bottom / top plates of all switchboards with suitable holes at no extra cost.

Range of overload relays / timers etc. shall be checked with requirement of motor actually to be connected at site and if the same is undersized / oversized, it shall be brought to the notice of the client / consultant, who shall arrange procurement of corrected components. However, the contractor shall not charge anything extra for

labour for such replacements.

The busduct shall be suitably supported between switchgear and transformer. The opening in the wall where the duct enters, the switchgear room shall be sealed to avoid rain water entry. The foundation of the switchgear shall be raised suitably for minor adjustment to ensure proper alignment and connection of the busduct at no extra cost. Expansion joints, flexible connection, etc. supplied by the manufacturer / contractor of the busduct shall be properly connected.

## 2. Testing

Before electrical panel is energised, the insulation resistance of each bus shall be measured from phase to ground. Measurement shall be repeated with circuit breakers in operating positions and contacts open.

Before switchgear is energised, the insulation resistance of all control circuits shall be measured from line to ground.

The following tests shall be performed on all circuit breakers during erection.

- Contact alignment and wipe shall be checked and adjustment where necessary in accordance with the breaker manufacturer's instructions.
- Each circuit breaker shall be drawn out of its cubicles, closed manually and its insulation resistance measured from phase to phase and phase to ground.
- All adjustable direct acting trip devices shall be set using values given by the consultant/ manufacturer.
- The dielectric strength of insulating oil wherever applicable, shall be checked.
- Before switchgear is energised, the following tests shall be performed on each circuit breaker in its test position.
- Close and trip the circuit breaker from its local control switch push button or operating handle. Switchgear control bus may be energised to permit test operation of circuit breaker with A.C. closing with prior permission of the client / consultant.
- Test tripping of the electrically operated circuit breaker by operating mechanical trip device.
- Test proper operation of circuit breakers latch, check carriage limit switch if provided. Test proper operation of lockout device in the closing circuit. Wherever provided by simulating conditions which would cause a lockout to occur.
- Trip breaker either manually or by applying current or voltage to each of its associated protective release.
- Before switchgear is energised, the tests covered above shall be repeated with each breaker in its normal operating position.
- Capacitor banks shall be tested as per manufacturer's instructions. In addition, test for output and/or capacitance, insulation resistance test and test for efficiency of discharge device shall be carried out.
- All electrical equipment alarms shall be tested for proper operation by causing alarms to sound under simulated abnormal conditions.

## 3. Performa For PCC, MCC, DB, Control Panel Test

- Circuit breaker or contactor module designation / bus no.
- Insulation resistance test (contacts open, breaker racked in position)
  - a) between each phase of bus : Mega ohm
  - b) between each phase and earth : Mega ohm
  - c) DC and AC control and auxiliary circuits : Mega ohm

d) between each phase of CT / PT and between

CT & PT circuit if any : Mega ohm

CT checks

a) CT ratio

b) CT secondary resistance

c) CT polarity check

- Check for contact alignment and wipe.
- Check / test all releases / relays.
- Check mechanical interlocks.
- Check electrical interlocks.
- Check switchgear / control panel wiring.
- Check breaker / contactor circuit for :
  - a) Closing - local & remote (wherever applicable)
  - b) Tripping - local & remote (wherever applicable)
- Opening time of breaker / contactor.
- Closing time of breaker / contactor.

[This proforma shall be jointly signed by the CLIENT / CONSULTANT and the contractor in duplicate].

### 3.4 INSTALLATION OF CABLE NETWORK

Cable network shall include power, control and lighting cables which shall be laid in underground trenches, hume pipe open trenches, cable trays, G.I. pipes, or on building structures as detailed in the relevant drawings, cable schedules or as per the client / consultant's instructions. Supply & installation of cable trays, G.I. pipes / conduits, cable glands and sockets of both end isolators, junction boxes, remote push button stations, etc. shall be under the scope of the contractor.

#### 1. General requirements for handling cables :

- Before laying cables, this shall be tested for physical damage, continuity, absence of cross phasing, insulation resistance to earth and between conductors. Insulation resistance tests shall be carried out with 500 / 1000 V megger.
- The cables shall be supplied at site, wound on wooden drums as far as possible. For smaller length and sizes, cables in properly coiled form can be accepted. The cables shall be laid by mounting the drum of the cable on drum carriage. Where the carriage is not available, the drum shall be mounted on a properly supported axle, and the cable laid out from the top of the drum. In no case the cable will be rolled on as it produces kinks which may damage the conductor.
- Sharp bending of cable shall be avoided. The bending radius for PVC insulated and sheathed, armoured cable shall not be less than 10 D, where "D" is overall diameter of the cable.
- While drawing cables through G.I. pipes, conduits, RCC pipes, ensure that size of pipe is such that, after drawing cables, 40% area is free. After drawing cables, the end of pipe shall be sealed with cotton / bituminous compound.
- High voltage (11 KV and above), medium voltage (240 V and above) and other control cables shall be separated from each other by adequate spacing or running through independent pipes / trays.

- Armoured cables shall never be concealed in walls / floors / roads without G.I. pipes, conduits or RCC pipes.
- Joints in the cable throughout its length of laying shall be avoided as far as possible and if unavoidable, prior approval of site engineer shall be taken. If allowed, proper straight through epoxy resin tight joint shall be made, without any additional cost.
- A minimum loop of 3 mtr. shall be provided on both ends of the cable, and on both ends of straight through cable joint. This additional length shall be used for fresh termination in future. Cable for this loop shall be paid for supply and laying.
- Cable shall be neatly arranged in the trenches / trays in such manner so that criss-crossing is avoided and final take off to the motor / switchgear is facilitated. Arrangement of cable within the trenches / trays shall be the responsibility of the contractor.
- All cable routes shall be carefully measured and cable cut to the required lengths and undue wastage of cables to be avoided. The routes indicated in the drawings is indicative only and the same may be rechecked with the client / consultant before cutting of cables. While selecting cable routes interference with structures, foundations, pipelines, future expansion of buildings etc. should be avoided.
- All temporary ends of cables must be protected against dirt and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulating tapes. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.
- Wherever cable rises from underground / concrete / masonry trenches to motors / switchgears / push buttons, these shall be taken in G.I. pipes of suitable size, for mechanical protection upto 300 mm. distance of concerned cable gland or as instructed by the client / consultant.
- The cable pass through foundation / walls of other underground structures, the necessary ducts for opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundation of structures the electrical contractor shall determine the location and obtain approval of the client / consultant before cutting is done.

## 2. LAYING OF CABLES (UNDERGROUND SYSTEM)

Cables shall be so laid in trench that this will not interfere with other underground structure. All water pipes, sewage lines or other structures which become exposed by excavation shall be properly supported and protected from injury until the filling has been rammed solidly in places under and around them. Any telephone or other cables coming in the way are to be properly shielded / diverted as directed by the owner / consultant.

- Cable shall be laid at minimum depth of 750 mm. in case of L.T. and 1200 mm. in case of H.T. from ground level. Excavation will be generally in ordinary alluvial soil. The width of trench shall be sufficient for laying of required no. of cables.
- Sand bedding 75 mm. thick shall be made below and above the cables. Layer of bricks (full size) shall be laid above sand bedding on the sides and above the of cables to cover cable completely. More than one cable can be laid in the same trench by providing a brick on edge between two cables. However, the relative location of cables in trench shall be maintained till termination. The surface of the ground after back filling the earth shall be made good so as to conform in all respects to the surrounded ground and to the entire satisfaction of the client / consultant.
- For all underground cables, route markers should be used :

- a) Separate route markers should be used for LT, HT and telephone cables.
- b) Route markers should be grounded in ground with 1:2:4 cement concrete pedestal size 230 x 230 x 300 mm..
- c) Cable markers should be installed at an interval not exceeding 30 mtr. along the straight routes of cables at a distance of 0.5 mtr. away from centre of cable with the arrow marked on the cable markers plate indicating the location of cable. Cable markers should also be used to identify change in direction of cable route and for location of every joint in underground cable.
- RCC hume pipe for crossing road in cable laying shall be provided by employer. No deduction shall be made for cable laying in hume pipe for not providing bricks, sand and excavation. RCC hump pipe at the ends shall be sealed by bituminous compound after laying and testing of cables by electrical contractor without any extra charge.

### 3. LAYING OF CABLE IN MASONRY TRENCHES

- Masonry / concrete trenches for laying of cables shall be provided by employer. However, steel members such as M.S. angles / flats etc. shall be provided and grouted by electrical contractor to support the cables without any extra charge. Cables shall be clamped to these supports with minimum saddles / clamps. More than one tier of cables can be provided in the same trench if the no. of cables are more.
- Entry of cables in trenches shall be sealed with bituminous MASTIC compound to stop entry of water in trenches.

### 4. LAYING OF CABLES IN CABLE TRAYS

- Cable trays and steel members such as M.S. angle / channel / flats etc. shall be provided and fixed by the erector.
- Cable shall be fixed in cable trays in single tier formation and cables shall be clamped with aluminium flat clamps and galvanised bolts / nuts.
- Earthing flat / wire can also be laid in cable tray alongwith cables.
- After laying of cables, minimum 20% area shall be spare.

### 5. TERMINATION AND JOINTING OF CABLES

- a) For HT cables suitable size of Reychem termination kit shall be used.
- b) Use of glands :

All PVC cables upto 1.1 KV grade, armoured or unarmoured shall be terminated at the equipment / junction box / isolators / push buttons / control accessories, etc. by means of suitable size double compression type cable glands. Armour of cable shall be connected to earth point. The contractor shall drill holes for fixing glands wherever necessary. Wherever threaded cable gland is to be screwed into threaded opening of different size, suitable galvanised threaded reducing bushing shall be used of approved type.

In case of termination of cables at the bottom of the panel over a cable trench having no access from the bottom, a close fit holes should be drilled in the bottom plate for all the cables in one line, then bottom plate should be split in two parts along the centre line of holes. After installation of bottom plate and cables with glands, it shall be sealed with cold sealing compound.

#### • USE OF LUGS / SOCKETS

All cable leads shall be terminated at the equipment terminals, by means of crimped type solderless connectors unless the terminals at the equipment ends are suitable for direct jointing without lugs / sockets.

The following is the recommended procedure for crimped joints and the

same shall be followed :

- a) Strip off the insulation of the cable and with every precaution, not in severe or damage any strand. All insulation's to be removed from the stripped portion of the conductor and ends of the insulation should be clean and square.
- b) The cable should be kept clean as far as possible before assembling it with the terminal / socket. For preventing the ingress of moisture and possibility of re-oxidation after crimping of the aluminium conductors, the socket should be filled with corrosion inhibiting compound. This compound should also be applied over the stripped portion of the conductor and the palm surface of socket.
- c) Correct size and type of socket / ferrule / lug should be selected depending on size of conductor, and type of connection to be made.
- d) Make the crimped joint by suitable crimping tool.
- e) If after crimping the conductor in socket / lug, some portion of the conductor remains without insulation the same should be covered sufficiently with PVC tape.
- f) For HT cable upto 11 KV the manufacturer's recommendation should be followed.

- **DRESSING OF CABLE INSIDE THE EQUIPMENT**

After fixing of cable glands, the individual cores of cable shall be dressed and taken along the cable ways (if provided) or shall be fixed to the panels with polyethylene straps. Cable shall be dressed in such a manner that small loop of each core is available inside the panel.

For motors of 20 HP and above, terminal box if found not suitable for proper dressing of aluminium cables, the erector shall modify the same without any additional cost.

Cables inside the equipment shall be measured and paid for.

- **IDENTIFICATION OF CABLES / WIRES / CORES**

Power cables shall be identified with red, yellow and blue PVC tapes. For trip circuits identification, additional red ferrules shall be used only in the particular cores of control cable at the termination points in the switchgear / control panels and control switches.

In case of control cables all cores shall be identified at both ends by their wire numbers by mean of PVC ferrules or self sticking cable markers, wire numbers shall be as per schematic / connection drawing. For power circuit also, wire numbers shall be provided if required as per the drawings of switchgear manufacturer / supplier.

## 6. TESTING OF CABLES

- Before energising, the insulation resistance of every circuit shall be measured from phase to ground. This requires 3 measurements if one side is grounded and 6 measurements for 3 phase circuits.
- Where splices or terminations are required in circuits rated above 650 volts, measure insulation resistance of each length of cable before splicing and/or terminating. Repeat measurements after splices and/or terminations are complete.
- DC high voltage test shall be made after installation on the following :
  - a) All 1100 volts grade cables in which straight through joints have been made.
  - b) All cables above 1100 V grade.





and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.

8. The earth conductors (Strips / Wires copper / Hot dip G.I.) Inside the building shall properly be clamped / supported on the wall with Galvanised Iron clamps and Mild Steel Zinc Passivated screws / bolts. The conductors outside the building shall be laid atleast 600 mm. below the finished ground level.
9. The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.
10. Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.
11. The earth conductors shall be in one length between the earthing grid and the equipment to be earthed

#### 4.2 EARTH LEADS AND CONNECTIONS

1. Earth lead shall be bare copper or Galvanised steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. G.I. strip buried in the ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is atleast 8 mm away from the wall surface.
2. The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

#### 4.3 TEST

1. The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3043.
2. The following earth resistance values shall be measured with an approved earth megger and recorded.
  - 1) Each earthing station
  - 2) earthing system as a whole
  - 3) Earth continuity conductors
3. Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 5 ohm in each case.
4. Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.
5. All tests shall be carried out in presence of the Pmc

### 5.0 CONCEALED / SURFACE CONDUIT WORKS

#### 5.1 LAYING OF CONDUITS

1. Conduits shall be laid before casting in the upper portion of a slab / in PCC if below flooring or otherwise, as may be instructed in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Conduits shall be so laid that they are interconnected. This is required to facilitate pulling of wires from different openings in case of any of the outlet is outlet is blocked during slab casting. Vertical drops shall be cut by the contractor to sufficient depth to allow full thickness of plaster over conduits. The width of the chases will be made to accommodate the required number of conduits. The chases will be filled with cement, coarse
2. When the conduit is to be embedded in a concrete member it shall be adequately

tied to the reinforcement to prevent displacement during casting. Tie wire to be supplied by the contractor.

3. Cutting of chases in any RCC member / finished floor / already finished surface is not allowed unless prior approval of Site Engineer is taken in site instruction book. If a chase is cut in an already finished surface, the contractor shall fill the chase and finish it to match the existing finish including painting at his cost to Site Engineer's satisfaction.
4. Contractor shall not cut any iron bars to fix the conduits. Puncher of wooden / steel shuttering for RCC slab / beams / column etc. for conduit work is also not allowed, unless Site Engineer permits in site instruction book under special conditions.
5. Run of conduit pipe through expansion joints in RCC members should be avoided as far as possible and if unavoidable, flexible conduit pipe should be used with ceiling outlet box on both sides of expansion joints.
6. Conduit on surface of RCC walls / RCC members shall be avoided as far as possible and if unavoidable prior approval of Site Engineer on sample saddles, clamps screws and a minimum 5 mtr. conduit laid on surface shall be taken, to achieve best possible workmanship. Distance between 2 consecutive clamps for fixing conduit on surface shall not exceed 900 mm. wooden patties for fixing saddles / clamps shall be used. Use of roll plug / steel fastener with hard setting / sealing compound is recommended.
7. In case of stone masonry, necessary conduits with M.S. boxes should be placed as the masonry is in progress, since after completing masonry, it is very difficult to cut chases in wells. Special location of cement concrete shaft is also recommended to conceal conduit in stone masonry and the same shall be provided by client / consultant.
8. In ground floor conduiting below the flooring should be avoided. Wherever it is unavoidable G.I. pipe should be used with prior approval of Site Engineer.

## 5.2 CEILING / WALL OUTLET BOXES FOR LIGHTS / FANS

1. Outlet boxes shall be of steel with aluminium cover and so installed as to maintain continuity throughout. These shall be protected at the time of laying by filling with jute / earth / cotton etc. so that no cement mortar finds its way inside during concreting or plastering etc. Typical sketches for such outlet boxes shall be supplied alongwith other working drawings. In beams conduit socket shall be provided in place of outlet boxes. The same shall be used for installation of luminaire.
2. For fixing light fixtures / brackets, outlet boxes complete with check nut for holding conduits shall be used. For lighting fixture suitable for 20 watts fluorescent tubes / incandescent lamps / mercury vapour lamps, only one outlet box is required. For fixing lighting suitable for 40 watts fluorescent lamps, two numbers outlet boxes should be provided at a distance of 300 mm. away from the centre in the longitudinal direction of the fixture, so that the use of patties / roll plug etc. may be avoided, as well as wiring from outlet box to the light fitting is to be installed in RCC beam and due to heavy reinforcement at the bottom of beam it is not possible to provide outlet boxes simple conduit should be provided. However alternative fixing arrangement shall be made in consultation with client / consultant.
3. For fixing ceiling fans, circular outlet boxes, 100 mm. diameter, complete with 12 mm. dia. Mild Steel rod 300 mm. long, for holding 12 mm. dia. Mild Steel cover 125 mm. dia. at bottom shall be used.

## 5.3 DRAW OUT JUNCTION BOXES

Steel drawout boxes at angle dimensions shall be provided at a convenient points on walls / ceilings to facilitate pulling of long runs of cables / wires. These shall be completely concealed with Anodised Aluminium, flush with plaster works. These draw boxes should be five sided. The location of these boxes is to be decided prior to fixing, as per site requirement and following should be treated as general

guidance for deciding the location of these :

1. These should be provided at a place where these are not in direct view. Recommended place is 400 / 450 mm. below ceiling, if conduits are running vertically.
2. Junction box in the offset of bottom of RCC beam and vertical wall should not be provided.
3. If junction boxes are coming side by side for two or more conduits, one common M.S. box of proper size can be used to act as junction box.
4. If junction box is to be provided in ceiling, its position should be so located that it is in line with other light / fan points.
5. Junction boxes should never be used for splitting one conduit into two or more. Junction box for such functions is avoidable and for this, number of conduits to be connected to one switch board should be calculated correctly as per drawing before laying conduits in ceiling.
6. Locating junction boxes on outer surface of exterior walls of building should be avoided as these are in direct view and are also exposed to weather.
7. Junction boxes should never be closed permanently by plaster. Removable covering of aluminium should be provided for conduit junction boxes for M.S. junction boxes removable hylem plate should be provided. This cover may be painted with wall colour.
8. Junction boxes in important areas should be avoided and can be located in toilets / corridors / service shafts and stores etc.

#### 5.4 SWITCH BOXES

Steel boxes of required sizes, shall be provided to house speed regulators of fans, switches for lights, fans, plug sockets etc. as per requirement of drawings. These should be so designed that accessories on Anodised aluminium sheet could be mounted with tapped holes and brass machine screws, leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on all walls of the boxes through which the conduits are entering. These shall be completely connected leaving edges flush with finished wall surfaces. Anodised aluminium cover should be fixed to these switch boxes by means of brass chrome plated machine screws and cup washers. Utmost care shall be taken by contractor to ensure that all switch boxes are in line and level.

Inside each switch box, one bolt shall be welded to receive earthing wire.

#### 5.5 SWITCH AND SOCKET

Switches shall be installed at 900 mm above finished floor level unless otherwise indicated on the drawings.

The switch controlling the light point or fan shall be connect on to the phase wire of the circuit and neutral shall be continuous, having no fuse or switch installed in the line except at the D.B. All fan regulators shall be fixed inside the switch boxes on adjustable flat M.S. strips / plates with tapped holes and brass machine screws, leaving ample space at the back and side for accommodating wires.

The cover plates to the switch box shall be fixed by means of sunk head brass cadmium screws.

Where two or more switches and fan regulators are installed together, they shall be provided with one gang cover plate with knockouts to accommodate required number of switches, sockets and regulators.

The switch controlling the socket outlet shall be on the phase wire of the circuit. The third pin of the socket shall be connected to the earth continuity conductor of the circuit

The switch boxes, installed back-to-back in the same wall shall be offset from each other, 150 mm horizontally, to preclude noise transmission.

#### 5.6 CLEANING AND PROTECTION OF CONDUIT SYSTEM

The entire conduit system including outlet boxes, junction boxes and switch boxes shall be thoroughly cleaned after completion of erection and tested for not blockage by air / sound or steel wire prior to finishing of building by air / sound or steel wire prior to finishing of building and before drawing in of cables / wires to safeguard conduit system against filling up with the plaster / cement slurry / water etc. all the outlet and switch boxes will have to be provided with temporary jute / cotton filling, covers and plugs etc.. Within tendered cost which shall be replaced later on by hylem / sheet cover after wiring as required.

#### 5.7 TESTING OF INSTALLATION

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

##### 1. INSULATION RESISTANCE

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

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

The insulation resistance shall be measured between

EARTH TO PHASE

EARTH TO NEUTRAL

PHASE TO NEUTRAL

PHASE TO PHASE

##### 2. EARTH CONTINUITY PATH

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

##### 3. POLARITY OF SINGLE POLE SWITCHES

A test shall be made to verify that every no-linked, single pole switch is connected to one of the phase of the supply system.

##### 4. COMPLETION CERTIFICATES

All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.

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

#### 6.0 INSTALLATION OF LIGHTING FIXTURES / FANS

##### 6.1 INSTALLATION OF LIGHTING FIXTURES

Scope of work under this item shall start from light point, with a 5 A bakelite connector, 2 core 1.5 mm.<sup>2</sup> PVC insulated wires from this connector to the

connector inside the lighting fixture, connections, fixing of lighting fixture complete with all accessories, lamps on wall / roof / steel truss etc. testing the lighting fixture and commissioning. If wire length of light point is enough to reach connector of light fitting, connector in light point can be deleted.

## 6.2 INSTALLATION OF EXHAUST FANS

Scope of work under this system shall start from exhaust fan point, with a ceiling rose, 2 core 2.5 mm.<sup>2</sup> PVC insulated wire from ceiling rose to connector of exhaust fan, connections, making fan opening in walls including repair / finishing fixing of exhaust fan complete with accessories and louvers on walls with hold-fasts, testing the exhaust fans and commissioning.

## 7.0 INSTALLATION OF EXTERNAL LIGHT FIXTURES

### 7.1 BRACKET FOR STREET LIGHT FITTINGS

The brackets shall be made of 38 mm. NB MS class "B" pipe approx. 1.8 mtr. long bent at the centre at an angle 120° C. with necessary holding brackets, hold fasts etc. with special reducer at the end to accommodate type of street light fitting to be fixed. Bracket shall have 1 coat of anti-corrosion paint before despatch to site and 2 coats of approved make and shade of aluminium paint. This bracket shall also be provided with one M.S. water tight box complete with the connector, neutral link, rewirable fuse etc.. See enclosed drawings of street light poles.

### 7.2 INSTALLATION OF POLES

Installation of poles shall be done as per enclosed drawings of street light poles. The depth of pole to be buried in ground shall be 1/5th of the total pole length or as specified in drawing, whichever is more. Special care shall be taken in erecting poles so that these are not strained or damaged during erection and are firmly stayed till the foundation are secured. The pole shall be grouted inside ground pit (cross-section 600 x 600 mm.) with cement concrete 1:2:4. Before the placement of concrete around pole in the pit, necessary conduit pipes (not less than 25 mm. dia.) shall be placed for facilitating drawing of cables. Separate conduit shall be provided for incoming and outgoing cables. The cement concrete shall be protected from prematured drying by curing for atleast 7 days after pouring. All concrete surface from 150 mm. below ground level to top shall be finished smooth with cement mortar 1:4.

### 7.3 INSTALLATION OF STREET LIGHT FIXTURES

This includes fixing of street light fittings complete with accessories and lamps at the end of the pole / bracket, connecting it with 3 x 2.5 mm.<sup>2</sup> aluminium conductor, PVC insulated cable from water tight M.S. box, testing, commissioning. Third core shall be connected with earthing point of light fitting at one end and earthing point of marshalling box at the other end.

### 7.4 GENERAL NOTES FOR STREET LIGHTING

1. For supplying and laying of cables, technical specification (wiring) shall be applicable reference shall be made under heading Cable Work elsewhere in the tender.
2. For street light poles along roads, nearest finished road level shall be taken as ground level and for poles along compound wall / away from roads, existing ground / finished ground shall be taken as ground level.
3. Distance of 1 mtr. shall be maintained between centre of pole and centre of curb of road. For compound wall poles, distance between compound wall and poles shall be 3 mtrs.
4. A loop of 1.5 mtr. of cable shall be provided near each street light pole for all incoming and outgoing cable.

- 8.1 After supply and installation of complete project or a particular building / area, following tests shall be carried out by the contractor before switching on the power to installation and the results shall be recorded and submitted to the Site-Engineer. If results are not satisfactory / as per standards set herewith, the contractor shall identify the defects / short coming and shall rectify the same. Nothing extra shall be paid for carrying out these tests and contractor has to arrange all necessary instruments.

8.2 INSULATION RESISTANCE TO EARTH

This is to be measured with all fuse links in place, all switches ON, all lamps and appliances in position by applying a voltage not less than twice the working voltage (subject to a limit of 500 V). Insulation resistance of the whole or any part of the installation to earth must not be less than 50 mega-ohms divided by the number of outlets (points and switch positions) except that it need not exceed one mega-ohm for the whole installation.

8.3 INSULATION RESISTANCE BETWEEN CONDUCTORS

Tests to be made between all the conductors connected to one pole or phase conductor of the supply and all the conductors connected to the middle wire or neutral or the other pole or phase conductors of the supply. For this test, all lamps shall be removed and all switches put ON. The result of the test must be 50 mega-ohms divided by the number of outlets (points and switch positions) but need not exceed 1 mega-ohm for the whole installation.

8.4 POLARITY OF SINGLE POLE SWITCHES

Tests shall be made to verify that all non-linked single pole switches are on phase conductor (live) and not on neutral or earth conductor. This can be done by connecting test lamps between two terminals of switch and earth. If the lamp lights up when switch is ON and either terminal is touched, the switch is correctly installed.

8.5 RESISTANCE OF METAL CONDUITS / SHEETS (EARTH CONTINUITY TEST)

In case of cables encased in metal whether conduit of metallic sheathing, the total resistance of the conduit or sheathing from the earthing point any other position in the completed installation shall not exceed 2 ohms. This can be carried out by following circuit :

One end of the load is connected to the ECC and its connection with the electrode and the other to the farthest point of the ECC. First, current through the circuit is measured with the resistance of 2 ohms short circuited by the link. Next, current is measured through the two ohms resistance by disconnecting the two leads from the ECC and joining them together. If current is more in the first case, the resistance of ECC is less than 2 ohms.

- 9.1 After completion of works and tests specified above, the various building of the project can be taken over by the employer as and when these are ready in all respects. However, the defect liability period of 12 months would start from the date, when all the buildings of the project have been completed and handed over, unless employer agrees for defect liability period in phased due to non-completion of civil work of few buildings for which electrical contractor is not responsible.

- 10.1 The Tenderer shall indicate the makes of tools, test equipment and other item listed below:

1. TOOLS

A. Set of spanners of sizes 6 mm to 32 mm width across flat

- Adjustable wrench of 36 mm jaw width
- Adjustable wrench of 23 mm jaw width

B. Heavy duty screw driver with full size insulated handle and blade length of

- 100 mm
- 50 mm
- 200 mm

2. TEST EQUIPMENT

A. 2500 V megger motor operated

B. 500 V megger hand operated

C. Multimeter (Battery operated) satisfying the following

- With 0-1 mA, 0-100 mA, 0-1A and 0-5A, AC & DC current ranges
- With 0-100 mV, 0-3V, 0-30 V, 0-300 V and 0-1000V AC & DC voltage ranges
- The resistance ranges shall be atleast five (0-100) m ohm, (0-1) Ohm, (0-10) Ohm, (0-100) Ohm, (0-100) mega ohm
- The Input impedance shall not be less than one mega Ohms for voltage ranges

3. LADDERS

Ladder shall be made out of light aluminium alloy of good strength. They shall be of step ladder, foldable, self supporting type with spreader of metallic angles or high strength nylon straps. The ladder shall be provided with shoes on bottom of legs. Rugs shall be flat type having thickness of 30 mm in case of 3 meters long ladders and 60 mm for 6 metres long ladder.

- 3 metres long
- 6 metres long

4. Tong tester - ammeter range 0 to 30, 150 & 300 Amps AC and voltmeter (0-600) V, class 1.0 with leads and leather case.