

CHAPTER NO. 31
ELECTRICAL INSTALLATIONS IN
BUILDINGS

SPECIFICATION NO. 31.1—Electrical Work (General)

1. The installation generally shall be carried out in conformity with the latest edition of the "Regulations for the electrical equipment of buildings of the Institution of Electrical Engineers (London)," hereinafter referred to as the "I.E.E. Regulations" but, where this specification or the attached Special Conditions of Contract differ from those regulations, the Specification and Special Conditions shall be followed. In addition all installations shall comply in all respects with the requirements of the Indian Electricity Act and the Indian Electricity Rules for the time being in force.

The I.E.E.
Regulations.

2. The definitions of terms in the latest edition of the I.E.E. Regulations (reprinted in Appendix XXII) shall apply except No. 27-A "Point" shall consist of the branch wiring from the branch distribution board or from the point of service entry where there is no branch distribution board together with a switch if required, as far as and including the ceiling rose or wall plug, etc. The list of conventional signs and symbols as given in appendix XXII shall be used in all drawings, wiring plans, etc.

Definitions and
conventional
symbols.

3. (a) The wiring shall be carried out on such system as may be stated in the special conditions of contract, or as otherwise specified. The wiring is to be done on the "distribution system" with main and branch distribution boards at convenient centres and without isolated fuses, except as specified for wall sockets in clause 17. All conductors shall be run, as far as possible, along the walls and ceiling, so as to be easily accessible and capable of being thoroughly inspected. In no case is wiring to be run above ceilings without the special approval, in writing, of the Engineer-in-charge. The balancing of circuits in 3 wire or 3-phase installations shall be arranged before-hand by the Engineer. Circuits on opposite sides of a 3-wire system, or on different phases of a 3-phase system, are to be kept as far apart as possible in all cases, the minimum distance from each other being 7 feet. Medium pressure wiring and all associated apparatus shall comply in all respects with the requirements of Rules 60 and 61 of the Indian Electricity Rules, 1937.

System of Wiring.

(b) All current consuming devices shall be suitable for the pressure and frequency of supply stated in the special conditions of contract, or as otherwise specified.

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Drawings.

4. All wiring diagrams shall be deemed to be 'drawing' within the meaning of the term as used in the general conditions of the contract and shall be prepared to the satisfaction of the Engineer-in-charge. Within one month of the taking over of the installation the contractor shall supply to the Engineer-in-charge a complete wiring diagram of the work done by the contractor. In the case of the original installation, in a building, drawings of the building shall be supplied by the Engineer incharge on request from the contractor. In the case of additions to existing installations, the contractor shall himself supply a wiring diagram of the additions only, in sufficient detail, to enable the Engineer-in-charge to bring his original wiring diagram of the building up to date. All wiring diagrams are to indicate, clearly, in plan, the relative positions of all main boards, branch boards, distribution boards, and the runs of the various mains, sub-mains, and circuits, with the position of all points and fittings.

Only the conventional symbol given in Appendix XXII are to be used. All circuits are to be clearly indicated and numbered on wiring diagrams, and all points are to be numbered with the same number as the circuit to which they are electrically connected.

Conductors.

5. All conductors are to be of copper in accordance with the Specification of the British Engineering Standards Committee as set forth in the latest edition of I.E.E. Regulations. Except as provided in clause 18 *infra* and clause 9 of Specification no. 31.3 insulated conductor shall have a cross-section less than .0020 square in., nominal area (3/.029") and every such conductor shall be stranded.

Cables.

6. (a) All cables, unless the contrary is expressly stated in the special conditions of contract, or otherwise, shall comply in all respects with the latest British Engineering Standards Association Specification for insulated annealed copper conductors for electric power and light and each coil must be accompanied by the maker's test certificate, stating the 'class' and giving the results of insulation tests.

(b) Twin flexible cables shall comply with the latest edition of the I.E.E. Regulation.

General precautions applicable to supply at medium or high pressure.

Rule 60—Where a licensee proposes to supply or use energy at medium or high pressure, he shall give notice to an Inspector and shall not commence or continue the supply unless and until he has complied with the following provisions, namely:—

(a) all live parts of apparatus shall, unless accessible only to, and under the control of, an authorised person, be protected

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by mechanically strong metal-casing or metallic covering securely fastened throughout;

- (b) suitable linked switches, of requisite capacity to carry and break the current shall be inserted in each conductor, near the point of origin on the consumer's premises;
- (c) every conductor, unless accessible only to an authorised person, shall be as far as is practicable completely enclosed in a mechanically strong metal-casing or metallic covering, securely fastened throughout or fixed in such other manner as may be approved in writing by an Inspector;
- (d) the supply to every apparatus shall be efficiently controlled by suitable linked switches, of requisite capacity to carry and break the current, in each conductor, placed near the apparatus in such a position as to be readily handled by the operator, so that by their means all pressure can be cut off from the apparatus concerned and from any device in connection therewith;
- (e) the word "CAUTION", both in English and in the vernacular, shall be affixed permanently in a conspicuous position, where possible, on every generator and every motor and every controlling or regulating apparatus in connection with such generator or motor :

Provided that where it is not possible to affix them on the generator motor or apparatus, they shall be fixed as near as possible:

Provided also that where the generator, motor, controlling or regulating apparatus is within an enclosure accessible only to an authorised person, one notice affixed to the enclosure shall be sufficient for the purposes of this sub-rule.

RULE 61—The owner of every main switchboard connected with Main Switch a supply of energy at medium or high pressure shall comply with the following provisions, namely:—

- (a) a clear space of not less than 3 feet in width shall be provided in front of the switchboard;
- (b) if there are any attachments or bare connections at the back of the switchboard, the space (if any) behind the switch-

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board shall be either less than 9 inches or more than 30 inches in width, measured from the further outstanding part of any attachment or conductor:

- (c) if the space behind the switchboard exceeds 30 inches in width, there shall be a passage-way clear to a height or of not less than 6 feet, save as regards any horizontal supports of the switchboard, which may be placed at a height of not less than 4 feet 6 inches.

Fall of Potential.

7. The cross-sectional area of all conductors inside buildings shall be so proportioned to their length that the drop in pressure from the main fuses to the further, or any consuming device, shall not exceed 2 per cent plus 1 volts of the normal pressure of the circuit directly connected to such consuming device, with all the consuming devices in use.

Rating of lamps and fans.

8. In estimating the current to be carried by any conductors, consuming devices are to be rated at the volt-amperage specified by the Engineer in the Special Condition of Contract or otherwise.

Tests.

9. Before current is switched on the installation shall satisfactorily pass the following tests:—

(A) **Insulation Resistance:**—(a) The insulation resistance shall be measured by applying between 'earth' and the whole system of conductors or any section thereof, with all fuses in place and all switches on, a direct current pressure of not less than twice the working pressure. Where the supply is derived from a three-wire (alternating or direct current) or poly-phase system the neutral 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 outer or phase conductors and the neutral.

(b) the insulation resistance of an installation measured as in A (a) above shall not be less in megohms than 25 divided by the number of points on the circuits, provided that:—

(i) any installation shall not be required to have an insulation resistance greater than 1 megohm;

(ii) lighting circuits shall be tested with all lamps in place, except in the case of earthed concentric wiring systems.

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- (iii) heating and power circuits, with or without lighting points, may be tested, if desired with the heating and power appliances disconnected from the circuits, but with the lamps (if any) in place ;
- (iv) the insulation resistance between the case or frame work and every live part of each individual dynamo, motor, heater, arc lamp, control gear or other appliance shall not be less than half a megohm.

Note.—In addition to the foregoing tests, it is advisable, wherever practicable, to take an insulation test between all the conductors connected to one pole or phase and all the conductors connected to the other pole or phase of a system.

(B) **Continuity of Metal Sheathing.**—The metal conduits or metallic envelopes of cables in all cases where such methods are used for the mechanical protection of electrical conductors shall be tested for electric continuity, and the electrical resistance of such conduits or sheathing, measured between a point near the main switch and any other point of the completed installation, shall not exceed 2 ohms.

10. Looping in system of wiring points shall be adopted in all types of wiring, i.e., casing and copping cleated TRS and conduit system.

11. (a) All main switches are to be of the iron clad type of approved make.

Switches.

(b) All switches and circuit breakers shall be constructed and installed in accordance with the latest edition of the I. E. E. Regulations. Handles of switches shall be so fastened that they do not tend to unscrew and become loose. All tumbler switches must be of the bakelite type, unless otherwise approved by the Engineer-in-charge.

(c) In earthed systems all single-pole switches on 2-wire circuits controlling lights, fans, plugs, etc., must be inserted in the outer or phase wire, as the case may be. In insulated D.C. systems such switches are to be inserted in the positive side.

(d) A fuse or unlinked single pole switch shall not be inserted in —

(i) The "middle" or "neutral" conductor of a three-conductor circuit supplied from a direct-current or single-phase-three-wire system (see diagram).

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- (ii) The "common return" of a two-phase three-conductor circuit.
- (iii) The "neutral" of a three-phase four-conductor circuit.
- (iv) That conductor of an installation which is permanently earthed at the source of supply without a circuit breaker or added resistance in the earth connection.

Note.—The requirements of sub-clause (d) above do not preclude the provision of an isolating link for testing purposes. Any system of supply having a "middle" conductor, "neutral" or "common return" not publicly declared or known to be earthed without a circuit breaker or added resistance in the earth connection shall be considered for the purposes of sub-clause (d) (iv) above to be a system having an insulated "middle" conductor, "neutral" or "common return", respectively.

(e) All unlinked single-pole switches throughout an installation shall be fitted in the conductor or conductors connected to the outer or phase conductors of the supply, or in the case of a two-wire system of supply, in the same conductor throughout, which shall not be a conductor earthed either with or without a circuit breaker or added resistance in the earth connection.

RULE 51. (2) In no case shall the consumer insert any single pole switch or cut-out or permit such switch or cut-out to be or to remain inserted in any earthed neutral conductor.

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

12. There shall be the iron-clad main switch any one main fuse on each pole of each main circuit at the point of entry of the supply except as provided in rule 51 (2) of Indian Electricity Rules. The switches must be linked unless otherwise specified in the Special Conditions of Contract.

**Main and Branch
Distribution
Boards.**

13. (a) Main and branch distribution boards unless otherwise specified in the conditions of contract shall be of iron clad type and shall be provided with a switch and fuse on each pole of each circuit, except as provided in rule 51(2) of Indian Electricity Rules.

(b) Branch distribution boards shall be provided with one fuse on live pole of each circuit. One spare circuit of the same current carrying capacity shall be provided on each branch distribution board. No sub-circuit for lights and fans radiating from a branch board shall

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carry more than 4 amperes. In estimating the total current on any sub-circuit each 5-amp. plug point shall be rated at 2 amperes.

(c) In writing a branch distribution board the total capacity of consuming devices shall be divided, as far as possible evenly between the number of ways of the board. The spare circuit shall be left for future extensions.

(d) In the construction and fixing of main switches and main and branch distribution boards the following requirements shall be fulfilled —

- (i) A small bracket for carrying a pilot lamp shall be fixed over each distribution board when required and connected through an independent single pole switch and fuse to the bus-bars of the board controlling the circuit.
- (ii) All main and branch distribution boards and fuses shall be approved by the Engineer-in-charge.
- (iii) Connections shall be arranged as far as possible to form their own diagram.
- (iv) Each circuit shall be clearly numbered, from left to right, in conspicuous figures, to correspond with the wiring plans (clause 4).
- (v) Iron clad switches and distribution boards shall be mounted on 2" X 2" X 1/4" angle iron frame covered with 1/8" thick iron sheet covering or in recessed cast iron boxes or in wall niches of suitable size as directed by the Engineer-in-charge.
- (vi) The casing shall be connected with the main switches and distribution board through flexible metal pipes.
- (vii) Angle iron frames for use with conduit or cleated wiring shall be provided with suitable inlets and outlets.

14. (a) Except as laid down in Clause 6 of Specification No. 31.5 where conductors pass through walls one of the following alternative methods shall be used :—

- (i) A hole of suitable area shall be made in the wall, through which the casing or conductors shall be carried so as to allow of an air space of not less than 1 inch on three sides of the casing or conductors, as the case may be ; or

Passing through walls.

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(ii) The conductors shall be carried in an approved heavy gauge welded conduit enamelled both inside and outside. Where casing wiring is used the ends of the conduit must be nearly fixed into the casing and the mouth of each tube shall be bushed with a snap-headed bush. Where the supply is alternating the conductors of the circuit must be bunched.

(b) Where a wall tube passes outside a building so as to be exposed to the weather, the outer end shall be turned downwards at right angles and suitably bushed.

Plugging Walls.

15. Except with the permission of the Engineer-in-charge, rawl or other special approved plugs are to be used for fixing of wiring, etc., to walls, ceiling, etc. Where the use of ordinary wooden plugs is sanctioned these shall be of well-seasoned teak or other approved hard wood, not less than 2 inches long by 1 inch square on the inner end and 3/4 inch square on outer end. They shall be cemented into the walls, to within 1/4 inch of the surface, the remainder being finished according to the nature of the surface used, with the plaster or lime punning. Unless otherwise specified 1-3/4 inch long iron screws may be used for attaching casing to the plugs. Where owing to irregular coursing or other reasons the plugging of the walls or ceilings presents difficulties, the casing, conduit or cleats (as the case may be) shall be attached to the wall or ceiling in a manner approved by the Engineer. In case of new buildings the T. W. plugs shall be fixed in walls before same are plastered.

Ceiling Roses.

16. (a) Ceiling roses shall not be used for pressures exceeding 250 volts.

(b) Not more than two pairs of flexible cords shall be attached to one ceiling rose unless it is specially designed for multiple pendants.

(c) Ceiling roses shall not embody fuse terminals as an integral part of them.

Wall Sockets.

17. All wall socket points shall include a switch and a fuse mounted alongside the wall socket. The connections between the switch, the fuse and the wall socket are to be so arranged that the switch is on the 'live' side of both the fuse and the wall socket. In earthed systems, the switch and fuse may be of the single-pole type connected in the outer or phase wire, as the case may be. In insulated systems a double-pole linked switch must be used.

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18. All wall-sockets shall be of 3 pin type. The 3rd pin shall be earthed through S.W.G. No. 8 G.I. wire run under the casing. The bonding of the 3rd pin with the G.I. earth wire shall be done by means of stranded G.I. wire. The bonding of 3rd pin of wall socket in the case of T.R.S. system of the wiring shall be done through No. 14 SWG bare copper wire run between cables and taken direct to the 3rd pin.

19. Where conductors require to be threaded through tubes or channels formed in the metal work of fittings, the tubes or channels must be free from sharp angles or projecting edges and of such a size as will enable them to be wired with the conductors used for the final sub-circuits without removing the braiding or taping. As far as possible all tubes or channels should be of sufficient size to permit of 'looping back'. If flexible wire is used for wiring fittings, other than portable fittings, the sub-circuit leads must terminate in a ceiling rose or connector, from which this will be carried into the fittings. All fittings must have not less than 1/2" nipple. Fittings and lamp-holders for gas filled lamps shall be adequately ventilated. In no case is the cross-sectional area of the wires for fittings to be less than 0.0010 square inch (23/0076").

Fittings.

20. Lamp-holders for use on brackets etc., shall have not less than 1/2 inch nipple, and all those for use with flexible pendants shall be provided with cord grips. All lamp-holders shall be provided with shade carriers. All cases must be solid and substantial. Except with the approval of the Engineer all holders are to be of the 'bakelite' type. Screw-holders will not be accepted for lamps below 100 watts.

Lamp-Holders.

21. All outdoor lamps shall have weather-proof fittings of approved design so as to prevent effectually the admission of moisture. Flexible cord conductors and cord grip lamp-holders must not be used when exposed to the weather. In verandahs and similar exposed situations plan pendants must not be used.

Outdoor Lamps.

22. All lamps, unless otherwise specified in the Special Conditions of Contract, shall be suspended at a height of 8 feet above the floor level. All lamps must be approved by the Engineer.

Lamps.

23. (a) (i) All ceiling fans shall be wired to a ceiling rose and suspended from a hook or shackle and insulated from the same. All joints in the suspension rod shall be screwed and all joints or bolts in connection therewith shall be additionally secured by means of split pins.

Fans and Regulators.

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(ii) The canopy at the top of the suspension rod shall effectually hide the suspension.

(iii) The leading in wires shall be not smaller than 3/029" and shall be protected against abrasion.

(b) Unless otherwise stated in the Special Conditions of contract.—

(i) All fans shall be suspended so that the blades are 9 feet above the floor.

(ii) Each fan shall have a separate tumbler switch, and speed regulator.

Attachment of
fittings and
accessories.

24. (a) In other than conduit wiring, all ceiling roses, wall sockets, switches, regulators, brackets, pendants and accessories attached to walls or ceilings shall be mounted on substantial teakwood blocks with dove-tailed corners, twice varnished after all fixing holes are made in them. Brass screws shall be used for attaching fittings and accessories to their base blocks. All teakwood blocks and boards shall have a backing of 3/8" thick teakwood, so as to prevent connections touching walls. The sides of the blocks shall be 3/4" thick and the front covering 5/8" thick. The covers of all blocks except round blocks shall be provided with brass hinges.

(b) Unless otherwise specified in the Special Conditions of Contractor all attachment blocks shall be spaced from the wall or ceiling by means of moisture-proof distance pieces not less than 1/8th of an inch thick.

Interchangeability.

25. Similar parts of all switches, lamp-holders, wall sockets and plugs, distributing boards, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable.

SPECIFICATION NO. 31.2—Wood Casing Wiring

(This system of wiring should generally be used in Government buildings)

1. All casing shall be of teakwood, free from knots, shakes, sap or other defects and shall have a smooth finish. The casing shall have a grooved body with a simple reeded or plain moulded cover.

Material and pattern of casing.

2. The scantling of casing and capping shall be to the satisfaction of the Engineer. The grooves shall be rounded and in no case shall the width of the fillet between the grooves be less than $\frac{1}{4}$ inch. The thickness of the back under the grooves, capping over the grooves and outer walls of the casing shall not be less than $\frac{1}{4}$ inch. Dimensions of grooves shall be such that the wires will not require any force to put them in place. The overall width and thickness of the casing shall not be less than $1\frac{1}{2}$ inch and $\frac{3}{4}$ inch, respectively. Where capping is attached to casing by screws at the sides, the thickness of the outer wall of the casing shall not be less than $\frac{3}{8}$ inch.

Dimension of casing and capping, etc.

3. Wires of opposite polarity shall not be run in the same groove. The neutral and outer in the case of 3-wire D.C. system and the neutral and phase wire in the case of A.C. system shall not be run in the same groove.

Grouping of Circuits.

4. Ordinarily, all casing shall be fixed, by means of iron screws of suitable sizes, to plugs at intervals not exceeding 3 feet arranged as provided for in clause 15 of specification no. 31.1. Unless otherwise specified, in the Special Conditions of Contract, all casing shall be spaced from the walls or ceiling by means of moisture proof distance pieces not less than $\frac{1}{4}$ inch thick. All screws shall be so spaced as not to break the wall of the grooves. Casing shall not be buried in walls, nor fixed in proximity to gas, steam or water pipes, or immediately below the latter.

Attachment of casing to walls and ceilings.

5. Where conductors pass through floors, the conductor shall be carried in an approved heavy gauge insulated conduit or tube. The floor tubes shall be carried 12 inches above floor level and 1 inch below ceiling level and neatly entered into the casing which shall, if required by the Engineer-in-charge, be suitably projected at the floor level. Where the supply is alternating current the conductors of the circuit must be bunched in the tube.

Passing through floors.

6. Casing and capping shall be run in lengths as long as possible. All joints shall be scarfed, or cut diagonally in longitudinal section. Capping shall be secured at the joint with two or more screws as may

Joints in casing and capping.

SPECIFICATION NO. 31-2—Wood Casing Wiring

be necessary. Joints in capping must break joint with those in the casing.

Conductors carried round mouldings and angles.

7. In order to avoid carrying casing round wood mouldings or beams holes should where practicable, be pierced through the same, provided that the piercing of the such holes does not appreciably weaken the structure. A separate hole should be pierced for each groove in the casing. Where casing forms an angle on a wall or ceiling the corners of the grooves must be properly rounded. Where casing attached to a wall is united to casing attached to a ceiling, corner pieces with front grooving shall be used at all inside angles.

Casing to harmonize with decorations.

8. When wiring is to be carried over ornamental work, such as cornice with which it is required to harmonize the design of any special casing which may be necessary shall be submitted to the Engineer for approval. Casing attached to the ceilings shall be carried completely across the ceiling whenever required by the Engineer-in-charge instead of being stopped at the fittings, and in all cases where it is required by the Engineer-in-charge, dummy casing must be used.

Attachment of capping.

9. Capping shall be attached to casing by round headed 5/8 inch No. 6 brass screws placed in each edge at intervals not exceeding 9 inches in all sizes above 2 inches in width, and along the centre in smaller sizes. In casing, having more than two grooves, screws, for fixing the capping, shall be placed in the fillets between the conductors as well as in the outer walls of the casing if so required by the Engineer-in-charge.

Painting and Varnishing.

10. All casing and capping shall be served before erection, internally and on the back, with two coats of varnish made up of not less than 3 lb. of pure shelac per gallon of spirit and externally with two coats of white paint. A final coat of paint shall be applied to casing and capping to match the colour of walls, etc., on which they are fixed.

Inspection.

11. Except with the sanction of the Engineer, capping shall not be put on until the work has been inspected with the wires in position and approved by the Engineer-in-charge. This inspection will be done from time to time as the work progresses, on the application of the contractor.

SPECIFICATION NO. 31.3--Conduit System

1. All conduit shall be screwed and in accordance with Specification no. 31 of the British Engineering Standards Association and shall be installed in accordance with I.E.E. Regulation no. 87 for screwed conduit except as hereinafter modified. It shall be supplied with or without an insulating lining as may be specified in the Special Conditions of Contract. The conduit shall be electrically continuous from distribution board to outlet boxes for fittings, switches and other appliances.

Conduit to be continuous.
2. The wire of a circuit may be bunched together in a conduit and, if the supply is alternating current, they shall be bunched. In sub-circuit wiring not more than 4 No. and 8 No. wire of 3/029" V.I.R. cables shall be bunched together in $\frac{3}{4}$ " diameter and 1" diameter conduit respectively. Conduit higher than 1" diameter shall not be used in circuit wiring. Circuits and mains shall not be bunched in the same conduit.

Bunching of wires.
3. The lengths of conduit shall be joined by means of screwed socket. Threads shall be free from grease or oil and no material of this nature shall be allowed to come in contact with the conductors. The greatest care shall be taken in preparing the conduit that no sharp edges or burrs are left which may damage the insulation. The Engineer incharge, with a view to ensuring that the above provision has been carried out, may require (if he should consider it necessary) that the separate length of conduit, etc., after they have been prepared, shall be submitted for inspection before being fixed.

Junctions in conduit.
4. In order to minimise condensation or sweating inside the tubes all outlets of conduit systems shall be properly drained and ventilated, in such a manner as to prevent the entry of insects.

Precautions against insects and damp.
5. Where insulating conduit is to be used the lining shall be firmly secured to the tube. The insulating material must not soften injuriously at any temperature below 212. Fahrenheit and must be composed of such materials as will not have a deteriorating effect on the dielectric of the conductor; it must be sufficiently tough and tenacious to withstand the abrasion test of drawing in and out long lengths of conductor from a length of tube. All bends and fittings shall be made so that neither the conduit nor the lining of the same will be injured when drawing in wires.

Insulating lining of tubes.
6. The outer surfaces of conduits including all bends unions trees, junction boxes, etc., forming part of the conduit system shall be protected from rust by being galvanised, or enamelled or by two coats of approved paint, applied before they are fixed. If so required by the Engineer-in-charge, all conduits shall be painted after fixing, in such manner as may be directed.

Protection of conduit against rust.

SPECIFICATION NO. 31.3—Conduit System

Fixing of conduit. 7. The conduit shall be buried in the walls and floors and fixed by means of metal steel hooks at an interval of not more than 3 feet. No conduit shall be above the surface of masonry unless so specified in the Special Conditions of contract or approved by the Engineer-in-charge.

Bends in conduit. 8. The conduit shall be brought round angles of walls by means of bends or circular inspection boxes as may be directed. Angles on the face of the wall shall be arranged for by means of cast iron inspection boxes, with suitable inlet and outlet sockets and screw joints. Each box shall be provided with a cover properly secured, flushed with surface of the wall, by means of which access to the conductor may be obtained. No bend shall have a radius less than $2\frac{1}{2}$ times the outside diameter of the conduit.

Outlets and accessories. 9. (i) All outlets for fittings, switches etc., shall be equipped with approved outlet boxes of cast iron.

(ii) All accessories such as switches, ceiling roses, wall sockets shall be of flush type only.

Erection and earthing of conduit.

10. The whole system of conduit shall be erected and completed before the conductors are drawn in. The whole metal system of conduit shall be electrically continuous throughout and shall be permanently and efficiently connected to earth in general conformity with the method laid down in section H, gas pipes must not be used to obtain an earth connection, and water pipes may only be used with the special approval in writing of the Engineer-in-charge. In a conduit system the pipe must be continuous when passing through walls or floors, and no other form of insulating or protecting tube is required.

**SPECIFICATION NO. 31-4—Cleated Wiring System
(For Temporary Installations Only)**

1. All cleated wiring shall be run so as to be visible and accessible throughout its length. Cleated wiring must not be run above ceilings, directly under floors, within partitions, or buried in plaster, and it must be kept away from all structural metal work, gas and water pipes.

Accessibility.

2. All cleats shall be of porcelain of approved design and must consist of two parts, a base piece and a cap. A special pattern of cleat should be used, if necessary, where conductors pass round corners, so that there may be no risk of the conductors touching the walls owing to sagging or stretching. Cleats shall be fixed at distances not greater than 3 feet apart and at regular intervals. There must be no apparent sag on the conductors and the conductors must not be less than $\frac{1}{4}$ inch away from walls, ceilings, etc.

Cleats.

3. (a) In ordinary cases, cleats shall be attached to plugs arranged as provided for in clause 15 of specification no. 31-1.

Fixing of cleats.

(b) Where practicable the same method shall be adopted in the case of stone walls, but when owing to irregular coursing or other reasons, it is impracticable to fix the cleats in a regular and workman like manner, a wooden batten shall be provided and fixed with not less than one plug, per four foot run. The batten shall be of teak or other suitable hard wood $\frac{3}{4}$ inch thick and one inch wider than the cleat used; it shall be chamfered on the edges, planed all over and varnished with two coats of varnish (prepared as specified in clause 9 of specification No. 31-2) or painted, as may be ordered by the Engineer-in-charge.

(c) Where reasons exist which prevent the use of either plugs or battens, cleats must be attached to the wall or ceiling in a manner approved by the Engineer-in-charge.

4. (a) For pressures up to 250 volt cleats shall be of such dimensions that, in the case of branch leads, conductors shall not be less than 1 inch apart, centre to centre; in the case of submains, not less than $1\frac{1}{2}$ " apart, centre to centre; in the case of mains, not less than $2\frac{3}{8}$ " apart, centre to centre :

Distance apart of wires.

Provided that this sub-clause shall not apply to twin conductors used with the approval of the Engineer-in-charge.

(b) Where the pressure exceeds 250 volt cleated wiring shall only be used under such conditions as may be laid down by the Engineer-in-charge in the Special Conditions of Contract.

**SPECIFICATION NO. 31-4—Cleated Wiring System
(For Temporary Installations Only)**

**Crossing of
conductors.**

5. Where cleated conductors cross each other they must be fixed to an insulating bridging piece, which will rigidly maintain a separation of at least one-half inch between the poles.

**Protection near
floors and
through walls.**

6. No cleat wiring shall be left unprotected within 6 feet of a floor. When brought the floor, it shall be enclosed in a conduit which must extend to at least 6 feet above floor level and one inch below ceiling level, or through as an alternative, porcelain or other non-absorbent, non-ignitable conduit may be used through the floor or wall and casing or other approved protecting covering for a distance of at least six feet above floor level. Where the conduit enters a switch block it may be terminated in the block even at lower than 6 feet when passing through party walls or fire resisting floors the holes through which the conduit passes must be filled with fire-clay or similar non-ignitable material, no space through which fire might spread being left around or inside the conduit. All conduit is to be adequately bushed to prevent abrasion of the insulation of the conductors.

SPECIFICATION NO. 31.5—Metal Sheathed Wiring System

1. All metal sheathed wiring on brick, stone or plastered walls and ceilings is to be run on teak wood strips fixed to the wall by plugs, as provided in clause 15. The teak wood strips are to be shaped to the size of wire and should lie flat against the face of the wall or ceiling. The teak wood strips shall be $\frac{1}{2}$ inch thick and fixed to plugs by means of iron screws of suitable sizes.

Attachment to walls and ceilings.

Note.—This system of wiring has a comparatively short life and is more expensive to maintain than the casing and capping system and should not be adopted except in special circumstances.

2. Where wiring is to be carried along the face of R. S. Joists, a wooden backing, the full width of the joint is to be first laid on the joist, and clipped to it as inconspicuously as possible. Wiring is to be fixed to this backing in the ordinary way.

Wiring on R. S. Joists.

3. These must be made by means of porcelain connectors enclosed in joint boxes approved by the Engineer. All metal sheathing must be bonded through or across these boxes. Bonding connections are to be arranged so as not to come in contact with plaster.

Joints.

4. When insulation has to be stripped for joints, etc., the metal sheathing is to be nicked only and not cut. The necessary length of metal sheathing is then to be removed with the outer tape and the original rubber insulation is to be left for a length of not less than $\frac{1}{4}$ inch beyond the edge of the metal sheathing.

Stripping insulation.

5. When required by the Special Conditions of Contract metal sheathed wiring must be covered with a steel sheet protective cover of not less than No. O.S.W.G. to protect it from damage. This is to be fitted in all cases where wires are within 6 feet of the floor.

Protection of wiring.

6. All wires taken through floors and walls must comply with the provision of clause 6 of specification no. 31.4.

Passing through floors and walls.

7. All wiring and protective covering is to be neatly painted after erection to match the colour of the wall, ceiling, etc., as the case may be.

Painting.

8. Wires are in no case to be buried in cement or plaster. When wires have to be let into the face of walls for any reason they are to be laid in teak wood troughing and covered in a manner to be approved by the Engineer-in-charge.

Buried wiring.

9. The electric resistance of the metallic sheathing including bonding measured between a point near the main switch and any other point of the installation must not exceed 2 ohms.

Resistance of metallic sheathing and bonding.

10. All metallic sheathing is to be efficiently earthed in accordance with section H.

Earthing of metallic sheathing.

SPECIFICATION NO. 31.6—Tough Rubber Covered Wiring System

General method
of installation.

1. Tough rubber covered cables such as cab-type, Maconite, etc., is to be installed on teak wood strips in a similar manner to that specified for the metal sheathed wiring system. Wiring for the point shall be carried out in looping in system, no joints or cut-out shall be provided.

Erection of
fittings.

2. Semi-recessed T.W. boards made of $\frac{1}{2}$ inch thick teak wood covered with $\frac{1}{8}$ inch thick bakelite sheet shall be used to house the control switches and wall sockets, ceiling roses for bell pushes and bed switches.

Note.—This system of wiring has a comparatively short life & is more expensive to maintain than the casing and capping system and should not be adopted except in special circumstances.

SPECIFICATION NO. 31.7--Overhead-Lines

1. (a) All conductors shall be of hard copper as per B.S. Specifications 125 and of approved manufacture.

Conductors.

(b) No conductor of smaller cross section than .01287 square inch shall be used.

(c) The sag and pole spacing shall be such that the conductors stress shall show a factor of safety of not less than 3.

(d) The minimum horizontal spacing of conductors on 4 line cross arms shall be 18 inches between the inner conductors and 42 inches between the outer conductors. For 2 line cross arms the minimum horizontal spacing shall be 18 inches. For cross arms carrying more than 4 lines the design shall be approved by the Engineer-in-charge.

The minimum vertical spacing of conductors shall be 1 foot.

The method of insulator bindings shall be approved by the Engineer before commencing the work.

2. A continuous earth wire shall be erected on the poles above all the conductors except in case of service entries and shall not be less than No. 8 S.W.G.G.I. wire. It shall be made secure by bonding same to C.I. Reels fixed on the top of the poles or by means of suitable clamps where C.I. Reels can not bear the strain. It will be fixed to draw eye bolts at the services.

Earth wires.

3. Each fifth pole shall be earthed in accordance with clause 2 of specification no. 31.8.

Earthing of Poles.

4. British Mannesman Weldless tubular solid stepped steel poles shall be used and base plates shall be fitted as supplied by the makers of the poles. The poles shall be sunk in the ground to a depth according to the maker's direction.

Poles.

In excavating the holes for poles as little earth should be disturbed as possible. The hole of the excavation shall be filled into within 3 inches of ground level with 1:2:4 cement concrete mixture and a plinth of concrete 9 inch high above the ground level and giving a 3 inch radial thickness round the poles will be constructed with a finishing surface of 2:1 cement and sand mixture.

5. Stays shall be Henley's or other approved type complete with all fittings including adjustable stay rods, thimbles, collar for securing the poles and with ratchet type lock nuts. Stay rods and thimbles must be in correct alignment with stay wire. The rod and anchor plate will be set in concrete 1:3:6 in the ground and provided with a 3" plinth. A length of 1'-6" of the rod will project above ground level.

Stay.

SPECIFICATION NO. 31.7—Overhead Lines

Cross arms.

6. The cross arms shall be of channel iron and shall not be less than $3" \times \frac{1}{2}"$ in size. They shall be erected so that the pull does not tend to separate the clamp from the bracket. Washers will be provided below nuts. Where cross arms are in contact with the poles, the cross arms shall be constructed in such a manner as to ensure that the arch of contact is at least $\frac{1}{3}$ of the circumference of the pole.

Insulators.

7. First quality double shall green or white glazed porcelain insulators of Henleys or other approved manufacture shall be used. They will be complete with all necessary galvanised pins, bolts and washers.

Service entries.

8. The service entries shall be made in galvanised iron piping the diameter of which shall be approved by the Engineer-in-charge. The bare conductors shall be kept at a minimum distance from any structure of six feet horizontally and 15 feet vertically except where they are adequately guarded in which case the minimum vertical clearance may be 9 feet.

The vertical entries shall be secured by at least two clamps of $2" \times \frac{1}{4}"$ size, at not more than 2 feet interval and firmly fixed to the wall by $\frac{3}{8}$ inch rag bolts let in 4 inches into the wall and grouted with a 1:2 cement and sand mixture. Horizontal entries will be by brackets of approved type with a back plate of at least $6" \times 6" \times \frac{1}{4}"$ and a suitable size lock nut. A coupler shall be provided against line pull on brackets. Lead bushes of force fit size shall be provided at the entry of the cable to the galvanised iron pipe.

Service fuses.

9. Service fuses shall be of first quality Henleys porcelain or other approved make and of suitable size to carry the ends of lines jointed to them. They shall be fixed at the pole end of the service line except where otherwise ordered.

Painting.

10. All poles, pole fittings and metal marks in connection with service entries will be painted after erection with two coats of approved paint.

SPECIFICATION NO. 31.8—Earthing

1. Earthing connections may be of either copper or galvanized iron. The earth wire and the earth plate must be of the same metal.

Material.

2. Earth plates of copper must not be less than $2' \times 2' \times \frac{1}{8}'$; an earth plate of galvanized iron must not be less than $2' \times 2' \times \frac{1}{4}'$ & G.I. earth pipes must not be less than 2 inch diameter and 4'-6" long. The tops of earth plates are not to be less than 10 ft. below ground level and the tops of earth pipes are not to be less than 9 ft. below ground level. The earth plate or pipe shall be surrounded by alternate layers of reasonable thickness of charcoal or coke and salt.

Arrangement of earth plates or pipes.

3. The earthing connection is to be securely bolted and soldered to the plate or pipe as the case may be. The earthing wire must be securely clamped between two washers. All bolts, nuts and washers are to be of the same material as the earthing wire and the plate or pipe. All iron bolts, nut and washers are to be galvanized.

Method of joining wire and plate or pipe.

4. For installations up to 50 amps. per main conductor, the earthing wire shall not be less than No. 8 S.W.G. and for installations of larger size either two earthing wires of not less than No. 8 S.W.G. each, or one earthing wire of not less than No. 4 S.W.G. is to be used.

Size of earthing wire.

5. (a) In all cases the provisions of Rules 54 and 57 of the Indian Electricity Rules, 1957, are to be complied with.

Number of earth points per installation.

(b) For metal-sheathed and conduit wiring in buildings, where the whole of the incoming supply is given at low pressure one earth connection is to be installed as near as convenient to the main board, and for such wiring, where the incoming supply is given at medium pressure, a separate earth connection and earth plate or earth pipe is to be installed as near as convenient to each low pressure main board, subject to the conditions contained in sub-clause (d) below.

(c) For all other types of wiring than metal sheathed or conduit, each iron clad switch or iron clad distribution board is to be earthed in a manner approved by the Engineer.

(d) The metallic coverings or supports of all medium pressure apparatus and conductors are, in all cases, to have not less than two separate and distinct earth plates or pipes with their respective earthing connections, arranged in a manner to be approved by the Engineer-in-charge.

6. All metal sheathing and conduit shall be so joined and connected across all junction boxes and other openings as to make good mechanical and electrical connection throughout their length. The electrical resistance of the metallic sheathing or conduit, including bonding,

Continuity of metal sheathing and conduit.

SPECIFICATION NO. 31.8—Earthing

between a point near the main switch and any other point of the installation, shall not exceed two ohms.

Resistance of earth.

7. No earth plate or earth pipe installed shall have a greater ohmic resistance than 10 ohms as measured by an approved earth testing apparatus. If one earth does not give satisfactory result, more than one earth shall be installed. All earthing connections are to be as free from joints as possible and in no case are joints to be made except where they are clearly visible. Earthing connections for lightning arresters are not to have any sharp bends.

Protection of earth connection.

8. All earth connections must be run in G.I. piping on surface of wall recessed in floors and the piping continued right up to the earth plate or earth pipe. A suitable reducing socket shall be provided for the latter in cases where copper earthing connections are used, No. 8, bare copper wire must be used up to the copper earth plate.

Earth connection from the building to the earth plate or pipe must not be run at a depth less than two feet below ground level.

Position of earth plates or pipes.

9. Wherever possible earth plates or pipes are to be located near to a water tap, water drain, or "down" pipe. Earth plates or pipes must be kept clear of all building foundations and in no case are they to be nearer than 6 feet from the outer face of the wall at plinth level.

SPECIFICATION NO. 31.9—Lightning Conductor

1. Conductor G.J. 7/10 S.W.G. (10 mm dia) stranded wire.
2. Earth Electrode 3/4" dia 9 ft. long G.I. pipe from ground level connecting the 2" dia 4'—6" long G.I. (perforated) pipe.
3. Lightning rod M.S. rod 1" dia 3 ft. long for all types of buildings.