

Chapter 1

WIRING

1.1	Mains in Metal Conduit	WG-MA/MC
1.2	Mains in PVC conduit	WG-MA/PC
1.3	Bunch of Wires	WG-MA/BW
1.4	Mains on GI Bare wire	WG-MA/GB
1.5	Concealing of Conduits	WG-MA/CC
1.6	PVC Flexible/Rigid Conduits/Casing-n-capping	WG-MA/CON
1.7	Wiring Accessories	WG-MA/WA
1.8	Modular switches and Accessories	No Specs
1.9	Point wiring	WG-PW/PW
1.10	Telephone wiring & Accessories	WG-TW/TW
1.11	Telephone Accessories	WG-TW/TA
1.12	Computer Cabling	WG-COC
1.13	Networking Components	WG-COC/NWC
1.14	Networking Accessories	WG-COC/NAS

General:

All material shall be conforming to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall either carry valid 'Quality Control' certificate issued by the Chief Engineer (Elect), P.W. Dept. Maharashtra State Govt. as included in approved list.

Work shall be carried out as per the Method of Construction specified by BIS. If there is no reference for particular Method of Construction in IS, such work shall be carried out as per the approved Method of Construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

Material shall be tested in approved Testing Laboratory and shall qualify the relevant tests as and when directed by Engineer In-Charge.

Recommended Standards:

The following list is showing Indian Standards, which are acceptable as good practice, and accepted standards.

IS 732: 1989	Code of Practice for Electrical Wiring Installations?
IS 4648: 1968	Guide for Electrical Layout in residential buildings
IS 9537 (Part 1): 1980	Conduits for Electrical Installations: General requirements
IS 9537 (Part 2): 1981	Rigid Steel Conduits
IS 9537 (Part 3): 1983	Rigid Plain Conduits of insulating material
IS 3419: 1989	Specifications for fittings for rigid non metallic conduits
IS 694:	PVC insulated cables for working voltages up to and including 1100V
IS 1554 (Part 1): 1988	PVC insulated (heavy-duty) electric cables for working voltages up to and including 1100V
IS 3961 (Part 5): 1968	Recommended current ratings for cables: PVC insulated light duty cables.
IS 4288: 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and including 1100V
IS 14772: 2000	Specifications for Accessories for household and similar fixed Electrical Installations
IS 3043: 1987	Code of practice for Earthing
SP 30: 1984	National Electrical Code
SP 7 (Group 4): 2005	National Building Code
IS 14927(Part 1): 2001	Cable Trunking and Ducting systems for electrical installations.

1.1 Conduits / Trunking (Casing Capping) (Surface type)**1.1.1 PVC Conduits****Specification No (WG-MA/CON)****Scope:****PVC Conduits: Surface**

Providing specified PVC Conduits and erecting as per approved Method of Construction; on surface of wall / ceiling, etc. including entries through walls / slabs / flooring as per requirement, and with all necessary hardware, accessories such as Spacers, Saddles, Bends, Tees, Junction boxes, Check-nuts, etc.; making conduits erection work rigid and duly finishing, removing debris from site.

Material:**PVC Conduit:**

PVC pipe minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No. 1/2) ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Method of Construction:**Erection PVC Conduits for Surface type wiring:****General:**

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm, round headed screws for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers. Distance between 2 spacers shall not be more than 600mm. Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/2 for PVC conduits). Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. or anti electrostatic partition/separate pipe should be used. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface and with colour coding conduit (For visual identification) as per Table No. 1/4. Flexible conduits shall be used at expansion joints.

Especially for PVC Conduits of surface type wiring:

In addition to general instructions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, it shall be done with bending spring. Size of conduit shall be as per Table No. 1/2 for number of wires to be drawn through the conduit.

1.1.2 PVC Trunking (Casing capping)

Specification No (WG-MA/CON)

Scope:**PVC Trunking:**

Providing specified PVC Trunking (Casing capping) and erecting as per approved Method of Construction, on surface of wall / ceiling, etc. including entries made with PVC conduit through walls / slabs / flooring as per requirement with all necessary hardware, accessories such as inner / outer Elbows, Tees, Junction boxes, etc. and duly finishing, removing debris from site.

Material:**PVC Trunking (casing capping):**

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/3 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8mm thick push-fit joints/ accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Method of Construction:**Erection of PVC Trunking for surface type wiring:**

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in single phase distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking or anti electrostatic partition to be provided. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and at required locations.

1.1.3 Rigid Steel Conduits

Specification No (WG-MA/CON)

Scope:

Rigid Steel Conduits: Surface

Providing specified Rigid Steel Conduits and erecting as per approved Method of Construction; on surface of wall / ceiling, etc including entries through walls / slabs / flooring as per requirement along with continuous earth wire, earth-clips and all necessary hardware, accessories; such as; spacers, saddles, Bends, Tees, Junction boxes, Check-nuts, etc. and duly finishing, removing debris from site.

Material:

Rigid Steel conduit:

Rigid steel conduit minimum 20mm dia and higher depending on No. of wires to be drawn as per Table No. 1/1, 16 gauge, ISI mark, ERW grade duly processed for anti-rust treatment and painted with black enamel paint including inspection type or normal accessories such as, 5mm thick 20mm width spacers and G.I. saddles for individual pipe or GI strip for bunch of pipe, sockets, open bends, junction boxes of required ways all of the same make.

Earth continuity wire:

GI wire of 2.5 Sqmm; GI earth clips 22g, 10mm width, for fixing earth wire along the conduits.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, PVC/ rubber bushings etc.

Method of Construction:

Erection of Rigid steel Conduits:

General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be duly screwed and firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm round headed for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers and saddles. Distance between 2 spacers shall not be more than 600mm. Separate pipe shall be used for each phase in single phase distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm or anti electrostatic partition to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface conduit with colour coding (For Visual identification) as per Table No 1/4. Flexible conduits shall be used at expansion joints. Bushing shall be provided at open ends.

Erection of Rigid steel Conduits:

Especially for Rigid Steel Conduit of surface type wiring

In addition to general conditions above, Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/1 for steel conduits). All exposed threaded portion of Rigid Steel Conduits shall be painted with anti corrosive paint. Sharp edges at cut ends shall be made smooth by removing burr. Inspection type conduits accessories shall be used as per requirement in accessible position to facilitate drawing or withdrawing of wires. All conduits piping work shall be properly Earthed with 2.5 sq. mm G.I Earth wire fixed to conduit and made continuous with Earth clips at every 1m and at ends and joints viz. bends, junction boxes.

Testing:

Earth continuity:

Earth continuity shall be ensured at termination points of Earth wire, and between the ends of Rigid steel conduit.

Polarity:

Polarity test and should be done including confirmation of phase entry in switch only.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter length of conduit / Trunking.

1.2 Conduits (Concealed type)

Specification No (WG-MA/CC)

1.2.1 Concealing PVC Conduits in RCC work

Scope:

Providing specified PVC conduit and laying / erecting in RCC work, such as slab, beam, column before casting as per approved Method of Construction along with of all required material including hardware, binding wire, fish wire; accessories such as deep / long neck PVC junction boxes, PVC / MS junction / draw-in boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, removing debris from site and supervising the work during casting to confirm rigidity, continuity and avoid damages.

Material:

PVC Conduit:

PVC pipe of minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No.1/2); ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; Couplers, long Bends, deep Junction boxes of required ways and resin / adhesive to make all joints rigid.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; PVC or fabricated from 16g CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plates on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire, steel fish wire etc.

Method of Construction:

Concealing of PVC conduits:

General:

Work shall be done in co-ordination with civil work and to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No 1/2 for PVC conduits) Separate pipe shall be used for each phase in single phase distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. The distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All PVC conduit bending shall be done with Bending Spring. All joints shall be made rigid with resin.

Concealing of PVC conduits:

In RCC work:

Work shall be commenced after fixing of steel re-enforcement on centering material. Conduits shall be firmly fixed on steel of RCC work by binding wire. Fixing of conduits shall be such that it will remain rigid during casting of slab, beam, and column even after use of vibrator. Deep junction boxes and other draw-in boxes shall be such that their open end and centering material will not have gap in between so as to avoid concrete entering inside even after fixing covers to steel re-enforcement; and be filled with dry sand. Open ends of conduits; to be concealed in walls, shall be provided with couplers / sockets at ends and be flush with bottom of beam, and located at the center of the beam. As far as possible bunching / grouping of conduits shall be avoided so that it will not affect strength of RCC work especially in beams. Suitable steel fish wire shall be drawn through in the conduits for drawing of wires later on.

1.2.2 Concealing PVC Conduits in walls / flooring

Scope:

Providing specified PVC conduit and erecting / laying in wall, flooring by making chases / grooves / entries as per approved Method of Construction along with of all required material including hardware such as 'U' nails, binding wire, fish wire; accessories such as PVC / MS junction boxes / inspection boxes, check-nuts, flexible PVC pipe, glands, drawing fish-wires

and making all piping rigid, refinishing the surface with cement mortar, removing debris from site.

Material:

PVC Conduit:

PVC pipe minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No.1/2), ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; Couplers, long Bends, Junction boxes of required ways, type and resin / adhesive to make all joints rigid.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; PVC or fabricated from 16g CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plate on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, steel fish wire, etc.

Other material for Surface finishing: Cement, sand, putty, and water.

Method of Construction:

Concealing of PVC conduits: (General)

Work shall be done in co-ordination with civil work to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No 1/2 for PVC conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. for which the distance between pipes shall not be less than 300 mm or anti electrostatic partition is be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No.1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done with Bending Spring. All joints shall be made rigid with resin.

Concealing of PVC Conduits In walls / flooring:

Chases shall be made in walls of adequate width, with cutter and chiseling through it. Necessary finishing of the wall surface shall be done. Work in flooring shall not disturb RCC work, Conduits of adequate size shall be erected with use of appropriate accessories, and 'U' nails. All joints shall be made rigid with resin. Draw-in / inspection boxes shall be fixed with check-nut, flush with surrounding surface and earthed.

1.2.3 Rigid Steel Conduits in RCC work

Specification No (WG-MA/CC)

Scope:

Concealing of Rigid Steel Conduits:

In RCC work:

Providing specified Rigid Steel conduit and laying / erecting in RCC work, such as slab, beam, column before casting as per approved Method of Construction along with continuous earth wire and all required material including earth clips, hardware, binding wire, fish wire; accessories such as deep junction boxes, MS draw-in / junction / inspection boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, removing debris from site and supervising the work during casting to confirm rigidity, continuity and avoid damages.

Material:

Rigid Steel conduit:

Rigid HG steel screwed conduit, minimum 20mm dia. and higher depending on No. of wires to be drawn as per Table No. 1/1, 16 gauge, ERW grade duly processed for anti-rust treatment and painted with black enamel paint, accessories for rigid steel conduits such as check nuts, long bends, deep junction boxes for slab, regular junction boxes for walls; of required ways, all of the same make.

Earth continuity wire:

GI wire of 2.5 sq. mm; GI earth clips 22g, 10mm width, for fixing earth wire along the conduits.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; fabricated from 16g CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plate on it.

Hardware:

U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, fish wire, etc.

Method of Construction:**Concealing of Rigid steel Conduits:****General:**

Work shall be done in co-ordination with civil work to suite final approved layout. Conduit shall be duly screwed and size of conduit shall be correct depending on number of wires to be drawn. (Table No.1/1, for Steel conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. for which distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For visual identification). Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done approved manner without changing the cross-section.

In RCC work:

Work shall be commenced after fixing of steel (re-enforcement) on centering material. Conduits shall be firmly fixed with steel in slab by binding wire. Fixing of conduits shall be possibly done with welding tags so that it will remain rigid during casting of slab, beam, and column even after use of vibrator. Deep junction boxes and other draw-in boxes shall be such that their open end and centering material will not have gap in between so as to avoid concrete entering inside even after fixing covers to steel re-enforcement; and be filled with dry sand. Open ends of conduits; to be concealed in walls, shall be provided with couplers / sockets at ends and be flush with bottom of beam, and located at the center of the beam. As far as possible bunching / grouping of conduits shall be avoided so that it will not affect strength of RCC work especially in beams. Suitable steel fish wire shall be drawn through the conduits for drawing of wires later on.

1.2.4 Rigid steel Conduits in walls / flooring

Specification No (WG-MA/CC)

Scope:**Concealing of Rigid steel Conduits:****In walls / flooring:**

Providing specified Rigid Steel Conduits and erecting in wall, flooring by making chases / grooves / entries as per approved Method of Construction along with continuous earth wire and all required material including earth clips hardware such as 'U' nails, binding wire, fish wire; accessories such as MS junction / inspection boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, refinishing the surface with cement mortar, removing debris from site.

Material:***Rigid Steel conduit:***

Rigid steel HG conduit minimum 20mm dia. and 16 gauge, ERW grade duly processed for anti-rust treatment and painted with black enamel paint, accessories for rigid steel conduits such as check nuts, long bends, deep junction boxes for flooring, regular junction boxes for walls; of required ways all of the same make.

Earth continuity wire:

GI wire of 2.5 sq. mm, GI earth clips 22g, 10mm width, for fixing earth wire along the conduits.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; fabricated from 16 SWG CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be

knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plates on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, GI fish wire, etc.

Other material for Surface finishing: Cement, sand, putty and water.

Method of Construction:

Concealing of Rigid Steel Conduits:

General:

Work shall be done in co-ordination with civil work to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No.1/1, for Steel conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc; for which the distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25 metre, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done approved manner without changing the cross-section.

Concealing of Rigid Steel Conduits in walls/ flooring:

Chases shall be made in walls of adequate width, with cutter and chiseling through it. Necessary finishing of the wall surface shall be done. Work in flooring shall not disturb RCC work, Conduits of adequate size shall be erected with use of appropriate accessories, and hardware like 'U' nails, etc. Draw-in / inspection boxes shall be fixed with check-nut, flush with surrounding surface and earthed.

Testing:

Earth continuity:

Earth continuity shall be ensured at termination point of Earth wire, between the ends of metal conduit.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter length of conduit.

1.3 Bunch of wires:

Specification No (WG-MA/BW)

Scope:

Bunch of wires:

Providing specified wires and drawing them through provided conduits / trunking and / or as directed; with coded ferrules, harnessing the bunch of wires with necessary material when used in panel boards, duly connecting / terminating with lugs, and testing for safety and beneficial use.

Material:

Wires: in conduits / trunking / panel boards

Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5.

Wires: open

PVC insulated and PVC sheathed wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5.

Earth Continuity Wire:

PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green yellow colour, ISI marked, of specified size but not less than 2.5 Sqmm as per Table No 1/5.

Lugs: Copper lugs of appropriate size & type

Other material: Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:

Bunch of wires:

Drawing of wires: General

Specified wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5, shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only, with appropriate type and size of lugs.

Drawing of wires: through PVC conduits

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/2.

Drawing of wires: through Rigid Steel conduits

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs / sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/1.

Open Wire bunch: Open wires shall be erected with due care so as to avoid chances of any mechanical injury. Harnessing shall be done with required material in an approved manner in panel boards or where ever necessary. For covering lead wires flexible conduit shall be used with gland as per necessity.

Testing:

Insulation resistance test:

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured between termination points of Earth wire.

Polarity Test:

Test shall be carried out for ensuring the correct polarity in switch and plug.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter length of single wire or bunch as specified.

1.4 Mains (surface type)

1.4.1 Mains in surface PVC conduit

Specification No (WG-MA/PC)

Scope:

Mains in surface PVC conduit:

Providing specified PVC Conduits, Wires and erecting the conduits as per approved Method of Construction; on surface of wall / ceiling, etc. including entries through walls / slabs / flooring as per requirement, and with all necessary hardware, accessories such as Spacers, Saddles, Bends, Tees, Junction boxes, Check-nuts / glands, etc.; making conduits erection work rigid; and drawing the specified wires through these conduits and duly connecting / terminating with lugs, complete finishing, removing debris from site; testing for safety and beneficial use.

Material:

PVC Conduit:

PVC pipe of minimum 20mm dia and above depending on No. of wires to be drawn (refer Table No 1/2); ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires)

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of appropriate colour coding as per Table No 1/5

Earth Continuity Wire:

PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green or green yellow colour, ISI marked, of specified size but not less than 2.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of appropriate type and size.

Other material: Rubber grommet, bush, flexible PVC conduit, gland etc.

Method of Construction:

Erection PVC Conduits for Surface type wiring:

General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm, round headed screws for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers. Distance between 2 spacers shall not be more than 600 mm. Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/2 for PVC conduits). Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface conduit with colour coding (For Visual identification) as per Table No. 1/4. Flexible conduits shall be used at expansion joints.

Especially for PVC Conduits of surface type wiring:

In addition to general instructions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, it shall be done with bending spring. Size of conduit shall be as per Table No. 1/2 for number of wires to be drawn through the conduit.

Drawing of wires: General

Wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5, shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Lead wires of sufficient extra length shall be provided and shall be terminated in the terminals of accessories only, with appropriate type and size of lugs.

Drawing of wires: through PVC conduits for surface type wiring

Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be drawn through conduit. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/2. At the termination end flexible PVC conduit shall be used with gland as per required.

1.4.2 Mains in PVC Trunking (casing capping)

Specification No (WG-MA/PC)

Scope:

Surface type Mains in PVC Trunking (casing capping)

Providing specified PVC Trunking, Wires and erecting the Trunking as per approved Method of Construction; on surface of wall / ceiling, etc. including entries made with PVC conduit through walls / slabs / flooring as per requirement with all necessary hardware, accessories such as inner / outer Elbows, Tees, Junction boxes, etc; including erection of specified wires in PVC trunking, with coded ferrules and duly connecting with lugs, and finishing, removing debris from site; testing for safety and beneficial use.

Material:

PVC Trunking:

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/2 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8mm thick push-fit joints/

accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, etc.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires)

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire: PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green colour, ISI marked, of specified size but not less than 1.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of appropriate type and size.

Other material: Flexible PVC conduit, gland coded ferrules, etc.

Method of Construction:

Erection of PVC Trunking for surface type wiring

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of unlevelled surface number and size of screws shall be changed to higher size as per requirement and in case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking or anti electrostatic partition is to be provided. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and required locations.

Erecting wires in Trunking:

Wires shall be erected within Trunking with adequate care. Correct colour coding as per Table No. 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be erected in single Trunking. Wires shall be terminated in the terminals of accessories only, with appropriate type and size of lugs. Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be erected through Trunking. Number of wires shall not exceed with respect to size of Trunking as per Table No. 1/3. After erection of wires double locking shall be checked while fixing capping. At the termination end flexible PVC conduit shall be used with gland as per required.

1.4.3 Mains in Rigid steel conduit (Surface type)

Specification No (WG-MA/MC)

Scope:

Surface type Mains in Rigid steel conduit:

Providing specified Rigid Steel Conduits and erecting as per approved Method of Construction; on surface of wall / ceiling, etc including entries through walls / slabs / flooring as per requirement along with continuous earth wire, earth-clips and all necessary hardware, accessories; such as; spacers, saddles, Bends, Tees, Junction boxes, Check-nuts, etc; and drawing the specified wires through these conduits in approved manner; with coded ferrules and duly connecting with lugs, and duly finishing, removing debris from site; testing the installation for safety and beneficial use.

Material:

Rigid Steel conduit:

Rigid steel HG screwed conduit minimum 20mm dia. and higher depending on No. of wires to be drawn as per Table No. 1/1, 16 gauge, ISI mark, ERW grade duly processed for anti-rust treatment and painted with black enamel paint, accessories for rigid steel conduits such as 5 mm thick 20mm width spacers and G.I. saddles, sockets, open bends, junction boxes of required ways all of the same make.

Earth continuity wire:

GI wire of 2.5 sq. mm GI earth clips 22g, 10mm width, for fixing earth wire along the conduits.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, PVC/ rubber bushings etc.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires): PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire:

PVC insulated wire minimum FR grade insulation copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, of specified size but not less than 2.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of appropriate size & type

Other material: Rubber Bush, Flexible metal conduit, gland etc.

Method of Construction:**Erection of Rigid Steel Conduits:****General:**

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be duly screwed and firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm round headed for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers and saddles. Distance between 2 spacers shall not be more than 600mm. Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/1 for steel conduits). Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface conduit with colour coding (For Visual identification) as per Table No 1/4. Flexible conduits shall be used at expansion joints. Bushing shall be provided at open ends.

Erection of rigid steel Conduits:**Specially for Rigid Steel Conduit of surface type wiring:**

In addition to general conditions above, Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/1 for steel conduits). All exposed threaded portion of Rigid Steel Conduits shall be painted with anti corrosive paint. Sharp edges and burr at cut ends shall be made smooth. Inspection type conduits accessories shall be used as per requirement in accessible position to facilitate drawing or withdrawing of wires. All conduits, piping work shall be properly earthed with 2.5 Sqmm G.I Earth wire duly fixed to conduit and made continuous with Earth clips at every 1m and at ends and joints viz. bends, junction boxes.

Drawing of wires:**General:**

Wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Lead wires of sufficient extra length shall be provided and shall be terminated in the terminals of accessories only, with correct type of and correct size of lugs.

Drawing of wires:**Through Rigid Steel conduits for surface type wiring:**

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs / sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/1. At the termination end flexible metal conduit shall be used with gland.

Testing:**Insulation resistance test:**

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured at all earth terminals and at earth terminals of metal enclosures.

Polarity test:

Polarity test shall be carried out for ensuring polarity in switch and plug.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter of pipe length.

1.5 Mains (Concealed type)**1.5.1 Mains in PVC Conduits in RCC work**

Specification No (WG-MA/CC, WG-MA/BW)

Scope:**Concealed Mains in PVC Conduits in RCC work:**

Providing specified PVC conduit, wires and laying / erecting Conduits in RCC work, such as slab, beam, column before casting as per approved Method of Construction along with of all required material including hardware, binding wire, fish wire; accessories such as deep PVC junction boxes, PVC / MS junction boxes / inspection boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, removing debris from site and supervising the work during casting to confirm rigidity, continuity and avoid damages and as and when directed drawing of specified wires through these conduits with fish wire, tagging with coded ferrules and duly connecting with lugs, complete testing the installation for safety and beneficial use.

Material:***PVC Conduit:***

PVC pipe of minimum 20mm dia and above, depending on number of wires to be drawn (refer Table No 1/2, ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; Couplers, long Bends, deep Junction boxes of required ways and resin / adhesive to make all joints rigid.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; PVC or fabricated from 16 SWG CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plates on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, GI fish wire, etc.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire: PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, of specified size but not less than 1.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of required size & type

Other material: Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:**Concealing of PVC conduits:****General:**

Work shall be done in co-ordination with civil work and to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No. 1/1 for Steel conduits & Table No 1/2 for PVC conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. The distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All PVC conduit bending shall be done with Bending Spring. All joints shall be made rigid with resin.

Concealing of PVC conduits:

In RCC work:

Work shall be commenced after fixing of steel (re-enforcement) on centering material. Conduits shall be firmly fixed on steel of RCC work by binding wire. Fixing of conduits shall be such that it will remain rigid during casting of slab, beam, and column even after use of vibrator. Deep junction boxes and other draw-in boxes shall be such that their open end and centering material will not have gap in between so as to avoid concrete entering inside even after fixing covers to steel re-enforcement; and be filled with dry sand. Open ends of conduits; to be concealed in walls, shall be provided with couplers / sockets at ends and be flush with bottom of beam, and at located at the center of the beam. As far as possible bunching / grouping of conduits shall be avoided so that it will not affect strength of RCC work especially in beams. Suitable steel fish wire shall be drawn through in the conduits for drawing of wires later on.

Drawing of wires:

General:

Wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Lead wires of sufficient extra length shall be provided and shall be terminated in the terminals of accessories only, with appropriate type and size of lugs.

Drawing of wires:

Through PVC conduits:

Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be drawn through pipe. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/2.

1.5.2 Concealed Mains in PVC Conduits in walls / flooring:

Specification No (WG-MA/CC)

Scope:

Concealed Mains in PVC Conduits in walls / flooring:

Providing specified PVC conduit, Wires and laying / erecting the conduits in wall, flooring by making chases / grooves / entries as per approved Method of Construction along with of all required material including hardware such as 'U' nails, binding wire, fish wire; accessories such as PVC / MS junction boxes / inspection boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, refinishing the surface with cement mortar, removing debris from site and as and when directed drawing of specified wires through these conduits with fish help of wire, tagging by coded ferrules and duly connecting / terminating with lugs, complete testing the installation for safety and beneficial use.

Material:

PVC Conduit:

PVC pipe minimum 20mm dia and above depending No. of wires to be drawn (refer Table No1/2, ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; Couplers, long Bends, Junction boxes of required ways and resin / adhesive to make all joints rigid.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; PVC or fabricated from 16g CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plate on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, steel fish wire, etc.

Other material for Surface finishing: Cement, sand, putty and water.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic tough pitch (ETP) grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire: PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, of specified size but not less than 2.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of appropriate size & type

Other material for wire drawing: Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:

Concealing of PVC conduits:

General:

Work shall be done in co-ordination with civil work and to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No. 1/1 for Steel conduits & Table No 1/2 for PVC conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. The distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done with Bending Spring. All joints shall be made rigid with resin.

Concealing of PVC Conduits In walls / flooring:

Chases shall be made in walls of adequate width, with cutter and chiseling through it. Necessary finishing of the wall surface shall be done. Work in flooring shall not disturb RCC work, Conduits of adequate size shall be erected with use of appropriate accessories, and 'U' nails. All joints shall be made rigid with resin. Draw-in / inspection boxes shall be fixed with check-nut, flush with surrounding surface and earthed.

Drawing of wires:

General:

Wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Lead wires of sufficient extra length shall be provided and shall be terminated in the terminals of accessories only, with correct type of and correct size of lugs.

Drawing of wires:

Through PVC conduits:

Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be drawn through pipe. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/2. At the termination end flexible PVC conduit shall be used with gland as per necessity.

1.5.3 Concealed Mains in Rigid Steel Conduits in RCC work

Specification No (WG-MA/CC, WG-MA/BW)

Scope:

Concealed Mains in Rigid Steel Conduits in RCC work:

Providing specified PVC conduit, Wires and laying / erecting the conduits in RCC work, such as slab, beam, column before casting as per approved Method of Construction along with continuous earth wire and all required material including earth clips, hardware, binding wire, fish wire; accessories such as deep PVC junction boxes, PVC / MS junction boxes / inspection boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, removing debris from site and supervising the work during casting to confirm rigidity, continuity and avoid damages and as and when directed drawing of wires through these conduits with fish wire, ferruling by coding tags and duly connecting with lugs, complete testing the installation for safety and beneficial use.

Material:

Rigid Steel conduit:

Rigid HG steel screwed conduit minimum 20mm dia. and higher depending on No. of wires to be drawn as per Table No. 1/1, 16 gauge, ERW grade duly processed for anti-rust treatment and painted with black enamel paint, accessories for rigid steel conduits such as check nuts, long bends, deep junction boxes for slab, regular junction boxes for walls; or required ways all of the same make.

Earth Continuity wire:

GI wire of 2.5 sq. mm 22g 10mm width, GI earth clips for fixing earth wire along with the conduits.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; fabricated from 16 SWG CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plates on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, steel fish wire, rubber / PVC bushes etc.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Wire: PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, of specified size but not less than 2.5 Sqmm as per Table No 1/5

Lugs: Copper lugs of required size & type.

Other material: Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:**Concealed Mains in Rigid Steel Conduits in RCC work:****Concealing of conduits:****General:**

Work shall be done in co-ordination with civil work and to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No1/1, for Steel conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. The distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the final approved layout, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25 m, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done approved manner without changing the cross-section.

Concealing of conduits:**In RCC work:**

Work shall be commenced after fixing of steel (re-enforcement) on centering material. Conduits shall be firmly fixed with steel in slab by binding wire. Fixing of conduits shall be possibly done with welding tags so that it will remain rigid during casting of slab, beam, and column even after use of vibrator. Deep junction boxes and other draw-in boxes shall be such that their open end and centering material will not have gap in between so as to avoid concrete entering inside even after fixing covers to steel re-enforcement; and be filled with dry sand. Open ends of conduits; to be concealed in walls, shall be provided with couplers / sockets at ends and be flush with bottom of beam, and located at the center of the beam. As far as possible bunching / grouping of conduits shall be avoided so that it will not affect strength of RCC work especially in beams. Suitable steel fish wire shall be drawn through the conduits for drawing of wires later on.

Drawing of wires:**General:**

Wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Lead wires of sufficient extra length shall be provided and shall be terminated in the terminals of accessories only, with correct type of and correct size of lugs.

Drawing of wires:**Through Rigid Steel conduits:**

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs / sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/1

1.5.4 Mains in Rigid steel Conduits in walls / flooring

Specification No (WG-MA/CC, WG-MA/BW)

Scope:

Concealed Mains in Rigid Steel Conduits in walls / flooring:

Providing specified Metal conduit, Wires and erecting in wall, flooring by making chases / grooves / entries as per approved Method of Construction along with continuous earth wire and all required material including earth clips hardware such as 'U' nails, binding wire, fish wire; accessories such as MS junction / inspection boxes, check-nuts, flexible PVC pipe, drawing fish-wires and making all piping rigid, refinishing the surface with cement mortar, removing debris from site and as and when directed drawing of wires through these conduits with fish wire, ferruling by coding tags and duly connecting with lugs, complete testing the installation for safety and beneficial use.

Material:

Rigid Steel conduit:

Rigid HG steel screwed conduit minimum 20mm dia. and higher depending on No. of wires to be drawn as per Table No. 1/1, 16 gauge, ERW grade duly processed for anti-rust treatment and painted with black enamel paint, accessories for rigid steel conduits such as check nuts, long bends, deep junction boxes for flooring, regular junction boxes for walls; of required ways all of the same make.

Earth continuity wire: GI wire of 2.5 sq. mm 22g 10mm width, GI earth clips for fixing earth wire along with the conduits.

Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate and of suitable size to accommodate No. of entries; fabricated from 16 SWG CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix cover plates on it.

Hardware:

'U' nails, plumbing and general use nails of required sizes, washers, check-nuts, steel binding wire 20g, steel fish wire, rubber, PVC bushes etc.

Other material for Surface finishing: Cement, sand, putty and water.

Wires: Mains / Sub-mains / Circuit mains (comprising phase and neutral wires):

PVC insulated wire of specified size, minimum FR grade insulation, copper conductor of electrolytic grade, having insulation of 1.1 kV grade, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire: PVC insulated wire minimum FR grade insulation copper conductor of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, of specified size but not less than 2.5 Sqmm as per **Table No 1/5**.

Lugs: Copper lugs of appropriate size & type

Other material: Rubber grommet, bush, harnessing material, flexible conduit etc.

Method of Construction:

Concealed Mains in Metal Conduits in walls / flooring Concealing of conduits:

General:

Work shall be done in co-ordination with civil work and to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No 1/1, for Steel conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. The distance between pipes shall not be less than 300 mm or anti electrostatic partition is to be provided. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All bending of conduits shall be done approved manner without changing the cross-section.

Concealing of Conduits in walls/ flooring:

Chases shall be made in walls of adequate width, with cutter and chiseling through it. Necessary finishing of the wall surface shall be done. Work in flooring shall not disturb RCC work, Conduits of adequate size shall be erected with use of appropriate accessories and hardware like 'U' nails, etc. Draw-in / inspection boxes shall be fixed with check-nut, flush with surrounding surface and earthed.

Drawing of wires:**General:**

Wires shall be drawn with adequate care. Correct colour coding as per Table No. 1/5, shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped only within circuit. For lighting load or single-phase distribution wires of two different phases shall not be drawn in single pipe. Lead wires of sufficient extra length shall be provided and shall be terminated in the terminals of accessories only, with correct type of and correct size of lugs.

Drawing of wires:**Through Rigid Steel conduits:**

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs / sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/1. At the termination end flexible metal conduit shall be used with glands as per necessity.

Testing:**Insulation resistance test:**

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured at all earth terminals and at earth terminals of metal enclosures.

Polarity Test:

Polarity test shall be carried out for ensuring correct polarity in plug and switch.

Mode of Measurement:

Measurement shall be carried out on the basis per running meter of pipe length.

1.6 Point wiring (Surface type)

Specification No (WG-PW/SW)

Scope:**Point wiring (Surface type):**

Providing all required approved specified material including hardware and erecting wiring on surface of wall, ceiling from switch board to outlet for light / fan / bell / independent plug point, in rigid steel / PVC conduit or PVC trunking as specified; fixing one board with a 1 way switch for one way point or two boards with a 2 way switch on each board, in case of 2 way point; for controlling power supply and one board / block with accessory for outlet of light / fan / plug and terminating wires within as per approved Method of Construction; removing all debris and testing the installation for safety and beneficial use.

Material:**Point wiring (Surface)****PVC conduit:**

PVC pipe of minimum 20mm dia and above depending No. of wires to be drawn (refer Table No 1/2); ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, inspection or non inspection type Elbows, Tees, Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

PVC Trunking:

PVC Trunking (casing capping) ISI mark, 1.2 mm thick, minimum 20 mm width and above depending on No. of wires to be drawn (Refer Table No 1/2 for the size of trunking and number of wires to be drawn); with double locking arrangement, 1.8 mm thick push-fit joints

/ accessories for PVC trunking such as couplers, elbows, internal / external angles, junction boxes of required ways of the same make.

Rigid Steel conduit:

Rigid steel screwed conduit minimum 20mm dia. and higher depending on No. of wires to be drawn as per Table No. 1/1, 16 gauge, ISI mark, ERW grade duly processed for anti-rust treatment and painted with black enamel paint, accessories for rigid steel conduits such as 5mm thick 20mm width spacers and G.I. saddles for individual pipe or GI strip for bunch of pipes, sockets, inspection type or normal; open bends, junction boxes of required ways all of the same make.

Wires: Phase and Neutral

PVC insulated wires of specified size, 1.1 kV, & minimum FR grade insulation, electrolytic tough pitch (ETP) copper conductor, ISI marked, of required colour coding as per Table No 1/5

Earth Wire:

PVC insulated minimum FR grade copper wires of electrolytic grade, having insulation of 1.1 kV grade, of green / green-yellow colour, ISI marked, 2.5 Sqmm or bare copper wire of 14g

Accessories:

Switch: 1 or 2 way Piano type 6/10 A, 1 or 2 way Modular type switch 6/10A.

Outlet: 6A angle / batten lamp holder or 3 plate ceiling-rose or Bakelite / porcelain three way connector or if plug point, 6A, 3-pin plug socket.

Boards:

Switchboards shall be double walled (back and front) of suitable size, to accommodate independent slot for each switch, socket, fan regulator. Boards shall be made up of 4mm thick marine grade plywood for back and front fixed on wooden frame with 0.8mm thick laminate pasted on exposed portion of front ply, totally varnished and with either brass hinged door or screwed top.

Or

As above with 3mm thick Bakelite/Hylam top instead of laminated front ply.

Or

Board made from Filled polypropylene.

Round/Square double wooden block or PVC board for mounting light / fan outlet accessory.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs, wooden gutties, PVC/ rubber bushings etc.

Method of Construction:

Point wiring (Surface)

Erection of conduits:

General:

Erection shall be done as per the final approved layout, in perfect level and plumb. Conduits shall be duly screwed and firmly fixed on spacers with saddles. Fixing of spacers shall be equidistant and at ends, bends, elbows, junction boxes, couplings, boards. CSK screws of minimum 35x8 mm and suitable plugs shall be used for fixing spacers and 12x5 mm round headed for fixing saddles on spacers. In case of stonewalls wooden gutties shall be grouted in wall for fixing of spacers and saddles. Distance between 2 spacers shall not be more than 600mm. Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution. Also for wiring for other utilities like data, telephone, TV cabling distance between pipes shall not be less than 300 mm. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of surface conduit with colour coding (For Visual identification) as per Table No 1/4. Flexible conduits shall be used at expansion joints. Bushing shall be provided at open ends.

Erection of conduits:

PVC pipes for surface type wiring:

In addition to General conditions above, all joints shall be made rigid with resin / adhesive. Wherever offsets are necessary, same shall be done with bending spring. Size of conduit shall be correct depending on number of wires to be drawn as per Table No. 1/2.

Or

Specially for Rigid Steel Conduit of surface type wiring:

In addition to general conditions above, Size of conduit shall be correct depending on number of wires to be drawn (as per Table No. 1/1 for steel conduits). All exposed threaded portion of Rigid Steel Conduits shall be painted with anti corrosive paint. Sharp edges and burr at cut ends shall be made smooth. Inspection type conduits accessories shall be used as per requirement in accessible position to facilitate drawing or withdrawing of wires. All

conduits piping work shall be properly earthed with 2.5 sq. mm G.I Earth wire fixed to conduit and made continuous with Earth clips at every 1m and at ends and joints viz. bends, junction boxes.

Or

Erection of PVC Trunking for surface type wiring:

Erection shall be done as per the final approved layout. The Trunking shall be in perfect level and plumb. Screws of minimum 35x8 mm and suitable plugs shall be used for fixing. In case of unlevelled surface number and size of screws shall be changed to higher size as per requirement and in case of stonewalls wooden gutties shall be grouted in wall for fixing of screws of Trunking. Distance between 2 screws shall not be more than 600 mm. Size of Trunking shall be correct depending on number of wires to be drawn as per Table No 1/3 but not less than 20mm. Separate Trunking shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring of other utilities like data, telephone, TV cabling and distance of 300 mm shall be maintained between the Trunking. Double locking shall be checked while fixing capping. Adequate use of accessories shall be made at joints and required locations.

Drawing of wires: General

Wires shall be drawn with adequate care. Correct colour coding as per Table No 1/5 shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped within circuit. For lighting load distribution wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only. Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm or as per specified shall be erected wherever necessary. In case of 2-way point wiring additional wires of phase conductor shall be provided between the 2-way switches.

Drawing of wires: through PVC conduits for surface type wiring

Insulated Earth wire of green or green-yellow colour of minimum 2.5 sq mm shall be drawn through pipe. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/2.

Or

Drawing of wires: through Rigid Steel conduits for surface type wiring

Bush shall be used at pipe opening to protect wire insulation from getting damaged due to burrs / sharp edges. Number of wires shall not exceed with respect to size of pipe as per Table No. 1/1.

Or

Erecting wires in Trunking:

Wires shall be erected within Trunking with adequate care. Number of wires shall not exceed with respect to size of Trunking as per Table No. 1/3. After erection of wires double locking shall be checked while fixing capping.

Fixing Switchboards and accessories:

Control switchboards shall generally be erected at 1.35m height or as specified and fixed with minimum 2 Nos. (and more as per size of board) of screws of length not less than 50mm, termination of wires shall be done with lugs on switch and other accessories only by carefully inserting all strands in lugs, terminals and proper tightening. Switches shall be provided on phase wire only. Bare wire shall not be used for looping incoming supply to switches and for earthing inside switchboards. For plug socket phase wire shall be connected in right side terminal when seen from front. Proper termination of earth wire in Earth terminal shall be ensured.

Testing:

Insulation resistance test:

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured at all earth terminals of plug outlets and at earth terminals of metal enclosures.

Polarity test:

Polarity test shall be carried out for ensuring the correct polarity in switch and plug.

Mode of Measurement:

Measurement shall be carried out on the basis per number of points, **for the point length up to 6 metre between switch and outlet.** For the length exceeding 6 metre 10% of overall rate shall be added for every 1m.

1.7 **Point wiring (Concealed type)**

Specification No (WG-PW/CW)

Scope:

Point wiring (Concealed type):

Providing all required approved specified material including hardware and erecting rigid steel / PVC conduits, junction boxes, provided fan boxes, along with required accessories in RCC slabs before casting and in walls, flooring by making chases, and refilling the same after erection of conduits, fixing concealed type boxes for switch boards in walls, drawing wires through conduits, from switch board to outlet for light / fan / bell / independent plug point fixing modular type switch for controlling power supply and an accessory for outlet of light / fan / bell / plug at other end, with mounting plate, and terminating wires within at both ends, as per approved Method of Construction, closing all junction boxes with plates; removing all debris and testing the installation for safety and beneficial use.

Material:

Point wiring (Concealed):

PVC conduit:

PVC pipe of minimum 20mm dia and above depending No. of wires to be drawn (refer Table No 1 / 2); ISI mark, HMS grade (2mm thick), accessories for PVC pipes of the same make that of pipe; such as Spacers & Saddles, Couplers, Bends, deep / normal Junction boxes of required ways and resin / adhesive to make all joints rigid. Black pipe shall not be used for surface type wiring.

Rigid Steel conduit:

Rigid steel screwed conduit minimum 20mm dia. and higher depending on No. of wires to be drawn as per Table No.1/1, 16 gauge, ISI mark, ERW grade duly processed for anti-rust treatment and painted with black enamel paint, accessories for rigid steel conduits such as sockets, bends, deep / normal junction boxes of required ways all of the same make.

Sheet metal Junction boxes / Draw-in boxes:

Junction box shall be 5 sided with removable top plate, fabricated from 16g CRCA sheet steel with earth terminal duly treated with antirust treatment and painted with two coats of red oxide paint. There shall be knockout holes in required numbers and dia. for entry of conduit pipes and arrangement to fix surface cover plate on it. Cover plate shall be made up of fire resistant PVC material / 3mm thick laminate / Bakelite / Hylam / transparent acrylic sheet painted from inside to match colour of wall with duly tapered edges.

Wires: phase and neutral wires

PVC insulated wires of specified size, 1.1 kV, & minimum FR grade insulation, electrolytic tough pitch (ETP) copper conductor, ISI marked, of required colour coding as per Table No 1/5

Earth Continuity Wire:

PVC insulated minimum FR grade copper wires of electrolytic grade, having insulation of 1.1 kV grade, of green colour, ISI marked, 2.5 Sqmm or bare copper wire of 14g

Lugs: Pin type Copper lugs.

Accessories:

Switch: 1 or 2 way Modular type switch 6/10A.

Outlet:

Modular type 6A angle / batten lamp holder or 3 plate ceiling-rose or Bakelite / porcelain 3 way connector or if plug point, 6A, 3-pin plug shuttered socket.

Boards:

Switchboards shall comprise of; concealed type box of required modules made of sheet metal or Polypropylene material, mounting plate and cover plate. The required modules shall be worked out on the basis of points, plug socket/sockets, step type fan regulator, etc are to be fixed. For every blank module, 1 way blank plate shall be fixed. All the above accessories shall be of same make, as that of switch.

Hardware:

Sheet Metal (SM) screws of sizes specified in Method of Construction, washers, rawl / PVC / fill type plugs / wooden gutties, 'U' nails, plumbing nails, steel binding wire, fish wire 20g, rubber / PVC bushes etc.

Other material for Surface finishing: Sand, Cement, water etc.

Method of Construction:

Point wiring (Concealed):

Concealing of conduits:

General:

Work shall be done in co-ordination with civil work and to suite final approved layout. Size of conduit shall be correct depending on number of wires to be drawn. (Table No. 1/1 for

Steel conduits & Table No 1/2 for PVC conduits) Separate pipe shall be used for each phase in 1-ph distribution and for power and light distribution and also for wiring for other utilities like data, telephone, TV cabling, etc. The distance between pipes shall not be less than 300 mm. Adequate use of conduit accessories shall be made at required locations. Entries in wall shall be at level of corresponding conduit with colour coding as per Table No. 1/4. (For Visual identification) Flexible conduits shall be used at expansion joints. Erection shall be done as per the layout finalized, with minimum sharp bends, with junction boxes at angular junctions and for straight runs at every 4.25m, in such manner so as to facilitate drawing of wires. All the bends shall be done with Bending Spring.

Concealing of conduits: In RCC work

Work shall be commenced after fixing of steel (re-enforcement) on centering material. Conduits shall be firmly fixed on steel of RCC work by binding wire. Fixing of conduits shall be such that it will remain rigid during casting of slab, beam, and column even after use of vibrator. Deep junction boxes and other draw-in boxes shall be such that their open end and centering material will not have gap in between so as to avoid concrete entering inside even after fixing covers to steel re-enforcement; and be filled with dry sand. Open ends of conduits; to be concealed in walls, shall be provided with couplers / sockets at ends and be flush with bottom of beam, and at located at the center of the beam. As far as possible bunching / grouping of conduits shall be avoided so that it will not affect strength of RCC work especially in beams. Suitable steel fish wire shall be drawn through in the conduits for drawing of wires later on.

Concealing of Conduits: In walls

Chases shall be made in walls of adequate width, with cutter and chiseling through it. Necessary finishing of the surface shall be done. Conduits of adequate size shall be erected with use of appropriate accessories and 'U' nails.

Drawing of wires:

Use of Steel fish wire shall be made for drawing of wires. Wires shall be drawn with adequate care. Correct colour coding shall be used for phase, neutral and earth. Wires shall not have intermediate joint in between terminals of the accessories. Earth-wire and Return wire (neutral) may be looped within circuit only. For lighting load distribution, wires of two different phases shall not be drawn in single pipe. Wires shall be terminated in the terminals of accessories only. Adequate extra length shall be left at termination points. In case of 2-way point wiring additional wires of phase conductor shall be provided between the 2-way switches.

Fixing Switchboards and accessories:

Control switchboards shall generally be erected at 1.35m height or as specified and fixed with minimum 2 Nos. of screws of length not less than 50 x 8mm, Boards shall be in line and plum and shall be in level with wall surface so as to fix mounting plate flush with wall, Termination of wires shall be done in switch and other accessories only by carefully inserting all strands in terminals and proper tightening. Switches shall be provided on phase wire only. Bare wire shall not be used for looping incoming supply to switches. Phase wire shall be routed through switch only. For plug socket phase wire shall be connected in right side terminal when seen from front. Proper termination of earth wire in Earth terminal shall be ensured. All blank modules shall be plugged with blanking plates.

Testing:

Insulation resistance test:

All wiring shall be tested with 500V Meggar between phases, phase – neutral and to Earth. IR value shall not be less than 1M-ohm.

Earth continuity:

Earth continuity shall be ensured at all earth terminals of plug outlets and at earth terminals of metal enclosures.

Polarity test:

Polarity test shall be carried out for ensuring the correct polarity in the plug.

Mode of Measurement:

Measurement shall be carried out on the basis per number of points, **for the point length up to 6 metre between switch and outlet.** For the length exceeding 6 metre 10% of overall rate shall be added for every 1metre.

2. DISMANTLING POINT WIRING: (WG-PW/DM)

Electrical installation of point wiring along with circuit mains from DBs shall be dismantled with adequate care without damaging surface of wall, ceiling, and flooring. The holes shall be refinished to match with the surrounding surface. Site shall be made clean by removing debris. Dismantled material shall be retained by the agency.

3. Mode of Measurement:

Executed quantity will be counted on the basis of number of points. (i.e. per Point)

Table No. 1/1
Maximum Number Of Single Core 1.1 kV Cables That Can Be Drawn In Rigid Steel Conduits

Size of cable mm ²		Size of conduit mm													
Nominal Cross sectional area	No. and dia. of wires	16		20		25		32		40		50		63	
		S	B	S	B	S	B	S	B	S	B	S	B	S	B
1.0	1 / 1.12 Cu	5	4	7	5	13	10	20	14						
1.5	1 / 1.4	4	3	7	5	12	10	20	14						
2.5	1 / 1.8 3 / 1.06 Cu	3	2	0	5	10	8	18	12						
4.0	1 / 2.24 7 / 0.85 Cu	3	2	4	3	7	8	12	10						
6	1 / 2.80 7 / 1.06 Cu	2		3	2	6	5	10	8						
10	11 / 3.55 Al 7 / 1.40 Cu			2		5	4	8	7						
				2		4	3	6	5						
16	7 / 1.70					2		4	3	7	6				
25	7 / 2.24							3	2	5	4	8	6	9	7
35	7 / 2.50							2		4	3	7	5	8	6
50	7 / 3.0 Al 19 / 1.80									2		5	4	6	5

Note 1: Cu- applicable to only copper cable; Al- applicable to only Aluminium cable

Note 2: The table shows maximum capacity of conduits for the simultaneous drawing of cables. The columns headed 'S' apply to straight runs of conduits which have distance not exceeding 4.25m between draw in boxes and which do not deflect from straight by an angle more than 15°. The columns headed 'B' apply to bent runs of conduit, which deflect from the straight by an angle of more than 15°.

Note 3: In case of inspection type draw in box has been provided and if the cable is first drawn through one straight conduit, then through the draw in box and then through the second straight conduit such system may be considered as that of straight conduit even if the conduit deflects through the straight by more than 15°.

Table No. 1/2
Maximum Number of Single Core 1.1 kV Cables That Can Be Drawn In Rigid Non-Metallic Conduits

Size of cable mm²		Size of conduit mm					
Nominal Cross sectional area	No. and dia. of wires	16	20	25	32	40	50
1.0	1 / 1.12 Cu	5	7	13	20		
1.5	1 / 1.4	4	6	10	14		
2.5	1 / 1.8 3 / 1.06 Cu	3	5	10	14		
4.0	1 / 2.24 7 / 0.85 Cu	2	3	6	10	14	
6	1 / 2.80 7 / 1.06 Cu		2	5	9	11	
10	11 / 3.55 Al 7 / 1.40 Cu			4	7	9	
16	7 / 1.70			2	4	5	12
25	7 / 2.24				2	2	6
35	7 / 2.50					2	5
50	7 / 3.0 Al 19 / 1.80					2 2	5 3

Note 1: Cu- applicable to only copper cable; Al- applicable to only Aluminium cable

Table No. 1/3
Maximum Number of Single Core 1.1 kV Cables in Cable Trunking (Casing and Capping)

Size of cable mm²	Size of Trunking mm					
Nominal Cross sectional area	12/16 x 12 mm	20 x 12 mm	25 x 12 mm	32 x 12 mm	40 x 20 mm	50 x 20 mm
1.0						
1.5	3	5	6	8	12	18
2.5	2	4	5	6	9	15
4.0	2	3	4	5	8	12
6		2	3	4	6	9
10		1	2	3	5	8
16			1	2	4	6
25				1	3	5
35					2	4
50					1	3

Note 1: Cu- applicable to only copper cable; Al- applicable to only Aluminium cable

Table No. 1/4
Colour Coding For Conduits in Wall Entry

Conduit for	Colour
Light / Power circuit	Black
Security wiring	Blue
Fire Alarm wiring	Red
Low voltage circuits	Brown
UPS circuits	Green

Table No 1/5
Colour Code for Wires

Type	Colour
Phase	Red, Yellow, Blue
Neutral	Black
Earth	Green

1.11 Telephone wiring (TW)

1. General

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which PSI mark is not available in market, it shall be approved either by ITD / DOT of Govt. of India.

Work shall be carried out as per the Method of Construction specified by BIS and as specified by DOT (Department of Telephone), Govt. of India. Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

2. Scope:

Specification No (WG-TW)

To provide wiring for telephone on surface of wall or ceiling concealed in slab, wall, under flooring, etc, through existing metallic conduits, rigid PVC conduits, PVC trunking, with all necessary hardware, material, etc. as specified.

To provide, install, test & commission the instruments / equipments and accessories used in telephone system, such as; Main Distribution Frames (MDF), Krone Modules, Over Voltage Magazine, PBX / EPABX, CO-axial cable, Rosette box, Jumper wire, etc.

3. Material:

PVC Telephone cable: PVC insulated Tinned copper solid conductor with minimum 0.5 mm dia. (Single & Multi pair) properly paired and colour coded, shall be terminated on KRONE module with suitable tool.

Jelly filled Armoured Telephone cable: PVC insulated, PVC sheathed with steel armouring, Tinned copper solid conductor with minimum 0.5 mm dia multi pair, with Jelly, properly paired and colour coded.

Saddles: Saddles fabricated from G I sheet of required gauge (16/18 gauge) either galvanized finish or painted with superior quality enamel black paint, with necessary shearing for mechanical strength, semi circular shaped with extended piece having suitable holes for fixing on spacer.

Hardware: Sheet Metal (SM) screws of required sizes, plugs, wooden gutties, etc.

MDF: Manufactured by reputed manufacturer of specified capacity, facility for wall mounting, with door & lock, aluminium frame for fixing of KRONE, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour.

Junction box: Manufactured by reputed manufacturer of specified capacity, facility for + wall mounting, with door & lock, aluminium frame for fixing of Krone, duly enclosed in cabinet made from 18 SWG CRCA sheet with powder coating of required colour. The depth of the box should consider the height of KRONE module plus protection magazine.

Over Voltage protection Magazine: Manufactured by reputed manufacturer of 10 pair capacity, with 3 pole gas discharge tube should be properly fitted on KRONE module in MDF / Junction box.

Rosette box: PVC / Bakelite box with LED indicator, RJ 11 jack, facility for fixing on wall.

Jumper wire: Twin twisted PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia.

KRONE Module: Disconnection type KRONE module having capacity to connect 10 pairs with silver-plated terminal contacts.

RG-11 Co-axial low voltage grade cable: PVC insulated with Tinned copper solid conductor minimum 0.5 mm dia, with connector at both ends suitable for termination in RJ type socket.

PBX (Analogue type): Manufactured by reputed manufacturer and approved by Telephone Engineering Certificate (TEC) of specified extensions, having following features:

- Direct Inward dialling (DID) with voice guidance facility.
- Caller line Identification (CLI) on Analog as well as digital extension.
- Call Billing software (CB)
- Dynamic STD locking
- Conferencing facility for specified extensions.

EPABX (Digital type): Manufactured by reputed manufacturer and approved by Telephone Engineering Certificate (TEC) of specified extensions, having following features:

- Direct Inward dialling (DID) with voice guidance facility.
- Caller line Identification (CLI) on Analog as well as digital extension.
- Call Billing software (CB)
- Dynamic STD locking
- Conferencing facility for specified extensions.
 - . Provision of battery back-up and power failure line transfer.

4. Method of Construction:

4.1 Drawing of telephone wire through Steel conduit / PVC conduit / PVC Trunking:
As specified in Chapter for Point Wiring.

4.2 Erection of Jelly filled armoured Telephone cable:

Erection shall be done as per the layout finalized, in perfect level and plum. Before fixing the cable shall be straightened as far as possible for good aesthetics look. Cable shall be fixed with saddles firmly clipped on cable. Saddles shall be fixed to wall with minimum 50x8 mm SM screws with plugs/wooden gutties (Distance between two saddles shall be minimum 600 mm). Wooden gutties shall be used wherever required (Especially for stone wall). The entries made in wall, floor slab, etc for laying the cable shall be made good by filling and finishing with plastering the same.

4.3 Erection of MDF Junction box / Rosette box / PBX / EPABX, etc:
Specified equipment shall be fixed to wall with minimum 50x8 mm SM screws, with necessary plugs, wooden gutties, etc. or may be fixed on Table Top if required.

5. Mode of Measurement:

Work done for telephone in Steel / PVC conduit / PVC Trunking will be measured on running meter basis, (i.e. per running meter) for each single run. For the other accessories / equipments shall be done as per unit specified. (i.e. Job / each)

1.12 Computer Cabling (COC)

A) UTP Networking Cable

General:

All material shall conform to relevant standard as per ISO/IEC11801, CENELEC EN50173 & TIA/EIA 568-B2-1; CUL listed & ETL verified.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of Engineer in Charge.

Scope:

Specification No (WG-COC/NC)

To lay the cables for Computers on surface of wall or ceiling concealed in slab, wall, under flooring etc, through existing metallic conduits, rigid PVC conduits, PVC trunking, with all necessary hardware, material, etc. as specified. The cable shall be used only for connections between Information Outlet & Patch/ Multimax Panel. (Exception: For making MDIX patch cord)

Material:

UTP cable:

4 pairs, 100 ohms, unshielded twisted pair (UTP), each pair separated by a PE former (Star shaped) solid 23AWG tinned copper conductor rated for temperature of 75⁰ C, PVC insulated grey colour with following types as in the table 1.12/1

Table 1.12/1

Sr. No.	Type	Class	Tested frequency
1	Cat 6	E	350MHz
2	Cat 6+	E	500MHz

- 1 The Category 6 cable and Category 6 channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6 channel cable, components, and applications for a period of 20 years.
- 2 The Delay Skew on the 100 meter channel shall not exceed 30 ns
- 3 The 20 year warranty shall be a transferable warranty and has component replacement policy in case of manufacturing defect
- 4 Category 6, 100mtr channel, **4-connection** model should guarantee 400% margin over standard NEXT specification across swept frequency
- 5 Category 6, 100mtr channel, **6-connection** model should guarantee +4dB margin over standard NEXT Specification across swept frequency (1~250MHZ)
- 6 The high performance Category 6 UTP cable 23AWG shall be of the traditional round design with Mylar bisector tape Non-Plenum rated.
- 7 The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem, Switched-56, T-1, ISDN, RS-232, RS422, RS-485, 10BASE – T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, IEEE 1394B S100 and S400, as well as all 77 channels (550 MHz) of analog broadband video.
- 8 The cable jacket shall comply with Article 800 NEC for use as a non-plenum cable. The 4 pair UTP cable shall be UL® and c (UL®) Listed Type CM.
- 9 Performance shall be characterized to 550 MHz to support high-bandwidth video applications

Non Plenum CAT6 UTP Cable

- 1 Weight=25.3 lb (1000 ft)
- 2 Jacket Thickness=.022 in
- 3 Outside Diameter=0.232 in
- 4 Conductor Diameter=.022 in
- 5 Insulation Type=High density Polyethylene
- 6 Jacket Material=PVC
- 7 Maximum Pulling Tension=25 lbs
- 8 Nom. Velocity of Propagation=0.69
- 9 Max DC Resistance=9.83 Ohms/100m

- 10 Mutual Capacitance @ 1 kHz = 4.95 nF/100m
- 11 Operating Temperature= -20 to 60° C
- 12 The high performance Category 6 UTP cable shall be of the **traditional round design with Mylar bisector tape.**
- 13 The 4 pair UTP cable shall be UL Type CM (non-plenum)
- 14 Performance shall be characterized to 550 MHz to support high-bandwidth video applications

Method of Construction:

The cable shall be laid in provided separate casing n capping/ PVC conduit/ trunking 400mm away from electrical cables wherever required without sharp bends. The cable shall be spliced at both the ends for punching/ crimping at keystone jacks/ UTP connectors.

Mode of measurement: Executed quantity shall be measured on running metre basis.

B) UTP Patch cord

Scope:

Specification No (WG-COC/PC)

Structured cabling, to make connections from switch to patch panel or information outlet to computer

Material:

UTP Patch Cord:

Assembly (conforming to EIA/TIA 568B-2-1) of Cat 6 type 4 unshielded twisted pair 24-26AWG (0.51mm-0.40mm), each pair separated by a PE former (Star shaped) 100 ohms stranded wire PVC insulated cables with modular RJ-45 polycarbonate UL94V housing 15milliohms gold over nickel contacts (superior three piece connector) crimped on both ends with T568A & T568B wiring schemes with 8P8C connection. The cord shall be branded. The cords shall be used in structured cabling in accordance with following table 1.12/2.

Table 1.12/2

Sr. No.	Length	Use in
1	1m	from switch to patch panel
2	3m	from computer to information outlet

- 1 All patch cords shall exceed TIA/EIA and ISO/IEC Category 6/Class E specifications.
- 2 All patch cords shall be backward compatible with Category 5 and Category 5E systems.
- 3 The patch cords shall incorporate an anti-snag feature that provides maximum protection from snagging during moves and re-arrangements.
- 4 Patch cords shall be UL listed, UL-C certified and AUSTEL approved.
- 5 Patch cords shall support network line speeds in excess of 1 gigabit per second.

Physical Specifications:

Contact Material:	Phosphor Bronze
Contact Plating:	Gold 50 micro-inch (1.27 microns) Nickel 100 micro –inch (2.54 microns)
Insertion Life:	750 minimum
Plug Material:	Polycarbonate UL-rated 94 V-O
Operating Temperature:	14°F to 140°F (-10°C to 60°C)

Method of construction:

The patch cord shall be erected for making connections from switch to patch panel or from computer to information outlet.

Mode of measurement: Executed quantity shall be counted on number basis

BACKBONE (Fibre Network)

C) PVC Armoured Optical Fibre Cable (OFC)

General:

All material shall conform to relevant standard as per IEEE, EIA/TIA 568-B.3

Scope:

Specification No (WG-COC/OFC)

Optical fibre cable is used for connecting remote places networks by means of fibre switch or fibre module without much loss of signal.

Material:

Optical Fibre Cable:

Dielectric & metallic sheath armoured multimode optical fibre cable for underground/ aerial applications, fibres separated into binder groups inside a Industry standard 3mm gel filled buffer tubes standard around a central strength member; water blocked with dry water blocking material, making access & handling individual tubes easier & craft-friendly cable core; operating temperature of 40 - 70⁰ C, crush resistance of 44N/m, as per table 1.12/3.

Table 1.12/3

Physical Specifications:

Fiber Count	Subunits	Outer Diameter in. (mm)	Weight lbs/kil kg/km	Minimum Bend		Max. Tensile Load		Max. Vertical Rise Feet (Meter)
				Radius	In. (cm)	lbs. (Newtons)		
						Loaded	Unloaded	
4 - 48	5	0.46 (11.7)	63 (94)	9.2 (23.4)	4.6 (11.7)	607 (2700)	180 (800)	2856 (871)
72	6	0.50 (12.7)	72 (107)	10.0 (25.4)	5.0 (12.7)	607 (2700)	180 (800)	2509 765)
96	8	0.58 (14.7)	95 (141)	11.5 (29.4)	5.8 (14.7)	607 (2700)	180 (800)	1904 (580)
144	12	0.74 (18.9)	146 (217)	14.8 (37.8)	7.4 (18.9)	607 (2700)	180 (800)	1237 (377)
288	24	0.86 (21.9)	211 (315)	17.2 (43.8)	8.6 (21.9)	607 (2700)	180 (800)	852 (260)

Note* There are 12 fibres per tube

04/ 06/ 12/ 24 fibres				
Sr. No.	Grade	Core dia.	1Gbps Distance at wavelength	
			850nm	1300nm
1	FR	62.5 µm	3000m	550m
2	FR	50 µm	1100m	600m
3	FRLS	62.5 µm	3000m	550m
4	FRLS	50 µm	1100m	600m

1. The cable shall support Gigabit Ethernet and legacy applications including Ethernet, Fast Ethernet, Token Ring, ATM and FDDI.
2. The loose tube dielectric OSP cable shall be armored with a corrugated polymer
3. coated steel tape and constructed with industry standard 3mm buffer tubes, stranded around a central strength member.
4. The armor layer shall provide crush protection meeting the Telcordia requirements for Superior Armored cable.
5. The buffer tubes shall compatible with standard hardware, cable routing and fan-out kits.

6. The cable core shall be water blocked with dry water-blocking materials, making access and handling of individual tubes easier and craft-friendly.
7. The cables shall be designed for point-to point applications as well as mid-span access, and provide a high-level of protection for fiber installed in the outside plant environment.

S. No	Features
1	Support 10 Gbps up to 300 meters
2	Meets and exceeds the next generation multimode fiber (OM3) specifications in standards
3	Gigabit Ethernet is supported up to over 1.0 kilometre for 1000BASE-SX.
4	Supports very high speed data transmission by controlling DMD
5	Differential Mode Delay Exceeds TIA-492AAAC-A (IEC-60793-2-10ed2) @ 850nm
6	> 2,000 MHz-km laser bandwidth at 850 nm
7	Core Diameter should be $50.0 \pm 3.0 \mu\text{m}$
8	Cladding Diameter should be $125.0 \pm 1.0 \mu\text{m}$
9	Max. Attenuation, Loose Tube Cable 3.0 dB/km
10	Coating/Cladding Concentricity Error should be $\leq 6 \mu\text{m}$
11	Clad Non-Circularity $\leq 1\%$
12	Zero Dispersion Wavelength 1297-1316 nm
13	Water Immersion, 73.4°F (23°C) should be $\leq 0.20 \text{ dB}$

Environmental and Mechanical

	Specification	Test Method
Operating Temperature	-40°to +70°C	FOTP - 3
Installation Temperature	20°to +70°C	N/A
Storage Temperature	-40°to +70°C	N/A
Crush Resistance	44 N/mm	FOTP - 41
Impact Resistance	Exceeds	FOTP - 25
Flexing	Exceeds	FOTP - 104
Twist Bend	Exceeds	FOTP - 85

Cable Identification:

Buffer Tubes and Fibres are identified with standard color coding:

1 - Blue	5 - Slate	9 - Yellow
2 - Orange	6 - White	10 - Violet
3 - Green	7 - Red	11 - Rose
4 - Brown	8 - Black	12 - Aqua

Hardware:

Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, clips etc.

Method of Construction:

As per the method of construction of PVC armoured cable. But these cables shall be tagged as "OFC" every metre length & can be laid in trench side by side. For underground cable laying cable indicator mentioning "Optical Fibre Cable" is a must.

Mode of measurement: Executed quantity shall be measured on running meter basis.

D) Fibre Patch Cord (FPC)

General:

All material shall conform to relevant standard as per IEEE, EIA/TIA, CENELEC

Scope:

Specification No (WG-COC/FPC)

The cord is to be used to connect fibre optic equipment to fibre optic cross-connects, interconnects & information outlets. (e.g. Remote Ethernet switch with fibre optic module can be connected to another same type of switch or Fibre Optic Switch.)

Material:

FRLS duplex fibre patch cord/ pigtails 1mtr in length with LC/ SC/ ST termination consisting of 1.6mm/ 3.0mm dia. 62.5um fibre with minimum bandwidth of 200MHz-km at 850nm & 500MHz at 1300nm with following specifications, as per table 1.12/4.

Table 1.12/4

Sr. No.	Outside dia.	Cable retention strength	Minimum Bend Radius	Maximum Cordage Tensile Load
1	1.6mm: 1.6mm x 3.3mm	50 Newton	Loaded: 5.1cm Unloaded: 3.5cm	Short Term : 3111 Newton Long Term: 93 Newton
2	3.0mm: 3.0mm x 5.9mm	50 Newton	Loaded: 5.8cm Unloaded: 3.5cm	Short Term : 400 Newton Long Term: 120 Newton

1. The fiber-optic patch cord shall be configurable with standard LC, SC, and ST terminations, and shall be available in either 1.6 mm or 3.0 mm duplex zip cord.
2. The 1.6 mm cordage shall exceed the requirements for larger diameter cordage and allows at least twice as many fibers to be installed in a cabinet.
3. The duplex cordage shall be 1.6 mm by 3.5 mm and have two single fiber cords joined together with a web.
4. The connector shall have a pull-proof design that helps prevent accidental disconnects and helps to assure optimal performance of equipment.
5. Custom hybrid patch cords shall also be available, to simplify migration to industry-leading connectors.
6. All fibers shall be Differential Mode Delay (DMD) tested by using a high-resolution test bench that exceeds the FOTP-220 standards and shall be independently certified by UL®.
7. All patch cords shall be a distinctive aqua color for positive identification.

Physical Specifications:

Minimum Bandwidth	@ 850 nm: 4700 MHz-km (laser), 3500 MHz-km (OFL) @ 1300 nm: 500 MHz-km (laser), 500 MHz-km (OFL)
Attenuation:	3.0 dB/Km @ 850 nm, 1.0dB/Km @ 1300 nm
Cable Outside Diameter:	Duplex: 1.6 x 3.7 mm
Min. Bend Radius:	2.5 cm
Operating Temperature Range:	-20 to 70 °C
Average Connection Loss:	LC = 0.1 dB
Return Loss Minimum:	-20 dB
Tip Material:	Ceramic
Mating Durability for:	500 Reconnects
Insertion Loss Change:	<0.2 dB
Temperature Stability:	-40 to + 75 °C
Insertion Loss Change:	<0.3 dB

Method of Construction:

Supplying & plugging FRLS duplex fibre patch cord/ pigtailed into the LC/ SC/ ST termination of LIU & fibre module/ fibre switch port complete.

Mode of Measurement: Executed quantity shall be counted on number basis

1.13 Networking Components (NWC)

Switches/ Routers

A) Web Smart Power Over Ethernet Switch (ENS)

General:

All material shall conform to relevant standard as per IEEE802.3af PoE

Scope:

Specification No (WG-NWC/ENS)

Preferred in Wireless LAN obviating the use of external power supply for Access Points

Material:

Ethernet Switch:

Ethernet Switch with PoE: 24 ports PoE (Power Over Ethernet) with IEEE 802.3af PoE protocol, each PoE to supply up to 15.4 Watts for connecting devices such as Access Point needing additional power, 10/100Base-Tx 24 Fast Ethernet ports, 1000 Base-T 4 ports, 2 combo ports for flexible copper/fibre Gigabit connections, VLAN web manageable switch with rack mountable clips, screws, console utility software, mechanisms to detect an attack against the central processing unit of the switch and to take corrective action on attacking interface.

1. Feature-rich solution with functionality enabling by Secure Always On access to mission critical applications
2. High performance switch architecture and stacking performance delivering 320Gbps
3. High-density 10/100 ports for edge connectivity
4. Two combo 10/100/1000/SFP uplinks ports per switch for high speed gigabit or low speed connections such as 100FX
5. Simplified converged network deployments through support for Power over Ethernet (PoE), advanced Quality of Service (Quos), and auto-configuration of ports with IP Handsets & Wireless Access Points

Technical Specifications:

- 10/100 Power over Ethernet ports: 24 per switch
- 10/100/1000/SFP Gigabit ports: 2 per switch
- SFP support: SX, LX, XD, ZX, CWDM, 100FX, & T1
- Resilient Stacking: up to 8 units / 192 ports per stack
- Stacking ports: 2 built-in stacking ports per switch
- Total stacking capacity: 320 Gbps
- Individual switch packet throughput: 6.6 Mpps
- Individual switch capacity: 48.8Gbps
- Concurrent VLANs: 256
- Jumbo Frame Support on Gigabit ports
- Maximum MAC addresses: 8,000

Standards Compliance:

- IEEE 802.3 10BASE-T Ethernet
- IEEE 802.3u 100BASE-TX Fast Ethernet
- IEEE (ANSI) 802.3 Auto-negotiation
- IEEE 802.3z Gigabit Ethernet
- IEEE 802.3x Flow Control
- IEEE 802.1Q VLANs

- IEEE 802.1p Priority Queues
- IEEE 802.1D Spanning Tree
- IEEE 802.1w Rapid Spanning Tree
- IEEE 802.1s Multiple Spanning Tree Groups
- IEEE 802.3ad Link Aggregation
- IEEE 802.1X Ethernet Authentication Protocol
- IEEE 802.3AB Link Layer Discovery Protocol
- RFC 783 Trivial File Transfer Protocol (TFTP)
- RFC 791/950 Internet Protocol (IP)
- RFC 792 Internet Control Message Protocol (ICMP)
- RFC 826 Address Resolution Protocol (ARP)
- RFC 854 Telnet Server and Client
- RFC 951 / 1542 BOOTP
- RFC 1112 Internet Group Management Protocol v1
- RFC 1215 SNMP Traps Definition
- RFC 1271 / 1757 / 2819 RMON
- RFC 1361 / 1769 Simple Network Time Protocol (SNTP)
- RFC 1493 Bridge MIB
- RFC 1573 / 2863 Interface MIB
- RFC 1643 / 2665 Ethernet MIB
- RFC 1905 / 3416 SNMP
- RFC 1906 / 3417 SNMP Transport Mappings
- RFC 1907 / 3418 SNMP MIB
- RFC 1945 HTTP v1.0
- RFC 2011 SNMP v2 MIB for IP
- RFC 2012 SNMP v2 MIB for TCP
- RFC 2013 SNMP v2 MIB for UDP
- RFC 2138 RADIUS
- RFC 2236 Internet Group Management Protocol v2
- RFC 2474 Differentiated Services Support
- RFC 2570 / 3410 SNMPv3
- RFC 2571 / 3411 SNMP Frameworks
- RFC 2572 / 3412 SNMP Message Processing
- RFC 2573 / 3413 SNMPv3 Applications
- RFC 2574 / 3414 SNMPv3 USM
- RFC 2575 / 3415 SNMPv3 VACM
- RFC 2576 / 3584 Co-existence of SNMP v1/v2/v3
- RFC 2660 HTTPS (Secure Web Server)
- RFC 2665 Ethernet MIB
- RFC 2863 Interfaces Group MIB
- RFC 2674 Q-Bridge MIB
- RFC 2737 Entity MIBv2
- RFC 2819 RMON MIB

Additional features:

- Customizable Auto-negotiation Advertisements (CANA)
- Distributed Link Aggregation Groups
- Virtual Link Aggregation Control Protocol (VLACP)
- Single IP address for stack management
- Resilient fail-safe stacking
- Automatic Unit Replacement (Configuration and Software)
- Automatic Detection Automatic Configuration (ADAC)
- 802.1X Single Host Single Authentication
- 802.1X Single Host Multiple Authentication
- 802.1X Multiple Host Multiple Authentication
- 802.1X Guest VLAN
- 802.1X Non-EAP (NEAP) access
- DSCP-based Recognition, Marking and Recolouring
- Ingress and Egress Port Mirroring
- Broadcast and Multicast Rate limiting per port
- ASCII Configuration File
- Web, NNCLI, JDM

- SSHv2 and SNMPv3 secure management support
- Secure Network Access (NSNA) support
- BPDU Filter
- Stack Monitor
- USB software and ASCII configure upload
- New unit quick to configure

Resiliency Features:

- Should support a technology which will allow multiple physical network links between two network switches and another device (which could be another switch or a network device such as a server) to be treated as a single logical link and load balance the traffic across all available links
- Generally all the physical ports in the link aggregation group must reside on the same switch. It should also support protocols remove this limitation by allowing the physical ports to be split between two switches.
- Load balancing mechanism should not be round robin or dynamic which may not work with applications like Voice & Video, where session persistence is must.

Main Objective of above features is to achieve Active-Active Cluster Switching. And achieve sub second fail over in case of Link failure & Device Failure, which will result in 99.999% uptime.

Power over Ethernet specifications:

- 802.3af compliant with Power classification support
- Signal pair power delivery
- Maximum 15.4 watts per port
- Maximum DTE Power AC 320 watts
- Maximum DTE Power AC + RPS 740 watts

Electrical specifications:

- Power supply: AC 100-240V, 50-60Hz
- Input current at 110v: 7.1A
- Input current at 220v: 3.6A
- Max power consumption: 470W

Dimensions:

- Width: 438.2mm (17.25 in)
- Height: 1RU 43.7mm (1.72 in)
- Depth: 368.3mm (14.5 in)

Environmental specifications:

- Operating temperature: 0 to 50 degrees C
- Storage temperature: -25 to 55 degrees C
- Relative humidity: 10% - 90%vnon-condensing
- Peak noise level: 42.3 dB
- Thermal rating: 375 BTU/hr
- Calculated MTBF: 242,552 hrs

Safety Agency Approvals:

- IEC 60950 International CB Certification
- EN 60950 European Certification
- UL60950 US certification
- CSA22.2, #60950 Canadian Certification
- NOM Mexican Certification

Electromagnetic Emissions and Immunity:

- CISPR22, Class A/CISPR24 International
- EN55022, Class A/EN55024 European
- FCC, Part 15, Class A US Certification
- ICES-003, Class A Canadian Certification
- AN/NZS 3548 Australian/NZ Certification
- BSMI - Taiwan - CNS 13438, Class A

- MIC - Korea - MIC, No. 2001-116
- VCCI Class A Japanese Certification

Hardware: Chromium plated brass nuts & bolts with special type of U shaped square washers of required sizes.

Method of construction:

The Ethernet switch fitted with rack mountable clips shall be fixed in U Rack (Networking Cabinet) with 4 nos. of chromium plated brass nuts & bolts. The switch shall be configured for TCP/IP addresses for switch IP & Gateway.

Mode of measurement: Executed quantity shall be counted on number basis

B) 24 Port Gigabit Switch (GBS)

Scope:

Specification No (WG-NWC/GBS)

To be used in wired LAN connections.

Material:

Gigabit Ethernet Switch:

24 nos. of 10/100/1000 Base-T Gigabit ports, 2 or 4 combo SFP slots for flexible fibre backbone, VLAN, manageable, 19" standard rack mountable, auto detection of MDI/MDIX, Layer 2, Safeguard Engine to protect against traffic flooding caused by virus/worm outbreaks with rack mountable clips, screws, console utility software.

1. Feature-rich solution with functionality enabling by Secure Always On access to mission critical applications
2. High performance switch architecture and stacking performance delivering 320Gbps
3. High-density 10/100/1000 ports for edge connectivity
4. Shared SFP uplinks ports per switch for gigabit fibre connectivity

Technical Specifications:

- 10/100/1000 Ethernet ports: 24 per switch
- SFP Gigabit ports: 4 per switch
- SFP support: SX, LX, XD, ZX, CWDM, 100FX & T1
- Resilient Stacking: up to 8 units
- Stacking ports: 2 built-in ports per switch
- Total stacking capacity: 320 Gbps
- Individual switch packet throughput: 36 Mpps
- Individual switch capacity: 88 Gbps
- Concurrent VLANs: 256
- Jumbo Frame Support on Gigabit ports
- Maximum MAC addresses: 8,000

Standards compliance:

- IEEE 802.3 10BASE-T Ethernet
- IEEE 802.3u 100BASE-TX Fast Ethernet
- IEEE (ANSI) 802.3 Auto-negotiation
- IEEE 802.3z Gigabit Ethernet
- IEEE 802.3x Flow Control
- IEEE 802.1Q VLANs
- IEEE 802.1p Priority Queues
- IEEE 802.1D Spanning Tree
- IEEE 802.1w Rapid Spanning Tree
- IEEE 802.1s Multiple Spanning Tree Groups
- IEEE 802.3ad Link Aggregation
- IEEE 802.1X Ethernet Authentication Protocol
- IEEE 802.3AB Link Layer Discovery Protocol
- RFC 783 Trivial File Transfer Protocol (TFTP)

- RFC 791/950 Internet Protocol (IP)
- RFC 792 Internet Control Message Protocol (ICMP)
- RFC 826 Address Resolution Protocol (ARP)
- RFC 854 Telnet Server and Client
- RFC 951 / 1542 BOOTP
- RFC 1112 Internet Group Management Protocol v1
- RFC 1215 SNMP Traps Definition
- RFC 1271 / 1757 / 2819 RMON
- RFC 1361 / 1769 Simple Network Time Protocol (SNTP)
- RFC 1493 Bridge MIB
- RFC 1573 / 2863 Interface MIB
- RFC 1643 / 2665 Ethernet MIB
- RFC 1905 / 3416 SNMP
- RFC 1906 / 3417 SNMP Transport Mappings
- RFC 1907 / 3418 SNMP MIB
- RFC 1945 HTTP v1.0
- RFC 2011 SNMP v2 MIB for IP
- RFC 2012 SNMP v2 MIB for TCP
- RFC 2013 SNMP v2 MIB for UDP
- RFC 2138 RADIUS
- RFC 2236 Internet Group Management Protocol v2
- RFC 2474 Differentiated Services Support
- RFC 2570 / 3410 SNMPv3
- RFC 2571 / 3411 SNMP Frameworks
- RFC 2572 / 3412 SNMP Message Processing
- RFC 2573 / 3413 SNMPv3 Applications
- RFC 2574 / 3414 SNMPv3 USM
- RFC 2575 / 3415 SNMPv3 VACM
- RFC 2576 / 3584 Co-existence of SNMP v1/v2/v3
- RFC 2660 HTTPS (Secure Web Server)
- RFC 2665 Ethernet MIB
- RFC 2863 Interfaces Group MIB
- RFC 2674 Q-Bridge MIB
- RFC 2737 Entity MIBv2
- RFC 2819 RMON MIB

Additional features:

- Customizable Auto-negotiation Advertisements (CANAs)
- Distributed Link Aggregation Groups
- Virtual Link Aggregation Control Protocol (VLACP)
- Nortel Multiple Spanning Tree groups
- Single IP address for stack management
- Resilient fail-safe stacking
- Automatic Unit Replacement (Configuration and Software)
- Automatic Detection Automatic Configuration (ADAC)
- 802.1X Single Host Single Authentication
- 802.1X Single Host Multiple Authentication
- 802.1X Multiple Host Multiple Authentication
- 802.1X Guest VLAN
- 802.1X Non-EAP (NEAP) access
- DSCP-based Recognition, Marking and Recolouring
- Ingress and Egress Port Mirroring
- Broadcast and Multicast Rate limiting per port
- ASCII Configuration File
- Web, NNCLI, JDM
- SSHv2 and SNMPv3 secure management support
- Nortel Secure Network Access (NSNA) support
- BPDU Filter
- Stack Monitor
- USB software and ASCII configure upload
- New unit quick to configure

Resiliency Features:

- Should support a technology which will allow multiple physical network links between two network switches and another device (which could be another switch or a network device such as a server) to be treated as a single logical link and load balance the traffic across all available links
- Generally all the physical ports in the link aggregation group must reside on the same switch. It should also support protocols remove this limitation by allowing the physical ports to be split between two switches.
- Load balancing mechanism should not be round robin or dynamic which may not work with applications like Voice & Video, where session persistence is must.
- Main Objective of above features is to achieve Active-Active Cluster Switching .And achieve sub second failover in case of Link failure & Device Failure which will result in 99.999% uptime

Electrical specifications:

- Power supply: AC 100-240V, 50-60Hz
- Input current at 110v: 1.3A
- Input current at 220v: 0.7A
- Max power consumption: 150W

Dimensions:

- Width: 438.2mm (17.25 in)
- Height: 1RU 43.7mm (1.72 in)
- Depth: 368.3mm (14.5 in)
-

Environmental specifications:

- Operating temperature: 0 to 50 degrees C
- Storage temperature: -25 to 55 degrees C
- Relative humidity 10% - 90% non-condensing
- Peak noise level: 42.4 dB
- Thermal rating: 290 BTU/hr
- Calculated MTBF: 312,001 hrs

Safety Agency Approvals:

- IEC 60950 International CB Certification
- EN 60950 European Certification
- UL60950 US certification
- CSA22.2, #60950 Canadian Certification
- NOM Mexican Certification

Electromagnetic Emissions and Immunity:

- CISPR22, Class A/CISPR24 International
- EN55022, Class A/EN55024 European
- FCC, Part 15, Class A US Certification
- ICES-003, Class A Canadian Certification
- AN/NZS 3548 Australian/NZ Certification
- BSMI - Taiwan - CNS 13438, Class A
- MIC - Korea - MIC, No. 2001-116
- VCCI Class A Japanese Certification

Hardware:

Chromium plated brass nuts & bolts with special type of U shaped square washers of required sizes.

Method of construction:

The Ethernet switch fitted with rack mountable clips shall be fixed in U Rack (Networking Cabinet) with 4 nos. of chromium plated brass nuts & bolts. The switch shall be configured for TCP/IP addresses for switch IP & Gateway.

Mode of measurement: Executed quantity shall be counted on number basis

C) Broadband ADSL Router (ADSL)

General:

All material shall conform to relevant standard as per ITU G.992.2 & RFC

Scope:

Specification No (WG-NWC/ADSL)

For broadband internet connections to individual computer or Wired LAN/ Wireless LAN.

Material:

Broadband ADSL Router:

ADSL2+ broadband router with PPP(Point-to-Point Protocol), DHCP support, TCP/IP, downstream up to 24Mbps, upstream up to 1Mbps, RJ-11 for ADSL line, RJ-11 for phone line with Patch cord 3 metre in length, 10/100 Base-T port, USB 1.1 & 9V adaptor with UTP(Ethernet) Patch Cord, USB 2.0 patch cord, USB driver software

- **Designed for the small to medium business** - Simpler than enterprise class routers but more robust than consumer grade routers
- **Secure** - Good security and heavy encryption, but easy to implement; simple yet statefull firewall with simple filters
- **Simplified architecture** - Has a smaller processor that does not require a noisy fan, making it small and attractive for in-office or desk top installation

Note: Provision of Network Interface Card (NIC) shall be made for computer without built in NIC.

Input/Output Requirements:

- WAN 1- 10/100 Base-T Auto-sensing - RJ-45
- LAN -4 Port Ethernet 10/100 Base-T Auto-sensing switch – RJ- 45 (fifth port for internal connection)

VPN Services:

- Minimum 10 IPSec tunnels
- IKEv1 Main Mode
- IKEv1 Aggressive Mode
- Up to 3 IP pools for Client
- 16 Split networks configured
- 64 Subnets specified for Split (inverse) network
- Diffie-Hellman Group 1, 2
- IPSec Tunnel Mode
- ESP
- Support for Dynamically addressed peers – ABOT
- NAT Traversal
- IPSec Transport Mode
- Keep Alive – For branch office and client tunnels
- VPN Router Client termination

Cryptographic Services:

- DES
- 3DES
- Data authentication SHA-1
- Data authentication MD-5
- AES -128
- AES – 192, 256 – Branch Office

Authentication Services:

- Pre-shared secrets
- External RADIUS support
- 802.1x/EAP support

Firewall:

- Statefull Packet Inspection
- IP application Inspection (FTP, SMTP, HTTP, Telnet, SSL, DNS, etc.)
- Denial of Service (DoS) detection and prevention
- URL Filtering
- Content filtering

ALG's:

- CU-SeeME
- FTP
- SIP
- H.323
- IPSEC
- VDiLive
- RealAudio

IP Services: NAT:

- NAT, Many to One, Static, Many to Many, Many One-to-One
- Port Forwarding
- IPsec pass-through
- SIP and H.323 ALG's
- Cone NAT
- NAT support for tunnel Mode IPsec tunnels

IP Services: Routing:

- Clear text routing
- Static
- RIP v1
- RIP v2

IP Services: DHCP:

- Client
- Server
- Relay
- Static mapping – 8 IP address lease mapping

IP Services: DNS:

- DNS Proxy
- Dynamic DNS

IP Services: NTP:

- RFC-867, 868, 1305

Layer Two Protocols:

- PPPoE
- IP masquerade/ alias – Configurable MAC address

Performance and Scaling:

- 20 Mbps 3DES throughput w/ 1500 byte packets
- 10 IPsec tunnels

Management:

- TFTP/FTP firmware upload
- RS232 console port
- Built-in Diagnostic tool
- SNMP
- Web GUI
- CLI (Command Line Interpreter)
- Remote management (FTP, Telnet, Web)

- Backup and restore configuration via FTP and Web

WAN and LAN Ports:

- The WAN and LAN ports are 10/100-base T Ethernet ports, without PoE

Two-Port Router:

- The router is based on the Intel IXP-425 network processor, running at 266 MHz. It will have 64 Mbytes of FLASH, and 32 Mbytes of RAM.

5-Port Switch:

- The 5-port layer-2 switch uses the Infineon 6996i chip

Serial Port:

- The serial port provides a DCE connection that can be used for either WAN back-up or for installing software into a router that has a corrupted software load

Power Supply:

- The router will be powered by 19 volts DC. The power supply circuit block will convert this supply to the supply voltages needed by the rest of the circuitry. The Business Secure Router 222 uses a universal wall-mount power supply.

Method of construction:

The ADSL Router shall be connected directly to the incoming phone line without any parallel telephone, then to telephone to avoid breaks in Internet connection, 9V DC adaptor connected to provide power supply, UTP patch cord for connections between router Ethernet port to computer/ switch. The router shall be configured as per the requirements of Broadband Internet Service Provider. As far as possible use of USB port shall be avoided.

Mode of measurement: Executed quantity shall be counted on number basis

Wireless LAN

D) Indoor LAN Dipole Antenna (DPA)

General:

All material shall conform to relevant standard as per IEEE.

Scope:

Specification No (WG-NWC/DPA)

To enhance the signal strength of Access Point & Wireless PCI adaptor/ Router up to 500 metres.

Material:

Indoor LAN Dipole Antenna:

2.4 GHz, 5dBi gain, 50 ohms Omni-Directional Indoor Antenna outer covering made from polyurethane, polycarbonate swivel mechanism with built-in connector (RP-SMA & Reverse SMA/ TNC) for 802.11b/g wireless network

Method of Construction:

Supplying & erecting 2.4 GHz, 5dBi Omni-Directional Antenna to be screwed to Access point/ wireless PCI adaptor complete.

Mode of Measurement: Executed quantity shall be counted on number basis.

E) Omni Directional Antenna (ODA)

Scope:

Specification No (WG-NWC/ODA)

To enhance the signal strength of Access Point & Wireless PCI adaptor/ Router at difficult to reach or far places.

Material:

Omni Directional Antenna:

2.4 GHz, 4dBi gain, Collinear, 50 ohms Omni-Directional Indoor Antenna covering horizontal 360 deg. vertical 36 deg. with 1.5m ULA-316 fixed cable, connectors (RP-SMA & Reverse SMA/ TNC), sturdy magnetic base stand to place it on flat surfaces & can be mounted on wall for 802.11b/g wireless network

Method of Construction:

Supplying & erecting 2.4 GHz, 4dBi Omni-Directional Antenna on wall or on the desktop or suitable place which shall be at least 150mm away from electronic devices such as computers, TV, video equipment & audio/video tapes.

Mode of Measurement: Executed quantity shall be counted on number basis.

F) Aesthetic Omni Directional Antenna (AODA)

Scope:

Specification No (WG-NWC/AODA)

To enhance the signal strength of Access Point & Wireless PCI adaptor/ Router at difficult to reach or far places.

Material:

Aesthetic Omni Directional Antenna:

2.4 GHz, 20W (cw) power handling, 40 deg down tilt, 50 ohms Omni-Directional Aesthetic Indoor Ceiling Antenna with ULA-316 fixed cable, connectors (RP-SMA & Reverse SMA/ TNC) for 802.11b/g wireless network.

S No.	Type	Colour	Gain (dBi)	Coverage (deg)		Cable (mtr)	Use
				Horizontal	Vertical		
1	Globe	White	4	360	63	2.0	Places with false ceiling
2	Rod	Gray-White	5	360	32	3.0	Any other place

Hardware: Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, etc.

Method of Construction

Supplying & erecting 2.4 GHz, Omni-Directional Indoor Aesthetic Ceiling Antenna on ceiling at suitable place fixed with required size of SM screws, plugs/ gitties etc. complete.

Mode of Measurement: Executed quantity shall be counted on number basis.

1.13 Networking Accessories (NAS)

LAN Accessories

A) **UTP connector (RJ-45) (UTPC)**

General:

All material shall conform to relevant standard as per TIA/EIA 568-B2-1.

Scope:

Specification No (WG-NAS/UTPC)

To make MDIX (Cross) patch cord required for cascade connections of switches & routers.

Material:

UTP connector:

Assembly of Gold over nickel contacts with 1.5A current carrying capacity, 30V with 15milli ohms contact resistance, 8P8C connection easy to crimp with crimping tool in polycarbonate UL94V housing.

Method of construction:

The UTP cable shall be spliced, untwisted not more than 12mm, inserted into the connector with sequence as shown in the **diagram** _____ as per EIA/TIA 568 B.2-1 & crimped firmly with crimping tool.

Mode of Measurement: Executed quantity shall be counted on number basis.

B) **Information Outlet (Ethernet) (IO)**

General:

All material shall conform to relevant standard as per TIA/EIA 568-B2-1.

Scope:

Specification No (WG-NAS/IO)

For connecting computers to wired LAN or external wireless Ethernet interface in Wireless LAN.

Material:

Information Outlet Flush/ Surface type:

Spring shuttered front access, high impact plastic body FR grade with high performance unshielded RJ-45 keystone jack (conforming to EIA/TIA 568-B.2-1 Cat 6), 15 milliohms contact resistance, gold over nickel spring contact, 1.5A current carrying capacity, with T568A/T568B wiring option, insulation displacement connector for cable crimping to accept 22-26AWG solid wire for connections up to Gigabit Ethernet.

1. All Category 6 outlets shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in TIA/EIA 568-B.2-1 Commercial Building Telecommunications Cabling Standard and ISO/IEC 11801:2002 Second Edition.
2. The Category 6 outlets shall be backward compatible with Category 5E, 5 and 3 cords and cables.
3. The Category 6 outlets shall be of a universal design supporting T568 A & B wiring.
4. The Category 6 outlets shall be capable of being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current 10BASE-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T and 1.2 Gbps ATM.
5. The Category 6 outlets shall be capable of being installed at either a 45° or a 90°

angle in any M-series modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates.

- The Category 6 outlets shall have improved pair splitters and wider channel for enhanced conductor placement. The outlet shall also have a low-profile wire cap, which protects against contamination and secures the connection. Multicolored identification labels shall be available to assure accurate installation.

Hardware:

Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, etc.

Method of construction:

The Information outlet shall be fixed on the wall with sheet metal (SM) screws, rawl plugs/wooden gitties and making due connections as per EIA/TIA 568 B.2-1 by splicing the UTP cable, untwisted up to 12mm & punching the 4 pairs in the keystone jack with the help of punching tool. Not a single wire shall be left without connections.

Mode of Measurement: Executed quantity shall be counted on number basis.

C) Keystone jack (RJ-45) (KJ)

Scope:

Specification No (WG-NAS/KJ)

Structured cabling, to provide connections to switch/ server from desktop computers/ Wireless devices in the patch panel.

Material:

Keystone jack:

High impact plastic body FR grade with high performance unshielded RJ-45 keystone jack (conforming to EIA/TIA 568-B.2-1 Cat 6) , 20milli ohms contact resistance, gold over nickel spring contact , 1.5A current carrying capacity, with T568A/T568B wiring option, insulation displacement connector for cable crimping to accept 22- 26AWG solid wire for connections up to Gigabit Ethernet

Method of construction:

The keystone jack shall be fixed with the help of its self-locking arrangement in provided patch panel before making due connection as per EIA/TIA 568 B.2-1 by splicing UTP cable, untwisted up to 12mm & punching the 4 pairs in the keystone jack with the help of punching tool. Not a single wire shall be left without connections.

Mode of Measurement: Executed quantity shall be counted on number basis.

D) Patch Panel (PP)

Scope:

Specification No (WG-NAS/PP)

Structured cabling for the installation of keystone jacks.

Material:

Patch Panel:

Three piece structure including front panel, cable management plate with pre-fitted B-clip to help in routing cables & metal case of 1.6mm thick Mild Steel powder coated panel of size 442.6mm X 44.5mm with the provision for 1 to 24 high density keystone jacks

- 24 and 48 port patch panels with 110 IDC connector terminations on rear
- The patch shall have electrical performance guaranteed to meet or exceed TIA/EIA 568-B.2-1 Category 6 and ISO/IEC Category 6/Class E specifications.
- The panel shall have vertical and horizontal cord organizers available as to improve patch cord management.

4. The panel shall be available in 24-port and 48-port configurations with universal A/B labeling and 110 connector terminations on rear of panel allowing for quick and easy installation of 22 to 24 AWG cable.
5. The patch panel shall have a black powder finish over high-strength steel.
6. The panel shall be equipped with a removable rear mounted cable management bar and front and rear labels.
7. The panel shall be UL listed, UL-C certified and ACA approved.
8. The panel shall support network line speeds in excess of 1 gigabit per second and be backward compatible with Category 5e, 5 and 3 cords and cables.
9. The Category 6 modular jack panels shall meet or exceed the Category 6/Class E standards requirements in ISO/IEC 11801, CENLEC EN 50173 and TIA/EIA and shall be UL Listed.
10. The panels shall be either wall or 19-inch rack mountable.
11. The panels shall meet the following specifications:

Performance Specifications:

	Category 6 Patch Panel		
	High Performance Solution	Premium Performance Solution	
	Category 6 Channel (4 Connectors)		
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	64.3%	5.0%	7.5%
NEXT	6.6 dB	6.0 dB	7.0 dB
PSNEXT	7.3 dB	7.5 dB	8.5 dB
ELFEXT	6.4 dB	6.0 dB	8.0 dB
PSELFEXT	6.1 dB	8.0 dB	10.0 dB
Return Loss	6.6 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

Operational Specifications:

Operating Temperature Range:	14°F to 140°F (-10°C to 60°C)
Storage Temperature Range:	-40°F to 158°F (-40°C to 70°C)
Humidity:	95% (non-condensing)
Nominal Solid Conductor Diameter:	0.025 to 0.020 in (0.64 to 0.51 mm) (22 to 24 AWG)
Nominal Stranded Conductor Diameter:	0.025 to 0.020 in (0.64 to 0.51 mm) (22 to 24 AWG)
Insulation Size:	0.042 in (1.08 mm) (22 to 24 AWG) Maximum DOD
Insulation Types:	All plastic insulates (including PVC, irradiated PVC, Polyethylene, Polypropylene, PTF Polyurethane, Nylon, and FEP)
Insertion Life:	750 minimum insertions of an FCC 8-Position Telecommunications Plug
Front Panel:	Black powder painted steel.
Plastic:	High-impact, flame retardant, UL-rated 94V-0 thermoplastic

Hardware:

Chromium plated brass nuts & bolts with special type of U shaped square washers of required sizes.

Method of construction

The Patch Panel shall be firmly secured in U Rack (Networking Cabinet) with 4 nos. of chromium plated brass nuts & bolts.

Mode of Measurement: Executed quantity shall be counted on number basis.

E) Lightguide Interconnect Unit (LIU)

General:

All material shall conform to relevant standard as per IEEE, EIA/TIA, CENELEC

Scope:

Specification No (WG-NAS/LIU)

To terminate the fibre backbone cables & the equipment cables.

Material:

Lightguide Interconnect Unit:

Wall mount type Lightguide Interconnect Unit with dimensions shown in the table, an interfacing unit for fibre cables coming in from field & those originating from the equipments. consisting of fibre spools to provide minimum bending radius & splice trays as splice cover for pigtail splicing, two compartment design with adaptor panel in the centre, compartmentalizing the box, complete aluminium housing, fully powder coated, two doors enclosure with lock & key, rubber grommets at the cable entry points for tight sealing; Splice trays of 140 x125 x 10mm complete aluminium body fully powder coated with provision for fibre splices fully cushioned splice holder containing grooves for fixing splice protective sleeves; FR grade high impact resistance plastic two halves design stackable sufficient room for excess cable.

Sr. No.	Ports	Dimensions	Fibre splices
1	12	300 x 300 x 80mm	6
2	24	370 x 350 x 80mm	12

Hardware:

Sheet Metal (SM) screws of required sizes, plugs, wooden gitties, etc.

Method of Construction:

Supplying & erecting Lightguide Interconnect Unit (LIU) on wall with cable termination complete with sheet metal screws of required size, plugs/ wooden gitties.

Mode of Measurement: Executed quantity shall be counted on number basis.

Fibre Accessories

F) ST "D" type Multimode Adaptor (MMA)

General:

All material shall conform to relevant standard as per IEEE, EIA/TIA 568-B.3

Scope:

Specification No (WG-NAS/MMA)

To couple two connectors together i.e. to provide optical connectivity between fibre cable & fibre switch/ fibre module.

Material:

ST "D" type multimode adaptor consists of Die cast zinc alloy housing Nickel plated, thread type mounting, washer, nut, 2 nos. of rubber plugs, high precision mechanical design Zirconium/ Phosphor Bronze sleeve having insertion loss < 0.3dB max, return loss < -40dB.

Method of Construction:

Supplying & fixing ST " D" type with threads in provided Lightguide Interconnect Unit on adaptor panel with nut & washer. The adaptor which is not in use shall be plugged with rubber plugs on both the sides to avoid dust accumulation in the adaptor.

Mode of Measurement: Executed quantity shall be counted on number basis.

G) ST "D" type Multimode Connector for LIU (MMA-LIU1)

General

All material shall conform to relevant standard as per IEEE, EIA/TIA 568-B.3

Scope:

Specification No (WG-NAS/MMA-LIU1)

To terminate the optical fibre cables in Lightguide Interconnect Unit (LIU)

Material:

1. **ST "D" type Multimode connector** consists of bayonet coupling, 2.5mm Zirconium Ferrule, wide range of Ferrule selection, pre-radiused ferrule to provide fast physical contact polishing, insertion loss < 0.5dB.
2. Distilled water (as lubricant & flushing agent between each polishing process).
3. Epoxy or Anaerobic adhesive (to bond the fibre inside the ferrule).

Tools to be used:

- Carbide cleaving tool with 30 deg tip (to cut off the fibre to the desired height above the ferrule)
- Portable Microscope (200X minimum)
- Polishing kit (includes a polishing puck, pads & an assortment of diamond, aluminium oxide & silica films)

Method of Construction:

The fibre shall be stripped & cleaved. Epoxy and polish connectors field-installed to terminate backbone and distribution cables. Epoxy and polish fibre termination include the following steps: injecting the connector ferrule with epoxy, curing, scribing the protruding fibre(s) from the ferrule, and polishing the ferrule end-face. The correct amount of epoxy must be injected into the ferrule and cured for the specified time and temperature before the ferrule end-face is scribed and polished. Air bubbles shall be avoided in the epoxy to avoid micro-bending and increased loss. The cured epoxy securely bonds the fibre to the ferrule over the operating temperature minimizing relative fibre movement. The connectors with fibre cable shall be tested for loss test with Optical Time Domain Reflectometer (OTDR) & recording the results.

Mode of Measurement: Executed quantity shall be counted on number basis.

H) No Epoxy No polish ST "D" type Multimode Connector (MMA-LIU2)

Scope:

Specification No (WG-NAS/MMA-LIU2)

To terminate the optical fibre cables in Lightguide Interconnect Unit (LIU)

Material:

ST "D" type Multimode connector with Factory pre-polished fibre stub end face consists of bayonet coupling, 2.5mm Zirconium Ferrule, insertion loss < 0.5dB

Tools to be used:

Carbide cleaving tool with 30 deg tip (to cut off the fibre to the desired height above the ferrule)

Method of Construction:

The no Epoxy no polish connectors field-installed to terminate backbone and distribution cables. The fibre shall be striped, cleaved, inserted into the connector & mechanically secured. The connectors with fibre cable shall be tested for loss test with Optical Time Domain Reflectometer (OTDR) & recording the results.

Mode of Measurement: Executed quantity shall be counted on number basis.

I) **Power over Ethernet Adaptor** (PoEA)

General:

All material shall conform to relevant standard as per IEEE, TIA/EIA.

Scope:

Specification No (WG-NAS/PoEA)

To provide DC power supply to Ethernet devices, which do not have external/ built-in power supply.

Material:

Power over Ethernet Adaptor with output voltage of 5V DC or 12V DC (selectable) with input of 48V DC consists of Power over Ethernet base unit, Power over terminal unit, AC to DC power adaptor, DC power cable & Ethernet cable.

Method of Construction:

Supplying & connecting Power over Ethernet Adaptor with all its connections of base unit, terminal unit & AC to DC power adaptor for supplying power to Access Point, Router or Wireless Ethernet Transceiver complete.

Mode of Measurement: Executed quantity shall be counted on number basis.

J) **Tri-Mode Dual band Wireless PCI LAN Card** (LANC1)

General:

All material shall conform to relevant standard as per IEEE 802.11 xs.

Scope:

Specification No (WG-NAS/LANC1)

Making provision of Wireless LAN connectivity for desktop PCs in difficult places where signal strength is low.

Material:

Wireless PCI 32 bit interface LAN card covering 100 metres (indoor) transmission speed of 108Mbps to connect 802.11b, 802.11g & 802.11a networks operating in two non-interfering bands 2.4 GHz & 5GHz with 4dBi to 5dBi gain Omni directional dipole antenna & driver.

Method of Construction:

Supplying & fixing Tri-mode dual band wireless PCI LAN card in desktop computer with installation of driver & configuration for TCP/IP address complete.

- K) **Mode of Measurement:** Executed quantity shall be counted on number basis.
Wireless PCI LAN Card (LANC2)

General:

All material shall conform to relevant standard as per IEEE 802.11g.

Scope:

Specification No (WG-NAS/LANC2)

Making provision of Wireless LAN connectivity for desktop PCs.

Material:

Wireless PCI 32 bit interface LAN card to connect 802.11g networks operating in 2.4 GHz band covering 100 metres range (indoor), transmission speed of 54Mbps with external dipole antenna, detachable reverse SMA connector & driver.

Method of Construction:

Supplying & fixing Wireless PCI LAN card in desktop computer with installation of driver & configuration for TCP/IP address complete.

Mode of Measurement: Executed quantity shall be counted on number basis.

- L) **Manageable Wireless LAN Access Point** (LAP1)

General:

All material shall conform to relevant standard as per IEEE 802.11b/g & IEEE802.3/u

Scope:

Specification No (WG-NAS/LAP1)

To provide wireless access to the WLAN network.

Material:

Wireless Access Point consists of 108Mbps turbo mode handling heavy data payloads, 2dBi gain detachable dipole antenna with reverse SMA connector, external AC to DC 5V adaptor.

Method of Construction:

Supplying & connecting Wireless Access Point with AC to DC adaptor to Ethernet switch with due configuration for TCP/IP address complete.

Mode of Measurement: Executed quantity shall be counted on number basis.

- M) **High Performance Manageable Wireless LAN Access Point with PoE (Power over Ethernet)** (LAP2)

General:

All material shall conform to relevant standard as per IEEE 802.11b/g, IEEE 802.3/u & IEEE 802.3af

Scope:

Specification No (WG-NAS/LAP2)

To provide high performance wireless access to the WLAN network.

Material:

Wireless Access Point consists of 108Mbps turbo mode handling heavy data payloads, dual 5dBi gain detachable dipole antenna with reverse SMA connectors, Power over Ethernet 10/100 Base-Tx port.

Note: *To connect the Access Point, availability of PoE Ethernet Switch or PoE adaptor is essential.*

Method of Construction:

Supplying & connecting Wireless Access Point to PoE Ethernet switch or Ethernet Switch through PoE Adaptor with due configuration for TCP/IP address complete.

Mode of Measurement: Executed quantity shall be counted on number basis.

N) **Dual Band High Performance Manageable Wireless LAN Access Point with PoE (Power over Ethernet) (LAN3)**

Scope:

Specification No (WG-NAS/LAP3)

To provide high performance wireless access to the WLAN network.

Material:

Wireless Access Point consists of 108Mbps turbo mode handling heavy data payloads operating in 2.4 GHz & 5 GHz bands, dual 5dBi gain detachable dipole antenna with reverse SMA connectors, Power over Ethernet 10/100 Base-Tx port.

Note: *To connect the Access Point, availability of PoE Ethernet Switch or PoE adaptor is essential.*

Method of Construction:

Supplying & connecting Wireless Access Point to PoE Ethernet switch or Ethernet Switch through PoE Adaptor with due configuration for TCP/IP address complete.

Mode of Measurement: Executed quantity shall be counted on number basis.

Chapter 2

FITTINGS

2.1	Lamps	FG-LP
2.2	Indoor fittings	FG-IF
2.3	Outdoor fittings	FG-OF
2.4	Accessories for fittings	FG-AS
2.5	Brackets for Outdoor fittings	FG/BKT
2.6	Fans	FG-FN
2.7	Accessories for Fans	No Specs
2.8	Drawings	

A) GLS/MF Lamps (GLS)**Specification No** (FG-LP/GLS)**Scope:**

Supplying and fixing of GLS/MF lamps suitable for 230 volts, and of specified wattage, conforming to IS: 418-1978. The lamp shall meet with the requirements mentioned in Table No. 2.1/1

Material:

Lamp: Made of blown molten glass, and shall comply with IS: 418-1978.

Filament: Made from Tungsten.

Cap: Made from high grade Aluminium sheet either Bi pin/Edison screwed.

Method of Construction:

The lamp shall be fixed at specified location as directed by site engineer.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

Table No. 2.1/1

Lamp Data for GLS lamps

Watts (W)	Filling	Filament	Finish	Luminous flux (lm) at 230 V
25	Vacuum	Single Coil	Clear	220
40				425
60				700
100				1380
150	Gas filled	Coiled coil		2080
200				2920
300				4700
500				8300
1000				18600
1500				29500

B) Fluorescent tubes (FT)**Specification No** (FG-LP/FT)**Scope:**

Supplying and fixing of fluorescent tube suitable for 230 volts, and of specified wattage, conforming to IS: 2418 (Part 1 to 4) - 1977. The lamp shall meet with the requirements mentioned in Table No. 2.1/2

Material:

Lamp: Based on Tri-phosphor fluorescent powder, with triple coil electrode & anode ring.

Cap: Bipin cap made from high grade Aluminium sheet.

Method of Construction:

The lamp shall be fixed at specified location as directed by site engineer.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Table No. 2.1/2

Lamp Data for Fluorescent tubes

Lamp Type	Colour Rendering Index	Colour Temp. (°K)	Lamp watt (W)	Lamp volt (V)	Operating lamp current (A)	Nominal luminous flux (lm)	Life (hrs)
Tri-band phosphor 36 W	82 %	6500	36	103	0.44	3250	15000
	84 %	4000	36	103	0.44	3250	15000
	86 %	2700	36	103	0.44	3250	15000
24 W	85 %	3000	24	-	-	1350	-
	85 %	3400	24	-	-	1350	-
Normal 18 W	54 %	6500	18	58	0.37	1015	-
Normal 36 W	54 %	6500	36	103	0.44	2450	-

C) **High Pressure Mercury Vapour Lamps (MV)**

Specification No (FG-LP/MV)

Scope:

Supplying and fixing of High pressure Mercury vapour lamps suitable for 230 volts, and of specified wattage, conforming to IS: 9900 (Part 1 to 4) - 1981. The lamp shall meet with the requirements mentioned in Table No. 2.1/3

Material:

Lamp: Hard glass lamp made from high pressure mercury vapour with quartz discharge tube in an ovoid shaped, internally phosphor coated outer shell, with average colour temperature 3800 °K

Cap: 3 Pin BC/Screwed cap made from high grade Aluminium sheet.

Method of Construction:

The lamp shall be fixed at specified location as directed by site engineer.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Table No. 2.1/3

Lamp Data for High Pressure Mercury Vapour lamps

Lamp Type	Colour Temp. (°K)	Lamp watt (W)	Lamp volt (V)	Operating lamp current (A)	Nominal luminous flux (lm)	Starting Time (min.)
HPL-N	3800	80	115	0.80	3500	3.5
HPL-N	3800	125	125	1.15	6250	3.5
HPL-N	3800	250	135	2.0	13500	4.0
HPL-N	3800	400	140	3.2	23000	4.0

D) **ML Blended Lamp/Self Ballasted Lamp (MLL)**

Specification No (FG-LP/MLL)

Scope:

Supplying and fixing of ML Blended lamps suitable for 230 volts, and of specified wattage, conforming to IS: 9900 (Part 1 to 4) - 1981. The lamp shall meet with the requirements mentioned in Table No. 2.1/4

Material:

Lamp: Hard glass lamp made from high pressure mercury vapour self ballasted with quartz discharge tube in an ovoid shaped, with average colour temperature 3600 °K

Cap: 3 Pin BC cap made from high grade Aluminium sheet.

Method of Construction:

The lamp shall be fixed at specified location as directed by site engineer.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Table No. 2.1/4

Lamp Data for High Pressure Mercury Vapour lamps

Lamp Type	Colour Temp. (°K)	Lamp watt (W)	Min. mains Voltage (V)	Lamp current (A)	Nominal luminous flux (lm)	Average life (hrs)
MLL	3600	160	190	0.72	2900	5000

E) High Pressure Sodium Vapour Lamps (SV)

Specification No (FG-LP/SV)

Scope:

Supplying and fixing of High pressure Sodium vapour lamps suitable for 230 volts, and of specified wattage, conforming to IS: 9974 (Part 1 & 2) - 1981. The lamp shall meet with the requirements mentioned in Table No. 2.1/5

Material:

Lamp: High pressure sodium vapour lamps with a polycrystalline translucent Aluminium discharge tube enclosed in an ovoid or tubular outer glass envelope. The ovoid shell shall have internally coated with uniform layer of diffusing powder applied electro statically. The discharge tube shall contain an amalgam of mercury and sodium along with Xenon gas as starting aid.

Cap: Screwed cap made from high grade Aluminium sheet.

Method of Construction:

The lamp shall be fixed at specified location as directed by site engineer.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Table No. 2.1/5

Lamp Data for High Pressure Sodium Vapour lamps

Lamp Type	Lamp watt (W)	Average Lamp volt (V)	Average lamp current (A)	Nominal luminous flux (lm)
SON	70	90	1.0	5800
SON	150	100	1.8	13500
SON-T	150	100	1.8	14000
SON	250	100	3.0	25000
SON-T	250	100	3.0	27000
SON	400	105	4.4	47000
SON-T	400	105	4.4	47500

F) Metal Halide Lamps (MHL)

Specification No (FG-LP/MHL)

Scope:

Supplying and fixing of Metal Halide lamps single/Double ended, suitable for 230 volts, and of specified wattage. The lamp shall meet with the requirements mentioned in Table No. 2.1/6

Material:

Lamp: High pressure metal halide gas discharged lamps with iodide additives indium, thallium and sodium in the mercury discharge. The discharge tube shall be enclosed in an

ovoid, hard glass outer bulb with fluorescent coating (HPI-BU) or clear tubular outer hard glass envelope, (HPI-T).

- Colour Temperature : HPI-BU - -> 4300 °K
: HPI-T - -> 4300 °K to 4900 °K

Cap: Pin type/Screwed cap made from high grade Aluminium sheet.

Method of Construction:

The lamp shall be fixed at specified location as directed by site engineer.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

**Table No. 2.1/6
Lamp Data for Metal Halide lamps**

Lamp Type	Lamp watt (W)	Minimum Voltage for Ignition (V)	Average lamp voltage after 100 burning hours (V)	Average lamp current after 100 burning hours (A)	Lamp starting current (A)	CRI (Ra)	Average luminous flux after 100 burning hours (lm)
HPI-BU	250	200	128	2.2	3.2	69	17000
HPI-BU	400	200	125	3.4	6.0	69	30600
HPI-T	70	200	90	1.0	1.4	80	5500
HPI-T	150	200	98	1.8	2.4	85	12100
HPI-T	250	200	128	2.2	3.9	65	17000
HPI-T	400	200	125	3.4	6.0	65	30500

G) Compact Fluorescent Lamps (CFL)

Specification No (FG-LP/CFL)

Scope:

Supplying and fixing of Compact Fluorescent lamps either with adapter (Retrofit – Instant Start type) or without (Pin type-PL tube to be used with ballast), suitable for 230 volts, and of specified wattage. The lamp shall have life of 10000 burning hours and shall meet with the requirements mentioned in Table No. 2.1/7. All lamps shall have pf above 0.9.

Material:

Lamp: Based on fluorescent powder, with electrode.

Cap: Pin type/Screwed cap made from high grade Aluminium sheet.

Method of Construction:

The lamp shall be fixed at specified location as directed by site engineer.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Table No. 2.1/7

Lamp Data for Compact Fluorescent lamps

Mounting type	Lamp watt (W)	Colour Temp. (°K)	Luminous flux (lm)	Efficacy (lm/W)	Average life in (hrs)
Retrofit	13	5000	575	44	10000
Retrofit	13	6000	575	44	10000
Retrofit	13	2700	550	42	10000
Retrofit	18	5000	850	47	10000
Retrofit	18	6000	850	47	10000
Retrofit	18	2700	800	45	10000
Retrofit	25	5000	1100	44	10000
Retrofit	25	6000	1100	44	10000
Retrofit	25	2700	1050	42	10000
PL	9	2700	400	44	10000
PL	11	2700	600	55	10000
PL	15	2700	900	60	10000
PL	15	5000	800	53	10000
PL	20	2700	1200	60	10000
PL	20	5000	1100	55	10000
PL	23	2700	1500	65	10000
PL	23	5000	1350	59	10000
PL	5	2700	250	50	8000
PL	5	4000	250	50	8000
PL	7	2700	400	57	8000
PL	7	4000	400	57	8000
PL	11	4000	900	91	8000

2.2 Indoor fittings (FG/IDF)

A) Bulkhead Fitting

Scope:

Specification No (FG-IDF/BHF)

Supplying and erecting bulkhead fitting with fine finished cast Aluminium enamel painted body with 20 mm conduit entry and clear glass / prismatic glass with guard and complete water tight hinged with locking screw porcelain holder to house CFL up to 5/9/11 Watt erected in position on polished double wooden block.

Material:

Bulkhead fitting:

Bulk Head Fitting shall be made from pressure die-cast aluminium LM6 body in stove enamel finish and fitted with a heat resistant elegant glass cover through a gasket. A two pin BC porcelain holder for GLS or a CFL holder shall be fitted inside the housing. An electro-galvanized MS wire guard for protection against pilferage. Glass and wire guard assembly shall be hinged to the body for ease of maintenance. The bulkhead shall be suitable for Integral type CFL, with cable entry through one no.3/4" B.S. threaded inlet. Incoming wires shall be terminated on the lamp holder terminals in case of GLS and in the terminal block in case of CFL. Two lugs with slots for facilitating wall/ceiling mounting. The fitting shall be I.P. 54 protected.

Wooden board: As per (WG-PW/PW) 1.6 specified in chapter for Point wiring.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Method of Construction:

The Bulkhead shall be mounted on polished double wooden block with required size of SM screws, duly wired.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

B) Mirror Light Fitting Suitable for CFL 9/13/18 watts (ML1)

Scope:

Specification No (FG-IDF/ML1)

Supplying and erecting luminaries suitable for 9/13/18 watt CFL lamp made of engineering Plastic in approved colour finish and an elegantly designed milky white acrylic front diffuser, and bright anodized Aluminium reflector, with VPIT ballast, lamp holder, and connector.

Material:

Fitting:

The Luminaries Comprises housing made of engineering plastic in approved colour finish and an elegantly designed milky white acrylic front diffuser enclosing a bright anodized Aluminium reflector. Pre-wired with vacuum pressure impregnated copper ballast, lamp holder and mains connector with two holes on rear side facilitates wall/ceiling mountings, the grommet should be provided at rear side.

Wooden board: As per 1.6 specified in chapter for Point wiring. (WG-PW/PW)

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Connection Wire: Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Method of Construction:

The fitting shall be mounted on polished Wooden / Laminated 4mm plywood top / block by required size of screws with necessary flexible wire for connection.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

C) Mirror Light Fitting Suitable for CFL 9 watts (ML2)

Scope:

Specification No (FG-IDF/ML2)

Supplying and erecting Mirror light fitting with 1 x 9 Watts CFL, with necessary Choke & accessories complete erected on polished wooden / sunmica block.

Material:

Fitting:

Channel fabricated from CRCA MS sheet and finished in reflector white inside and outside. Pre-wired with vacuum pressure impregnated copper ballast, lamp holder and mains connector, and an aesthetically appealing serrated / reeded opal diffuser held in position by decorative end covers white (W) / deep blue (B) / orange (O) / H.C. grey (G), post office red (R) / Black (BK) or approved colour, 12mm dia grommet. Two 6.5 mm dia holes on the rear side of the channel to facilitate wall / ceiling mounting.

Wooden board: As per 1.6 specified in chapter for Point wiring. (WG-PW/PW)

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Connection wire: Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The fitting shall be mounted on polished Wooden / Laminated 4mm plywood top / block by required size of screws with necessary flexible wire for connection.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

D) Mirror Optic Recessed down Lighter suitable for 2 x 18 watts CFL (DL1)

Scope:

Specification No (FG-IDF/DL1)

Supplying and erecting circular type recessed down lighter suitable for 2x18 watts CFL, including gear box. The luminaire comprises a ceiling ring spun from Aluminium attached to mounting unit made of mild steel. The mounting unit has a pair of sliding brackets for fixing the luminaire to the ceiling.

Material:

Fitting:

Scientifically designed highly polished & anodized Aluminum reflector ensures precise light control with optimum light utilization, leading to substantial savings in energy cost and excellent ambient conditions. Reflector is fitted into the frame with decorative screw

arrangement. Frame is fabricated from CRCA MS sheet and epoxy powder coated white. Precoated frame ensure corrosion free life. Fitting shall have a prismatic acrylic diffuser resting on upper part of reflector to reduce glare. Retaining clips facilitate mounting in false ceilings.

Ballast: As per (FG-FG/AS1) specified in chapter 2.4.

Bi-pin lamp holder: Conforming to IS: 3323/80 with amendment No.1 to the extent possible /applicable.

Capacitor / Condenser: As per (FG-FG/AS7) specified in chapter 2.4.

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The fitting shall be fixed firmly in the designated place (False ceiling / unspecified ceiling) with the help of swinging bracket, and making the connection.

In case where fittings are to be installed flush with /on false ceiling; layout shall be given to civil wing and work shall be done in co-ordination with civil wing e.g. making recesses in false ceiling.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

E) **Mirror Optic CFL fitting** (MOF)

Scope:

Specification No (FG-IDF/MOF)

Supplying & erecting recessed / surface down lighter with mirror optics suitable for specified wattage of CFL.

Material:

Fitting:

Housing fabricated from CRCA sheet, epoxy powder coated, white enamelled, with mirror assembly comprising of significantly designed high purity aluminium reflector for high optical performance back wing light and with improved vertical illumination.

Ballast: As per (FG-FG/AS1) specified in chapter 2.4.

Bi-pin lamp holder: Conforming to IS: 3323/80 with amendment No.1 to the extent possible /applicable.

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Chain: Heavy duty lacquered MS chain with hooks.

Block: As per 1.6 specified in chapter for Point wiring. (WG-PW/PW)

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

Mirror optic fitting suitable for specified wattage of CFL complete erected on wooden block/PVC block /on ceiling directly in case of surface mounting fitting, as directed by site engineer, with necessary screws of suitable size, with rawl plugs, gutties, etc. In case of recesses mounting, the fitting shall be secured and erected by fixing the hook at ceiling, and the chain shall be fixed to the fitting, in such a manner that the fitting shall be in level with the designated place (false / unspecified ceiling)

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

F) **Box type Fluorescent fitting** (BFF)

Scope:

Specification No (FG-IDF/BFF)

Supplying & erecting white stove enamelled / powder coated box type fluorescent fitting suitable for T 8 tube/ tubes, with specified ballast, and necessary accessories, duly wired up for use on 250 V AC, supply and erected if required on varnished wooden / PVC block with flexible wire, twin core 24/0.20 mm. and with necessary materials complete and marking Sr. No. and date of erection.

Material:

Fitting:

White stove enameled / powder coated box type fluorescent fitting suitable for T 8 tube, made of CRCA sheet not less than 0.5 mm thick, painted white on the reflector side and gray/any other colour (specified by the Engineer in-charge) on other surface. Wire ways shall be smooth & free from sharp edges, burrs, flashes & like which might cause abrasion of the insulation of the wiring. Parts such as metal set screws shall not protrude into wire ways. Fitting shall be duly wired up internally with appropriate size of wire. (Refer drawing no.IDF-1 (Fig.1))

Ballast: As per (FG-FG/AS2) / (FG-FG/AS3) / (FG-FG/AS4) specified in chapter 2.4.

Tube holders: As per (FG-FG/AS8) specified in chapter 2.4

Starter: As per (FG-FG/AS11) specified in chapter 2.4

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Starter holder: As per (FG-FG/AS9) specified in chapter 2.4

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Paint: Superior quality enamel paint of specified colour.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Chain: Heavy duty lacquered MS chain with hooks.

Down Rod: Steel conduit as per (WG-MA/CON) specified in chapter for Point wiring.

Block: As per 1.6 specified in chapter for Point wiring. (WG-PW/PW)

Method of Construction:

The complete fitting with all the above accessories shall be fixed on wooden / PVC block with SM screws (minimum size shall be 25x8 mm). The wooden/PVC block shall be fixed on wall/ceiling with SM screws (minimum size shall be 75x8mm) with necessary plugs, gutties, etc. S. No and date of erection shall be painted/marked by enamel paint. The fitting shall be connected with PVC insulated copper wire leads, to the point and testing shall be carried out.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

G) Chalk Board type Fluorescent fitting (CBF)

Scope:

Specification No (FG-IDF/CBF)

Supplying & erecting white stove enameled / powder coated Chalk board type fluorescent fitting with enameled reflector of 0.8 mm thick, white on the reflector side and gray on other surface suitable for T 8 tube/ tubes, with specified ballast, and necessary accessories, duly wired up for use on 250 V AC, supply including material required for erection and erecting as per requirement complete and marking Sr. No. and date of erection.

Material:

Fitting:

White stove enameled / powder coated Chalk board type fluorescent fitting suitable for T 8 tube, made of CRCA sheet not less than 0.5 mm thick, with enameled reflector of 0.8 mm thick, painted white on the reflector side and gray on other surface. Wire ways shall be smooth & free from sharp edges, burrs, flashes & like which might cause abrasion of the insulation of the wiring. Parts such as metal set screws shall not protrude into wire ways. Fitting shall be duly wired up internally with appropriate size of wire. (Refer drawing no.IDF-1 (Fig.2))

Ballast: As per (FG-FG/AS2) / (FG-FG/AS3) / (FG-FG/AS4) specified in chapter 2.4.

Tube holders: As per (FG-FG/AS8) specified in chapter 2.4

Starter: As per (FG-FG/AS11) specified in chapter 2.4

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Starter holder: As per (FG-FG/AS9) specified in chapter 2.4

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Paint: Superior quality enamel paint of specified colour.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Block/ Board: As per 1.6 specified in chapter for Point wiring. (WG-PW/PW)

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories shall be fixed on wooden / PVC block with SM screws (minimum size shall be 25x8 mm). The wooden/PVC block shall be fixed on wall/ceiling with SM screws (minimum size shall be 75x8mm) with necessary plugs, gutties, etc. S. No and date of erection shall be marked/painted by enamel paint. The fitting shall be connected PVC copper wire leads, to the point and testing shall be carried out.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

H) **Industrial type Fluorescent fitting** (INF)

Scope:

Specification No (FG-IDF/INF)

Supplying & erecting white stove enameled / powder coated Industrial type fluorescent fitting with enameled reflector of 0.8 mm thick, white on the reflector side and gray on other surface suitable for T 8 tube/ tubes, with specified ballast, and necessary accessories, duly wired up for use on 250 V AC, supply including material required for erection and erecting as per requirement complete and marking Sr. No. and date of erection.

Material:

Fitting:

White stove enameled / powder coated Industrial type fluorescent fitting suitable for T-8 tube, made of CRCA sheet not less than 0.5 mm thick, with enameled reflector of 0.8 mm thick, painted white on the reflector side and gray on other surface. Wire ways shall be smooth & free from sharp edges, burrs, flashes & like which might cause abrasion of the insulation of the wiring. Parts such as metal set screws shall not protrude into wire ways. Fitting shall be duly wired up internally with appropriate size of wire. (Refer drawing no.IDF-1 (Fig.3))

Ballast: As per (FG-FG/AS2) / (FG-FG/AS3) / (FG-FG/AS4) specified in chapter 2.4.

Tube holders: As per (FG-FG/AS8) specified in chapter 2.4

Starter: As per (FG-FG/AS11) specified in chapter 2.4

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Starter holder: As per (FG-FG/AS9) specified in chapter 2.4

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Paint: Superior quality enamel paint of specified colour for marking.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Block: As per 1.6 specified in chapter for Point wiring. (WG-PW/PW)

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories duly wired up shall be fixed on block with SM screws (minimum size shall be 25x8 mm). The block shall be fixed on wall/ceiling with SM screws (minimum size shall be 75x8mm) with necessary plugs, gutties, etc. The fitting if, to be ceiling suspended, it shall be fixed to the provided 16 SWG 20 mm dia., HG conduit duly threaded in ball suspension plate. The provided ball suspension plate shall be fixed on block with SM screws (minimum size shall be 25x8 mm) and the block shall be fixed at ceiling with SM screws (minimum size shall be 75x8mm) with necessary plugs, gutties, etc. S. No and date of erection shall be marked/painted by enamel paint. The fitting shall be connected with PVC insulated copper wire leads, to the point and testing shall be carried out.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

I) **Recess /Surface mounting Mirror Optic Fluorescent Fitting** (MOP)

Scope:

Specification No (FG-IDF/MOP)

Supplying & erecting white stove enameled / powder coated Mirror Optic type fluorescent fitting with enameled reflector of 0.8 mm thick, white on the reflector side and gray on other

surface suitable for T 8 tube/ tubes, with specified ballast, and necessary accessories, duly wired up for use on 250 V AC, supply including material required for erection and erecting as per requirement complete and marking Sr. No. and date of erection.

Material:

Fitting:

White stove enameled / powder coated recess /surface mounting mirror optic type fluorescent fitting suitable for T 8 tube, made of CRCA sheet not less than 0.5 mm thick, painted white on the reflector side and gray on other surface, and with Mirror assembly comprising of significantly designed high purity aluminium reflector for high optical performance. Wire ways shall be smooth & free from sharp edges, burrs, flashes & like which might cause abrasion of the insulation of the wiring. Parts such as metal set screws shall not protrude into wire ways. Fitting shall be duly wired up internally with appropriate size of wire. (Refer drawing no.IDF-2 (Fig.4 & Fig.5))

Ballast: As per (FG-FG/AS2) / (FG-FG/AS3) / (FG-FG/AS4) specified in chapter 2.4.

Tube holders: As per (FG-FG/AS8) specified in chapter 2.4

Starter: As per (FG-FG/AS11) specified in chapter 2.4

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Starter holder: As per (FG-FG/AS9) specified in chapter 2.4

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Paint: Superior quality enamel paint of specified colour.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Chain: Heavy duty lacquered MS chain with hooks.

Down Rod: As per (WG-MA/CON) specified in chapter for Point wiring.

Block: As per 1.6 specified in chapter for Point wiring. (WG-PW/PW)

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories shall be fixed on wooden / PVC block / on provided chain / down rod with ball suspension plate with SM screws (minimum size shall be 25x8 mm). The wooden/PVC block shall be fixed on wall/ceiling with SM screws (minimum size shall be 75x8mm) with necessary plugs, gutties, etc. The fitting if, to be ceiling suspended, it shall be fixed to the provided 16 SWG 20 mm dia., HG conduit duly threaded in ball suspension plate. The provided ball suspension plate shall be fixed in wooden /PVC block with SM screws (minimum size shall be 25x8 mm).The wooden/PVC block shall be fixed at ceiling with SM screws (minimum size shall be 75x8mm) with necessary plugs, gutties, etc. In case of recesses mounting, the fitting shall be secured and erected by fixing the hook at ceiling, and the chain shall be fixed to the fitting, in such a manner that the fitting shall be in level with the false / unspecified ceiling. Sr. No and date of erection shall be marked or painted by enamel paint. The fitting shall be connected PVC copper wire leads, to the point and testing shall be carried out.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

2.3 Outdoor fittings (FG/ODF)

A) Street Light fitting suitable for CFL (CSL)

Scope:

Specification No (FG-ODF/CSL)

Supplying & erecting Street Light suitable for specified wattage of CFL complete with serrated acrylic diffuser & gasket, with necessary control gear and erected on provided bracket.

Material:

Fitting:

The fitting canopy shall be made of deep drawn of CRCA Sheet, powder coated / epoxy powder coated CRCA sheet housing with epoxy white powder coated CRCA sheet steel gray tray covered with anodized Aluminium reflector wired with a provision for housing open construction ballast required for specified wattage of CFL with clear acrylic cover with rubber gasket fixed by 4 Nos. toggles of suitable OD entry for direct mounting pipe bracket. Fitting shall be with degree of protection IP 54 electrical Safety Class-I. Fitting shall be duly wired up internally with appropriate size of wire. (Refer drawing no.ODF-1 (Fig.1 & Fig.2)

Ballast: As per (FG-FG/AS1) specified in chapter 2.4.

Bi-pin lamp holder: Conforming to IS: 3323/80 with amendment No.1 to the extent possible /applicable.

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided bracket, on wall/street light pole or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

B) Street Light fitting suitable for HPMV/HPSV/MH Lamps (GSL)

Scope:

Specification No (FG-ODF/GSL)

Supplying & erecting Street Light fitting suitable for specified wattage of HPSV/HPMV/MH lamps, with all accessories, erected with provided bracket on wall/street light pole or at any place as directed by Site engineer with necessary materials.

Material:

Fitting:

The fitting comprises deep drawn one piece Aluminium body. Lamp compartment has stove enamel white finish from inside & gray finish from outside. nickel chrome plated reflector / Aluminium reflector is mounted inside the lamp compartment for high optical efficiency control gear compartment houses a detachable gear tray & is wired with provided copper wound ballast, power factor improvement capacitor, electronic ignitor & with mains connector. The cable entry is through mounting pipe & terminated on mains connector inside the control gear housing with felt gasket which ensures weather proofness & also prevents entry of insects inside the housing. The fittings lamp compartment shall have IP 43 protection & IP 23 protection for control gear compartment. The fitting shall be ISI marked to IS: 10322 part -5: 1987 with Amendment No.1&2 and comply with requirements of IS: 10322: part-5/Sec-1:1985 with Amendment No.1&2 IS: 13383: part 2: 1992 with Amendment No.1. Fitting shall be duly wired up internally with appropriate size of wire. (Refer drawing no.ODF-2 (Fig.3))

Ballast: As per (FG-FG/AS5) specified in chapter 2.4

Ignitor: As per (FG-FG/AS6) specified in chapter 2.4

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided bracket, on wall/street light pole or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

C) Street Light fitting suitable for T 8 Fluorescent tubes (FSL1)

Scope:

Specification No (FG-ODF/FSL1)

Supplying & erecting Street Light suitable for specified wattage complete with serrated acrylic diffuser & gasket, with necessary control gear and erected on provided bracket.

Material:

Fitting:

ISI marked Fluorescent Street light fittings complete with electronic ballast, transparent cover made out of 3mm thick acrylic sheet, gear cum reflector tray, canopy and lamp holder duly wired for use on 240 volt AC single phase 50 Hz without fluorescent lamp. Canopy shall be made of Aluminium sheet 1.25 mm thick minimum. Gear cum reflector tray (GCRT) shall be made of either CRCA sheet of 0.8 mm thick or Aluminium sheet of 1.25 mm thick.

Fitting shall be suitable for mounting up to a height of 15 meters and shall be able to withstand wind load test. It shall conform to class-1 of IS: 10322 (part 5/sec 3)/87 with amendment 1 and IP-53 protection with photometric test requirement with luminous efficiency not less than 65%.

i) Various components of fittings shall conform to IS specification as noted below.

a) Electronic ballast (EB) to IS: 13021: Part-1:1991 with Amendment No.1, IS: 13021: Part-2:1991 with Amendment Nos.1 and 2 and additional requirement as per the

b) Bi-pin lamp holders to IS: 3323/80 with amendment No.1/

c) PVC cables to IS: 694/90 with amdt.No.1 & 2.

ii) Surface of CRCA Steel and Aluminium sheets used shall be properly phosphatized and stove enamelled white on the reflector side, tray side and other surface stove enamelled grey.

iii) The street light fittings shall be required with socket bore of 30mm or 40 mm or 50mm for side entry/top entry type fittings. The socket bore, however, will be specified by the indenters at the time of placement of supply order.

iv) All wire leads to be adequately covered with sleeves for protection against accidental contacts.

v) All hardware parts used should be zinc coated or nickel/chromium plated so as to be corrosion resistant.

vi) Fitting shall be wired with multi-stranded copper wire terminating on suitable connectors. The wiring shall be properly clamped.

Ballast: As per (FG-FG/AS1) specified in chapter 2.4.

Bi-pin lamp holder: Conforming to IS: 3323/80 with amendment No.1 to the extent possible /applicable.

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided bracket, on wall/street light pole or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

D) Energy efficient T-5 2X14 & 2X24 Street Light fitting (FSL2)

Scope:

Specification No (FG-ODF/FSL2)

Supplying & erecting Energy efficient T-5 2X14 & 2X24 Street Light fitting suitable for specified wattage of T-5 lamp complete with serrated acrylic diffuser & gasket, with necessary control gear and erected on provided bracket.

Material:

Fitting:

ISI marked Energy efficient T-5 2X14 & 2X24 Street Light fitting complete with electronic ballast, transparent cover made out of 3mm thick acrylic sheet, gear cum reflector tray, canopy and lamp holder duly wired for use on 240 volt AC single phase 50 Hz without T-5 lamp. Canopy shall be made of Aluminium sheet of width 3" minimum per lamp. Gear cum reflector tray (GCRT) shall be made of either CRCA sheet of 0.8 mm thick or Aluminium sheet of 1.25 mm thick. Fitting shall be suitable for mounting up to a height of 15 meters and shall be able to withstand wind load test. It shall conform to class-1 of IS: 10322 (part 5/sec 3)/87 with amendment 1 and IP-65 protection

i) Various components of fittings shall conform to IS specification as noted below.

a) Electronic ballast (EB) to IS: 13021: Part-1:1991 with Amendment No.1, IS: 13021: Part-2:1991 with Amendment Nos.1 and 2 and additional requirement as per the

b) Bi-pin lamp holders to IS: 3323/80 with amendment No.1/

c) PVC cables to IS: 694/90 with amdt.No.1 & 2.

ii) Surface of CRCA Steel and Aluminium sheets used shall be properly phosphatized and stove enamelled white on the reflector side, tray side and other surface stove enamelled grey.

- iii) The street light fittings shall be required with socket bore of 30mm or 40 mm or 50mm for side entry/top entry type fittings. The socket bore, however, will be specified by the indenters at the time of placement of supply order.
- iv) All wire leads to be adequately covered with sleeves for protection against accidental contacts.
- v) All hardware parts used should be zinc coated or nickel/chromium plated so as to be corrosion resistant.
- vi) Fitting shall be wired with multi-stranded copper wire terminating on suitable connectors. The wiring shall be properly clamped.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided bracket, on wall/street light pole or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

E) Flood Light fitting suitable for HPMV/HPSV/MH Lamps (GFL)

Scope:

Specification No (FG-ODF/GFL)

Supplying & erecting Flood Light fitting suitable for specified wattage of HPSV/HPMV/MH lamps, with all accessories, erected with provided bracket on wall/street light pole or at any place as directed by Site engineer with necessary materials.

Material:

Fitting:

Luminaries comprising of a die cast aluminium housing with store enamel finish. A flat toughened heat resistance glass is firmly fixed with a synthetic rubber gasket to the housing by stainless steel toggles. Control gear comprises of provided copper wound ballast, power factor improvement capacitor, and electronic ignitor & with mains connector. Luminaire shall be mounted on a MS cradle for rotating in horizontal & vertical planes for facilitating positioning of the luminaire to effectively illuminate the target area. Brightened & anodized aluminium reflector for high optical efficiency. Cable entry shall be through suitable cable glands/ nipple provided for cable entry.

(Refer drawing no.ODF-2 (Fig.4))

Ballast: As per (FG-FG/AS5) specified in chapter 2.4

Ignitor: As per (FG-FG/AS6) specified in chapter 2.4

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided bracket, on wall/street light pole or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

F) Gate Light fitting (PTL) suitable for HPMV/HPSV/MH Lamps (PTL)

Scope:

Specification No (FG-ODF/PTL)

Supplying and erecting Gate light fitting suitable for specified wattage of HPMV/SV/MH lamp/lamps, complete with control gear, duly wire and erected on provided pipe/pole or at any other place, as directed by site engineer.

Material:

Fitting:

The fitting comprising of a control gear capsule made of die cast aluminium alloy and shall have provision for fixing of control gear. Fitting shall have acrylic bowl with ushroom/round shape bowl of specified diameter, and shall be fixed on the top of the capsule. The bowl shall be adequately gasketed for weather proofness. The inner diameter of control gear capsule base shall be suitable for pipe of 50 mm to 77 mm O.D. Fitting shall have entry for

termination of cable. The control gear capsule shall have IP 43 protection class. (Refer drawing no.ODF-2 (Fig.5))

Ballast: As per (FG-FG/AS5) specified in chapter 2.4

Ignitor: As per (FG-FG/AS6) specified in chapter 2.4

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided pole/pipe or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

G) Gate / Garden Light fitting suitable for CFL (GLT)

Scope:

Specification No (FG-ODF/GLT)

Supplying and erecting Gate / Garden light fitting suitable for specified wattage of CFL (One or Two), complete with control gear, duly wire and erected on provided pipe/pole or at any other place, as directed by site engineer.

Material:

Fitting:

The fitting comprising of a control gear capsule made of die cast aluminium alloy and shall have provision for fixing of control gear. Fitting shall have acrylic bowl with mushroom/round shape bowl of specified diameter, and shall be fixed on the top of the capsule. The bowl shall be adequately gasketed for weather proofness. The inner diameter of control gear capsule base shall be suitable for pipe of 50 mm to 77 mm O.D. Fitting shall have entry for termination of cable. The control gear capsule shall have IP 43 protection class.

Ballast: As per (FG-FG/AS5) specified in chapter 2.4

Ignitor: As per (FG-FG/AS6) specified in chapter 2.4

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Terminal connector: As per (FG-FG/AS10) specified in chapter 2.4.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided pole/pipe or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

2.4 Accessories for fittings (FG/AS)

Specifications for Ballasts / Ignitor / Condenser

Scope:

This chapter deals with supply, erection and connecting the accessories required in various types of fittings suitable for fluorescent tubes, HPMV/SV/MH lamps, etc., and giving necessary testing of the fittings after erecting the accessory.

Specification No (FG-FG/AS1)

1. CFL Ballast:

Ballast shall be copper wire wound, polyester filled or vacuum impregnated type suitable for Compact fluorescent lamp (CFL) conforming to I.S. 1534 with amendment No. 1 to 4 suitable for use on 230 V, 50 Hz, Single phase AC Supply, Temperature rise for ballast shall be 50 degree C, above the ambient temperature under normal conditions, minimum preheating current shall be 153 milliamp at 90 % of rated voltage and maximum 240 milliamp at 110 % of the rated voltage.

Specification No (FG-FG/AS2)

2. Electromagnetic Ballast for T 8 fluorescent tubes:

The ballast shall be of self Inductive coil of super enamelled copper low loss silicon steel lamination inductive coil with or without as additional resistor, designed to give operational characteristics for 40 W, at rated voltage of 220 V to 240V with calibration current 0.43 A., conforming to IS: 1534. Air temperature of the ballast winding shall not exceed 25^o C above ambient, with appropriate IP protection class.

Specification No (FG-FG/AS3)

3. Electronic Ballast for T 8 fluorescent tubes:

The High frequency electronic ballast suitable for T 8 tube shall have circuit P.F of 0.95 / protected against mains disturbances, automatic cut off protection for a deactivated tube, glass fuse in main input circuitry, short circuit protection for a limited duration for both PCB terminals and components. Should withstand 1.5 KV AC high voltage for insulation as per IS 1302/ Part I. Terminal block should be provided for mains and lamp connections, separate earthing terminal & tamper proof warrantee seal, the losses should not be more than 4 watts & without humming noise.

Specification No (FG-FG/AS4)

4. VPIT Ballast T 8 fluorescent tubes:

Vacuum impregnated low loss copper ballast made of low loss silicon steel lamination with super enamelled copper wire, vacuum impregnated with white resin, two way terminal block and winding temperature limited to 120^oC, conforming to IS 1534 (Part -1 of 1977) and suitable for 240 Volt 50 Hz, AC supply.

Specification No (FG-FG/AS5)

5. Ballast for HPMV/SV and Metal Halide Lamps:

Ballast shall conform to IS: 6616/82 with the following variations. The ballast shall be marked with watt loss and at rated voltage power delivered shall be between 92.5% and 107.5% of the power delivered by the reference ballast.

Ballast used in the fittings shall be energy efficient where watt loss will not exceed the following limits:-

Ballast for 70 Watts Lamp	:	15 Watts max.
Ballast for 150 Watts Lamp	:	19 Watts max.
Ballast for 250 Watts Lamp	:	26 Watts max.
Ballast for 400 Watts Lamp	:	38 Watts max.

Winding Resistance shall be within a Tolerance of +5% & 10 % on values declared by the manufacturer.

Specification No (FG-FG/AS6)

6. Ignitor:

Ignitor shall be suitable for HPSV/MV and Metal Halide lamps. It shall not pulsate after the lamp has been fully ignited. Ignitor improper connection shall not cause any deleterious effects on the luminaries. The components shall be fitted inside the polypropylene, insulating container. Necessary wires with standard colour coding (Red, yellow & Black), shall be drawn outside the container for facilitating the connections.

Specification No (FG-FG/AS7)

7. Condenser / Capacitor:

Made of Metallized Polypropylene (MPP) housed in a polypropylene container, hermetically sealed designed for tropical conditions, of appropriate capacity conforming to IS: 1569 of 1976 used for P.F improvement not less than 0.9 for all types of luminaries or other appliances. Condenser shall be connected across the mains or in series with one ballast for lead / lag circuit.

Specification No (FG-FG/AS8)

8. Tube holders:

Lamp holder should be designed for tubular fluorescent T 8 lamps for all wattages, for end to end mounting, rotary locking type. The holder shall conform to IS: 3323 of 1980.

Specification No (FG-FG/AS9)

9. Starter holder:

Starter holder made from PVC with copper contacts, and groove for securely holding the starter. The starter holder shall conform to IS: 2215/1984.

Specification No (FG-FG/AS10)

10. Terminal connector:

Connector shall be made of Porcelain / Bakelite / PVC, with necessary brass / copper contacts, screws for connections. The nominal cross sectional area of the connector shall be suitable for leads of 2.5 mm².

Specification No (FG-FG/AS11)

11. Starter:

Starter made of bi-metallic glow switch housed in polypropylene can with plastic cover and brass pins, with radio interference suppression capacitors and heavy gauge nickel plated brass contact, conforming to IS 2215 of 1983. Starter shall be suitable for fixing in all types of starter holders.

Method of Construction:

The above accessories shall be fixed in the fitting, duly wired and necessary testing shall be carried out in presence of site engineer.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

2.5 Brackets for Outdoor fittings (BKT)

A) Bracket welded to Pole Cap (BKT/BPC)

Scope:

Specification No (FG-BKT/BPC)

Fabrication of Street light bracket of specified diameter 'B' class G.I. Pipe, of specified length welded to pole cap erected on top of the pole for erection of either single /

double, side entry WP fluorescent/CFL/MV/MH/SV fitting(s), duly painted with one coat of red oxide & one coat of Aluminium paint, and erecting the same with provided leads.

Material:

GI Pipe: GI Pipe of specified diameter as per (CW-PLB/GP) mentioned in chapter 17.5

Pole Cap: Pole cap fabricated from 4 mm thick MS Sheet, of 30 cm in length.

Corner support: 3 mm thick MS flat / sheet

Set screws: MS bolts, nuts of 6 mm dia.

Paint: Red oxide & Aluminium paint.

Method of Construction:

The bracket shall be fabricated as per drawing No(s) BKT-1 (Fig.1 Fig.3), BKT-2 (Fig.4, Fig.5) and shall be placed on the pole cap. Inner diameter of pole cap shall be as per the outer diameter of pole with sufficient clearance, so as to facilitate easy placing of the cap on top of pole. Two holes of minimum 6 mm diameter shall be drilled to pole cap. The nuts shall be placed on the pole cap duly aligned with the hole, and shall be butt welded. Bolts shall then be tightened through the nut so as to hold the bracket in vertical position.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

B) Wall Bracket (BKT/WB)

Scope:

Specification No (FG-BKT/WB)

Fabrication of Street light bracket of specified diameter 'B' class G.I. Pipe, 1.2 m in length erected on wall for erection of side entry WP fluorescent/CFL/MV/MH/SV fitting(s), duly painted with one coat of red oxide & one coat of Aluminium paint, and duly connected to supply with PVC wire leads.

Material:

GI Pipe: GI Pipe of specified diameter as per (CW-PLB/GP) mentioned in chapter 17.5

Hardware: Grouting MS bolts, nuts of 10 mm dia. & 100 mm length. 'U' shaped clamps of suitable diameter made of GI.

MS Flat: MS flat 3 mm thick 50 mm wide

Paint: Red oxide & Aluminium paint.

Wire leads: 1.5 mm², as per (WG-MA/BW) mentioned in chapter 1.3

Miscellaneous: Cement, Sand, Water, etc.

Method of Construction:

The bracket fabricated as per drawing No BKT- 1 (Fig.2) shall be erected on wall as explained below:

- MS flat of length 15 cm with 10 mm diameter hole shall be welded to the pipe as shown in drawing.
- Grouting bolts shall be grouted in wall and finished with cement plaster.
- Bracket shall be placed on the grouted bolts with clamps and nut shall be tightened.
- Fitting shall then be inserted onto the bracket and connections shall be made.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

C) Street Light Bracket (BKT/SLB)

Scope:

Specification No (FG-BKT/WB)

Fabrication of Street light bracket of specified diameter 'B' class G.I. Pipe, of required length erected on pole for erection of side entry WP fluorescent/CFL/MV/MH/SV fitting(s), duly painted with one coat of red oxide & one coat of Aluminium paint, and duly connected to supply with PVC wire leads.

Material:

GI Pipe: GI Pipe of specified diameter as per (CW-PLB/GP) mentioned in chapter 17.5

Hardware: MS nuts & bolts, Rubber Grommet.

MS Flat: MS sheet 5 mm thick 40 mm wide.

Paint: Red oxide & Aluminium paint.

Wire leads: 1.5 mm², as per (WG-MA/BW) mentioned in chapter 1.3

Method of Construction:

The bracket fabricated as per drawing no BKT-2 (Fig.6)... , shall be erected on pole as explained below:

- Clamps of required length shall be fabricated as per outer diameter of pole and the pipe used for bracket.
- Bracket shall be clamped with the pole and the nuts bolts shall be tightened so as to keep bracket in plum.
- Hole for drawing the mains wire shall be drilled just below the bracket. The grommet shall be placed and the wires shall then be drawn.
- Fitting shall then be inserted onto the bracket and connections shall be made.

Mode of Measurement: Executed quantity shall be measured on running metre basis of the pipe used. (i.e. each)

2.6 Fans (FG/FN)

A) Ceiling Fans

Scope:

Specification No (FG-FN/CF)

Supplying and erecting Ceiling fan of specified sweep with all accessories and necessary materials, erected in provided hook/clamp.

Material:

Ceiling Fan:

Electric Ceiling fan capacitor type with double ball bearing complete with capacitor, 300 mm down rod, canopies, shackles, reel insulator, half threaded bolts of 9.53 mm (3/8") dia 62.5 mm (2-1/2") to 88 mm (3-1/2") long and 7.94 mm (5/16") dia 44.5 mm (1-3/4") to 57 mm (2-1/4") long with nuts, with lock type split pin, spring & plate washers, etc.; three number blade made of Aluminium alloy, suitable for single phase, AC 210 volts, 50 Hz supply and conforming to class I of IS : 374/1979 with amendment no 1 to 6 except for performance parameters to the extent modified as details in general requirements. The down rod shall be capable to withstand a tensile load of 1000 kg without breakdown and a torsion load of 500 kg.cm without breakage as per Clause 10.14.1 of IS: 374/1979 with amendment no.1 to 6. Electrical motor should be single phase permanent capacitor type with no. of poles 12/14/16/18 (As per sweep), Class-I with basic insulation. Class of insulation shall be B class. The winding wire used for fan should be synthetic enamelled of 30 to 38 SWG.

Connection wire: Flat / round Two core flexible stranded copper wire cord 24/0.2mm ISI marked.

Paint: Superior quality enamel paint of specified colour for marking Sr. No and date of rection.

Table 2.6/1

Performance Parameters for Fans suitable for Rated Voltage

S.No.	Sweep	Maximum Input Power in watts	Air delivery in m ³ /minute at Rated Voltage	Minimum Service Value at 180 V
1	900 mm	42	140	3.4
2	1200 mm	50	215	4.3
3	1400 mm	60	270	4.5

Method of Construction:

Blades of ceiling fan shall be properly fixed. Down rod, clamp shall be carefully fixed with nut bolt and split pin. Canopies shall be tightened on down rod keeping sufficient clearance. Wiring connections shall be made with required wire leads. Regulator of fan shall be erected on provided switchboard with required wire leads.

Testing:

After erection fan shall be tested by connecting to supply at all positions of regulator. Also steadiness of fan shall be checked at full speed, so that there is no wobbling.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

B) Exhaust Fans

Scope:

Specification No (FG-FN/EXF)

Supplying and erecting Exhaust fan of specified sweep and speed, with all accessories and necessary materials, suitable to work on 230 V / 415 V, AC Supply 50 Hz, erected in position.

Material:

Exhaust Fan:

ISI marked Exhaust fan suitable for Single/Three phase AC 230/415 Volts 50 Hz, capacitor run with mounting ring, four numbers of fixing hole without regulator and louvers. The sweep and speed shall be as per table below. Fan motor with moisture proof treatment and E class insulation, ISI marked, conforming to IS: 2312/67 with amendments 1 to 8. The fan mounting rings shall be proper pre-treatment followed with at least two coats of primer; final finish shall be with two coats of grey colour paint duly baked. The connecting leads shall be brought out for making connections.

Paint: Superior quality enamel paint of specified colour.

Table 2.6/2

Corresponding Speed with Sweep

S.No.	Sweep	Speed in RPM	Voltage level	CFM in m ³ /hr
1	375 mm	900	230 V	2460
2	375 mm	1400	230 V	4000
3	450 mm	1400	230 V	6800
4	450 mm	900	230 V	4350
5	375 mm	900	415 V	2460

Method of Construction:

The Exhaust fan complete with all above accessories and duly wired shall be erected at specified position, connected to the supply and tested.

Testing:

After erection fan shall be tested by connecting to supply. Also steadiness and vibrations if any, of fan shall be checked at full speed, so that there is no wobbling.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

2.7 Accessories for Fans (FG-FAS)

Metal Sheet Cawl (MSC)

A) Metal Sheet Cawl

Scope:

Specification No (FG-FAS/MSC)

Supplying & erecting metal sheet cawl made from GI sheet of specified shape and with radius more than the size of exhaust fan. The cawl mounted on angle iron frame to be fixed to wall with grouting nut & bolts, duly painted.

Material:

GI Sheet: 20/22 SWG

Angle iron: 25x5x3 mm, 40x40x4 mm

MS Flat: 25 x 3 mm

Metal mesh: Expanded metal mesh

GI Wire: 8 SWG

Paint: Red Oxide, Superior quality enamel paint

Grouting bolts: 6 x 100 mm, 10 x 100 mm MS nut, bolts.

Finishing material: Cement, Sand, Putty, and Water.

Method of Construction:

Sector shaped Cawl:

Fabrication of Cawl shall be made from 22 SWG GI Sheet. The cawl shall be of round with sector shape, having radius more than the radius of exhaust fan. Cawl shall be fixed to the angle iron frame made from 40x40x4 mm angle, duly welded and the edges made smooth by removing burrs, etc. At the open end expanded metal mesh shall be fixed with 25x3 mm MS flat. Spray painting shall be done by applying 1 coat of red oxide and 2 coats of superior quality enamel paint of colour directed by site engineer. Cawl than shall be fixed on wall by grouting the foundation bolts. The damaged portion of wall shall be finished properly with cement mortar, with necessary colour washing. (Refer drawing no FG-FAS-3 (Fig. 5) for fabrication details.)

Rectangular/Round shaped Cawl:

Fabrication of Cawl shall be made from 20 SWG GI Sheet with slanting flaps at 45 degree. The cawl shall be of rectangular/round shape, having 10 cms radius more than the radius of exhaust fan. Cawl shall be fixed to the angle iron frame made from 25x25x3 mm angle, duly welded and the edges made smooth by removing burrs, etc. At the fan end expanded metal mesh shall be fixed. The flaps shall be rigidly fixed by GI wire of 8 SWG on the width wise. Spray painting shall be done by applying 1 coat of red oxide and 2 coats of superior quality enamel paint of colour directed by site engineer. Cawl than shall be fixed on wall by grouting the foundation bolts. The damaged portion of wall shall be finished properly with cement mortar, with necessary colour washing. (Refer drawing no FG-FAS-3 (Fig. 6 & Fig.7) for fabrication details.)

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

DRAWINGS

Fan clamp for round pipe with hook (Refer drawing no. FG-FAS-1 (Fig.1)

Fan clamp for I-beam with hook (Refer drawing no. FG-FAS-1 (Fig.2)

Fan box with hook (Refer drawing no. FG-FAS-2 (Fig.3)

Chapter 3

APPLIANCES

3.1	Water-heaters	AP-WH
3.2	Air-conditioners	AP-AC
3.3	Water-coolers, Refrigerators	AP-WC
3.4	Air Cooler	AP-ACR
3.5	Water Purifier	AP-WPF
3.6	Inverter,	AP-INV
3.7	On line UPS	AP-UPS
3.8	Batteries for Inverter & UPS	No Specs
3.9	Voltage Stabilizers	AP-VS

3.1 Water Heaters (AP-WH)A) Storage / Pressure type Water Heaters (STWH)**Scope:****Specification No** (AP-WH/STWH)

Supplying, erecting and testing of horizontal/ vertical, stove enameled, storage/pressure type water heater, suitable for wall / floor mounting, of specified capacity, one inlet with non return valve, one outlet with dead weight, pressure reducing valve, stop cock; suitable to work on 230/250-V single phase AC Supply, heating element of specified wattage, thermostat, control fusible plug, pilot lamp etc. ISI mark only and marking of S No. and date of erection. (IS 2082)

Material:

Outer Casing: Corrosion proof stove enameled/ powder coated, mild steel / engineering plastic body. Colour of the casing shall be as directed by Engineer in-charge.

Inner tank: It should be of electrolytic copper (99% pure) properly fabricated so as to be leak proof and of specified capacity.

Heating Element: Mineral filled / tubular / copper cord & nickel plated, and conforming to IS: 4159, of specified wattage.

Pilot Lamp: A neon gas field indicating lamp shows functioning of heating elements along with thermostat & thermal cut-out.

Thermal Insulation: Resin bonded glass wool slab insulation & should be filled between two casings of storage water heater.

Thermostat: A Stem type snap action thermostat, which should cut off the electric supply automatically as per setting of temperature & should be ISI mark.

Thermal Cut-out: In case of thermostat failure this cutout should cut off the electric supply automatically and should restart only on pressing the reset knob.

Pressure Release Valve: If pressure exceeds above 50 psi, it should release the pressure & should be fitted on the inlet pipe.

Dead weight: It will operate when pressure in inside tank increase beyond specified limit.

Fusible plug: Cast aluminium body with threading, and hole for plug with fusible metal. The metal shall be fused, only all the other safeties fails & at high pressure

Hardware: 100x10 mm grouting bolts, MS washers, nuts, etc.

Wall Fasteners: 100x10 mm with vertical cuts, and pin at the centre, washer and nut, etc., made of MS. (Similar to Anchor bolt fastener)

Grouting material: Cement, Sand, water, etc.

Paint: Superior quality enamel paint of specified colour.

Method of Construction:

The water heater shall be erected in required position with necessary hardware's and base is grouted, as per the site situation. The water heater is to be connected to water supply on inlet side by valve, mountings and connected to outlet tap.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

3.2 Air Conditioners (AC)A) Window Model Air Conditioners (WAC)**Scope:****Specification No** (AP-AC/WAC)

Supplying, erecting, and testing Window model room air conditioner of specified tonnage, conforming to I.S.1391 suitable for operation on single phase, AC supply, 230/250 Volts 50 Hz, using best quality compressor, dehumidifier in provided air circulating, ventilators and

fitting in position in recess or in window to required size, and connected to supply, and marking of S No. and date of erection.

The AC unit shall be capable of performing following functions:

- Cooling
- Dehumidifying
- Air Circulating
- Air Filtering
- Ventilation

The Window AC should be of minimum 3 Star rating as directed by B.E.E.

Material:

Compressor:

The room air conditioners shall be fitted with hermetically sealed type suction cooled (Reciprocating) or discharge cooled (Rotary) compressor with suitable rated capacitor start electric motor. It should start unloaded and shall be equipped with overload protection. The compressor shall be mounted on resilient mountings for quiet operation. The compressor shall conform to IS.10617 (part-1): 1983 with amendment 1 & 2.

Cooling capacity for Compressors shall be as under:

For 1.5 Ton -	Minimum 4750 kcal/hour
For 2.0 Ton -	Minimum 6250 kcal/hour

Energy efficiency ratio for Compressor shall be minimum 2.625 kcal/hour/watt.

Cabinet:

The cabinet of the air conditioner be made from either galvanized MS sheet of 1mm thickness or aluminium alloy sheet of 1.2mm thickness. The sheets shall be suitably stiffened by embossing the fabrication work and shall be of suitable workmanship. The sheets shall be suitably phosphate and protected by powder coated paint. The galvanized steel sheets shall conform to IS: 277:2003 and have a coating grade of 120 gm/m².

Air Filter: The air filters provided shall be of cleanable type and made of synthetic material.

Thermostat:

The air-conditioner shall be fitted with thermostat suitable for a working range from 16 degree Centigrade to 35 degree Centigrade with a differential of +/-1 degree Centigrade, with operational voltage as 240V and current rating not exceeding 25 amps. The thermostat shall conform to IS: 11338:1985.

Condenser: As per (FG-FG/AS7) specified in chapter 2.4

Paint: Superior quality enamel paint of specified colour.

Method of Construction:

The AC unit shall be fixed in the recess/window with necessary materials. The outer frame shall be fitted to recess or cutout made in window making the recess/window air tight, duly connecting the unit to power supply by means of metal clad switch & plug and giving satisfactory trials.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

B) Split type Air Conditioners (SAC)

Scope:

Specification No (AP-AC/SAC)

Supplying, erecting, and testing Split type room air- conditioner of specified tonnage, conforming to I.S.1391, having one/two air handling units Hi-wall / ceiling (suitable for false ceiling) mounting type having cooling unit and the outdoor condensing unit connected with 12/9 mm copper piping up to 6 meter duly insulated and 3 core copper flexible cord of required length etc. with stand for condensing unit, complete with testing etc. (Conforming to IS: 1391 Part-I & Part-II with all amendments & as per BEE) suitable for operation on single phase, AC supply, 230/250 Volts 50 Hz, using best quality compressor, and fitting in position as per site situation and as directed by site engineer, duly connected to supply, and marking of S No. and date of erection.

The AC unit shall be capable of performing following functions:

- Cooling

- Dehumidifying
- Air Circulating
- Air Filtering
- Ventilation

The Split type AC should be minimum 3 Star rating as directed by B.E.E.

Material:

Compressor:

The air conditioners shall be fitted with hermetically sealed type suction cooled reciprocation or discharge cooled rotary compressor (as applicable), compressor unit operating on Refrigerant R-22 with suitable rated capacitor start electric motor. It shall be equipped with overload protection. These shall be mounted on resilient mountings for quiet operation. The compressor shall conform to IS: 10617 part (1) -1983 (amendment 1 & 2)

The air conditioners shall be complete with automatic temperature control and cut-in and cut-out etc. for temperature range 16 degrees to 35 deg. C. The differential of the thermostat for cut-in and cut-out shall not be greater than +/- 1 degree Centigrade.

Outdoor Cabinet:

The cabinet of the evaporator unit and condensing unit shall be made from galvanized steel sheet of 1.0mm thick with stiffness for robust construction and shall have rounded corners, steel parts/front panel etc. shall have stove-enameled finish preceded by undercoat of anti corrosive primer paint phosphate and through cleaning of the surface. Alternate method of corrosion protection like plastic powder coating, electrostatic paintings are also acceptable in lieu of stove enameled finish. Galvanized sheet shall conform to IS: 277/ 2003.

Indoor Unit:

The indoor units made of ABS/HIPS shall be of flame retardant and impact resistant life. ABS/HIPS indoor unit cabinet shall pass in flammability test requirement for Grade V-O as per UL -94. For impact resistance the unit duly packed, when dropped from a height of 1 metre shall show no damage.

Air Filter: The air filters provided shall be of cleanable type and made of synthetic material.

Thermostat: Thermostat or electronic thermostat as per IS 11338: 1985.

Condenser: As per **(FG-FG/AS7)** specified in chapter 2.4

Piping:

Suction line -Copper pipe of min 0.70mm thickness and of suitable diameter as per manufacturers design.

Liquid line -Copper pipe of min 0.70mm thickness and of suitable diameter as per manufacturers design.

Drain pipe -15mm dia flexible PVC pipe.

Connection Cable: Suitable capacity 3 Core PVC insulated FRLS copper wire to be electrically connected to both the units.

Paint: Superior quality enamel paint of specified colour.

Remote Control: Remote control (Cordless) shall be provided with one On/Off timer, selecting Fan speed(Three speeds) and setting up of temperature.

Drain Pipe: Drain pipe (15mm dia flexible PVC pipe).

Method of Construction:

The installation shall comprise the following work:

- Mounting/Fitting indoor & outdoor units at the respective locations on provided MS stands with necessary hardware's.
- Laying refrigerant piping of 6m length and connecting both the units after drilling hole/holes in the wall, if required. The thickness of the copper tubing shall not be less than 0.70mm and diameter of required size by flaring, threading, etc.
- Insulating the suction pipe with expanded polyethylene or foam 5mm tubing.
- Laying 15mm drain pipe to throw out the condensate water formed in the Indoor unit.
- Leak testing of the entire system.
- Charging Refrigerant gas in the unit.
- Suitable electric wiring between indoor and outdoor units up to 6 m length & up to switch within 3 metre of location of indoor unit.
- Testing and giving satisfactory trials.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

C) Copper Pipes for Air-conditioning & Refrigeration System (AP-AC/CP)

Scope:

Specification No (AP-AC/CP)

Supplying & erecting Soft Copper pipes of specified diameter from Indoor to Outdoor units with necessary straightening, bending, flaring, swaging and coupling including Oxy-Acetylene Brazing on wall or flooring or both by fixing with clamps in an approved manner.

Material:

Semi-flexible Soft Copper Pipes made specifically from Copper tubes having Standard specification ASTM B-68/B-75 that are Billet heated, extruded, drawn, process annealed, eddy current tested and finally hydrostatically tested & inspected to have uniform grain size 0.015–0.004, controlled hardness, elongation (40% Min) & tensile strength having symbol C12200 with or without internal grooves and uniform thickness 22 gauge shall be used. The specified diameter of the pipes shall refer to the inside diameter of the pipes.

Pressure Testing:

All piping shall be factory tested to hydrostatic test pressure of atleast one and a half times the maximum operating pressure. Once installed, the pressure test will be conducted on site at minimum pressure 200psig for a period not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-charge. Piping repaired subsequent to the above pressure test shall be re-tested in the same manner. System may be tested in sections and such sections shall be securely capped. Pressure gauges may be capped off during pressure testing of the installation.

Method of Construction:

Soft Copper pipes of specified diameter, thickness, and fittings with Oxy-Acetylene Brazing shall be erected on wall or flooring using clamps and duly pressure tested as specified. Before preparing the piping, exact measurement shall be taken. The pipes shall be of single length as much as possible and laid on site lower than electrical pipes or DBs. The pieces of pipes will be swaged as required for proper fitting of joints wherever required, loaded into brass flare nuts of appropriate sizes at each end, expanded & flared to perfection without any cracks using flaring tool. Each joint will be cleaned with a file and the burr removed out. If possible (for pipe size over 3/4") the pipe pieces will be cleaned internally with a soft muslin cloth. The pieces of pipes will then be welded whilst taking proper care that no burr is left and no dust enters in the system. The pipes will be adequately supported by clamps and the entire system will be satisfactorily tested. Any surplus material shall be disposed off satisfactorily without causing any nuisance.

Mode of measurement:

Measurement shall be for one meter of each type and diameter of pipe laid complete with fittings, clamps, etc. as specified. The length shall be measured net on the straight and bends along the centre line of the pipe and fitting correct up to a cm. (i.e. per meter)

3.3 Water Coolers, Refrigerators (WCR)

A) Water Coolers (WC)

Scope:

Specification No (AP-WCR/WC)

Supplying, erecting, testing and commissioning self contained water cooler with specified storage capacity & cooling capacity, and marking S No and date of erection.

Material:

Water Cooler:

The water cooler shall be suitable for operation on 230 V +/- 10% , 50 Hz, single phase AC supply with hermetically sealed type suction cooled compressor with overload protection conforming to IS :-10617(part I) : 1983 with amendment no 1&2.

Tank:

Tank shall be fabricated from SS sheet of 0.8 mm min. thickness as per ISI 304 and shall be made by electrically seam welded lap joints or alternatively from 0.63 mm thickness stainless steel sheet with PUF insulation, with required number of Taps. However tank fabricated by double seam jointing is also acceptable if the same is reinforced and sealed by lead free solder material. Use of lead soldering material for sealing the joints of water tank is not permitted. Water tank cover and lid bottom shall be made of 1.25 mm aluminum sheet duly anodized / epoxy painted / high impact polystyrene (HIP) of 1.5 mm thickness. Positive locking of the lid is to be provided (lock with two keys). A drain valve at the bottom of the storage tank to be provided to draw out water while cleaning.

Cabinet (Body):

The cabinet of the water cooler shall be made of GS or SS sheet of 1.0 mm. The front panel, below the water outlets in the storage type water coolers shall be made of stainless steel of 0.8 mm. The drain pan for storage type water coolers shall be made of stainless steel sheet of 0.63 mm upto size 40 liters/hour and beyond 40 liters/hour of 0.8 mm thickness. The bottom pedestal shall be made of 2.65 mm minimum thick stainless steel sheet. Pedestal shall have a minimum ground clearance of 100 mm for ease of cleaning. Pedestal shall be strong enough to withstand weight with storage tank full and shall be reinforced to prevent skewing. The body shall be held securely with the pedestal with stainless steel nuts and bolts. The drain size should be 25 mm or above. In case water outlets are provided on three sides then all the three lower panels should be made of aluminium sheet or stainless steel sheet.

The mild steel components used in the manufacture of the cabinet shall be individually degreased, pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign elements. Immediately after pickling the MS parts shall be given phosphate treatment. The components along with the front panels shall then be given a primer coat with a finish coat of stove with a finish coat of stove enamel paint. The finish shall be smooth and uniform with hard tough film of the enamel adhering to the surface. The finish shall be free from all the visible defects and shall not chip when tapped lightly with a dull pointed instrument. Alternatively method of corrosion protection like plastic powder coating, electrostatic painting shall be permitted

Refrigeration coils to be fully soldered to the outside of the tank for good thermal contact and not merely tack welded.

There shall not be any gap between water tank cover (mask) and water tank to prevent rodent/ insect/ dust entry.

Water tank overflow should be adequately covered with strainer such as wire mesh etc to avoid rodent/ insect/ dust entry.

Condenser Fan Motor: The condenser fan motor shall be capacitor start and capacitor run (CSR) or permanently split capacitor (PSC) or alternatively permanently lubricated motor may be provided.

Thermostat: The thermostat shall conform to IS: 11338-1985. The position of the thermostat shall be adjustable through a rotary switch mounted on the front or side panels. Min and max of the thermostat setting shall be from 0 degree Celsius and 25 degree Celsius which shall be marked.

Method of Construction:

The water cooler shall be fixed at designated place or as directed by the site engineer, duly connected with inlet and drain by leak proof joints. The water cooler is to be erected on stand and tested.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

3.4 Air Coolers (ACR)

A) Desert type Air Coolers (DAC)

Scope:

Specification No (AP-ACR/DAC)

Supplying and erecting and testing evaporative air cooler (desert Cooler) with fibre body, 230/250 Volts, 50 cycles, comprising of fan, pump,, drip proof motor , filter pads,

confirming to IS: 3315 and having specified cooling capacity, complete with 5 metre long 3 core cable and 5A hand shield type three pin top and marking S No. and date of erection.

Material:

Exhaust fan for Inlet air:

Exhaust fan shall be complete with motor and ISI marked to IS: 2312:1967 with amendment No 1 to 8. Fan shall be complete with motor and fan, motor shall be ISI marked to IS: 996:1979 with amendment No 1, 2 &3. Cooler pump shall be ISI marked, and confirming to IS: 11951:1987 with amendment No 1 to 4. Exhaust fan shall be of 900mm (6 pole motor) and shall have single speed

Cooler:

Cooler shall be suitable for operation on 230 volts +/- 10%, single phase, 50 Hz AC supply. Pump set shall conform to IS: 11951-1987 with amendment no.1 to 4. The coolers shall be complete with fan, motor, filter pads, water pump, etc. Fan motor will be of 1400 rpm (4 poles) and shall have three speeds. Filter panel, front grill, and top of the cooler body shall be made of 0.8 mm galvanized steel sheet. The sump tank and rest of the body shall be made of 1.2 mm thick galvanized steel sheet. The galvanized steel sheet shall be ISI marked and shall have zinc coating not less than 120 gm/m² and shall conform to IS: 277-2003. All internal surfaces including inside of the tank, fan blades, motor body, pump, pump body and frame shall be painted with water resistant paint conforming to IS: 9862-1981 with amendment No 1.

Water pump shall be provided with proper clamping arrangement. The shaft of the pump shall be stainless steel. Impeller, housing, and fan shall be of polypropylene. The pump shall conform to IS: 11951-1987 with amendment No 1 to 4 and shall be ISI marked.

Suitable nylon bushes shall be provided in the grill for easy and smooth movement of louvers.

The filter pads shall contain wood wool. The filter pads shall be fixed over the panel and secured by clamping guard of galvanized wire of 2 mm dia approx and net size 50 to 75 mm approx, square/ rectangular. The wire guard shall be fixed in the clamps to avoid any sagging.

15 mm size punched hole shall be provided to fix the float valve where required.

The drain plug of brass shall be fitted in such a way so as to be able to completely drain the water from the tank.

The inside wiring connection shall be through suitable non-ferrous thimbles and the live contacts of rotary switch shall be protected by suitable enclosure of insulating material.

Rotary switches:

The cooler shall be provided rotary/ piano type On-Off and speed selection switch for three speed cooler fan motor.

Method of Construction:

The air cooler shall be fixed at designated place or as directed by the site engineer, duly connected to electric supply by means of 3 core copper wire and tested.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

3.6 Inverter (AP-INV)

General

This part of the specifications covers the technical aspects of the Digital pure Sine wave Inverter.

Scope:

Supplying, erecting, testing & commissioning of Digital pure sine wave Inverter with necessary safeties, etc.

Specification No (AP-INV)

Material:

Equipment manufactured as per standard manufacturer's specification. The unit housed in powder coated CRCA sheet enclosure with following fault protection on mains / inverter mode:

- Under voltage on mains mode
- Over voltage on mains mode
- Charger protection on mains mode
- Overload on inverter mode
- Short circuit on inverter mode
- Low battery on inverter mode
- Battery reverse on inverter mode
- Under voltage on inverter mode
- Over voltage on inverter mode
- LED display for above fault protection
- Alarm for above fault protection
- Arrangement to cut of neutral of supplier when supply from invertors is on.

In addition to above the inverter shall comply with the specifications mentioned in Table No. 3.6/1

Table No. 3.6/1

Additional Specifications for Inverter

S.No.	Specifications / Features		Standard Parameters
1	Input AC range	Under Voltage Under Voltage restoration Over Voltage Over Voltage restoration	180 +/- 5 V 185 +/- 5 V 260 +/- 5 V 255 +/- 5 V
2	Output on Inverter Mode	Maximum power Minimum Efficiency Voltage (Inverter mode) Frequency (Inverter mode) Overload Transfer time	As specified 85 % (As per Clause 7.9.3 of ISS) 230 V Nominal +/- 12% 50 Hz +/- 2% > 110% for 10 minutes 30 ms
3	Conversion	Switching device Harmonic distortion	MOSFET or IGBT. < 5 %
4	Inverter mode protection	Low battery Battery reverse Over load Short Circuit	Electronic trip Through fuse Electronic trip Electronic trip
5	Mains mode protection	Over load / Short Circuit Charger	Through MCB Through MCB
6	Battery	Charging time	10 – 12 hours
7	Battery charger	Constant voltage with current limit	10 amp with boost voltage & float voltage as per manufacturer's specification High power factor boost charger
8	LED Display	Switch On, Inverter ON, Low battery Pre-alarm, Battery low, Mains ON, Smart charge, Overload, Short Circuit, Battery fuse fail, Battery reverse, MCB Trip.	As per manufacturer's standard specification
9	Alarms	Low battery Pre-Alarm Overload Pre-alarm Short Circuit MCB Trip	Continuous beeping Continuous beeping Continuous beeping Continuous beeping
10	Environmental	Operating temperature Storage temperature Humidity	0 - 40 ⁰ C 0 - 40 ⁰ C 0 -95 % RH non-

			condensing
11	Enclosure	CRCA/MS sheet minimum 1.2 mm thick	Aesthetically finished, duly pre treated and powder coated.

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each)

3.7 On Line UPS (UPS)

General

This part of the specifications covers the technical aspects of the Online UPS system for 1 to 10 kVA capacity.

Scope:

Specification No (AP-UPS)

Supplying, erecting, testing & commissioning of Online UPS with necessary safeties, etc.

Material:

Equipment manufactured as per standard manufacturer's specification and as tabulated in Table No. 3.7/2. The unit housed in powder coated CRCA sheet enclosure with following fault protection on mains / UPS mode:

- Under voltage on mains mode
- Over voltage on mains mode
- Charger protection on mains mode
- Overload on UPS mode
- Short circuit on UPS mode
- Low battery on UPS mode
- Battery reverse on UPS mode
- Under voltage on UPS mode
- Over voltage on UPS mode
- LED & LCD display for above fault protection
- Alarm for above fault protection
- Batteries shall be of Sealed Maintenance Free type (Tubular). The selection of number of batteries required shall be as per Table No 3.7/1

Table No. 3.7/1

Details of Batteries required for the UPS in respect to the Backup Period.

kVA rating	DC Voltage	Output pf	No of SMF Batteries	Back Up Period				
				15 mins.	30 mins.	1Hr	2Hrs	3Hrs
1kVA	36V	0.7	3	17AH	2 X 17AH	42AH	65AH	100AH
2kVA	96V	0.7	8	17AH	26AH	42AH	65AH	100AH
3kVA	192V	0.8	16	17AH	17AH	26AH	42AH	65AH
5/6 kVA	192V	0.8	16	17AH	26AH	42AH	65AH	100AH
8kVA	240V	0.8	20	17AH	26AH	42AH	100AH	2X 65AH
10kVA	240V	0.8	20	26AH	42AH	65AH	2X 65AH	2X 100AH
A)	The Batteries considered are Sealed Maintenance Free Batteries (SMF)							
B)	The Batteries need to be placed in Ambient Temperature of 20Deg C - 25Deg C							
C)	The UPS is considered to be working @ 90% Load of its capacity							

Table No. 3.7/2

Specifications & Standard Parameters of On Line UPS

The UPS shall comply with specifications as indicated in the following table:

S.No.	Specifications / Features	Standard Parameters
1	Technology	True online Double Conversion design (DSP / Microprocessor based)
2	Input voltage range	160 V to 270 V for 1 Phase Input 335 V to 477 V for 3 Phase Input
3	Input power factor	Near unity Power factor > 0.93 for 1 Phase input
4	Generator compatibility	Yes (1.2 times the UPS rating)
5	Nominal input frequency	50 Hz +/- 6 %
6	Rectifier type	Advance Rectifier with inbuilt APFC (Advance Power Factor Compensated) for 1 Phase . IGBT charger Advance Rectifier with inbuilt APFC (Advance Power Factor Compensated) for 3 Phase .
7	Output Voltage	230 V AC +/- 1 % for 1 Phase Output . 400 V AC (380/415 selectable) for 3 Phase & Neutral .
8	Total Harmonic distortion	1 Phase Output < 3 % for Linear load < 5 % for Non-linear load 3 Phase Output < 2 % for Linear load < 5 % for Non-linear load
9	Overload Capacity	110 % for 10 Seconds & 130 % for 2 Seconds for 1 & 2 kVA UPS . 125 % for 10 Minutes & 150 % for 60 Seconds for 3 to 10 kVA UPS .
10	Inverter	IGBT based PWM with Digital control (Microprocessor based)
11	Crest Factor	3: 1 for 1 & 2 kVA UPS . 5: 1 for 3 to 10 kVA UPS .
12	Static Bypass	Automatic bypass switch facility
13	Display	Should be User friendly with LED & LCD display with showing important parameters.
14	Output Power factor	0.7 lag to Unity within kVA & kW rating.
15	Load in terms of PC per kVA. (PC with 15" CRT Monitor)	3 PC's per kVA (for 1 & 2 kVA UPS) 5 PC's per kVA (for 3 to 10 kVA UPS)
16	Battery type	SMF / Thick plate / Tubular
17	DC Voltage	1 kVA – 36 V, 2 kVA – 96 V, 3 & 5 kVA – 192 V, 8 to 10 kVA – 240 V
18	Battery charger current limit	1 & 2 kVA – 6 A, 3 & 5 kVA – 4 & 6 A, 8 & 10 kVA – 8 & 15 A.
19	Ambient temperature	45 ⁰ C
20	Noise level	< 50 db @ 3 metres
21	Testing standards	IEC 62040 Part III
22	Isolation Galvanic	Isolation transformer from 3 to 10 kVA

Mode of Measurement: Executed quantity will be measured on number basis. (i.e. each.

3.9 Voltage Stabilizer (VS)

A) Servo Motor controlled Voltage Stabilizer (SVS)

Scope:

Specification No (AP-VS/SVS)

Providing single phase auto/manual line voltage servo motor operated voltage stabilizer confirming to IS 9815-1981 of specified KVA capacity duly tested with guarantee for one year marking S. No. & date of erection.

Material:

- Single Phase auto/manual line voltage stabilizer confirming to IS 9815-1981 with following components:
- Motorized variable voltage auto transformer.
- Double wound Buck boost/series transformer
- Servo control sensing card (PCB)
- Suitable for input 160 to 250 volts & output voltage $230 \pm 1\%$
- Zero wave distortion losses should be negligible with 95% efficiency
- No phase shift.
- No effect of load power factor.
- Natural air-cooled.
- Correction rate 20 to 30 volts per second.
- Audio alarm for over voltage & under voltage.
- Volt meter 0-300 volts with selectors switch to monitor input & output voltage, overload & short circuit protection.

Method of Construction:

The stabilizer shall be installed at designated place as directed by engineer in-charge, with both input & output connected, with necessary testing.

Mode of Measurement: Executed quantity will be measured on number basis. (i.e. Each)

Chapter 4

ENERGY SAVING DEVICES

4.1	Solar Hot water system	ESD-SHWS
4.2	Pipes for Solar Hot Water System	ESD-HWP
4.3	Solar Lighting	ESD-SOL
4.4	Energy Devices (Harmonic Active Filter, APFC Panel with Harmonic filters)	ESD-ESD/DAHF ESD-ESD/APFC
4.5	Miscellaneous	No Specs
4.5	Drawings	

Scope:**Specification No (ESD-SHWS)**

Supplying, erecting, testing and commissioning of Solar Water Heating System with & without heat exchanger for cold & warm regions respectively with Solar flat plate collector conforming to IS: 12933 (part 1) with amdt.no.1 and IS: 12933 (Part 2)/2003 suitable for inlet water with chlorine and fluorine content up to 100 ppm and supply hot water at the outlet. (Refer drawing no.ESD-SHWS-1)

Material:**1. Solar water heating system:**

Comprising of solar flat plate collector, collectors stand assembly, stainless steel insulated hot water storage tank with heat exchanger and various other components.

Solar flat plate collector component shall have:

- Solar flat plate collector cover plate made of toughened glass
- Sheet for absorber made of copper
- Absorber made of copper sheet and copper tube.

2. Solar Flat Plate Collector:

Solar flat plate collector shall conforming to IS: 12933 (Part 1) with amdt.no.1 and IS: 12933 (Part 2)/2003 and various components shall be as under:

Cover plate: Cover plate shall be toughened glass and thickness of 4.0 mm (min.) conforming to section-1 of IS: 12933(Part-2)/2003. The solar transmittance of the cover plate shall be minimum 82 percent at near normal incidence.

Collector Box: Collector box shall be made of Aluminium sections only. Type, grade, size, workmanship and finish of the material used shall be as per section-2 of IS: 12933 (pt2)/2003. The minimum thickness of Aluminium shall be as under:

- a) Channel section for sides 1.6 mm
- b) Sheet for bottom 0.7 mm
- c) Support for glass retaining 1.2 mm
- d) Sheet for entire body 1.0 mm

3. Absorber:

Absorber shall consist of riser, header, and sheet for absorber. The Diameter of header shall be 25.4 +/-0.5mm and thickness 0.71mm. The Diameter of riser shall be 12.7 +/- 0.5mm and thickness 0.56mm and made of copper only. The distance between the risers from center to center shall be 120mm. Type grade, size, workmanship and finish of the material used shall be as per section-3 of IS:12933 (Part 2)/2003.

Riser and header assembly designed for working pressure up to 24.5 K Pa (2.5 kg/cm²) shall be tested for leakage at a minimum hydraulic pressure of 490 K Pa (5 kg/cm²).

Sheet for absorber:

Sheet for absorber shall be made of copper only. Type, grade, size, workmanship and finis of the material used shall be as per sectiob-3 of IS: 12933 (pt2)/2003. A sample piece of the absorber for having minimum area of 400 square cm. shall be heated in an oven at temperature of 175 degree C for 2 hours. After heating, the sample shall be taken out from the oven and cooled at room temperature. The cooled sample shall be inspected visually for damages, if any. There shall not be any appearance of blistering/rupture/peeling off of the coated/painted surface and of weakening of the bonding between absorber sheet and risers/headers.

Collector box insulation: Insulation shall be provided at back and sides. Thermal Resistance ® of insulation material shall be minimum 0.96 m square degree C/W for back insulation and minimum 0.48 m square degree C/W for side insulation. This shall be derived after determining thermal conductivity (K) value at 100 degree C mean temperature in accordance with IS:3346.Collector box insulation shall conform to sec.4 of IS: 12933(Part-2)/2003

Gaskets and Grommets: Gaskets and Grommets shall conform to sec.5 of IS: 12933 (Part-2)/2003.

4. Insulated hot water storage tank: The thickness of the water storage tank shall be uniform.

Material: Insulated hot water storage tank shall be non-pressure type and made of stainless steel grade (X04Cr19Ni9 or X07Cr18Ni9 of IS: 1570(part 5)/1985), TIG welded.

Insulation: Solar water heating system (SWHS) up to and including 500 LPD shall be insulated with 40mm thermal grade PUF insulation of 32 Kg/ meter cube or higher density. PUF insulation could be pre extruded type fitted with FRP exterior cladding or alternatively injection moulded in a twin walled steel tank and PPE end cap. Other systems shall be insulated with 100 mm thick Rock wool of 48Kg/m³ density with 22swg Aluminium cladding. Systems up to 500 LPD may also alternatively be installed with 100 mm thick Rock wool of same specifications with aluminium or GI powder coated cladding.

Tank stand: Tank stand assembly shall be made of MS angle of size (min) 38x38x4 mm duly pre-treated and stove enamelled with black Colour paint. Alternatively tubular structure with Powder coating could also be provided.

5. **Heat Exchanger:** Heat Exchanger shall be cage type and made of copper/stainless steel tubes of grade X04Cr19Ni9 or X07Cr18Ni9 of IS: 1570(part 5)/1985 .Heat exchangers shall have a minimum of 0.24 sq. meters heat transfer area per 100 LPD capacities.
6. **System inter connecting piping:** ISI marked G.I. pipes, medium class of IS: 1239 duly insulated with 50mm thick rock wool of 48 Kg/m³ density and 26swg Al cladding. EPDM hose pipes can also be used for systems up to and including 500LPD.
7. **Collector stand:** Collector stand assembly shall be made of MS angle of size 38x38x4 mm duly pre-treated and stove enamelled with black Colour paint. Alternatively tubular structure with Powder coating could also be provided.
8. **Make up water tank:** The capacity of make up tank shall be 5 litres up to 500 LPD and 10 litres for 1000 LPD and above.
9. **Electrical heaters:** Electrical heater shall be ISI marked. Electrical heater backup shall be two nos. each of rating 3 KW for 500 LPD, 3 nos. each of rating 3 KW for 1000 LPD, 4 nos. each of rating 3 KW for 2000 LPD and 2 nos. of 3 KW rating in each of the three phase for 3000 LPD.
10. **Temperature Gauge:** Dial type, duly calibrated and suitable for temperature range from 0 degree C to 120 degree C and shall be provided for capacity above 500 LPD.
11. **Valves:** 3 valves, one for inlet, outlet, and make up tank each.

Method of Construction:

The entire Solar Hot water system with all accessories shall be installed at designated place, with necessary plumbing, wiring and testing.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

4.2 Pipes for Solar Hot Water System (ESD-HWP)

A) Thermal insulated GI pipes: (TIP)

Scope:

Specification No (ESD-HWP/TGP)

Supplying and erecting ISI mark GI Pipe with accessories, as piping for solar hot water system of specified diameter with resin bonded flap rock wool/glass wool insulation with aluminium cladding to withstand the temperature of 100 degree C maximum, complete as directed by the site engineer.

Material:

GI Pipe: As per (CW-PLB/GP) specified in chapter 17.5 for Plumbing

Glass Wool: Superior quality with thermal conductivity value 1.67 per cm² per watt.

Rock wool: Superior quality with density of 30 – 32 kg/ cm²

Bonding material: Resin or adhesive.

Cladding material: Aluminum sheet of 26 SWG or Plastic sheet, Chicken mesh.

MS Clamps: Clamps fabricated of required length and shape, of 3 mm thick mild steel having 25 mm width.

Hardware: Sheet Metal (SM) screws of required sizes, plugs/wooden gutties, etc.

Method of Construction:

Before preparing the piping, exact measurements shall be taken. The pipes shall be insulated either by rock wool or with glass wool as explained below:

Glass wool insulation: Firstly the outer surface shall be cleaned so as to make it free from oily substance, if any. Then the glass wool shall be pasted with resin or adhesive uniformly for a thickness of 50 mm. The glass wool shall then be covered with plastic sheet so as to hold it in position, this will form the insulation. Then the aluminium sheet shall be fixed to the insulation and the ends shall be securely fixed with SM screws. The insulation at fixing ends of pipe (i.e. at coupling, bend, elbows, Tee's, valves, etc) shall be done after the piping is fixed to the system. The entire insulated piping shall be tested for leakages, temperature.

Rock wool insulation: As mentioned above, but with rock wool bonded to the pipe and covered with chicken mesh to hold in its place.

The insulated piping shall be fixed on wall or at any other location directed by the site engineer, with MS clamps fixed with SM screws, with plugs, wooden gutties (for erection on stone wall) complete. In addition to above the erection shall meet the requirements mentioned in para 4.2.1 of chapter 17.5 for Plumbing.

Mode of Measurement:

Executed quantity shall be measured on running meter basis, including the entire accessory. The lengths shall be measured net on the straight and bends along the center line of the pipes and fittings correct up to a cm. (i.e. per meter)

B) Polyethylene Composite Pipes: (PCP)

Scope:

Specification No (ESD-HWP/PCP)

Supplying and erecting Polyethylene Composite Pipe with accessories, as piping for solar hot water system of specified diameter, suitable for continuous operating temp. of 95 degree C. and rated pressure of 6.9 Kg / sq. cm at 82 degree C complete as directed by the site engineer. The pipe shall have chemical composition prepared as per ASTM F1282-02 specifications (pressure rating of 13.8 kg per sq cm and 11 kg per sq. cm at 60 degree, short term excursions to 95 degree C) and shall not affect the overall performance

Material:

Composite Pipes & accessories:

Pipes shall be made from aluminum and polyethylene composite by combining the two materials along with adhesive layers. The pipe shall have the following properties:

Properties of Pipe:

- a) No thermal expansion and deformation.
- b) High flexibility, frost resistant, ready to use with plastic.
- c) Malleable. Easy to form curves, bends.
- d) Corrosion free.
- e) No scaling build up, to avoid reduction in flow of water.
- f) Non-toxic, rust free and shall not allow growth of micro-organisms to make it contamination free.
- g) Fire retardant with Low smoke.
- h) UV resistant and shall be Opaque.
- i) Pipe walls shall not allow Permeation. (No entry of foreign material inside the pipe through the pipe walls)
- j) Low coefficient of linear expansion.
- k) Thermal expansion of 25×10^{-6} degree Kelvin (Expansion/Contraction rate shall be less than 10% of Plastic pipe). Anti-freezing, with thermal conductivity of 0.43 watt /m degree Kelvin.

MS Clamps: Clamps fabricated of required length and shape, of 3 mm thick mild steel having 25 mm width.

Hardware: Sheet Metal (SM) screws of required sizes, plugs/wooden gutties, etc.

Method of Construction:

Before preparing the piping, exact measurements shall be taken. The pipe shall be joined by compression/crimp fitted with internal as well as external end with necessary sealing arrangement, to make it leak proof.

The piping shall be fixed on wall or at any other location directed by the site engineer, with MS clamps fixed with SM screws, with plugs, wooden gutties (for erection on stone wall) complete. In addition to above the erection shall meet the requirements mentioned in para 4.2.1 of chapter 17.5 for Plumbing.

Mode of Measurement:

Executed quantity shall be measured on running meter basis, including the entire accessory. The lengths shall be measured net on the straight and bends along the center line of the pipes and fittings correct up to a cm. (i.e. per meter)

4.3 Solar Lighting (ESD-SOL)

A) Solar Street Light (SOL)

Scope:

Specification No (ESD-SOL/STL)

Supplying & erecting Solar Street Light Fittings suitable for specified wattage of CFL, along with GI/MS Pipe Pole. The system should be designed to automatically switch ON at dusk, operate throughout the night, and automatically switch OFF at the dawn, under average daily, solar radiation conditions of 5 kWh/m² on a horizontal surface. (Refer drawing no.ESD-SOL-1 (Fig.1))

Material:

1. PV Module(s):

- The PV module(s) shall contain crystalline silicon solar cells.
- The power output of the module(s) under STC should be a minimum of 74 W, either two modules of minimum 37W output each or one module of 74W output should be used.
- The operating voltage corresponding to the power output mentioned above should be 16.4 V.
- The open circuit voltage of the PV modules under STC should be at least 21.0 Volts.
- The terminal box on the module should have a provision of opening for replacing the cable, if required.

2. Inverter:

- The inverter should be of quasi sine wave or full sine wave type with frequency in the range of 20-35 KHz.
- The total electronic efficiency should be at least 80%.
- No blackening or reduction in the lumen output by more than 10% should be observed after 1000 ON/OFF cycles (two minutes ON followed by four minutes OFF is one cycle).
- The idle current consumption should not be more than 10 mA.
- Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery through out the year.
- Necessary length of wires, cables, and fuses should be provided.
- The PV module will be used to sense the ambient light level for switching ON and OFF the lamp.

3. Electronic Protections:

- Adequate protection is to be incorporated under no load conditions e.g. when the lamp is removed and the system is switched ON.
- The system should have protection against battery overcharge and deep discharge conditions.
- Fuses should be provided to protect against battery overcharge and deep discharge conditions.
- A blocking diode should be provided as a part of the electronics to prevent reverse flow of current throughout the PV module(s), in case such diode is not provided with the solar module(s).
- Full protection against open circuit accidental short circuit and reverse polarity should be provided.

4. Mechanical Hardware:

- A metallic frame structure (with corrosion resistance paint) to be fixed on the pole to hold the SPV module(s). The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45 degrees so that the module(s) can be oriented at the specified tilt angle.

- The pole should be made of mild steel pipe with a height of 4 meters above the ground level, after grouting and final installation. The pole should have the provision to hold the weather proof lamp housing. It should be painted with a corrosion resistant paint.
- A vented acid proof and corrosion resistant painted metallic box for outdoor use should be provided for housing the battery.

Method of Construction:

The entire solar light with all accessories shall be installed at designated place, duly wired and giving necessary testing.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

B) Solar Home Lighting System (SHL)

General:

A solar home system aims at providing solar electricity for operating lights and/or fan or energizing a DC operated portable TV set for specified hours of operation per day.

Scope:

Specification No (ESD-SOL/SHL)

Supplying & erecting Solar Home Light Fittings suitable for specified wattage of CFL/DC Fan, along with required accessories.

Material:

1. Models:

The model shall be as mentioned in the Table No. 4.3/1 given below:

Table No. 4.3/1

Model wise details of Solar Home Lights

S.No	Model Configuration	Details of PV Module	No. of 9/11 Watts CFL	No. of DC Fan (Wattage < 20 Watts)	Battery
1	Model 1 (1 Light)	1x18 Wp under STC	1	0	1x12 V, 20 AH, Tubular/Plate, low maintenance
2	Model 2 (2 Lights)	1x37Wp under STC	2	0	1x12 V, 40 AH, Tubular/Plate, low maintenance
3	Model 3 (1 Light and 1 Fan)	1x37Wp under STC	1	1	1x12 V, 40 AH, Tubular/Plate, low maintenance

2. Lamps:

- The lamps shall be of compact fluorescent (CFL) type, either 4-Pin or 2 Pin types, with rating of 9/11W. For the 4-Pin type CFL a suitable preheating circuit must be provided.
- (b) The light output from the lamps should be around 600 +/- 5% lumens (9W CFL) and 900 +/- 5% lumens (11W CFL).
- (c)The lamps should be housed in an assembly suitable for indoor use, with a reflector on its back. While fixing the assembly, the lamp should be held in a base up configuration.

3. Battery:

- The battery will be of flooded electrolyte type, positive tubular plate, low, maintenance lead acid battery.
- (b) The battery will have a minimum rating of 12V, 20 or 40 or 75 Ah, the discharge rate of 1/10th of the AH capacity of the battery.

- 75% of the rated capacity of the battery should be between fully charged & load cut off conditions.
- 4. Electronics:**
- The inverter should be of quasi sine or full sine wave type with frequency in the range of 20-35 KHz. Half wave operation is not acceptable.
 - (b) The total electronic efficiency should be at least 80%.
 - © No blackening or reduction in the lumen output by more than 10% should be observed after 1000 ON/OFF cycles (two minutes ON followed by four minutes OFF is one cycle.)
 - (d) The idle current consumption should not be more than 10 mA.
 - (e) Electronics should operate at 12 V and should have temperature compensation for proper charging of the battery though out the year.
 - Necessary lengths of wires/cables, switches suitable for DC use and fuses should be provided.

5. PV Module(s):

- The PV module(s) shall contain crystalline silicon solar cells.
- The power output of the module(s) under STC should be a minimum of 18W or 37W or 74W. In case of Model 4 & 5 either two modules of 37 W each or one module of 74W should be used.
- The operating voltage corresponding to the power output mentioned above should be 16.4 V
- The open circuit voltage of the PV modules under STC should be at least 21.0 Volts
- The terminal box on the module should have a provision for opening for replacing the cable, if required.
- A strip containing the following details should be laminated inside the module so as to be clearly visible from the front side:

6. DC Fan:

- The wattage of the fan should not be more than 20 Watts and it should operate at 12V DC.

7. Electronic Protections:

- Adequate protection is to be incorporated under no load conditions e.g. when the lamps are removed and the system is switched ON.
- The system should have protection against battery overcharge and deep discharge conditions.
- Fuses should be provided to protect against short circuit conditions.

8. Mechanical Components:

- Metallic frame structure (with corrosion resistance paint) to be fixed on the roof of the house to hold the SPV module(s). The frame structure should have provision to adjust its angle of inclination to the horizontal between 0 and 45, so that it can be installed at the specified tilt angle.
- A vented metallic box with acid proof and corrosion resistance paint, for housing the storage battery indoors should be provided. The box can be of injection Moulded plastic or wooden for home lighting models 1, 2 and 3 only.

Method of Construction:

The entire Solar Home light with all accessories shall be installed at designated place, duly wired and giving necessary testing.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

C) Solar Cell for Street Light (SOL/CELL)

Scope:

Specification No (ESD-SOL/CELL)

Supplying and erecting Solar panel comprising high efficiency mono-crystalline / multi crystalline Photo Voltaic Cell 20 W per Single module suitable for 4-5 hrs backup with necessary clamps and module frame.

Material:

PV Cell: PV Cell of specified output as mentioned in specification no. (ESD-SOL/STL)

Module Frame: - A metallic frame structure is coated with corrosion resistance paint is fixed on the pole to hold the solar photovoltaic module. The frame structure is inclined at an angle of 20° with the horizontal.

Hardware: MS Nuts & bolts with washers, etc.

Clamps: MS Clamp of required width & minimum 3 mm thick.

Method of Construction: The PV Cell for solar light with all accessories shall be installed at designated place and giving necessary testing.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

D) Battery for Solar Street Light (SOL/BAT)

Scope

Specification No (ESD-SOL/BAT)

Supplying and erecting approved make battery with capacity of 12 V 25/40/75 AH with duty cycle 8-10/10-12 hrs suitable to charge on PV cell with necessary wiring connections erected in powder coated protection box with stand and nut bolts.

Material

Battery: The battery shall be of flooded electrolyte type, positive tubular plate, and low-maintenance lead acid battery. The battery will have a minimum rating of 12V, 25 or 40 or 75 Ah, the discharge rate of $1/10^{\text{th}}$ of the AH capacity of the battery. 75% of the rated capacity of the battery should be between fully charged & load cut off conditions.

Leads: PVC insulated multi stranded copper wire of adequate size.

Enclosure / Box: CRCA sheet 20 SWG or as directed by the Engineer-in-charge, with powder coating.

Hardware: MS Nuts & bolts with washers, etc.

Method of Construction:

The battery for solar light with all accessories shall be installed at designated place, duly wired and giving necessary testing.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

E) Solar Power Generator (SOL/GEN)

Scope:

Specification No (ESD-SOL/GEN)

Supplying and erecting Solar Power Generator up to 100 WP 230V, 50 Hz for connecting between battery and light fixture.

Material: Solar Power Generator (SPG):

SPG shall give O/P to CFL with input at 12V applied from the module and output rating shall be up to 100 WP, at put 230 to 260V, AC ($\pm 5\%$), controlled either manually or automatically. The body of solar power generator shall be powder coated form outside and inside.

Method of Construction:

The SPG for solar light with all accessories shall be installed at designated place, duly wired and giving necessary testing.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

4.4 Energy Devices (ESD-ED)

A) Digital Active Harmonic Filter (DAHF)

Scope:

Specification No (ESD-ED/DAHF)

Designing, supplying, erecting, testing, and commissioning of Digital Active Harmonic filter cum Power conditioner, with high speed IGBT device for specified filtering current.

Material:

The unit shall comprise of following features and meet the following parameters:

Topology	4 wire (3Ph + N) Active Power Filter		
Technology	Digital Closed Loop Active Filter with Source Current Sensing 32 bit, Digital Signal processing, High speed IGBT's in power circuit with necessary CT for current sensing.		
Working Principle	Synchronous rotating reference frame.		
Application	Selectable for Harmonic Filtration & or PF Correction.		
Compensation Filter current	30 AMP	60 AMP	
Heat dissipation	< 1500 W	< 1700 W	
Input Voltage	Nominal 400 Volt Phase to Phase Accepted Phase to Phase voltage range: +10%, -15%		
Input Frequency	Nominal: 50Hz +/-10%, (60Hz Optional)		
Interrupting capacity	100 KA, Fused	100 KA, Fused	
Over load capacity	Limiting to nominal current continuous limiting operation possible		
Harmonics Filtering	3 rd to 31 st Harmonic compensation attenuation ratio up to 96%. Programmable for Selective Harmonic Elimination.		
Power Factor correction	Adjustable up to unity from 0.6 lag or 0.6 lead without Over compensation OR Under compensation		
Audible noise level	< 65 db (A)	< 65 db (A)	
Operating temperature range	-5°C To 40°C		
Storage temperature range	-25°C To + 55°C		
Relative Humidity	Max. 90%, Non-condensing		
Standards	IEEE 519 for compensated harmonics IEC / EN62040-2: 2006- Category C3. EN 50178: 1997. CE approved.		
Protection degree	IP32		
Electrostatic discharge immunity	4 KV contact / 8 KVA air discharge		
Cooling	Forced air cooling with axial flow fan		
Color	Havells grey or as specified by Engineer in-charge		
Access	Front access		
External cable connections	Bottom / Top Entry (Front Side)		
Configuration	Standalone/ with facility of Paralleling up to 8 Machines.		
Switches for →	1. ON 2. OFF 3. Reset 4. Up	5. Down 6. Acknowledge 7. Soft Key 1 8. Soft Key 2	
Remote Signals for →	1. Filter Running – 1 Amp – 125 V AC 2. Fault		
Indications for →	1. OK (Filter Running) 2. Alarm 3. Warning		
Display Faults for →	1. Wrong Phase sequence 2. External Inhibit 3. Fast DCOV 4. Rph CTFB Wrong 5. Yph CTFB Wrong 6. Bph CTFB Wrong 7. DC Over voltage	8. Over Load 9. Over Temp. 10. Over current 11. No Sync 12. Mains Abnormal 13. DC Under Volt 14. Filter Trip	
Display Parameters for →	1. Status 2. ID 3. Input Voltage 4. Input Voltage Waveform 5. Input Voltage FFT 6. Input Current 7. Input Current Waveform 8. Input Current FFT	11. No. of mains failures 12. Total Filter ON Time 13. Alarm Log 14. Power Factor 15. DC BUS Voltage 16. Filter Load % 17. Mains Frequency 18. Heat Sink Temp.	

	9. Input Current (KW) 10. Input Power (KVA)	19. Date & Time
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Method of Construction:

The entire equipment shall be installed at designated place, duly wired with provided cable/leads and giving necessary testing.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

B) APFC Panel with Harmonic suppressor (APFC)

Scope:

Specification No (ESD-ED/APFC)

Supplying, Installing Testing & commissioning manual / Auto power load correction panel of required capacity in kVAR, 440 Volts, 3 phase 50 Hz, Thyristor switch consisting of minimum 4 steps suitably design to take care of 5% of load variation at any time. Steps configuration shall be by the Engineer in charge as per site conditions.

Material:

Capacitors: App Type IS: 13585 part-I 1994 any type gas filled 525 Volts.

Thyristor switches: Thyristor switches should be designed for zero crossing with snubber circuit forced cooling & min 1600 PIV rating.

Series reactor: Copper wound dry type, iron core suitable as per requirement.

Harmonic filter circuit: Circuit suitable to filter Harmonics up to 17th Harmonics.

CRCA sheet: CRCA sheet 14/16 SWG with 7 tank process & powder coating suitable to site condition of required colour shade.

MS angles & channels: Size as per site condition.

Bus bar: Electrolytic copper bus bar of suitable capacity.

Exhaust fan: Tube axial exhaust fan of adequate capacity.

Fabrication materials: MS Jali, Hinges, nut bolts washers, screws etc. of suitable size.

Switchgear: SFU, MCB, MCCB, HRC Din type fuse base as specified in chapter switchgear.

Power factor Controller Relay: Minimum four steps, microprocessor based programmable intelligent relay / dynamic correction Intelligent relay with switches time from selected 1sec.to 1200 sec. having display of system v/s, current, frequency, target PF, THD, short fall KVAR, active power KW, KVAR, Harmonic display up to 17th order.

Accessories: Digital ammeter, digital Voltmeter, Bar primary CTS Class 1, 15VA and of require ratio, selector switch indicating pilot Lamps all Bakelite with colour glass, push buttons.

Method of construction:

APFC panel shall be designed to cater required KVAR capacity with 20% expandable additional load requirement.

Fabrication of panel shall be in such away to accommodate additional extra capacitors.

Panel shall be delivered after testing in presence of the engineer in charge.

Method of Construction:

The entire equipment shall be installed at designated place, duly wired with provided cable/leads and giving necessary testing.

Mode of Measurement: Executed quantity will be measured according to the sum of capacitor banks installed on kVAR basis. (i.e. per kVAR)

4.5 Miscellaneous

Intelligent Energy Saver for AC Units (ESD-AC) Scope:

Specification No (ESD-AC)

Supplying and erecting Intelligent Energy Saver suitable up to 5 TR Window / Split Type Air Conditioning Unit and Packaged type Air conditioning units working on voltage of 230V single phase solid state microprocessor based intelligent control wall mounting connected to indoor unit.

Material: As per manufacturer's standard specification.

Method of Construction:

The Energy saver unit with all accessories shall be installed at designated place, duly wired and giving necessary testing.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

4.6 LED Fittings (ESD-LED)

A) Surface / Recessed Mounting LED Luminaries

Scope:

Specification No (ESD-LED/IDF)

Supplying & erecting approved make, Surface / recessed mounting indoor fitting of specified wattage to provide specified lux level at specified height with p.f. > 0.95, complete as per manufacturer's specification, with appropriate driver.

Material:

Fitting: Scientifically designed highly polished & anodized Aluminum reflector ensures precise light control with optimum light utilization either with clear glass / frosted glass cover with ring or as per manufacturer's specification, leading to substantial savings in energy cost and excellent ambient conditions. Frame is fabricated from CRCA/MS sheet and epoxy powder coated white. Percolated frame ensure corrosion free life. Retaining clips for recess mounting fittings to facilitate mounting in false ceilings. Luminaries comprises of a deep drawn MS sheet canopy along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver: The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's: The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt.

Metal Core PCB's: The PCB should be of metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Method of Construction:

The fitting shall be fixed firmly in the designated place (False ceiling / unspecified ceiling) with the help of swinging bracket, and making the connection. In case where fittings are to be installed flush with /on false ceiling; layout shall be given to civil wing and work shall be done in co-ordination with civil wing e.g. making recesses in false ceiling.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

B) Bulk Head type LED Luminaries

Scope:

Specification No (ESD-LED/BHF)

Supplying & Erecting LED bulkhead Fitting of appropriate size with 8 W with minimum 50-70 lux level at ground level with p.f. > 0.95 with frosted glass.

Material:

Fitting:

Luminaries comprises of a deep drawn MS sheet body with clear acrylic cover of 3mm thickness or as per manufacturer's specification, along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322The surface of the canopy should be powder coated / stove enameled. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver:

The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's:

The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.

Metal Core PCB's: The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Wooden board: As per (WG-PW/PW) 1.6 specified in chapter for Point wiring.

Hardware: Sheet Metal (SM) screws, washers, plugs / wooden gutties, etc.

Method of Construction:

The complete fitting with all the above accessories shall be erected as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

C) Halogen type LED Luminaries

Scope:

Specification No (ESD-LED/HAL)

Supplying & erecting Halogen type LED fitting of specified wattage to provide specified lux level at specified height, complete with acrylic cover and gaskets, with appropriate driver circuit and erected on provided bracket.

Material:

Fitting: Scientifically designed highly polished & anodized Aluminum reflector ensures precise light control with optimum light utilization either with clear glass / frosted glass cover with ring, leading to substantial savings in energy cost and excellent ambient conditions. Reflector is fitted into the frame with decorative screw arrangement. Frame is fabricated from CRCA/MS sheet and epoxy powder coated white. Precoated frame ensure corrosion free life. Retaining clips facilitate mounting in false ceilings.

Luminaries comprises of a deep drawn MS sheet canopy along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver: The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's: The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.

Metal Core PCB's : The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Method of Construction:

The complete fitting with all the above accessories shall be erected as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

D) LED Street Light / Flood Light Luminaires

Scope:

Specification No (ESD-LED/ODF)

Supplying & erecting Street Light fitting of specified wattage to provide specified lux level at specified height, complete with acrylic cover and gaskets, with appropriate driver circuit and erected on provided bracket.

Material:

Fitting: Luminaries comprises of a deep drawn MS sheet canopy with clear acrylic cover of 3mm thickness, along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322 and Ingress Protection IP-55. The surface of the canopy should be powder coated / stove enameled. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver: The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's: The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.

Metal Core PCB's: The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Method of Construction:

The complete fitting with all the above accessories shall be erected with provided bracket, on wall/street light pole or at any place as directed by Site engineer, duly connected and giving necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e each)

Chapter 5

SWITCHEARS

5.1	LT --I/C M/C Switches, ATS, Bus Bar, Feeder Pillar	SW-SWR
5.2	I/C M/C Distribution boards	SW-DB
5.3	LT -- MCB	SW-MCB
5.4	LT -- MCBDB	SW-MCBDB
5.5	LT -- MCCB	SW-MCCB
5.6	LT -- RCCB	SW-RCCB
5.7	LT – Oil Circuit Breakers	SW-OCB
5.8	LT – Air Circuit Breakers	SW-ACB
5.9	HT – SFU, LBS	SW-HTS
5.10	HT – Breakers (VCB)	SW-VCB
5.10	Drawings	

5.1 LT—I/C M/C Switches, ATS, Feeder Pillar (SWR)**General**

All material shall conform to relevant standard as per BIS and shall carry ISI mark.

Work shall be carried out as per the method of construction as specified by BIS/Chapter 16 of P.W. Dept. Handbook/NEC.

Refer IS; 13947/1993, For Switch gears, IS: 13703/1993 for HRC fuses.

Incoming contacts for all switchgears shall be shrouded for avoiding accidental contact.

A) Indicator DP (BDP)**Scope:**

Specification No (SW-SWR/BDP)

Supplying surface/flush mounting Bakelite D.P switch and erecting on filled polypropylene ISI marked board or on screwed board with top of plywood pasted with laminate.

Material:

DP Switch: Bakelite double pole switch 32A 250V, with copper contacts for make & break, and fuse, indicator lamp with shrouded incoming contacts.

Boards: As per (WG-PW/SW) in chapter of Wiring para No. 1.6

Hardware: SM screws, rawl plug, wooden gutties etc.

Method of Construction:

The DP switch shall be erected on specified board or flush in provided enclosure.

Mode of Measurement:

Executed quantity will be counted on number basis. (i.e. Each)

B) IC/Metal clad DP (MDP)**Scope:**

Specification No (SW-SWR/MDP)

Supplying and erecting IC/Metal clad DP switches of specified rating on angle iron frame of suitable size.

Material:

DP Switch: Single phase Double pole metal / iron clad weatherproof air break switch fuse unit, confirming to IS: 13947 (part- 1 &3)/ 1993 with facility to de-link neutral, suitable for single phase 240 volts, 50 Hz AC supply, having positive make break arrangement with shrouded incoming contacts, cable entry holes, sealing arrangement and mounting arrangements.

Fabrication: Required size of angle iron / MS Flat.

Paint: Superior quality enamel paint of specified shade & colour, Red Oxide paint.

Hardware: SM screws, MS Nuts & bolts, rawl plug, wooden gutties etc.

Grouting Material: Cement, Sand, Putty, water, etc.

Method of Construction:

The switch shall be erected at designated place duly mounted on suitable size of angle iron frame as per Table no. 5.1/1 with the help of required nut bolt washer etc. The angle frame to be erected on wall with the help of screws, or to be grouted in wall with the help of cement concrete etc. Frame shall be painted prior to erection.

Mode of Measurement:

Executed quantity will be counted on number basis. (i.e. Each)

C) **IC/Metal clad TP/TPN switches** (MTP)

Scope:

Specification No (SW-SWR/MTP)

Supplying and erecting IC/Metal clad TP/TPN /on load/off load changeover switches of specified rating on angle iron frame of suitable size.

Material:

TP/TPN Switches: Three phase Triple pole / Three phase Triple pole with neutral link weatherproof metal clad air break switch fuse unit of specified rating, confirming to IS: 13947 (part- 1 &3)/ 1993 with positive make and break arrangement with shrouded incoming contacts, facility suitable for Three phase 415 volts, 50 Hz AC supply, It shall be fitted with interlock-able cover and re-wire able type porcelain fuse and having cable entry holes, sealing arrangement and mounting arrangements.

Fabrication: Required size of angle iron / MS Flat.

Paint: Superior quality enamel paint of specified shade & colour, Red Oxide paint.

Hardware: SM screws, MS Nuts & bolts, rawl plug, wooden gutties etc.

Grouting Material: Cement, Sand, Putty, water, etc.

Method of Construction:

The switch shall be erected at designated place duly mounted on suitable size of angle iron frame as per Table No. 5.1/1 with the help of required nut bolt, washer, etc; on frame/wall. The angle frame to be erected on wall with the help of screws, or to be grouted in wall with the help of cement plaster, and finished as original. The Frame shall be painted prior to erection.

Mode of Measurement:

Executed quantity will be counted on number basis. (i.e. Each)

D) **Metal clad TP/TPN Switches with HRC fuse** (TPHRC)

Scope

Specification No.: (SW-SWR/TPHRC)

Supplying and erecting Metal clad TP/TPN switches with HRC Fuses of specified rating on angle iron frame of suitable size.

Material:

TP/TPN Switches: Combination fuse switch unit, Metal clad, Triple pole with Neutral link, Degree of Protection IP-2L3 as per IS: 13947 (pt.3) 1993.Quick make and break, Inter-lockable cover, uninterrupted duty, Utilization category AC-23A and confirming to IS: 13947 (Part.3) 1993. It shall be suitable for three high rupturing capacity equal to 80 KA (HRC) cartridge fuses confirming to IS: 13703 (Part.1) 1993 and IS: 13703 (Part.2/Section & 2) 1993 having rupturing capacity 80 KA minimum, with rated voltage 415 Volts, 50 Hz. AC with shrouded incoming contacts.

Enclosure: Made of CRCA sheet of thickness not less than 1.2mm.

Fuses: 80 kA High rupturing capacity fuses with ISI mark.

Mounting: Required size of angle iron / MS Flat.

Paint: Superior quality enamel paint of specified shade & colour, Red Oxide paint.

Hardware: SM screws, MS Nuts & bolts, rawl plug, wooden gutties etc.

Grouting material: Cement, Sand, Putty, Water, etc.

Method of Construction

The switch shall be erected at designated place duly mounted on suitable size of angle iron frame as per table no. 5.1/1 with the help of required nut bolt, washer, etc on frame/wall. The angle frame to be erected on wall with the help of screws, or to be grouted in wall with the help of cement plaster, and finished as original. The Frame shall be painted prior to erection.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

Table No.5.1/1
Minimum size of angle to be used for Mounting frames of Switchgear

S No.	Capacity	Minimum Size of angle iron
1	16A,32 A, DP/TP/TPN/ changeover switch	25x25x3 mm
2	63A to 200 A DP/TP/TPN/ changeover switch	40x40x5 mm
3	300 A and above TPN/changeover switch	50x50x6 mm

E) Mini Feeder Pillar (MFP)

Scope:
Specification No (SW-SWR/MFP)

Fabrication of feeder pillar with CRCA sheet, fixing of aluminium strips/bars, with necessary painting and complete erection on provided cement concrete foundation.

Material:

Incoming Isolator: 200 A Four Pole MCCB with 35 kA SC rating

CRCA Sheet: 14 gauge

Fabrication: Angle iron of required size.

Bus bar strip: Aluminium strips with colour coding heat shrinkable sleeves

Insulators: Bus bar insulators (Porcelain/Epoxy)

Gasket: Rubber / Neoprene gasket

Red Oxide: Red oxide paint /Primer

Paint: Superior quality Enamel paint

Hardware: MS nut bolts of required size and length. MS Hinges, Self locks for door.

Danger Board: Danger notice in Marathi & English

Foundation material: Cement, Sand, water.

Method of Construction

The mini feeder pillar shall be fabricated from 14 SWG CRCA sheet. The size of the chamber shall be 75 cm in height, 50 cm in width and 35 cm in depth. The top cover (50 cm in width and 30 cm in depth) shall be fabricated in such a manner so as to have slope on all four sides. The slope shall start at the centre of the chamber. Front door of the feeder pillar shall have self locking arrangement (minimum two) and shall be fixed as directed by the site engineer. The door shall be made water proof by fixing the rubber / neoprene gasket on the inner side. Necessary provision for ventilation shall be made on both side of feeder pillar chamber. These shall be complete with welded non ferrous metallic mesh so as to make it vermin proof. The entire fabricated chamber shall be fixed frame made from 50x50x5 mm angle iron. Dimensions of the frame shall be as per the size of the frame and the depth of the legs shall be 50 cm. The extended portion of the leg of frame shall be covered on all four sides with 14 SWG CRCA sheet duly fixed with suitable size of MS bolts & nuts. The chamber shall have removable bottom plate at the end of the frame, with holes of suitable diameter for incoming and outgoing cables. Four numbers of aluminium bars of 40 x 5 mm cross section with 35 cm in length for three phases & neutral duly covered with colour coded PVC heat shrunk sleeves or covered with PVC insulation tapes with colour coding, shall be fixed inside the chamber on porcelain / epoxy insulators in staggered manner so as to facilitate the connections of cable leads. (Minimum two insulators shall be provided), with main cable socket to each bar. The provided Four Pole MCCB of 500 V 200 A rating, shall be fixed on mounting made from CRCA sheet at the bottom for terminating the incoming cable.

The feeder pillar chamber door shall be fixed with enamel iron G.I. Sheet 18 gauge caution board of size 200 mm x150 mm or have sticker pasted, as per I.S.2551 of 1982.

The entire feeder pillar thus fabricated shall be erected in cement concrete foundation (with excavation of soil) with 4 numbers of suitable size foundation bolts. The minimum dimensions of the cement concrete foundation shall be 60 cm in width, 50 cm in depth and 30 cm height. ([Refer drawing no. SW-SWR-1 & SW-SWR-2](#))

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

5.2 I/C M/C Distribution boards (MDB)

Metal clad DB (MDB)

Scope:

Specification No (SW-SWR/MDB)

Supplying, erecting Metal clad distribution board of specified ways and rating, suitable 250 V/440 V 50 Hz, AC supply, erected on iron frame/board.

Material:

Distribution board: Fabricated from 18 gauge C.R.C.A. sheet steel of required ways, 250/440 V having kitkat pattern H.C. type fuse bridges 16 A/32 A and Neutral bar connector with earth terminal.

Mounting: Required size of angle iron / MS Flat.

Paint: Superior quality enamel paint of specified shade & colour, Red Oxide paint.

Hardware: SM screws, MS Nuts & bolts, rawl plug, wooden gutties etc.

Boards: As per (WG-PW/SW) in chapter of Wiring Para. No. 1.6

Method of Construction:

The switch shall be erected at designated place duly mounted on suitable size of angle iron frame as per Table no. 5.2/3 with the help of required nut bolt, washer, etc on frame/wall. The angle frame to be erected on wall with the help of screws, or to be grouted in wall with the help of cement plaster, and finished as original. The Frame shall be painted prior to erection.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

Table No. 5.2/3
Minimum size of angle to be used for fabrication of frames for DB's

Sr. No	Rating of Distribution Boxes	Minimum size of angle iron in mm
1	DB 16 A, 250 V.	25x25x3
2	DB 16 A, 415 V	40x40x3
3	DB 32 A, 415 V	40x40x5

5.3 Miniature Circuit Breakers (MCB) (MCB)

SP/SPN/DP/TP/FP MCB'S

Scope:

Specification No (SW-SWR/MCB)

Supplying MCB of specified poles, current rating, and either of B or C series with required wiring connections & lugs etc. and erecting in provided enclosure / distribution board.

General Specifications for MCB's

- MCB's shall be of current limiting type, ISI marked confirms to IS 8828 – 1996.
- The power loss per pole shall be low and shall be in accordance with IS 8828 – 1996.
- All cable entries shall be either from bottom or top.
- MCB's shall be of C- curve characteristic & shall have quick make & break non-welding self wiping silver alloy contacts for 10 kA short circuit both on the manual & automatic operation.
- All the active, live parts of MCB's should be out of human reach, ensuring safety & confirms to IP: 55 degree of protection.
- The MCB's must house transparent label holder to ensure circuit identification.
- The MCB's must have fully insulated safety shutters.

- The MCB's shall have lockable switching lever.
- The Minimum electrical endurance shall be 20,000 operations.
- The housing of the MCB shall be mounted self-extinguishing DMC (Dough Moulding Compound).
- The short circuit Current shall be brought to zero within 4 to 5 milliseconds from the time they are established.
- All MCB's shall have a minimum short circuit Capacity of 10kA RMS.

Material:

Single Pole / Single pole with Neutral / Double Pole / Triple pole / Four pole: MCB, ISI marked as per IS 8828 : 1996 (IEC 60898) with hammer trip and watch mechanism 15 arc plates, 10 KA capacity with nominal rating of 240/415V.

Lugs: Copper lugs of suitable size as per **(CB-CL/CU)** in chapter 7.10 for Cable

Method of Construction:

MCB shall be erected in provided enclosure / distribution board and terminating the provided wires by copper lugs (crimping type) and connecting the same.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

5.4 Distribution Board suitable for MCB's (MCBDB)

Horizontal / Vertical type DB's

Scope:

Specification No **(SW-SWR/MCBDB)**

Supplying of MCBDB suitable for 230 V / 415 V, horizontal/vertical, with/without door specified ways (poles), surface / flush mounting to house incoming and outgoing MCB's, and erected on iron frame. of

General Specifications for MCBDB's

- DB's shall be prewired and shall be fabricated as per IS: 8623.
- Suitable for flush mounting & surface mounting, with 100 A copper bus bar (For Horizontal type DB), neutral bar, earth bar & cable ties for cable management.
- In case of Vertical DB the bus bar shall be of 200 A rating.
- DB's shall be of IP – 43 degree of protection.
- All the MCB distribution boards shall be fabricated out of 18 SWG thick sheet steel duly rust inhibited through a process of degreasing, pickling, phosphating & powder coating to an approved colour over primer & shall be of the totally enclosed dust proof type suitable for wall mounting.
- All components shall be mounted on DIN rails & covered totally with a sheet steel cover rendering it finger-safe. Access to the internal connections shall be only through removing the cover sheet.
- All DB's shall be internally prewired using copper insulated high temperature PVC wires.
- Bus bars & neutral bar shall be fully insulated with standard colour code.
- Bus bar withstanding capacity shall be 10kA.
- DB's must have facility of reversing door without modification, pan assembly for ease of installation & convertible locking.

Material:

Horizontal/Vertical type MCBDB: ISI marked as per IS 8623, of specified ways (poles), surface/flush mounting, with/without door, suitable for 230 V / 415 V.

Lugs – Copper lugs of suitable size as per **(CB-CL/CU)** in chapter 7.10 for Cable

Iron work: Suitable size of angle/flat.

Hardware: SM screws, rawl plug, gutties, etc.

Method of Construction:

MCBDB shall be erected at designated location and directed by site engineer and terminating the provided wires by copper lugs (crimping type) and connecting the same.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

Chapter 5 Switchgears (SW)**5.4 Distribution Board suitable for Mac's (MCBDB)****Scope:****Specification No**

DB's shall be prewired and shall be fabricated as per IS: 8623, IS: 13032.

Suitable for flush mounting & surface mounting, with 200 A copper bus bar, neutral bar, earth bar & cable ties for cable management. DB's shall be of IP – 42 degree of protection.

All the distribution boards shall be fabricated out of 18 SWG thick sheets steel duly rust inhibited through a process of degreasing, pickling, phosphating & powder coating to an approved colour over primer & shall be of the totally enclosed dust proof type suitable for wall mounting. All components shall be mounted on DIN rails & covered totally with a sheet steel cover rendering it finger-safe. Access to the internal connections shall be only through removing the cover sheet. All DB's shall be internally prewired using copper insulated high temperature PVC wires. Bus bars & neutral bar shall be fully insulated with standard colour code. Bus bar withstanding capacity shall be 10kA. DB's must have facility of reversing door without modification, pan assembly for ease of installation & convertible locking.

Material: Vertical type DB: ISI marked as per IS 8623, of specified ways (poles), surface/flush mounting, with door, suitable for 415 V.

Iron work: Suitable size of angle/flat.

Hardware: SM screws, rawl plug, gutties, etc.

Method of Construction: DB shall be erected at designated location and directed by site engineer and terminating the provided wires by copper lugs (crimping type) and connecting the same.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

C. MCCB Panel Board (MCCBPB)**Scope:****Specification No (SW-SWR/MCCBPB)**

Supplying & erecting Floor / Wall mounting type Panel board suitable for 415 V, of specified rating with provided MCCB's as incomer & outgoing side of specified ways complete erected on provided iron frame. (Excluding MCCB's)

General Specifications

Panel boards shall be fabricated as per IS: 8623, IS: 13947, IS: 2147.

PB's shall be of IP – 31/41 degree of protection.

All the panel boards shall be fabricated out of 1.6 mm thick CRCA sheet steel duly rust inhibited through a process of degreasing, pickling, phosphating & powder coating to an approved colour over primer & shall be of the totally enclosed dust proof type suitable for floor / wall mounting.

Panel boards shall be fabricated in Modular type for coupling future system/Metering Module/Add on Module, etc.

Bus bar shall withstand 25/35 KA short time current having rating of 250 A/400 A respectively.

Incoming Module:

Suitable for accommodating incoming Three/Four Pole MCCB up to 400 A with preformed copper interconnections.

Outgoing Module:

Suitable for mounting Single/Three/Four Pole MCCB's up to 250 A.

Copper bus bar of specified rating with shielded by transparent polycarbonate shrouds with extension tags and with adequate space for termination of cables onto MCCB's.

Material:

Panel Board: ISI marked as per IS 8623, of specified ways (poles), wall / floor mounting, suitable for 415 V.

Hardware: MS nuts & bolts, washers, etc.

Method of Construction:

Panel board shall be erected at designated location and directed by site engineer and terminating the provided wires/cables by lugs (crimping type) and connecting the same.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

5.5 Moulded Case Circuit Breaker (MCCB) (MCCB)

Scope:

Specification No (SW-SWR/MCCB)

Providing & erecting 3 Pole/4 Pole MCCB of specified rating and with specified short circuit rupturing capacity in KA, complete erecting in provided enclosure & connected with provided leads on incoming and out going side, complete.

General Specifications for MCCB's

- MCCB's should comply with IS 13947 part -2, IEC (6094) and IEC 60947-3 & IEC 60947 part – 2.
- The MCCB shall be suitable for universal mounting i.e. the load/line shall be interchangeable with shrouded incoming contacts.
- The MCCB shall be suitable for minimum operating voltage of 415V.
- The thermal setting shall be adjustable from 64 % to 100% of its normal current.
- The magnetic setting shall be adjustable from 3.5 to 10 In (normal current).
- Trip reset should be available Manual / Automatic.
- Isolator switches for electronic circuits to open the MCCB automatically.
- The MCCB's must house transparent label holder to ensure circuit identification.
- The MCCB's must have fully insulated safety shutters.
- Overload Zone adjustable from 0.4 to 1 in with line (For 630 amp & above MCCB)
- Short circuit Zone adjustable from 1.5 to 10 In with time.

Material:

3 pole or 4 Pole MCCB Moulded case circuit breaker. Fixed version– front Terminals with current rating & breaking capacity as below:

i.	63 A to 125 A	-	15 KA
ii.	160 A to 250 A	-	35 KA
iii.	300/400 A	-	35 KA
iv.	630 A	-	70 KA

Method of Construction:

3 pole /4 pole MCCB shall be erected in provided enclosure & connected with provided leads/strip on incoming & out going site complete

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

5.6 Residual Current Circuit Breaker (RCCB)

A) Residual Current Circuit Breaker (RCCB)

Scope:

Specification No (SW-RCCB/RCCB)

Supplying, erecting, and commissioning of 2/4 Pole RCCB of specified rating, conforming to IS: 12640, duly connected with copper leads, copper lugs, etc., in provided enclosure.

General Specifications for RCCB

- RCCBs shall be ISI marked as per IS 12640 (part 1) – 2000 and Confirming to IEC 61008-1.
- It shall work on residual current energy, having 30 milliamp sensitivity and shall protect against earth leakage.
- Tripping time shall be maximum 30 milliseconds.
- Breaking capacity shall be 20 kA.
- RCCB shall operate for rated leakage at nominal Ten volts AC, and also in both, Neutral Open & Snapping condition.
- RCCBs shall have trip free mechanism with quick make & break non-welding self wiping silver alloy contacts for 20 KA short circuit current both on the manual & automatic operation. Test knob facility shall be provided.
- All the active, live parts of RCCBs should be out of human reach, ensuring safety & confirms to IP20 degree of protection.
- The RCCBs must house transparent label holder to ensure circuit identification.
- The RCCBs must have fully insulated safety shutters.
- The Minimum electrical endurance shall be 20,000 operations.

Material:

2 Pole / 4 pole, RCCB, ISI marked as per IS: 12640-2000 (IEC 61008-1) with hammer trip and watch mechanism 15 arc plates, 20 KA breaking capacity of specified rating suitable for 240/415V.

Lugs – Copper lugs of suitable size as per (CB-CL/CU) in chapter 7.10 for Cable
PVC Copper leads: As per WG-MA/BW specified in chapter of Wiring in para. no. 1.3

Method of Construction:

2 / 4 Pole RCCB shall be erected in provided enclosure & connected with leads, with necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

B) Residual Current Circuit Breaker with over voltage cut Off (RCBO)

Scope:

Specification No (SW-RCCB/RCBO)

Supplying, erecting, and commissioning of 2 Pole RCBO (RCCB+MCB) of specified rating, conforming to IS: 12640 duly connected with copper leads, copper lugs, etc., in provided enclosure.

General Specifications for RCBO

- RCBO's with integral combination of RCCB+MCB, shall be ISI marked as per IS 12640 (part 1) – 2000 and Confirming to IEC 61008-1.

- It shall work on residual current energy, having 30 milliamp sensitivity with protection against earth leakage and over voltage upto 290 Volts.
- Tripping time shall be maximum 30 milliseconds.
- Breaking capacity shall be 10 kA.
- RCCB shall operate for rated leakage at nominal Ten volts AC, and also in both, Neutral Open & Snapping condition.
- RCBO's shall have trip free mechanism with quick make & break non-welding self wiping silver alloy contacts for 10 kA short circuit both on the manual & automatic operation. Test knob facility shall be provided.
- All the active, live parts of RCBO's should be out of human reach, ensuring safety & confirms to IP20 degree of protection.
- The RCBO's must have transparent label holder to ensure circuit identification.
- The RCBO's must have fully insulated safety shutters.
- The Minimum electrical endurance shall be 20,000 operations.

Material:

2 Pole / 4 pole, RCBO with integral combination of RCCB+MCB, ISI marked as per IS: 12640-2000 (IEC 61008-1) with hammer trip and watch mechanism 15 arc plates, 10 kA breaking capacity of specified rating suitable for 240/415V.

Lugs – Copper lugs of suitable size as per **(CB-CL/CU)** in chapter 7.10 for Cable

PVC Copper leads: Copper leads of suitable size, as per **(WG-MA/BW)** specified in chapter of Wiring in para. No. 1.3

Method of Construction:

2 /4 Pole RCBO shall be erected in provided enclosure & connected with leads, with necessary testing.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

5.7 LT – Oil Circuit Breakers (OCB)

Scope:

Specification No (SW-SWR/OCB)

Supply, erection of panel mounting, non-draw out type Oil Circuit Breaker of specified rating and rupturing capacity, triple pole 440 V, 50 Hz, neural link, oil filled, totally enclosed. (Conforming to BSS 936/1960 & IS 2516/1965)

Material:

Enclosure:

Compact, all-welded robustly constructed steel enclosure, suitable for wall mounting/pedestal mounting with standard finish of dark admiral grey paint, making perfect for industrial use under the most severe operating conditions. The unit should also be suitable to mount on the switchboard directly.

Protection:

Overload protection:

Overload protection is through a triple pole series, operated upto 200 Amps and above CT operated electromagnetic overload coils suitably time lagged with oil dash pots operated directly on the mechanism tripping the breaker on sustained overloads. These overload devices are instantaneous self resetting type with an inverse time-lag characteristic protecting the circuitry faster than any other type of protection. Suitable range of calibration is also provided for, thus ensuring more accurate fool proof overload protection.

Under Voltage protection:

Electro-magnetic under voltage protection by an under voltage coil fitted separately and acts directly on the mechanism Normal coil voltage is 415 Volts 50 cycles AC, A special arrangement shall be made to make it impossible to close the breaker as long as there is no supply.

Short Circuit Protection:

Short Circuit Protection is ensured through Electromagnetic series/CT operated overload devices.

Contacts:

Contacts should be substantial size cross section made of Electrolytic 99.9% purely copper contacts that have durable silver plating on contacts. The fixed contacts are spring finger type, fitted with easily removable arcing, Contacts. The moving contacts for lower range are made of flat copper bars made into specific shapes and for higher ranges are made from copper 'V' bars. Moving arcing contacts are made of hard bronze Metal and are self-aligning type fitted to 'V' bars. Rupturing capacity shall be 15MVA up to 400A and 25 MVA for capacity above 400A up to 800A.

Oil:

First filling of oil shall be done in the oil tank & in dashpot with specific gravity 0.96, and dielectric strength 30kV at 2.5mm gap.

Termination:

Cable end box & glands on incoming side & out going sides should be provided.

Method of Construction:

The O.C.B. should be erected on provided panel board complete with first filling of oil in oil tank & in dash pot with connecting to bus bar by means of provided insulated copper strip of suitable rating as per the rating, complete.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

5.8 LT – Air Circuit Breakers (ACB)

Scope:

Specification No (SW-SWR/ACB)

Supplying, erecting, and commissioning of Air Circuit breaker of specified rating, confirming to IS 2516/IES157 manually operated non draw out type/draw out type erected at position in provided panel board in approved manner.

Material:

Air Circuit Breaker:

Draw out type/non draw out type manually quick make quick break type front operated mechanical indication for ON/OFF position with 50 kA short circuit rating. Trip free mechanism with high performance characteristic based on modular construction and should be compact.

The breaker shall have following accessories:

- **Auxiliary Switch:** Auxiliary switch shall consist of 2 NO & 2 NC contacts. The total Auxiliary switch block shall have minimum six auxiliary. In case of draw out breakers two sliding contacts should be provided.
- **Alarm Switch:** For breaker with thermal and magnetic trip units the indication should be direct from trip unit through micro switch with necessary wiring.
- **Shunt Release:** Shunt trips are used for remote control. Shunt trip coil should operate through an auxiliary switch. The operating ranges should be normally 50-110 % of the rated voltage.
- **Under voltage Release:** Under voltage release must be energized before closing breaker. This should be provided for remote control.
- **Over current release:** Over current release shall consist of Current Transformer with slides on each current carrying path of a bi-metal relay common to all transformers. The transformer shall have a fix ratio suited to particular setting range. Overload releases shall be thermal time lagged. Overload relay range shall be 50 % to 100 % of CT ratio. Frame shall facilitate site adjustment from 25-100% of ACB rating to match the load requirement.
- **RA unit** - given for 0-110% operating range of SHT-ensures supply available to shunt trip from same AC source in short circuit condition.

- **RC unit** – for up to 3secs. Time delay with U/V trip. Ideal for protection against transient voltage dips and nuisance tripping continuously adjustable time delay range of 40-500 ms with S/c trip ideal for selective interruption co-ordination of ACB's.
- Contacts made of electrolytic copper of 99.9 % purity, of ACB shall be totally shrouded, for eliminating access to live parts.
- Short Circuit release pick up shall be adjustable for closer protection.
- Breaker shall be compact in size, for saving space in the cubicle and as far as possible shall be lightweight for easy handling.
- Thermal over load and magnetic short circuit protection shall be provided.

Method of Construction:

The breaker should be erected on provided panel board or cubicle as the case may be, complete with connecting to bus bar by means of provided insulated copper strip of suitable cross section as per the rating, complete.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

5.9 HT -- SFU's, Load Break Switch (HTS)

A) HT Switch Fuse Unit/ Load Break Switch (LBS)

Scope:

Specification No (SW-HTS/LBS)

Supplying and erecting extendable/ non extendable type load break switch with fuses of required rating and with IP 55 protection class, on provided MS channels/ trench/ foundation in an approved manner.

Recommended Standards:

IS 9920 (Latest Revision):- Rating, performance, testing of load break switch
 IS 9921 :- Standards for temperature of electrical parts exposed to air

Load Break Switch should normally comply with the following parameters:

S. No	Specifications	11 KV	22 KV
1	Rated Voltage	12 KV	24 KV
2	Rated Current	630A	630A
3	Rated short time current	25 KA	25 KA
4	Rated making current	62.5 KA	62.5 KA
5	Rated breaking current	630A	630A
6	Impulse withstand voltage		
	Earth and between poles	75 KV	125 KV
	Across the isolation distance	85 KV	145 KV
7	Power frequency test voltage		
	Earth and between poles	28 KV	50KV
	Across the isolation distance	32 KV	60KV

Material:

- **Steel Sheet**
- **Electrolytic Aluminium Bus bar of 400A**
- **Arc Chutes**
- **Epoxy Resin Cast Type Insulators**

- **H.T. Fuses of adequate capacity**
- **Shunt Trip Coil**
- **Manual trip push button**
- **Auxiliary contacts**
- **Earth switch**
- **Earth Bus bar copper (25x3)**

Method of Construction:

Load break switch should be erected on provided MS channels/ trench/ foundation as per approved drawing by site in charge.

Manufacturer's certificate for type test should be obtained.

Routine Type test should be carried out at site.

An earth switch having separate operating handle should be interlocked with main switch should be checked.

An operating handle with correct sequence device having ON and OFF position and arrangement for pad locking provided should be checked.

Application:

Load break switch is suitable mainly for underground H.T. distribution system. It can be used for switching of transformers, overhead lines, capacitors, ring mains and cables.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

B) Ring Main Unit: (RMU)

Scope:

Specification No (SW-HTS/RMU)

Supplying and erecting Indoor type ring main unit with 2 incoming and 1 outgoing with HRC fuses and with IP 55 protection class, complete erected on provided CC foundation/ MS channels/ trench in an approved manner. (Refer drawing no. SW-HTS-1)

Recommended Standards:

IS 9920 (Latest Revision):- Rating, performance, testing of Ring Main Unit
IS 9921 :- Standards for temperature of electrical parts exposed to air

Material:

- **Steel Sheet**
- **Electrolytic copper Bus bar of 400 A**
- **Arc Chutes**
- **Epoxy Resin Cast Type Insulators**
- **H.T. Fuses of adequate capacity**
- **Shunt Trip Coil**
- **Manual trip push button**
- **Auxiliary contacts**
- **Earth switch**
- **Earth Bus bar copper (25x3)**

Method of Construction:

Ring main unit should be erected on provided MS channels/ trench/foundation as per approved drawing by site in charge.

Manufacturer's certificate for type test should be obtained.

Routine Type test should be carried out at site.

An earth switch having separate operating handle should be interlocked with main switch should be checked.

An operating handle with correct sequence device having ON and OFF position and arrangement for pad locking provided should be checked.

Application:

Ring Main Unit is suitable mainly for underground distribution system. It can be used for switching of transformers, overhead lines, capacitors, ring mains and cables
Mode of Measurement: - Per RMU

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

B) Ring Main Unit: (RMU)

Scope:

Specification No (SW-HTS/RMU)

Supplying and erecting Indoor type ring main unit with **1 or 2 incoming and 2 or 1 outgoing** with HRC fuses and with IP 55 protection class, complete erected on provided CC foundation/ MS channels/ trench in an approved manner.

Recommended Standards:

IS 9920 (Latest Revision):- Rating, performance, testing of Ring Main Unit

IS 9921:- Standards for temperature of electrical parts exposed to air

Material: Steel Sheet, Electrolytic copper Bus bar of 400 A, Arc Chutes, Epoxy Resin Cast Type Insulators, H.T. Fuses of adequate capacity, Shunt Trip Coil, Manual trip push button, Auxiliary contacts, Earth switch, Earth Bus bar copper (25x3)

Method of Construction:

Ring main unit should be erected on provided MS channels/ trench/foundation as per approved drawing by site in charge. Manufacturer's certificate for type test should be obtained. Routine Type test should be carried out at site. An earth switch having separate operating handle should be interlocked with main switch should be checked. An operating handle with correct sequence device having ON and OFF position and arrangement for pad locking provided should be checked.

Application: Ring Main Unit is suitable mainly for underground distribution system. It can be used for switching of transformers, overhead lines, capacitors, ring mains and cables

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

C) Vacuum Circuit Breaker: (VCB)

Scope:

Specification No (SW-HTS/VCB)

Supplying and erecting approved make 11kV / 22 kV, 630A, Vacuum Circuit breaker of required rating, on provided MS channels / trench / foundation in an approved manner.

Material: Steel Sheet, Aluminum Bus bar Arc Chutes, Epoxy Resin Cast Type CT's & PT's, Earth Bus bar aluminum (25x6), Panel comprising the above manufactured as per Manufacturer's standard specifications.

General Specifications for 11kv / 22 Kv 630A 350MVA VCB Switchboards

Panels shall be suitable for Indoor Free Standing Floor mounting Dust and Vermin proof type complying with IS3427, VCB Panels shall be extensible on either sides and fully compartmentalized with separate chambers for breakers, bus bars, current and voltage transformers relays & instruments and cable chambers, Each cubicle shall be provided with Pressure Relief Flap at top, The panel shall be fabricated with 2mm-sheet steel and 2.5mm-sheet steel shall be used for load bearing members. The panel shall be finished with Electrostatic Powder Coating of LIGHT GREY or with any other colour suggested by the Engineer-in-charge. Panel shall be suitable for rear side bottom cable entry for incoming and outgoing for 11KV panels. Bus bars shall be PVC sleeved or tapped. Vacuum Circuit breakers shall be horizontal Isolated and Horizontal draw out type. Vacuum Circuit breakers shall be fully type tested at CPRI and comply with IS 13118. Vacuum Circuit breakers shall be suitable for Manual/Motor Spring Charging operation. HT Switchgear shall be housed in separate vertical sections for each circuit.

Panel shall be provided with the following:-

Panel space heater controlled by thermostat with On/Off Switch, Cubicle illumination lamp with On/Off switch, 240V AC, 15A Plug & Socket. Panel shall be suitable for degree of protection IP55 as per IS 2147 for Indoor. Current Transformers shall be of Epoxy Resin Cast fixed type. Potential transformer shall be of draw-out type and shall be provided in the rear side of the panel.

MAIN BUSBARS: 630A TP Aluminium, Bus bar size: 50mm X 10 mm X 2 Run per phase.

Earth bus bar: 25mm X 6mm FLAT

Method of Construction:

VCB Panel shall be erected on provided MS channels/ trench/foundation as per approved drawing by site in charge.

Manufacturer's certificate for type test should be obtained.

Testing: Routine Type test should be carried out at site.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

Chapter 6

CONTROL PANEL

6.1	Sheets	No Specs
6.2	Bus-bars	CP-BB/
6.3	Measuring Instruments	No Specs
6.4	Accessories	No Specs

Chapter 6

Control Panel (CP)

6.2 Bus bar (BB)

Scope:

Specification No

(CP-BB)

Fabrication of bus bar chamber, fixing of bus bar of specified metal, complete erection of the bus bar chamber on provided angle iron or as instructed.

Material:

Sheet: 16 gauge CRCA sheet

Fabrication material: Angle iron of required size, Hinges made from MS.

Bus bar strip: Aluminum/Copper strips covered with colour coded PVC heat shrunk sleeves or wrapped with PVC insulation tape with colour coding.

Bus bar support: Bus bar insulators (Porcelain/Epoxy)

Earth stud: MS Nut & Bolt minimum 10 mm diameter.

Packing material: Rubber / Neoprene gasket

Paint: Red oxide paint /Primer, Enamel paint

Hardware: Nuts, bolts, washers, etc of required size & length.

Danger Board: GI Sheet danger board in Marathi & English or Screen printed sticker.

Method of Construction:

The bus bar chamber shall be fabricated from 16 SWG CRCA sheet with necessary clearance on all side as mentioned in Table No 5/1 duly painted with one coat of red oxide/primer and with 2 coats of Superior quality enamel paint of required shade. The earth stud shall be welded to the chamber. The bus bar shall be fixed on fabricated bracket (to be fixed on inner rear surface of the box), with minimum three porcelain / epoxy bus bar insulator minimum at both ends & at the centre of the bar (with distance of 45cms.between insulators), with minimum 40x8 mm MS nut bolt, spring washers, etc. The above method shall be adopted for all the 4 bars. The bar shall be vertically fixed in staggered manner so as to maintain clearance in between the bars as per Table No. 6.2/2. All the bars shall either be covered with colour coded PVC heat shrunk sleeves or wrapped with PVC insulation tape with colour coding. (i.e. R, Y, B, N). The chamber shall be fixed on 25x25x4 mm angle iron frame to make it sturdy. The chamber shall have minimum one hole per bus bar for fixing incoming cable, and required holes for the out going cables. The size of the bar either aluminium / copper for the required rating shall be as per Table No 6.2/1

Mode of Measurement:

Measurement will be on running metre basis of the length of the bus bar provided in the chamber. (i.e. per meter length of bus bar)

Table No 6.2/1

Dimensions of Bus bar chamber & Size & Number of Strips required for the corresponding current rating.

S.No	Dimensions of Bus bar chamber Length, Height, Depth in mm	Aluminum/ Copper bus bar length per phase in mm	Current rating in amperes	No. of Insulators (Epoxy /Porcelain) per bus	Recommended rectangular cross section			
					Aluminium		Copper	
					No. of strips per phase	Size in mm	No. of strip per phase	Size in mm
1	1150x400x150	1000	100	3	1	25x5	1	20x5
2	1150x400x150	1000	200	3	1	40x5	1	30x5
3	1150x400x150	1000	300	3	1	50x5	1	40x5
4	1150x500x300	1000	400	3	1	50x10	1	50x5
5	1150x500x300	1000	630	3	2	40x10	-	-
6	1150x500x300	1000	800	3	2	50x10	-	-

Table No 6.2/2

Minimum Clearance between Bus Bars in Bus Bar Chamber / Control Panel

(IS: 4237-1967)

S.No.	Voltage level (kV)	Clearance in mm	
		Between Phases	Between Phase & Earth
1.	0.416	19	16
2.	0.6	25	19
3.	3.3	51	35
4.	11	127	77
5.	22	242	140
6.	33	356	223

Chapter 7

CABLES

7.1	LT Cables (Aluminium)	CB-LT/AL/
7.2	LT Cables (Copper)	CB-LT/CU
7.3	HT Cables	CB-HT/
7.4	Cable Joints, Termination Kit (LT)	CB-JT/LT
7.5	Cable Joints, Termination Kit (HT)	CB-JT/HT
7.6	Cable Enclosure (Pipes)	CB-CE/
7.7	Cable Glands	CB-GL/
7.8	Street Light Boxes & Cable Indicators	CB-SB/ CB-CIP
7.9	Cable Lugs (Copper)	CB-CL/CU
7.10	Cable Lugs (Aluminium)	CB-CL/AL
7.10	Drawings	

7.1, 7.2, & 7.3 Armoured Cables (HT & LT)

1. **General**

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall be as included in approved list.

Work shall be carried out as per the method of construction specified by BIS. If there is no reference for particular method of construction in IS, such work shall be carried out as per the approved method of construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

2. **Cables: (Armoured)**

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

SP 30: 1984	:	National Electrical Code
SP 7 (Group 4): 2005	:	National Building Code
IS 1255: 1983	:	Code of practice of Installation & Maintenance of armoured cables up to 33 kV.
IS 3961: Part 2: 1967	:	Recommended current ratings of PVC cables.
IS 1554: Part 1; 1988	:	PVC Insulated (Heavy duty) Electric Cables; Part 1 for working voltages up to and including 1100 Volts.
IS 1554: Part 2; 1988	:	PVC Insulated (Heavy duty) Electric Cables; Part 1 for working voltages up to and including 3.3 kV to 11 kV.
IS 10810: Part 63; 1993	:	Method for Test of cables, Part 63 Smoke density of electric cables under fire condition.

3. **Scope: (Armoured cables)**

Specification No. (CB-LT/AL, CB-LT/CU, CB-HT)

Providing armoured cable of specified voltage level, size & specified conducting material (Aluminum / Copper) as per **Table no. 7/3** including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

4. **Material:****Cables:**

Cables shall be PVC for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, colour, shall carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every metre and having the total count of progressive length in meter at each mark.

Earth wire: Galvanized Iron (G I) wire of appropriate gauge as per Table No 7/1.

Glands: As per specification **(CB-GL)**

Lugs: As per specification **(CB-CL/AL, CB-CL/CU)**

Saddles: Saddles fabricated from GI sheet of required gauge and size depending on dia of cable either galvanized or painted with superior quality enamel black paint with necessary shearing mechanical strength, semi circular shaped with extended piece having suitable holes for fixing.

G I Strip: 22 g x 25 mm width G I Strip.

Clamps: MS Clamps fabricated of required length and shape, having the size of 3/6 mm thick mild steel having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast grip for holding the cable.

Identification tags: For identifying root, connection position GI strip with identification mark / name embossed / painted with arrangement to tie should be fix on cable or arrangement of ferrules to be done.

Hardware: Sheet Metal (SM) screws of required sizes, plugs / wooden gutties, etc.

4. **Method of Construction:**

General:

- a) Irrespective of method of construction the cable ends shall be terminated with appropriate size & type of glands with lugs duly crimped, as directed by Site engineer.
- b) Wherever the cable has to be bent, the turning radius shall be as mentioned in Table No 7/2. Grouping of cables shall be done with adequate distance between cables as mentioned in IS so as to minimize de-rating. Cables shall be tagged/ferruled with identification name / mark at the point from where distribution starts and at ends. Bare earth wire of appropriate size as per Table no. 7/1 shall run along with the cable. Earth wire running with the cable shall be terminated at the earth terminal nearest to cable termination.

5.1 **Erection of Cable on Surface:**

Erection shall be done as per the routes and layout finalized, in perfect level and in plumb. Before fixing the cable shall be straightened as far as possible for good aesthetics look, continuous bare GI earth wire of required gauge as per Table No 7/1 shall be run. Cable with G I wire shall be fixed by saddles firmly clipped on cable and shall be fixed to wall with minimum 50 x 8 mm SM screws with plugs/wooden gutties, etc. (Distance between two supports / saddles shall be maximum 450 mm). Wooden gutties shall be used wherever required (Especially for stone wall). The entries made in wall, floor slab, etc for laying the cable shall be made good by filling and finishing with plastering the same.

5.2 **Erection of Cable on Trusses:**

Cable along with bare GI earth wire, while erecting on trusses, shall be firmly clamped by wrapping GI strip of 22 g, 25 mm width of required length fixed to truss with nuts and bolts.

5.3 **Erection of Cable on Pole:**

Cable along with bare GI earth wire, while erecting on pole, shall be firmly clipped by suitable wooden / epoxy resin cast grips, clamped with 25 x 3 mm or 50x6 mm MS strip of required length and fixed to pole with nuts and bolts.

5.4 **Laying of Cable in provided Trench/Pole:**

While laying Cable along with bare GI earth wire, utmost care shall be taken to prevent damage to the insulation of the cable and to the open end. Cable shall be brought out from trench vertically straight (minimum 1.0 metre above G L). Care shall be taken to inspect the trench so that depth of cable shall not be less than as shown in Table No 7/4. Suitable size of cable loops shall be provided near termination point at adequate depth.

5.5 **Erecting cable in constructed Trench / duct:**

Erection of cable/s in constructed trench / duct, shall be as per guide lines of IS 1255.

5.6 **Erection of cable/s on trays:**

Cable/s shall be tied with PVC tags on GI trays. At bending point care shall be taken so that sharp edges of sheet will not damage insulation of cable.

5.7 **Mode of Measurement:** Executed quantity shall be measured on the basis of running metre per run of cable.

6. **Dismantling**

Cable laid underground, or fixed on any surface shall be dismantled carefully without damaging complete with all its accessories, making coil and stored as directed. The surface of the dismantled cable shall be made clear by removing of unwanted material, cement mortar, etc. When cable is dismantled from trench refill back the trench and making the surface proper.

7. **Mode of Measurement:** Executed quantity shall be measured on the basis of running metre per run of cable.

Table No 7/1

Size of Bare GI Earth wire to be used with LT Cables upto 1.1 kV

S.No.	Size of cable	Size of bare GI Earth wire to be used with cable
1	2.5 Sqmm to 50 Sqmm of all cores.	12 SWG
2	70 Sqmm to 95 Sqmm of all cores.	10 SWG
3	120 Sqmm and above of all cores.	8 SWG

Table No 7/2**Minimum bending Radius for Cables**

S.No.	Voltage level of cables	Single core	Multi core Unarmoured	Multi core Armoured
1	Up to 11 kV	20 D	15 D	12 D
2	Up to 22 kV	25 D	20 D	15 D
3	Up to 33 kV	30 D	25 D	20 D

Note: D diameter of cable.

Wherever possible, 25 percent larger radii than the specified above should be used.

Table No 7/3**Current Rating (In Ground) for PVC/ XLPE Insulated 1.1 kV Grade Cables**

Nominal area of conductor	Aluminum Conductor				Copper Conductor			
	Single Core		Multi Core		Single Core		Multi Core	
	PVC	XLPE	PVC	XLPE	PVC	XLPE	PVC	XLPE
Sqmm								
10	51	55	46	50	65	71	60	65
16	66	74	60	68	85	95	77	87
25	86	98	76	90	110	125	99	115
35	100	118	92	108	130	150	120	138
50	120	137	110	126	155	175	145	161
70	140	172	135	158	190	220	175	202
95	175	204	165	187	220	260	210	239
120	195	234	185	215	250	301	240	276
150	220	262	210	240	280	336	270	308
185	240	298	235	273	305	381	300	350
240	270	344	275	316	345	441	345	405
300	295	387	305	355	375	496	385	455
400	325	458	335	420	400	586	425	538
500	345	495	-	-	425	635	-	-
630	390	555	-	-	470	710	-	-
800	440	625	-	-	-	-	-	-
1000	490	685	-	-	-	-	-	-

Rating Factors for Variation in Ambient Air Temperature

Air Temperature (°C)	40	45	50
Rating Factor (XLPE)	1.00	0.94	0.88
Rating Factor (PVC)	1.00	0.90	0.81

Table No 7/4

Minimum laying Depth of cables (IS: 1255)

S.No.	Voltage level of cables	Minimum depth from top of the cable
1	Up to 1.1 kV	750 mm
2	3.3 kV to 11 kV	900 mm
3	22 kV to 33 kV	1050 mm
4	At road crossing	1000 mm
5	At railway crossing (from Bottom of sleepers to Top of pipe)	1000 mm

Notes below Table No 7/4:

1.	PVC Insulated electrical cable for voltage grade up to 1.1 kV is based on 8 volts drop.			
2.	The distances are given in meters and after rounding.			
3.	The distances are given in meters and after rounding.			
For Temperature Correction please see as detailed below:				
Ground temp.	20 degree C	25 degree C	30 degree C	35 degree C
Rating factors:	0.95	0.90	0.85	0.80

Table No 7/5

Distance up to which different sizes of UG Aluminum Conductor Cables 1.1 kV grade, can be used for different current ratings of 8 Volts drop. (PVC insulated, PVC Sheathed, 3 cores or 4 cores)

Maximum Conductor temperature – 70 degree C														
S. No	Current	Distance in meters for the following cable sizes in Sqmm												
		6	10	16	25	35	50	70	95	120	150	185	240	300
1	5	165	260	415	725	895	1300	1925	2360	3065	3555	4300	5770	6460
2	10	80	130	205	360	450	650	960	1180	1530	1775	2150	2885	3230
3	15	55	85	140	240	300	430	640	785	1020	1185	1430	1920	2155
4	20	40	65	100	180	225	325	480	590	765	890	1075	1440	1615
5	25	30	50	80	145	180	260	385	470	610	710	860	1150	1290
6	30	25	40	70	120	150	215	320	390	570	590	715	960	1075
7	40	20	30	50	90	110	160	240	295	380	445	535	720	805
8	50	-	25	40	70	90	130	190	235	305	355	430	575	645
9	60	-	-	35	60	75	110	160	195	255	295	355	480	535
10	70	-	-	30	50	65	90	135	165	215	255	305	410	460
11	80	-	-	-	45	55	80	120	145	190	220	265	360	405
12	90	-	-	-	40	50	70	105	130	170	195	235	320	360
13	100	-	-	-	35	45	65	95	115	150	175	215	290	320
14	110	-	-	-	-	40	60	85	105	140	160	195	260	290
15	120	-	-	-	-	35	55	80	95	125	145	180	240	270
16	130	-	-	-	-	-	50	75	90	115	135	165	220	250
17	140	-	-	-	-	-	45	70	80	110	125	150	205	230
18	150	-	-	-	-	-	-	65	75	100	115	140	190	215
19	160	-	-	-	-	-	-	60	70	95	110	130	180	200
20	170	-	-	-	-	-	-	55	70	90	105	125	170	190
21	180	-	-	-	-	-	-	50	65	85	100	120	160	180
22	190	-	-	-	-	-	-	-	60	80	90	110	150	170
23	200	-	-	-	-	-	-	-	60	75	90	105	145	160
24	225	-	-	-	-	-	-	-	-	65	80	95	125	145
25	250	-	-	-	-	-	-	-	-	-	70	85	115	130
26	275	-	-	-	-	-	-	-	-	-	-	80	105	115
27	300	-	-	-	-	-	-	-	-	-	-	70	95	105

(LT/HT Cables) (JT/LT/HT)**1. Scope:****Specification No (CB-JT/LT/HT)**

Providing straight through cable jointing kit of approved make and jointing cable as per the manufacturer's instructions and duly marking name of jointer and date.

2. Material:

Joint kit: Kit manufactured by reputed manufacturer with PVC moulds made in two parts, with epoxy compound, earth continuity lead of appropriate cross section having lugs at both ends, aluminum ferrules of the size of the cable, cross shaped epoxy spacer, MS clips for holding the moulds, adhesive for pasting the moulds.

3. Method of Construction:**3.1 Straight through joint Kit: LT/HT Cables**

Before providing joint to the cable, the cable ends of the equivalent length of the joint moulds, shall be prepared by removing the outer PVC insulation along with the steel armouring. The ferrule shall then be inserted over the bare core of the cable, and shall be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimped portion shall be wrapped first with the PVC insulation tape and then with the insulation tape used for wrapping HT conductor. The above method shall be carried out for all the cores strictly following the colour code. The leads of the both the cables now shall be placed into the mould by using the epoxy spacer, for having sufficient gap in-between the leads. The earth continuity lead shall be clamped to the both ends of the cable. After covering the cable leads with the PVC moulds, the edges shall be clipped after applying the adhesive on the inside face of the moulds. The pasting of moulds shall be rigid and as far as possible leak proof, so that the epoxy compound shall not spill out. Now the duly stirred epoxy compound shall be poured and fill till the compound rises through the risers provided on the moulds.

After completing the above procedure, the joint shall be allowed to dry out for at least 8 to 10 hours (for epoxy compound to get hardened) depending upon the size of cable. Before connecting to supply, the dry and hardened joint shall be tested for its insulation level with 1000 V/ 5000 V Meggar.

The cable should be fixed or laid in such manner that there should not be pressure on end of moulds or on jointing position of cables. (Refer drawing No. CB-JT-1)

3.2 Outdoor/Indoor end termination Kit: LT/HT Cables

Before providing end termination kit to the cable, the cable end of the equivalent length of the moulds, shall be prepared by removing the outer PVC insulation along with the steel armouring. The ferrule shall then be inserted over the bare core of the cable, and shall be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimping shall be done in such a manner that there shall be no air gap. Then the crimped portion shall be wrapped first with the PVC insulation tape and then with the insulation tape used for wrapping HT conductor. The above method shall be carried out for all the cores strictly following the colour code. The leads of the cable now shall be placed into the mould by using the epoxy spacer, for having sufficient gap in-between the leads. The earth continuity lead shall be clamped to the ends of the cable. After covering the cable leads with the PVC moulds, the edges shall be clipped after applying the adhesive on the inside face of the moulds. The pasting of moulds shall be rigid and as far as possible leak proof, so that the epoxy compound shall not spill out. Now the duly stirred epoxy compound shall be poured and fill till the compound rises through the risers provided on the moulds. (Refer drawing No. CB-JT-2)

After completing the above procedure, the joint shall be allowed to dry out for at least 8 to 10 hours (for epoxy compound to get hardened) depending upon the size of cable. Before connecting to supply, the dry and hardened joint shall be tested for its insulation level with 1000 V/ 5000 V Meggar.

4 Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each).

7.7 Cable Glands (GL)

Scope:

Specification Nos (CB-GL)

Termination of cable ends with cable glands for preparing and fixing the cable leads for connection. Cable glands shall be of Flange type.

Material:

Cable glands: Flange type heavy duty. Made of high purity brass metal, with brass washers, rubber rings, threaded stud with washers and nuts.

Method of Construction

Before erection of gland, the cable end shall be prepared by removing the outer PVC insulation up to the point where gland to be fixed, by assessing the length of leads required. Bottom portion of gland shall be inserted over the steel armouring, and then armour strips shall be bent for the length of collar of gland, remaining length of armoring shall be cut. The cable end shall then be, inserted through the entry of plate where the cable is to be terminated. The top portion of gland with washer shall be then inserted in such a manner that the bent armour strip should be touching the surface of the entry. The nuts shall be tightened with spring washers over the projected stud portion. Fixing of gland shall be at right angle to the gland plate. Tightening shall assure continuity of earth. Hole to the gland plate shall be punched / knocked out, of correct diameter with respect to gland size.

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each).

7.8 Street Light Boxes & Cable Indicators

A) **Cable Indicator Plate (CIP)**

Scope:

Specification No (CB-CIP)

Providing and fixing of cable indicator plate along the route of under ground cable.

Material:

Cable indicator plate: Circular plate made of cast iron having 100 mm dia. and 6 mm thick.

Iron rod for fixing of cable indicator plate: 700 mm long galvanized iron rod of 12 mm dia., and 150 mm long cross bar welded at bottom or hook to be made with same continuous bar.

Method of Construction:

Cable indicator plate fixed/welded to the 700 mm long iron rod or angle, with 150 mm cross bars welded at bottom as fasteners or bent in 'J' shape to hook the cable in the bent portion, shall be buried along the route of cable in the trench made for laying the cable. For clear visibility, the Cable indicator plate shall be buried in such a manner that the plate should be minimum 200 mm above the ground level and shall be provided at every 15-25 metre in straight run, at both ends of road crossing and immediate before and after turning point of cable.

Mode of Measurement:

Executed quantity will be measured on number basis. (I.e. each).

B) **Street Light Boxes (SB)**

Scope:

Specification No (CB-SB)

Providing and fixing of CRCA sheet metal / FRP boxes on pole with MS Clamps fixing to poles and terminating the cable.

Material:

CRCA sheet metal box: 16 gauge CRCA sheet with mounting arrangement for kitkat / MCB

Bakelite connectors: Bakelite connector of 2/4 ways, 32A, 250 V.

MS Clamps: Clamps fabricated of required length and shape, of 3 mm thick mild steel having 40 mm width.

Hardware: 10 mm mild steel nuts and bolts.

Paint for CRCA box: Superior quality aluminum / silver paint or required shade enameled paint as per the requirement of site engineer.

Primer / Red oxide: Superior quality primer / red oxide for use on sheet metal.

Method of Construction:

CRCA Sheet metal boxes:

Box shall be fabricated from 16 gauge CRCA sheet as per dimensions specified in item, with minimum 3 mm fold on front side of the box so as to make it water proof (Rubber beading / gasket shall be pasted on the edges / asbestos rope beading). Edges of front cover shall be folded in such a manner so that it shall cover the front opening of the box. The front cover shall be fixed either by screws or be hinged (as per requirement), with self-locking arrangement. There shall be provision of fixing connector / porcelain kitkat fuse / single pole MCB, inside the box. Provision of two holes of minimum 10 mm dia. for fixing bolt of clamp and one hole of required dia. for PVC wire leads, shall be made at the rear side of the box and provision for holes of required dia. at bottom for fixing the cable gland of incoming and outgoing cables. Box shall have earth terminal. Box shall have anti rust treatment and be painted with two coats of red oxide and finally two coats aluminum / silver paint. Rubber gasket shall be provided for making the box watertight. Unless and otherwise specified, the mounting height of the box shall be minimum 1750 mm from the finished ground level for facilitating easy maintenance.

FRP boxes:

FRP boxes manufactured with minimum wall thickness of 2.7 mm either gray or blue in colour, having provision for fixing either porcelain kitkat fuse or Single pole MCB, 4 way bakelite connector, and with provision of two holes of minimum 10 mm dia. for fixing bolt of clamp and one hole of required dia. for PVC wire leads, shall be made at the rear side of the box and one hole of required dia. at bottom to for fixing the cable gland of incoming and outgoing cables. The front cover shall be hinged, with locking arrangement and lock and key. The mounting height of the box shall be minimum 1750 mm from the finished ground level for facilitating easy maintenance. Wherever required fixing of box shall be done with MS clamps of required length, so as to hold pipe pole / RSJ pole and shall be duly painted in approved manner.

Mode of Measurement:

Executed quantity will be measured on number basis. (I.e. each).

2. **Scope:**

Specification Nos (CB-CL/AL, CB-CL/CU)

Crimping of lugs, and fixing to the terminals with nuts and bolts, etc.

3. **Material:**

Lug: Lug shall be of high purity aluminum / copper / bimetallic of required type, with required size of hole and smooth finished both from inside and outside.

Hardware: Brass or Cadmium plated mild steel nuts and bolts, bimetallic washers.

Anti-Oxide paste: Paste of superior quality manufactured by reputed manufacturer.

4. **Method of Construction:**

Before fixing of lugs to the cable end, the cable end to the equivalent length of the lug shall be prepared by removing the outer PVC insulation along with the steel armouring and then, the inner PVC insulation. The paste shall be applied to the cable lead and inside the lug prior to the inserting of lug on the cable lead. The lug shall then be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimping shall be done in such a manner that there shall be no air gap. Then the crimped portion shall be wrapped with the PVC insulation tape. (Colour of tape shall be of that of cable lead) The above method shall be carried out for all the cores. The cable end with lug shall then be terminated into the terminal and then be tightened with either brass nuts or Cadmium plated nuts as directed by Engineer in-charge.

5. **Mode of Measurement:**

Executed quantity will be measured on number basis. (i.e. each).

Chapter 8

OVERHEAD SYSTEMS

8.1	Steel Poles	OH-PL
8.2	Spun Poles	OH-SPP
8.3	Hot dipped Galvanized Poles & High Mast	OH-HM
8.4	Brackets	OH-BKT
8.5	Conductors	OH-CON
8.6	Insulators	OH-INS
8.7	Accessories	No Specs
8.8	Drawings	

8.1 Steel Poles (OH-PL)A) Steel Tubular Poles (OH-PL/STP)**Scope:****Specification No** (OH-PL/STP)

Supply of steel tubular swaged pole (Swan type or other wise) as per IS 2713: Part 2 1980, fabricated with earthing stud, pole base plate with required numbers of holes as per drawing and erecting the pole, including painting in provided foundation as per method of construction.

Material:**Pole:** Steel tubular swaged pole (Swan type or other wise) as per Table No 8/1**Base plate:** MS Base plate of 30x30x0.6 cms.**Pole Cap:** Pole cap 4 mm thick with inside diameter equal to outside Dia. of the pole and minimum height shall be 100 mm and welded or fixed with set screws.**Earth Stud:** Earth stud 5/8"mm Dia. bolt welded to pole with required size nut and double G.I. /M.S. washers**Paint:** Red oxide paint as primer, bituminous paint, Aluminium paint/ any other paint as per the instructions of engineer-in-charge.**Method of construction:**

Before erection of pole base plate of size 30x30x0.6 cm shall be full length welded or fixed with 4 set screws at the bottom of the pole, a suitable hole of required diameter and at specified height shall be drilled and welded with knock out nipple for laying wires for street light poles at required height. The pole shall be then painted by 2 coats of red oxide paint and one coat of bituminous paint before erection for min 1/6 length which is to be buried in ground & after erection remaining portion to be painted by two coats of aluminium paint. The pole shall be erected in provided pit with cement Concrete foundation and muffing in perfect plumb. (As per drawing)

Mode of Measurement:

Executed quantity will be measured on number basis. (I.e. each)

Table 8.1/1
Swaged Poles Made From Steel of Ultimate as per IS: 2713 (Part-II) 1980

Designation	Overall Length in mtr	Planting Depth in mtr	Height above Ground in mtr	Length of Sections in mtr			Outside Diameter / Thickness of Sections			Approx Weight of Pole. Kg
				Bottom h3	Middle h2	Top h1	Bottom	Middle	Top	
410 SP-28	9.00	1.50	7.50	5.00	2.00	2.00	139.7 x 4.50	114.3 x 3.65	88.9 x 3.25	113
410 SP-31	9.00	1.50	7.50	5.00	2.00	2.00	165.1 x 4.50	139.7 x 4.50	114.3 x 3.65	147
410 SP-52	11.00	1.80	9.20	5.60	2.70	2.70	165.1 x 4.50	139.7 x 4.50	114.3 x 3.65	175
410 SP-60	12.00	2.00	0.60	5.80	3.10	3.10	165.1 x 5.40	139.7 x 4.50	114.3 x 3.65	208

B) Rolled Steel Joist (RSJ) Poles (OH-PL/RSJ)**Scope:****Specification No** (OH-PL/RSJ)

Supply and erection of Rolled Steel Joist (Girder) pole as per IS 2713, including painting in provided foundation as per method of construction.

Material:

Pole: Rolled Steel Joist (Girder) As per Table No 8.1/2

Base plate: MS Base plate of 30x30x0.6 cms.

Hardware: Nut and bolts for fixing earth wire

Paint: Bituminous paint, Aluminium paint, Red oxide paint.

Method of construction:

Before erection of pole base plate of size 30x30x0.6 cm shall be full length welded at the bottom of pole, a suitable hole of required diameter and at specified height shall be drilled for earth stud. The pole shall be then painted by 2 coats of red oxide paint as primer for full length and then by one coat of bituminous paint before erection for min. 1/6 length which is to be buried in ground & after erection remaining portion to be painted by two coats of aluminium paint. The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plumb. (As per drawing)

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each)

Table No. 8.1/2
Weight of various sizes of RSJ Poles with 8.5 meter length

RSJ POLE	Size	Weight per Meter
Rolled steel Joist	150x80 / 150x75mm	14.9 Kg/meter
Rolled steel Joist	200x100 mm	25.4 Kg/meter
Rolled steel Joist	175x90 mm	19.3 Kg/meter
Rolled steel Joist	100x116 mm	23.0 Kg/meter
Rolled steel Joist	125x75 mm	12.42 Kg/meter
Rolled steel Joist	152x152 mm	37.0 Kg/meter

C) Rail Poles (OH-PL/RLP)

Scope:

Specification No (OH-PL/RLP)

Supply and erection of Rail Pole including painting in provided foundation as per method of construction.

Material:

Pole: Rail Pole 29.76 Kg/ metre, as per IS 2713 (Part II)

Base plate: MS Base plate of 30x30x0.6 cms.

Hardware: Nut and bolts for fixing earth wire

Paint: Bituminous paint, Aluminium paint, Red oxide paint.

Method of construction:

Before erection of pole, base plate of size 30x30x0.6 cm shall be full length welded or fixed with 4 set screws at the bottom of pole, a suitable hole of required diameter and at specified height shall be drilled for earth stud. The pole shall be then painted by 2 coats of red oxide paint as primer for full length and then by one coat of bituminous paint before erection for 1/6 length which is to be buried in ground & after erection remaining portion is to be painted by two coats of aluminium paint. The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plumb.

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each)

D) **G I Pipe Pole (OH-PL/GIP)**

Scope:

Specification No (OH-PL/GIP)

Supply and erection of ISI mark G.I. Pipe Pole 'B' Grade 75/80 mm dia. 6 m long including painting in provided foundation as per method of construction.

Material:

Pole: ISI mark G.I. Pipe Pole 'B' Grade 75/80mm dia. of total length 6 meter

Base plate: CI/MS Base plate of 30x30x0.6 cms.

Pole Cap: Pole cap 4 mm thick with inside diameter equal to outside Dia. of the pole and minimum height shall be 75 mm shall be welded or fixed with set screws.

Earth Stud: Earth stud 5/8"mm Dia. size bolt welded to pole with required size nut and double G.I. /M.S. washers

Paint: Bituminous paint, Aluminium paint/ any other paint as per the instructions of engineer-in-charge, Red oxide paint.

Method of construction:

Before erection of pole base plate of size 30x30x0.6 cm shall be full length welded or fixed with 4 set screws at the bottom of pole, a suitable hole of required diameter and at specified height shall be drilled and welded with knock out nipple for laying wires of street light. The pole shall be then painted by 2 coats of red oxide paint as primer and one coat of bituminous paint before erection for 1/6 length which is to be buried in ground & after erection remaining portion to be painted by two coats of aluminium paint. The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plum. (As per drawing no)

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each)

8.2 PSC Poles (PSC)

PSC Poles (OH-PL/PSC)

Scope:

Specification No (OH-PL/PSC)

Supply and erection of PSC Rectangular pole in provided foundation as per IS 13158 1991, and as per method of construction mentioned below.

Material:

PSC Rectangular Poles as per Specifications in Table 8/3 and as per satisfactory tests minimum required as per IS.

Table 8.2/3

Specifications for PSC Poles

Top Cross section in mm	Bottom Cross section in mm	Length in metre	Weight in kg
90x102	90x275	8	140
105x115	105x315	9	200

Method of construction:

The pole shall be erected in provided pit with cement concrete foundation and muffing or as instructed by site-in-charge in perfect plum. 1/6th of the total length of pole shall be buried in ground. The poles shall not to be used for end pole, large angle pole (angle more than 30^o), cut point or span length more than 65 mtr length, where heavy vehicular traffic exists and to be used for straight poles or small angle pole. (As per drawing)

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each)

8.2 PSC / Spun / GRP Poles (OH-PL/PSC/ SPN / GRP)
Spun Poles (SPN)

Specification No (OH-PL/SPN)

Scope:

Supplying and erecting pre stressed concrete PSC spun tubular pole on provided foundation as per IS 13158/1991 and as per method of construction.

Material:

PSC spun poles are as per specification in the table below and as per satisfactory tests minimum required as per IS. Poles are manufactured by centrifugal compaction process of concrete grade M-50.

Top cross section in mm	Bottom cross section in mm	Length in meter	Weight in kg
160	266	8	300
160	280	9	300
206	353	11	300
206	353	11	500
206	366	12	500

Method of Construction:

The pole shall be erected in provided concrete foundation having circular cavity matching with outer diameter of the pole and of requisite depth as per instructed by site in charge.

Mode of Measurement:

Executed quantity will be measured on number basis

Glass Reinforced Polymer Composite Poles (GRP)

Specification No (OH-PL/GRP)

Scope:

Supplying and erecting glass reinforced polymer composite (GRP) with high impact strength in square / conical with specified top & bottom diameter and thickness, length, etc designed to withstand wind load up to 180 km/ hr.

Material: Poles: Poles shall be as per standard manufacturer's specification.

Technical Specifications for GRP Poles

Sr.No	Details	Units
1	Specific Gravity	1.65 Kg/dm ³
2	Glass content (percentage by weight)	45 – 55%
3	Water absorption	0.5%
4	Tensile strength	400 + 50 MPa
5	Flexural strength	350 + 50 MPa
6	Compressive strength	200 + 50 MPa
7	Impact strength	>180 KJ/ m ²
8	Dielectric strength	3 – 7 KV/mm
9	Thermal conductivity	0.2 – 0.3 Kcal/mH ^o C

Method Of Construction:

The pole shall be erected at designate location and at requisite depth as instructed by site in charge.

Mode of Measurement:

Executed quantity will be measured on number basis

8.3 Hot dipped Galvanized poles & High Mast (HM)

A) High Mast (OH-PL/HM)

Scope:

Specification No (OH-PL/HM)

Supplying and erecting 12.5 m /16 m / 24 m high-mast and its accessories as specified below.

Material:

Hot dipped galvanised pole with details as given in the Table below;
(Refer drawing no. OH-PL-1 & OH-PL-2)

The design life of high mast shall be minimum 25 years.

Height	12.5 m without Power Tool	12.5 m with Power Tool	16 m Power Tool	20 m Power Tool	Remarks
1. Material	Hot dipped galvanised as per specification BSEN ISO 1461	Hot dipped galvanised as per specification BSEN ISO 1461	Hot dipped galvanised as per specification BSEN ISO 1461	Hot dipped galvanised as per specification BSEN ISO 1461	Each section shall be fabricated out of individual plates duly folded and welded. There shall be only one longitudinal seam weld per section. Hot deep internally and externally having uniform thickness of 85 microns for bottom section and 65 microns for top and middle section
Top and bottom Dia. Thickness	110 mm and 242 mm thickness 3 / 3 mm	150 mm and 360 mm thickness 3/3 mm	150 mm (thickness 3mm) and 460 mm (thickness 4mm)	150 mm (thickness 3mm) and 460 mm (thickness 4mm)	
Overlap	1.5 times the Dia	1.5 times the Dia	1.5 times the Dia	1.5 times the Dia	At site sections shall be joined together by slip-stressed- fit method. No site welding or bolted joints shall be done to the mast.
Max. Dynamic loading to withstand Max. Wind pressure	As per IS 875 part 3	As per IS 875 part 3	As per IS 875 part 3	As per IS 875 part 3	Max. Dynamic loading to withstand Max. wind pressure
Opening of base door	175 X 500 mm	225x1050 mm	1200 X 250 mm	1200 X 250 mm	
Double internal lock	Yes	Yes	Yes	Yes	
Base plate	20 mm thick 320 X 320 mm	25 mm thick 520 mm Dia	25mm thick 670mm Dia	30 mm thick 670mm Dia	The welding connection of the base flange shall be fully developed to the strength of the entire section. The base flange shall be provided with supplementary gussets between the bolt- holes to ensure elimination of helical stress concentration.
Anchor plate	3 mm	5 mm	8 mm	8 mm	

2. Accessories	12.5 m	12.5 m	16 m	20 m	Remarks
Lantern Carriage arrangement	Hexagonal Lantern Carriage for 6 fittings symmetrically	Lantern carriage of 50 NB ERW Class-B M.S pipe covered with PVC sleeve suitable to carry 250 Kg load upto 6 fittings	Lantern carriage of 50 NB ERW Class-BM.S pipe covered with PVC sleeve suitable to carry 250 Kg load upto 8 fittings	Lantern carriage of 50 NB ERW Class-BM.S pipe covered with PVC sleeve suitable to carry 250 Kg load upto 8 fittings	Hot deep, in two halves with stainless steel bolts and lock type stainless steel nuts to ensure easy installation, lining with protective PVC arrangement. junction box of cast aluminium-weather proof
Raising and lowering mechanism	----	Yes	Yes	Yes	Completely self sustaining Winch fixed at the base without the need of brake shoe, spring or clutches. Gravity activated pawls. Gear ratio 53:1, with self lubricating oil bath
Head frame	Yes	Yes	Yes	Yes	Galvanised
MCB erected on PVC board	Yes	Yes	Yes	Yes	OF suitable rating.

- 3. **Lighting protection** - By G.I. single spike 1200mm at top
- 4. **Trailing** - PVC sheathed 5 X 2.5 Sq. mm copper cable
- 5. **Winch** - Double drum, oil bath (SAE 90/140) with lubrication arrangement
- 6. **Wire rope** - 2 Nos stainless steel wire rope 7/19, 6mm dia. Breaking load capacity 2400 Kgx2
- 7. **Integral power tool** - 3 Ph 1 HP 2m/ min single speed,
- 8. **Torque limiter** - Upto 500Kg adjustable
- 9. **Aviation obstruction light** - Twin dome with 2 Nos 100W GLS/LED lamp

Standards applicable:

- a) I.S. 875 (part- III) 1987 - Code and practice for design for structures
- b) BSEN10-025/DIN17100 - Grades of M.S plates
- c) B.S 5135/AWS - Welding
- d) B.S. ISO1461 - Galvanising
- e) TR. No.7 2000 of ILE UK - Specification for Mast and foundation

Manufacturer of the Mast must have conducted wind tunnel test on their Mast sample.

Mode of Measurement:

Executed quantity will be measured on number basis (i.e. each)

B) Octagonal Poles (OPL)

Scope:

Specification No (OH-PL/OPL)

Supplying and erecting 9 m high galvanised octagonal pole details are as specified below.

Material:

9 m high galvanised Octagonal pole with details of given below.

Particulars	CSR Item No 8-3-3	CSR Item No 8-3-4
Material	Galvanised as per specification	Hot dipped galvanised as per specification BSEN ISO 1461
Top and bottom Dia. Thickness	100 mm A/F and 200 mm A/F thickness 3mm HT plate	70 mm A/F and 155 mm A/F thickness 3mm HT plate
Bracket	1500 mm long decorative sword type single arm bracket	1500 mm long decorative sword type double arm bracket

Method of construction:

The pole shall be erected in provided cement concrete foundation specially designed. Erection shall be in plum.

Mode of Measurement:

Executed quantity will be measured on number basis (i.e. each)

8.4 Brackets (BKT)

A) Pole Bracket (Cross arm) (OH-PL/BKT)

Scope:

Specification No (OH-PL/BKT)

Supply and erection of MS Pole Bracket for erection of L T insulators on provided pole.

Material:

Pole Bracket: MS pole bracket fabricated as per specifications in Table 8.4/1. Thickness and size of channel is to be checked from the steel table.

Table No 8.4/1
Details of Pole Brackets

Item No	Material of bracket	Length	No of insulator	No of insulator or	Guarding Extension piece	Remark
8-4-1	Angle iron 50x50x6 mm	550 mm	2	2		For LT guarding for vertical formation
8-4-2	Angle iron 50x50x6 mm	750 mm	2	2		For LT guarding for horizontal formation
8-4-3	ISMC Channel 75x40x 6.8 mm	550 mm	4	4		For LT 3 phase 4 wire vertical formation

8-4-4	ISMC Channel 75x40x 6.8 mm	750 mm	5	5		For LT 3 phase 5 wire vertical formation
8-4-5	ISMC Channel 75x40x 6.8 mm	550 mm	2	2		
8-4-6	ISMC Channel 75x40x 6.8 mm	1100 mm	4	4		
8-4-7	ISMC Channel 75 x40x 6.8 mm	550 mm	2	2	300mm of same channel	
8-4-8	ISMC Channel 75 x40x 6.8 mm	1100 mm	4	4	300mm of same channel	

D' type Clamps: MS Flat of 50x6mm, 15 mm MS nut bolts

Paint: Silver paint, Red oxide paint

Method of construction:

The cross arm shall be made up of size of channel mentioned in above table. The length shall be as stated above table. The cross arm shall be complete with pole clamp of size 50X6 mm MS flat and holes required for pin / shackle insulator. For MS pole bracket with guarding extension, an extension piece of same size of length 300 mm shall be welded to bracket as per drawing attached herewith. The cross arm and pole clamp shall be painted with one coat of red oxide and two coat silver enamel paint any other colour paint (as per the instructions of engineer in-charge).

Cross arm shall be fabricated **as per drawing no. OH-PL/BKT-1 (Fig.2 & Fig.3)**

Mode of Measurement: Executed quantity will be measured on number basis. (i.e. Each)

B) Vee Cross Arm (OH-PL/VCA)

Scope:

Specification No (OH-PL/VCA1)

Supplying Vee cross arm, suitable for 11 kV and necessary ancillary materials complete erection on provided pole with necessary painting as per specification and as per instructions from the site engineer.

Material:

Cross arm: Channel Iron cross arm

Hardware: G.I. nut bolts

Flat: MS flat 80 x 10 mm thick

Clamp: Two clamps made from MS flat of size 80 x 10 mm.

Paint: Red oxide, Silver paint.

Method of construction:

Fabricating the Vee cross arm for erecting Insulators with channel 75 x 40 mm with 4.4 mm thick web and 7.3 mm thick flange, length of 45 mm for base of insulator, vertical member of suitable length to maintain the clearance of 1220 mm, with angle of 60 degrees to horizontal and M.S. flat of 80 x 10 mm at centre of cross arm fixed to the pole by means of two M.S. clamps of 80 x 10 mm. M.S. flat with 15mm. dia bolts and nuts duly painted with one coat of red oxide paint and two coats of aluminium paint. Cross arm shall be fabricated **as per drawing no. OH-PL/BKT-1 (Fig.1)**

Detailed specifications of material of the items included in CSR are given in Table No 8.4/2.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

C) Vee Cross Arm (OH-PL/VCA)

Scope:

Specification No (OH-PL/VCA2)

Supplying Vee cross arm, suitable for 22 kV and necessary ancillary materials complete erection on provided pole with necessary painting as per specification and as per instructions from the site engineer.

Material:

Cross arm: Channel Iron cross arm

Hardware: G.I. nut bolts

Flat: MS flat 80 x 10 mm thick

Clamp: Two clamps made from MS flat of size 80 x 10 mm.

Paint: Red oxide, Silver paint.

Method of construction:

Fabricating the Vee cross arm for erecting Insulators with channel 75 x 40 mm with 4.4 mm thick web and 7.3 mm thick flange, length of 45 mm for base of insulator, vertical member of suitable length to maintain the clearance of 1530 mm, with angle of 60 degrees to horizontal and M.S. flat of 80 x 10 mm at centre of cross arm fixed to the pole by means of two M.S. clamps of 80 x 10 mm. M.S. flat with 15mm. dia bolts and nuts duly painted with one coat of red oxide paint and two coats of aluminium paint. Cross arm shall be fabricated as per drawing no. OH-PL/BKT-1 (Fig.1)

Detailed specifications of material of the items included in CSR are given in Table No 8.4/2.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

**Table No 8.4/2
Details of Iron Cross Arm / Bracket as Per Item in CSR**

Item No.	Item description	Size of channel	Clamps	Nut bolts
8-4-11	100X50 channel cross arm	100 x 50 mm. with 4.7 mm thick web and 7.5 mm thick flange channel X 2.7 m length	Two clamps of 50x6mm. M.S. flat	15mm. nuts and bolts
8-4-12	Vee-cross arm	made out of channel 75 x 40 mm with 4.4 mm thick web and 7.3 mm thick flange with clearance of 1220 mm. between the insulators as per drawing attached here with	Clamps of 75x10 mm of MS Flat	15mm. dia bolts and nuts
8-4-13	Vee-cross arm	100x50 mm with 4.7 mm thick web and 7.5 mm thick flange size suitable with clearance of 1530 mm. between the insulators	Clamps of 75x10 mm of MS Flat	15mm. dia. bolts and nuts
8-4-14	Channel with clamp for erection of 11/22 KV pin insulators	75x40 mm with 4.4 mm thick web and 7.3 mm thick flange channel	Clamps of 80x10 mm of MS Flat	with 3 sets screws
8-4-15	Channel bracket for guarding	channel iron 1600 mm. in length and 75x40 mm. with 4.4 mm. thick web and 7.3 mm thick flange	Clamps of 50x6 mm of MS Flat	15mm. dia nuts and bolts with 2 earthing clips, made from 25x3 mm
8-4-16	Angle iron bracket for guarding	Angle iron bracket 65 x 65 x 6mm. Angle 1600 mm. in length and 75x40 mm. with 4.4 mm. thick web and 7.3 mm thick flange	Clamps of 50x6 mm of MS Flat	15mm. dia nuts and bolts with 2 earthing clips, made from 25x3 mm

8.5 Conductors

(CON)

A) All Aluminium Conductors (AAC) (OH-CON/AAC)

Scope:

Specification No (OH-CON/AAC)

Supply and erection of All Aluminium Conductors for overhead line.

Material:

Conductor: All aluminium stranded conductor (As per table 8.5/1)

Binding wire: 12 SWG aluminium binding wire

Clamps: PG clamps as per requirement

Method of construction:

At first the conductor is removed from bundle/drum straighten without knots, bends, etc.

Stringing of conductor shall be done with draw vice. Conductor shall not be twisted while stringing. Shackle insulators shall be used if the line deviates by 30 degrees or more, at terminal pole and at junction/ cut pole.

Parallel double groove clamp having two nut bolts designated to carry full line current shall be used for making Jumper wire connections.

On straight line the conductor shall be bounded on top groove of insulator and at angular position binding shall be done in side groove. Binding wire of 12 SWG shall be of the same metal as that of conductor.

Mode of Measurement:

For measurement purpose, sum of the total conductor including jumper connections shall be considered. (i.e. per km)

B) Aluminium Conductor Steel Reinforced (ACSR) (OH-CON/ACSR)

Scope:

Specification No (OH-CON/ACSR)

Supply and erection of aluminium conductor steel reinforced for overhead line.

Material:

Conductor: All aluminium conductor steel reinforced (As per table 8.5/1)

Binding wire: 12 SWG aluminium binding wire

Clamps: PG clamps as per requirement

Method of construction:

At first the conductor is removed from bundle/drum straighten without knots, bends, etc.

Stringing of conductor shall be done with drawing vice. Conductor shall not be twisted while stringing. Disc insulators shall be used if the line deviates by 30 degrees or more, terminal pole and tri-pole or four pole structure at terminal pole and at junction/ cut pole.

Parallel double groove clamp having two nut bolts designated to carry full line current shall be used for making Jumper wire connections. Universal parallel double groove clamp having two nut bolts shall be used for Tap Off point.

On straight line the conductor shall be bounded on top groove of insulator and at angular position binding shall be done in side groove. Binding wire of 12 SWG shall be of the same metal as that of conductor.

Mode of Measurement:

For measurement purpose, sum of the total conductor including jumper connections shall be considered. (i.e. per km)

Table No. 8.5/1
Conductor Specifications As Per I.S. 398/1961

Code Name of Conductor	Resistance at 20 ^o ohm /km.	Approx. Current Carrying Capacity in Amperes.		Number of Strands / Diameter of each Strand in mm	Overall Diameter of Conductor in mm	Weight of Conductor (kg/km)
		At 40 ^o C	At 45 ^o C			
All Aluminium Conductor						
Rose	1.361	116	108	7/1.96	5.88	58
Gnat	1.071	133	123	7/2.21	6.63	73
Irish	0.850	150	138	7/2.48	7.44	92
Pansy	0.677	178	165	7/2.78	8.34	116
Ant	0.544	204	189	7/3.10	9.30	144
ACSR Conductor						
Squirrel	1.374	115	107	6+1/2.11	6.33	85
Weasel	0.911	150	139	6+1/2.59	7.77	128
Ferret 4.04	0.679	181	618	6+1/3.0	9.00	171
Mink 0.06	0.456	234	217	6+3.66	10.98	255
Raccoon	0.365	270	250	6+1/4.09	12.27	318
Dog 0.1	1.137	520	482	30+7/3.0	21.00	976

Table No 8.5/2

Minimum Clearance between Conductors
(IS: 4237-1967)

S.No.	Voltage level (kV)	Clearance in mm	
		Between Phases	Between Phase & Earth
7.	11	460	305
8.	22	610	460
9.	33	915	610
10.	110	1675	1000
11.	230	3350	1675
12.	400	4000	3500

8.6 Insulators (INS)

A) Porcelain Disc Type Insulator 11/22/33 kV (OH-INS/DI)

Scope:

Specification No (OH-INS/DI)

Supplying porcelain disc type insulator, suitable for 11/22/33KV and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the over-head line as per instructions from the site engineer

Material:

Insulator: Distribution class Disc type insulator made from porcelain, suitable for specified voltage level, having ISI mark, with necessary hardware.

Hardware: Nuts, washers, etc.

Binding wire: Bare Copper wire or conductor.

Clamps: MS clamps.

Method of construction:

Distribution class porcelain disc type insulator, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the over-head line. Connection shall be made with bare copper wire of specified gauge.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

B) Pin Type Insulator 11/22/33 kV (OH-INS/PN)

Scope:

Specification No (OH-INS/PN)

Supplying porcelain Pin type insulator, suitable for 11/22/33KV and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the over-head line as per instructions from the site engineer

Material:

Insulator: Distribution class Pin type insulator made from porcelain, suitable for specified voltage level, having ISI mark, with necessary hardware.

Hardware: Nuts, washers, etc.

Binding wire: Bare Copper wire or conductor.

Clamps: MS clamps.

Method of construction:

Distribution class porcelain pin type insulator, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the over-head line. Connection shall be made with bare copper wire of specified gauge.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

C) Post Type Insulator 11/22/33 kV (OH-INS/PST)

Scope:

Specification No (OH-INS/PST)

Supplying porcelain Post type insulator, suitable for 11/22/33KV and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the over-head line as per instructions from the site engineer

Material:

Insulator: Distribution class Post type insulator made from porcelain, suitable for specified voltage level, having ISI mark, with necessary hardware.

Hardware: Nuts, washers, etc.

Binding wire: Bare Copper wire or conductor.

Clamps: MS clamps.

Method of construction:

Distribution class porcelain post type insulator, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the over-head line. Connection shall be made with bare copper wire of specified gauge.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

D) Thyrite type Lightning Arrestor 11/22 kV (OH-INS/LA)

Scope:

Specification No (OH-INS/LA)

Supplying porcelain Thyrite type lightning arrestor, suitable for specified voltage level and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the over-head line as per instructions from the site engineer.

Material:

Arrestor: Distribution class Thyrite type lightning arrestor made from porcelain, suitable for specified voltage level, having ISI mark.

Hardware: Nuts, washers, etc.

Binding wire: Bare Copper wire or conductor.

Clamps: MS clamps.

Method of construction:

Distribution class porcelain Thyrite type lightning arrestor, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the over-head line. Connection shall be made with bare copper wire of specified gauge.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

Chapter 9

EARTHING

9.1	Plate, Pipe	EA-EP/
9.2	Accessories	No Specs
9.3	Drawings	

9.1 Plate / Pipe type Earthing**A) Plate type Earthing (With or Without CI Cover, Funnel, etc) (EA-EP)****Scope:****Specification No (EA-EP)**

Supplying and erecting galvanised cast iron / copper earth plate type / G.I. pipe type earthing **with / without C.I. cover** as per instructions from the site engineer.

Material:

Earth Plate: Galvanised cast iron / Copper earth plate or G.I. pipe as per specifications given in Table No 9.1/1.

CI Cover: As per specifications given in Table No 9.1/1.

Earthing Conductor: Copper/G.I. strip/Annealed bare copper wire/G.I. earth wire of size as per specifications given in Table No 9.1/1.

GI Pipe: As per specification **(CW-PLB/GP)** mentioned chapter no. 17.5 for watering, and as enclosure for Earth wire, refer specifications given in Table No 9.1/1.

Hardware: Screw / nut bolts with required washer of dimensions, Rawl plug / clip/ 'U' nails and material as per specifications given in Table No 9.1/1.

Filling material: Coal /Charcoal/ salt as per specifications given in Table No 9.1/1. as per specifications given in Table No 9.1/1.

Lugs: As per specification **(CB-LG/AL, CB-LG/CU)** mentioned chapter 7.9 & 7.10 Copper/ Aluminium lugs as per specifications given in Table No 9.1/1.

Method of construction:

Pit is to be dug of required dimension and depth for the earthing at site, and laying of Galvanised cast iron / Copper earth plate or G.I. pipe shall be as per Table No 9.1/1. The earth connection to equipment/ switch gear and earthing electrode shall be connected as shown in the diagram and as per IS 3043 amended up to-date. The connections shall be made either by strip or double run of earth wire with drilling, welding, riveting, brazing and nut bolting to plate or pipe, where ever required in an approved manner. As far as possible continuous strip shall be used, but where ever jointing of strip is unavoidable, the overlap portion must not be less than $2^{1/2}$ times the width of the strip either welded/ brazed/soldered by all sides or 6 inches overlap with two nut bolts/ riveting of adequate size with required washer and covered by anti-corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in charge.

Pit shall then be filled with screened soil with alternate layer of coal and salt, and if, necessary brick masonry work (Where ever applicable) shall be done as specified in IS: 3043, with laying wires in PVC/ G.I. pipe and watering arrangement as per **drawing no EA-1** and covered with C.I. Cover (Where ever applicable).

Where ever requires or as specified by Site Engineer, a Test link shall be provided for facilitating the testing of resistance of earth electrode.

Testing:

The value of each earth electrode shall be measured by earth tester in presence of site Engineer and record to be submitted.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

**Table No 9.1/1
Detailed Specifications of various types of Earthing**

Type of earthing ----->		Galvanised cast iron earth plate type without C.I cover	Copper earth plate type with C.I cover	Galvanised cast iron earth plate type with C.I cover	Pipe type earthing with out C.I cover
S.No.	Particulars				
1)	Depth from top of plate Up to Ground level	1.5 m	1.5 m	1.5 m	1.5 m
2)	Size & type of material for pipe / Plate type earthing.	Cast iron earth plate size 60x60x0.6 cms	Copper earth plate size 60x60x0.6 cms	cast iron earth plate size 60x60x0.6 cms	'B' grade G.I. pipe 40mm. dia. 2.5 mtr. Long or 20 mm dia. G.I. Rod
3)	Salt/charcoal	30 Kg. charcoal and salt each	30 Kg. charcoal and salt each	40 Kg. charcoal and salt each	N A
4)	Type of Wire	Double G.I. wire 8 SWG	Double G.I. 8 SWG	Double G.I. 6 SWG	double G.I. 8 SWG
5)	Wire enclosure	12mm. dia. G. I. pipe 2 mtr. Long	12mm. dia. G. I. pipe 2 mtr. Long	12mm. dia. G. I. pipe 2.5 mtr. Long	N A
6)	Nut bolts	12 mm dia. Cadmium / GI	12 mm dia. Cadmium / GI	12 mm dia. Cadmium / GI	N A
7)	Washers	GI	GI	GI	N A
8)	Watering pipe	19mm. dia. G.I. pipe	19mm. dia. G.I. pipe	19mm. dia. G.I. pipe	N A
9)	Lugs	Yes	Yes	Yes	Yes
10)	funnel	No	yes	yes	N A
11)	Brick Masonry	No	yes	yes	N A

B) Low Impedance Earthing (Pipe in pipe technology) (EA-EPP)

Scope:

Specification No (EA-EPP)

Supplying and erecting approved type earthing system with **Pipe in pipe technology** with necessary ancillary materials and complete erection as per instructions from the site engineer

Material:

GI Pipe: As per specification no. **(CW-PLB/GP)** mentioned chapter 17.5;

1. 50 mm dia x 3 meter long (In place of traditional GI pipe Earthing), for LV / MV applications.

Or

2. 80 mm x 3 meter long (In place of traditional copper plate Earthing), for HV/EHV applications.

Earthing Conductor: G.I strip/GI earth wire of size as per specifications given in Table No 9.1/1.

GI Pipe: As per specification no. (CW-PLB/GP) mentioned chapter 17.5 for watering and as enclosure for Earth wire, as per specifications given in Table No 9.1/1.

Hardware: Screw / nut bolts with required washer of dimensions, Rawl plug / clip/ 'U' Nails and material as per specifications given in Table No 9.1/1.

Filling material: Coal /Charcoal/ salt as per specifications given in Table No 9.1/1. as per specifications given in Table No 9.1/1.

Lugs: As per specification no. (CB-LG/AL, CB-LG/CU) mentioned in chapter 7.9 & 7.10 for Copper/ Aluminium lugs and as per specifications given in Table No 9.1/1.

Method of construction:

Earthing Pipe in pipe technology with ancillary materials shall be done by digging an 8" / 10" dia hand bore 10.5' deep sufficient to install the electrode in normal soil conditions. The space between the soil and the electrode is filled up with electrolyte material mixed with the dug out mother soil, along with water and tightly packed up to the base of the terminal. In rocky areas and under hard soil and sandy soil conditions the method of installation will be as specified by manufacturer. Installation shall include drilling, welding, reventing, brazing and nut bolting pipe when ever required in an approved manner with required material such as nut bolts and washer etc. and with necessary brick masonry work as per the specification. (As per IS 3043 amended up to-date). As far as possible continuous GI strip shall be used but when ever jointing of strip is un avoidable, the jointing over lap portion must not be less than $2^{1/2}$ times the width of the strip either welded/ brazed/soldered by all sides or overlap of 6 inch with two nut bolts/ riveting of adequate size with required washer and covered by anti corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in-charge.

Testing:

The value of each earth electrode shall be measured by earth tester and record to be submitted. (Also refer drawing No. EA-2)

Mode of Measurement: Executed quantity will be measured on number basis i.e. each

Chapter 9 Earthing (EA)

C) Early Streamer Emission Lightning Arrestor (EA-LAP)

Scope:

Specification No (EA-LAP)

Supply, installation of early streamer storm master type lighting protection complies with lightning air terminal, supporting mast, guy rope, down conductor, maintenance free fast earth electrode at specified location as per drawing and design.

Material:

ESE Storm Master Type Lightning Protection complies with the Lightning Air Terminal - Configured as a Spheroid which is comprised of separate electrically isolated 4 panels surrounding an Earthed Central Finial. The Insulation Material used to electrically isolate the panels shall be comprised of a base Polymer (UV rated Evopren) which provides high Ozone & UV resistance with a di-electric strength of 24-38 KV/mm tested as per NFC 17-102 & IEC 60-1:1989. The ESE terminal shall be tested & certified by CPRI (Central Power Research Institute, Govt of India) for the Impulse current of 45 KA (8/20 micro sec) with 5 positive & 5 negative impulse.

Lightning counter- (6 digits, 7 segment Tercal digital display) in an IP 67 enclosure with the minimum sensitivity of 1500A & maximum capacity of 220 KA (8/20 micro second waveform) tested as per IEC 60-1:1989

Design System:

For designing lighting arrestor the necessary data is length height and width of area to be protected that is complete drawing of area .The protection radius(Rp) of Stormaster terminal is calculated using the formula as defined by national French standard NFC 17-102(July 1995)

$$R_p = \sqrt{h(2D-h) + \Delta T(2D + \Delta T)}$$

Rp:-Radius of protection (in meter)

h:Actual height of stormaster terminal for Area to be protected (in meter)

D: Is a Constant in meter. It depends on protection level as specified in NFC 17-102

D=20 meter for protection level 1(High protection)
D=45 meter for protection level 2(Medium protection)
D=60 meter for protection level 3(Standard protection)

The terminal shall offer a protection radius in meter with the different Level Of Protection & preferably to be mounted on roof top & centre of the building.

Triggering Time 15 in microsecond - 32 mtrs

Triggering Time 30 in microsecond - 48 mtrs

Triggering Time 50 in microsecond - 68 mtrs

Triggering Time 60 in microsecond - 79 mtrs

Method of Installation:

The lightning arrester air terminal is preferably to be mounted on roof top according to drawing and design; it must contain the supporting mast with base plate, guying rope wire to protect against the wind load. The down conductor should be 70 sq mm single core copper flexible cables properly connected between the air terminal finial to earthing system. The digital counter is fixed at eye level on down conductor

Mode of Measurement:

Executed quantity will be measured on number basis.

Chapter 10

SUB STATION

10.1 Transformer	SS-TR
10.2 Accessories	No Specs
10.3 Drawings	

Scope:**Specification No (SS-TR)**

Supplying and erecting AC three phase 11 or 22 kV/0.44 kV, 50 Hz, oil immersed and naturally cooled indoor/outdoor type copper wound distribution transformer of specified capacity, connected delta on HV side and star on LV side with additional neutral brought out on load side.

Recommended standards:

The following list shows Indian Standards which are acceptable as good practice and accepted standards.

IS 335: 1963	Dielectric Strength
IS 2026 part I 1977	Specification for Transformer
IS 2026 part II 1977	Specification for type of cooling and permissible temp. rise of transformer
IS 2026 part III 1981	Specification for insulation level and dielectric strength of transformer
IS 2026 part IV 1977	Specification for terminal marking tapping and connections
IS 1180 part I 1989	Specification for outdoor type three phase distribution transformer
IS 10028 Part I 1985	Code of practice for selection installation and maintenance of transformers
CBIP/TAC Manuals	

Material:

1. Copper wound Transformer with Delta connection on HV side and star connection on LV side complete with Manufacturer's test certificates
2. Standard mountings required for transformer are shown below. The mountings are to be selected from them and any additional if required.

- Off load tap changing
- Oil conservator with fitting holes and cap and plain oil level gauge
- Silica gel dehydrating breather
- Oil drain valve
- Thermometer pockets
- Oil filter valve
- Lifting arrangement
- Two earthing terminals
- Diagram and rating plate
- Four bi directional plain rollers
- Air vent
- Explosion vent
- Terminal arrangement
- Bushing with lugs and/or cable end box on LV side
- HV cable end box and/or HV bushing

The transformer losses shall be as mentioned in Table No 10.1/1

Method of Construction:

The contractor should intimate name of manufacturer and make of the Transformer and location of the manufacturer factory to engineer in charge prior to delivery of the transformer. After manufacturing of the transformer, the agency/contractor shall intimate the engineer-in-charge for carrying out the inspection.

After receipt of intimation engineer-in-charge or his representative should inspect the Transformer at manufacturer factory and shall carry out the following tests jointly in presence of concern contractor.

- 1) Open Circuit test
- 2) Short Circuit test
- 3) Specific Resistance Test
- 4) Insulation Resistance of HV, LV, in between HV and LV, Winding and Body.
- 5) Dielectric Strength and acidity test of Transformer oil.

The test results of joint inspection shall be recorded on the test report of Transformer with its Sr. No. prior to delivery of the Transformer to site.

Necessary work of plinth and or for D.P. structure with D.O. set, L.A., A.B. switch should be completed before dispatch of the transformer. The channel arrangement on plinth is to be done. Earthing arrangement should be completed. The Transformer should be installed on plinths / double pole structure/floor by arranging chains pulley block, crane etc as per IS Norms.

After installation of Transformer the stopper/lock should be provided to rollers of the Transformer.

The connection of H.T/L.T. side should be completed by provided Copper wire/ cable with necessary lugs to avoid loose connection. The earthing (2 Nos for Neutral & 2 Nos for Body) should be connected from distinct electrodes. The earthing should be connected by lugs/proper size of strip.

The Engineer in charge or his representative should check all connections on H.T. side, L.T. side and earths and insulation and earth resistance test should be carried out and results obtained shall be recorded.

Statutory Permissions to be obtained by the Agency/Contractor:

Before commencement of work, the drawings of installation shall be got approved from the Electrical Inspector, I E & L Department.

The installation should be got inspected from Electrical Inspector and obtain written permission to charge the Transformers.

Commissioning:

After above formalities the Transformer, should be charged/commissioned in presence of Engineer in charge or his representative along with load trials and shall be handed over to the department for beneficial use

After charging the Transformer, line, phase voltages and line current shall be measured, and the same shall be submitted.

Following test certificates shall be submitted:

1. Manufacturer's original certificate of Transformer as stipulated in IS.
2. Test certificate for dielectric strength of oil as per IS.
3. Test results of IR values.
4. Test results of all earth electrodes.
5. Readings of Voltages & currents at the time of commissioning.

Table No 10.1/1

Capacity wise maximum losses of Transformers

Sr. No.	Transformer Rating kVA	Voltage Ratio in kV	Winding	(At 75°C) Losses at No Load (Watts)	(At 75°C) Losses at 50 % Load (Watts)	(At 75°C) Losses at 100 % Load (Watts)	Short Circuit Current Amp
1	63	11/0.433	Cu	155	380	1250	
2	63	22/0.433	Cu		362	1193	
3	63	11/0.433	Al	180		1235	84
4	63	22/0.433	Al				
5	100	11/0.433	Cu	220	520	1800	
6	100	22/0.433	Cu		495	1717	
7	100	11/0.433	Al	260		1765	133.34
8	100	22/0.433	Al				
9	160	11/0.433	Cu	400		2400	
10	160	22/0.433	Cu				
11	160	11/0.433	Al				
12	160	22/0.433	Al				
13	200	11/0.433	Cu	500		3000	
14	200	22/0.433	Cu				
15	200	11/0.433	Al	500		3000	266.67
16	200	22/0.433	Al				
17	250	11/0.433	Cu	550		3600	
18	250	22/0.433	Cu				
19	315	11/0.433	Cu	580		4200	420.02
20	315	22/0.433	Cu				
21	500	11/0.433	Cu				
22	500	22/0.433	Cu				
23	630	11/0.433	Cu	1000		7000	840.04
24	630	22/0.433	Cu				

DRAWINGS

- SS-1 : 22kv Plinth mounted substation
- SS-2 : 22kV Pole mounted substation
- SS-3 : Layout of Plinth mounted substation with feeder pillar
- SS-4 : Layout of Plinth mounted substation with LT panel room
- SS-5 : Layout of Plinth mounted substation with 4 pole structure for 2 transformers
- SS-6 : Layout of Partial outdoor substation
- SS-7 : Layout of Indoor substation for one transformer
- SS-8 : Layout of Indoor substation for two transformers
- SS-9 : 22kV Metering cum isolator panel
- SS-10 : 11kV Earth pits & connections
- SS-11 : Overhead line distribution system 1
- SS-12 : Overhead line distribution system 2

Chapter 11

GENERATORS

11.1	Generators	GEN-GEN
11.2	AMF Panel	GEN-AMF
11.3	Acoustic Enclosure	GEN-ACS
11.3	Drawings	

11.1 Generators**A) Portable Generator (PG)****Scope:****Specification No (GEN-PG)**

The work includes supplying, erecting, final testing, putting in to operation and handing over of the complete system of portable generator set with petrol start & Kerosene run suitable to give specified output at 220 V +/-13 volts A. C. with accessories like tool kit and comprehensive maintenance of the installation up to 1 year from date of commissioning.

Material:

Portable generator suitable to give output 1400 VA/ 2000 VA output Generator with built in voltmeter, non fuse circuit breaker, along with one set of tool kit comprising of one spanner, screw driver spark plug opener & Oil, fuel etc.

Portable Generator shall be of standard design and of original manufacturer with petrol start and kerosene run engine of 4 stroke, single cylinder, TCI ignition system, centrifugal governor, air cooled, semi dry type air cleaner and recoil starter, noise suppressor, oil alert system, with brushless, self exciting, two pole, rotating field type and with "E" class insulation alternator suitable to give specified output, duly tested at full load for continuous 2 hours with first filling of oil and fuel.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

B) Diesel Generator (DG)**Scope:****Specification No (GEN-DG)**

Providing D.G. Set at site, carrying out all preparatory works, assembling, installing, making adjustments, confirming all pre-commissioning requirement as per manufacturer's instructions, commissioning, final testing, putting in to operation and handing over of the complete system of D.G. set including inspection from inspectorate office. The work include necessary minor Civil works including opening on wall/Slab/floor and making good as it was etc. & comprehensive maintenance of the DG set for 1 year from date of commissioning.

Material:

Diesel Generator set with continuous rating, 3 Phase, 415 V., 50 Cycles A.C. supply of specified capacity, comprising of totally enclosed air/water cooled diesel engine with standard control panel & tool kit. ([Refer drawing no. GEN-DG-1 & GEN-DG-2](#))

Diesel Engine:

The engine shall be of standard design of original manufacturers. It should be a totally enclosed air/water cooled Diesel engine with 4 stroke multi cylinders developing suitable BHP (As per Table 11/3) for giving power rating of (As per table 11/3) at the load terminals of alternator at 1500 R.P.M., at armature temperature of 40⁰ C for height at 1000 Meter above M.S.L. at 50% R.H. The engine shall be capable of delivering specified power at variable loads for P.F. of 0.8 (lag) with 10% over load available in excess of specified output for one hour in every 12 hours. The average load factor of the engine over period of 24 hours shall be 0.85 for power output. The engine shall conform to IS: 10000 and Amended up to date.

The engine shall be fitted with following accessories:-

- 1) Dynamically balanced fly wheel.
- 2) Necessary flexible coupling and guard for alternator and engine applicable
- 3) Lubricating oil cooler
- 4) Air cleaner Dry/Bath type
- 5) Lubricating oil pressure gauge
- 6) Lubricating oil filter with replicable element

7) Dry exhaust manifold with suitable exhausts heavy duty residential type exhaust silencer and vertical hot air duct both lagged with asbestos rope exhaust piping of required length to reduce noise level.

8) 12/24 V. Electric starting equipment complete with standard batteries, dynamo, cut-out, ammeter, necessary wiring, self starter etc. The system shall be capable of starting D.G. set within 20 to 30 second even in winter condition with an ambient temperature down to 0° C.

9) Mechanical Governor of Class A2 for up to and including 200 KVA capacity and electronic governor of Class A1 for capacity above 200 KVA shall be provided as per standard design of manufacturer. Governor shall be a self contained unit capable of monitoring speed.

10) Radiator

11) Daily fuel Tank

Daily fuel service tank of minimum capacity as per Table 11/1, below, fabricated from M.S. sheet with inlet, outlet connections air vent tap, drain plug and level indicator (gauge) M.S. fuel piping from tank to engine with valves, unions, reducers, flexible hose connection and floor mounting pedestals, twin fuel filter. The location of the tank shall depend on standard manufactures design.

Table 11/1

Minimum capacity of Daily fuel tank for Generators

Sr. No	Capacity of D.G. set	Minimum Fuel Tank Capacity
1.	Up to 25 KVA	100 Liters
2.	Above 25 KVA to 62.5 kVA	120 Liters
3.	Above 62.5 KVA to 125 KVA	225 Liters
4.	Above 125 KVA to 200 KVA	285 Liters
5.	Above 200 KVA to 380 KVA	520 Liters

Engine Control Panel:

Engine control panel should be fitted with following accessories/indicators and shall have display:-

- Start/stop key switch
- Lube oil pressure indication
- Water temperature indication
- RPM indication
- Engine Hours indications
- Battery charging indication
- Low lube oil trip indication
- High water temperature indication
- Over speed indication

Battery Charger:

The battery charger shall be of Trickle & Boost type, and suitable to charge required numbers of batteries at 12V/ 24 Volts complete with, transformer, rectifier, charge rate selector switch, indicating ammeter, voltmeter, battery over charging protection with audible alarm. Connections between the battery charger & batteries shall be provided with suitable copper leads with lugs.

Battery:

Battery capacity and copper cable sizes for various engine capacities shall be as per the details given in Table No 11/2. Cable sizes shown are for maximum length of 2m length, if higher size of cable is required, it shall be selected in such a way that voltage drop does not exceed 2 V.

Table 11/2
Battery Capacity and Copper Cable Sizes for Various Engine Capacities

S.No.	D G Set Capacity	Battery Capacity (AH)	Copper Cable size in mm ²	Electrical System (Voltage)
1.	Upto 25 kVA	88	35	12
2.	Above 25 kVA upto 62.5 kVA	120	50	12
3.	Above 62.5 kVA upto 82.5 kVA	150	50	12
4.	Above 82.5 kVA upto 125 kVA	180	50	24
5.	Above 125 kVA upto 500 kVA	180	70	24

For AMF applications, a static battery charger working on mains supply recommended to keep the batteries charged at all times.

Alternator:

Alternator of specified rating, 415 Volts, 1500 RPM, 3 Ph, 50 HZ, A/c Supply with P.F 0.8 lagging at 40^o C armature temperature for height 1000 mtr. Above MSL at 50 % R.H.

alternator shall be brush less type self regulated having static excitation system having capacity of desired output confirming to IS: 4722-1968 with automatic voltage Regulation + 5% operated voltage from no load to full load, two numbers of earth terminal on opposite sides. Terminal box shall be suitable for underground cables and same shall be with stand mechanical and thermal stresses developed due to any short circuit at the terminals. The alternator shall be in accordance with following standards:-

IS: 4722 The performance of rotating electrical machines

IS: 4889 Rules for method of declaring efficiency of electrical machines

IS: 13364 Part I 1992 Alternator-voltage Regulation up to 20 KVA

IS: 13364 Part II 1992 Alternator Voltage regulation above 20 KVA to 80 KVA

Performance:

Voltage dip shall not exceed 20 % of the rated voltage for any step load or transient load as per IS: 8528 (Part I). The winding shall not develop hot spots exceeding safe limits due to unbalance of 20% between any two phases from no load to full load.

The performance characteristics of the alternator shall be as below:-

- (a) Efficiency at full load 0.8 P.F.
 - (i) Up to 25 KVA- not less than 82 %
 - (ii) Above 25 KVA and up to 62.5 KVA- not less than 86 %
 - (iii) Above 62.5 KVA/upto 250 KVA- not less than 90 %
 - (iv) Above 250 KVA- not less than 93 %
- (b) Total Distortion factor
 - Less than 3 %
 - (i) 10 % Overload One Hour in every 12 hrs of continuous operation
 - (ii) 50% overload 15 seconds.

Common Base Plate:

Engine and alternator shall be coupled by means of flex plate/flexible coupling as per manufacturer standard design and both units shall be mounted on a common base plate together with all auxiliaries to ensure perfect alignment of engine and alternator with minimum vibrations. The base plate shall be suitable for installation on suitable anti-vibration mounting system comprising of 6 anti-vibration pads duly provided.

Control Panel:

Floor/wall mounted control panel Box comprising of voltmeter, ammeter, selector switches MCCB/MCB of adequate capacity, indicator lamp duly wired with HRC fuses. Alternator &

control panel shall be connected with provided suitable capacity armored cable with necessary cable glands & lugs etc.

Exhaust system:

It shall comprise of following parameters:-

Exhaust system should create minimum back Pressure.

Smooth bends shall be used for minimizing the back pressure.

Minimum number of bends shall be used for minimizing the back pressure.

Pipe sleeve of larger diameter should be used while passing the pipe through concrete wall & gap shall be filled with felt lining.

Exhaust piping inside the Acoustic enclosure / Generating set room should be lagged with asbestos rope and covered with aluminum sheet cladding to avoid heating of the area.

Class 'B' MS pipes and long bend/elbows should be used.

The exhaust outlet should be in the direction of prevailing winds and should not allow exhaust gases to enter air inlet / windows, etc.

Factory Testing:

DG set shall be tested in presence of Engineer in charge or his authorized representative in the factory for following before dispatch;

- Full load trial for 12 hour. Fuel, lubricating oil, etc shall be arranged by the agency.
- 10% overload trial for one hour within 12 hrs test.

Certificates:

- Manufacturer's test certificates for Engine, Alternator and of the set.
- Necessary certificate for the engine model so selected along with compliance of noise and emission norms as per latest CPCB guidelines for D.G. set should be furnished from the manufacturer along with manufacturer's technical details.
- Permission from Electrical Inspector.

Method of Construction:

The DG Set with canopy shall be erected with due care and ensuring the perfect level with the help of Spirit level, on provided cement concrete foundation and connecting the provided earthing connections. The exhaust system shall be connected to the exhaust manifold. After ensuring the filling of fuel, lubricating oil and medium of coolant, the set shall be commissioned, with giving necessary full load trials or with the available load at site. The set shall then be handed over to the department along with the installation report given by the manufacturer and with all the necessary certificates and permissions obtained.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

Table No 11/3

Rating of Alternator and minimum BHP of Engine

S No.	KVA Capacity of Alternator	Minimum BHP of Diesel Engine	Average Fuel consumption litre per hour at 100 % Load
1	10	12	3.0
2	15	19	4.1
3	20	26	6.0
4	25	32	6.4
5	30	42	8.3
6	40	50.5	10.3
7	50	65.8	13.0
8	62.5	76	15.6
9	75	91	16.0
10	82.5	102	18.6
11	100	127	22.8
12	125	154	28.0
13	140	166	30.0
14	160	198	34.3
15	180	235	40.0
16	200	254	44.0
17	250	313	54.0

11.2 Automatic Mains Failure Panel (AMF)

Scope:

Specification No (GEN-AMF)

The work includes supplying, installing, Testing & commissioning of automatic mains failure control panel including auto by-pass, suitable for specified rating of DG Set complete with accessories **and comprehensive maintenance of the panel up to 1 year from date of commissioning.**

AMF Panel shall comply following IS specification:

IS: 2147 1962

Degree of protection.

IS: 4722

H.V. testing for panel

Material:

Panel shall consist of following:

Power module a pair of electromechanically interlocked contactors for all the phase / phases & neutral. (For mains & generator)

Overload relay for generator contactor, neutral contactor for mains and generator.

Control and Metering module: Line voltage monitor. Generator voltage monitor, Ammeter, 3 times attempt to start facility.

MCB/MCCB of suitable rating for auto/manual operation. Auto/manual switch.

Emergency stop push buttons.

Manual start push button.

Frequency meter.

Engine hour and RPM meter. (Taco meter)

Two earthing studs.

Protection module: The engine shutdown in the unlikely event of low lube oil pressure, high cylinder head temperature, high water temperature (For water cooled engine)

Indicators with alarm for Full/ Maximum Load on generator.

Indicators for Load on mains, Load on D.G. set, Engine fails to start, Emergency stop.

Battery charger complete with transformer/ rectifier, D.C Voltmeter and Ammeter, selector switch for trickle, off, and boost charging and current adjustment.

Main supply failure monitor.

Timers.

Fault reset push button.

Method of Construction:

AMF Panel complete with relays, timers, set of CT's for metering & protection and energy analyzer to indicate currents, phase and line voltages, frequency, power factor, KWH, KVARH & provision for overload, short circuit, fault, under frequency, control cabling from AMF panel to diesel engine and elsewhere if required, complete with metering as per material list.

System Operation:

The above-mentioned facilities provided shall be functional for following operational requirements:

1. Auto Mode

- A line voltage monitor shall monitor supply voltage on each phase when the mains supply voltage fails completely or falls below set value (variable between 80 to 95 % of the normal value) on any phase, the monitor module shall initiate start-up of diesel engine. To avoid initiation due to momentary disturbance, a time delay adjustment between 0 to 5 second shall be incorporated in start-up intimation.
- A three attempt starting facility shall be provided 6 seconds ON, 5 seconds OFF, 6 seconds ON, 5 Seconds OFF, 6 seconds ON. If at the end of the third attempt, the engine does not start it shall be locked out of start and a master timer shall be provided for this function, suitable adjustment timers are to be incorporated which will make it feasible to vary independently ON-OFF setting periods from 1-10 seconds, if alternator does not build up voltage after the first or second start as may be the case, further starting attempt will not be made until the starting facility is reset.
- Once the alternator has built up voltage, the alternator circuit breaker shall close connecting the load to the alternator. The load is now supplied by the alternator. When the main supply is restored and is healthy as sensed by the line voltage monitor setting, both for under voltage or unbalance, the system shall be monitored by a suitable timer which can be set between 1 minute to 10 minutes for the load to be transferred automatically to main supply.
- The panel shall start the set in the event of fault condition of under voltage, over voltage, phase reversal, high frequency, neutral snapping, short circuit, etc., on the mains side. If the above fault condition arises if the load is being fed from the DG Set, then the panel start cut off the load from the set with an audible alarm, and the set shall run on no load.

2. Manual Mode:

- In a manual mode, it shall be feasible to start-up the generator set by the operator on pressing the start push button.
- Three attempts starting facility shall be operative for the start-up function.
- Alternator circuit breakers closing and trip operations shall also be through operator only by pressing the appropriate button on the panel and closed shall be feasible only after alternator has built up full voltage.

3. Test Mode:

- When under test mode, pressing of test button should complete the start up sequence simulation, and engine shall be started.
- Engine shall build up voltage but the set shall not take load by closing alternator circuit breaker when the load is on the mains, monitoring performance for voltage/ frequency etc. shall be feasible without supply to load
- If during test mode, the power supply has failed, the load shall automatically get transferred on DG Set.
- Bringing the mode selector to auto position shall shut down the set provided main supply is ON if the mains supply is not available at that time, the alternator shall take load.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

11.3 Acoustic Enclosure (AEC)

Scope:

Specification No (GEN-AEC)

The Work includes supplying & erecting the Acoustic Enclosure (Canopy) fabricated from CRCA sheet of specified gauge, suitable for indoor / outdoor installation exposed to weather conditions & to limit overall noise level to 75 dB at distance 1 meter from the enclosure as per CPCB / MPCB norms under free field condition.

Material:

Acoustic enclosure (canopy) shall be fabricated out of the CRCA sheet of thickness not less than 1.6 mm on the outside cover with inside cover having not less than 0.6 mm thick perforated power coated CRCA sheet.

Method of Construction:

The construction of Acoustic enclosure (canopy) should be such that, it shall prevent entry of rain water splashing into the enclosure, and shall allow free & quick flow of rain water to the ground in the event of heavy rain.

The detailed construction shall conform to the details as under:-

The hinged doors shall be made from not less than 16 SWG (1.6 mm) thick CRCA sheet and will be made air tight with neoprene rubber gasket and heavy duty locks.

All sheet metal parts should be processed through 7-tank process.

The enclosure should be powder coated.

The enclosure should accommodate the daily service fuel tank of the D.G. set to make the system compact.

There should be provision of fuel gauge, which should show the level of the fuel even when the DG set is not running. The gauge should be calibrated. The fuel tank should be filled from the out side as in automobiles and should be with a lockable cap.

The batteries should be accommodated in the enclosure in battery rack.

The canopy should be provided with high enclosure temperature safety device.

The acoustics lining should be made up of high quality insulation material/ glass / mineral or rock wool of minimum 50 mm thickness and shall be of 75 kg/m³ to 100 kg/m³ density for sound absorption as per standard design of manufacturers to reduce the sound level as per CPCB norms. The insulation material shall be covered with fine glass fiber cloth and would be supported by perforated MS sheet duly powder coated.

The enclosure shall be provided with suitable size and No. of hinged type doors along the length of the enclosure on each side for easy access inside the acoustic enclosure for inspection, operation, and maintenance purpose. Sufficient space will be provided inside the enclosure on all sides of the D.G. set for inspection, easy maintenance, and repairs.

The canopy should be as compact as possible with good aesthetic look

The complete enclosure shall be of modular construction.

The forced ventilation shall be as per manufacturer design using either engine radiator fan or additional blower fans. If the acoustic enclosure is to be provided with forced ventilation then suitable size of axial flow fan with motor (Auto-start arrangement) and suitable size of axial flow exhaust fan to take the hot air from the enclosure complete with necessary motors and auto start arrangement should be provided. The forced ventilation arrangement should be provided with auto stop arrangement to stop after 5 minutes of the stopping of D.G. sets.

The acoustic enclosure should be suitable for cable connection through bus-trucking. Such arrangements on acoustic enclosure should be water proof and dust-proof conforming to IP-65 protection.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each)

Chapter 12

WATER PUMPS

12.1 Centrifugal	WP-CGP/
12.2 Ejecto type Water Pump	WP-EJP/
12.3 Submersible Pumps for Bore wells	WP-SMP/
12.4 Submersible pumps for Open well	WP-OSP
12.5 Accessories	No Specs
12.6 Drawings	

12.1 Centrifugal Pump (CGP)**General:**

This part of the specifications deals with providing, installing, testing & commissioning of Centrifugal pump.

All material shall conform to relevant standard as per BIS and shall carry ISI mark.

Work shall be carried out as per the method of construction as specified by BIS/Chapter 16 of P.W. Dept. Handbook/NEC.

Scope:

Specification No (WP-CGP)

Providing, installing, testing & commissioning of ISI mark Centrifugal water pump (Monobloc), of required HP with specified discharge and head with required size of suction & delivery, foundation bolts grouted in provided cement concrete. (As Per IS: 9079 specifications)

The following list records those Indian Standards, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical Code

SP 7 (Group 4): 2005 : National Building Code

Material:

Pump Body: Cast iron Grade FG 200 of IS 210 -1978

Impeller: Cast iron Grade FG 200 of IS 210 -1978

Shaft: High grade carbon steel Grade C-40 of IS 2073

Bearings: Stainless Steel

Motor: Squirrel cage induction.

Protection class: IP 55 TEFC with Class "F" insulation, with copper windings operated on Single phase, 250 V / Three phase 415 V, 50 Hz, AC, Supply, with 2900 RPM. IS: 325

Base plate: Mild steel

Foundation Nut Bolts: Mild steel

Shaft seal: Fitted with high quality mechanical seal ensuring zero leakage

Method of Construction:

Pump mounted with motor on base plate, shall be placed on provided foundation with perfect alignment, proper leveling. The pump should be connected to suction & delivery in an approved manner, with provided MS / CI flange. (Refer drawing no.WP-1 (Fig.1))

After the completing the erection of pump ,it shall be run continuously for minimum 2 hours, and following tests shall be carried out for its performance:

a) Alignment, b) Bearing noise, c) Discharge, d) Current

Mode of Measurement: Executed quantity will be counted on number basis. (Each)

Dismantling:

Dismantling of pump along with/without pipeline shall be done with utmost care with required tools / shackles, machinery, if any. The dismantled pump and the pipeline shall be store in a safe place or shall be transported to the place as per the direction of Engineer-in-charge.

Mode of Measurement: Executed quantity will be counted on number basis. (Each)

12.2 Ejecto Type Jet Water Pump (EJP)**General:**

This part of the specifications deals with providing, installing, testing & commissioning of Ejecto type Jet pump.

All material shall conform to relevant standard as per BIS and shall carry ISI mark.

Work shall be carried out as per the method of construction as specified by BIS/Chapter 16 of P.W. Dept. Handbook/NEC.

Scope:

Specification No (WP-EJP)

Providing, installing, testing & commissioning of ISI mark Ejecto type Jet water pump of required HP with specified discharge and head with required size of suction, delivery & pressure pipe, with "H" type MS clamps to hold the suction & pressure pipe and duly grouted with foundation nuts & bolts on provided cement concrete, spring washers of requisite size or on provided angle iron frame. (As Per IS 9079 specifications)

The following list records those Indian Standards, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical Code
SP 7 (Group 4): 2005 : National Building Code

Material:

Pump Body: Cast iron Grade FG 200 of IS 210 -1978

Impeller: Cast iron Grade FG 200 of IS 210 -1978

Shaft: High grade carbon steel Grade C-40 of IS 2073

Bearings: Stainless Steel

Motor: Squirrel cage induction. TEFC fan cooled with Class "F" insulation, with copper windings operated on Single phase, 250 V / Three phase 415 V, 50 Hz, AC Supply, with 2900 RPM. IS: 325

Venturi & nozzle: High tensile bronze.

H type clamps with nut bolts: Made from Mild steel.

Foundation Nut Bolts: Mild steel.

Method of Construction:

First inspect the jet pump for any foreign particles in nozzle as well as in venturi with the help of screw for freeness of plunger of foot valve to ensure no damage has taken place in transit. Plunger should be free for up & down movements. While connecting Suction & pressure pipe to jet pump, do not over tighten as this may damage the threads on jet pump and also do not move away the two pipes. A good practice is to hold two pipes together by tying with steel wire keeping the pipes in vertical position & filling the same with water & checking the leakage of venturi, as well as of joints. Ensure that the pipes are independently supported so as to avoid the transmitting of load of pump.

After the completing the erection of pump, it shall run continuously for minimum 2 hours, and following tests shall be carried out for its performance:

a) Alignment, b) Bearing noise, c) Discharge, d) Current

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each).

Dismantling:

Dismantling of pump along with the pipeline shall be done with utmost care with required tools / shackles, machinery, if any. The dismantled pump and the pipeline shall be store in a safe place or shall be transported to the place as per the direction of Engineer-in-charge.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each).

12.3 Submersible Pump for Bore Well (SMP)

General:

This part of the specifications deals with providing, installing, testing & commissioning of Submersible pump.

All material shall conform to relevant standard as per BIS and shall carry ISI mark.

Work shall be carried out as per the method of construction as specified by BIS/Chapter 16 of P.W. Dept. Handbook/NEC.

Scope:

Specification No (WP-SMP)

Supplying and erecting ISI mark submersible pump set suitable for bore well, with high quality wear resistance and dynamically balanced bronze impeller with stainless steel shaft sleeves, pump-coupling and pivot with squirrel cage induction motor of 415 V/230 V, 50 cycles A.C. supply winding with waterproof PVC insulated copper wire of high precision strength, not to be affected by chemically aggressive water and suitable bronze

bearings with nut & bolts etc. of required stage, specified H.P, discharge, head and delivery pipe with necessary H. type clamp of suitable size and strength.

The following list records those Indian Standards, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical Code
SP 7 (Group 4): 2005 : National Building Code
IS 8034 : Submersible Pumps

Material:

Pump Body: Cast iron Grade FG 200 of IS 210 -1978.

Impeller: Made of Gun metal.

Shaft: High carbon steel Grade C-40 of IS 2073.

Bearings: Mitchell type thrust bearing unit with tilting pad assembly.

Motor & Pump: Windings with weather proof class, PVC insulated copper wire, Rotor with stainless steel shaft & spine coupling, Stage casing high grade engineering polymer & intermediate plate with stainless steel protection ring, Re-woundable stator with stainless steel casing, Diffuser with stainless steel protection ring, etc.

H type clamps with nut, bolts: Made from Mild steel.

Foundation Nut Bolts: Mild steel.

Method of Construction:

Before installing the pump, the bore shall be checked thoroughly for its trueness and presence of any protruding material (stones, tree roots, etc). After ascertaining the trueness, the pump along with pipe line shall be lowered in to the bore with the help of Tripod. While connecting delivery pipe to Submersible pump do not over tighten as this may damage the threads on Submersible pump, Keep the pipes in vertical position & fill the same with water & check the leakage at joints. The delivery pipes shall be clamped with 2 Nos of 'H' type clamps and shall be rested on the top of the bore casing. (Refer drawing no.WP-1 (Fig.2))

After the completing the erection of pump ,it shall be run continuously for minimum 2 hours, and following tests shall be carried out for its performance:

a) Alignment, b) Bearing noise, c) Discharge, d) Current

Mode of measurement: - Executed quantity will be counted on number basis. (i.e. each).

Dismantling:

Dismantling of pump along with the pipeline shall be done with utmost care with required tools / shackles, machinery, if any. The dismantled pump and the pipeline shall be store in a safe place or shall be transported to the place as per the direction of Engineer-in-charge.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each).

12.4 Submersible Pumps for Open well (OSP)

General:

This part of the specifications deals with providing, installing, testing & commissioning of Submersible pump.

All material shall conform to relevant standard as per BIS and shall carry ISI mark.

Work shall be carried out as per the method of construction as specified by BIS/Chapter 16 of P.W. Dept. Handbook/NEC.

Scope:

Specification No (WP-OSP)

Supplying and erecting ISI mark submersible pump set suitable for bore well, with high quality wear resistance and dynamically balanced bronze impeller with stainless steel shaft sleeves, pump-coupling and pivot with squirrel cage induction motor of 415 V/230 V, 50 cycles A.C. supply winding with waterproof PVC insulated copper wire of high precision strength, not to be affected by chemically aggressive water and suitable bronze bearings with nut & bolts etc. of required stage, specified H.P, discharge, head and delivery pipe with necessary H. type clamp of suitable size and strength.

The following list records those Indian Standards, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical Code
SP 7 (Group 4): 2005 : National Building Code

Material:

Pump Body: Cast iron Grade FG 200 of IS 210 -1978.

Impeller: Made of high quality and purity Bronze metal.

Shaft: High grade carbon steel Grade C-40 of IS 2073.

Bearings: Stainless steel.

Motor & Pump: Windings with weather proof class, PVC insulated copper wire, Rotor with stainless steel shaft & spine coupling, Stage casing high grade engineering polymer & intermediate plate with stainless steel protection ring, Re-woundable stator with stainless steel casing, Diffuser with stainless steel protection ring, etc.

H type clamps with nut bolts: Made from Mild steel.

Foundation Nut Bolts: Mild steel.

Method of Construction

While connecting delivery pipe to Submersible pump do not over tighten as this may damage the threads on Submersible pump, Keep the pipes in vertical position & fill the same with water & check the leakage at joints. The delivery pipe shall be clamped with 2 Nos of 'H' type clamps and shall be rested on the top of the well.

After the completing the erection of pump ,it shall be run continuously for minimum 2 hours, and following tests shall be carried out for its performance:

a) Alignment, b) Bearing noise, c) Discharge, d) Current

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each).

Dismantling:

Dismantling of pump along with the pipeline shall be done with utmost care with required tools / shackles, machinery, if any. The dismantled pump and the pipeline shall be store in a safe place or shall be transported to the place as per the direction of Engineer-in-charge.

Mode of Measurement: Executed quantity will be counted on number basis. (i.e. each).

Chapter 13

FIRE FIGHTING & FIRE ALARM

13.1 Main Fire Pumps (Single Stage Centrifugal)	FF-MFP/SSC
13.2 Main Fire Pumps (Multi Stage Centrifugal)	FF-MFP/MSC
13.3 Main Fire Pumps (Submersible)	FF-MFP/SBM
13.4 Jockey Pumps	FF- MFP/JP
13.5 Booster Pump	FF- MFP/BP
13.6 Pipes	FF-PP
13.7 Valves	FF-VL
13.8 Fire Fighting Accessories	FF-FFA
13.9 Fire Alarm System	FF-FAS
13.1 Fire Alarm accessories	FF-FAAS
13.1 P. A. System	FF-PAS
13.1 Sprinklers	FF-SPR

- 13.1 Main Fire Pumps (Single Stage Centrifugal) (FF-MFP/SSC)
 13.2 Main Fire Pumps (Multi Stage Centrifugal) (FF-MFP/MSC)
 13.4 Jockey Pumps (FF-MFP/JP)
 13.5 Booster Pumps (FF-MFP/BP)

General:

Fire safety in building has become very important consideration in construction and maintenance. A normal office building has fire load in the form of large quantity of papers and furnishing. Buildings like Hospitals, Laboratories, Auditorium, Libraries, and Museum etc. require fire safety provisions by virtue of their type of occupancy and importance irrespective of their height.

The design and installation of a fire fighting system is of utmost importance. The fire fighting installation on completion will have to be got cleared from the local fire fighting authorities (Fire Service) for its efficacy, suitability and usability by the Fire Service in the event of a fire.

Following types of water based fixed fire fighting installations are normally provided in buildings:

- Wet Riser.*
- Down Comer.*
- Automatic Sprinkler.*

The design of fire fighting system for a building shall base as per the provisions in National Building Code of India (Part IV) (Amended up to date) and also considering the provisions in the Development Control Rules of local body/authority.

The operating pressure of individual hydrant shall be between 5.5 kg/cm² to 3.5 kg/cm² and the operating pressure of the furthest level hydrant from main pump shall be minimum 3.5 kg/cm².

The pipeline will be designed in such a way that it should be possible to get discharge at any location.

Specifications:

This part deals with the specifications of following pumps:

Specification No(s)

- | | |
|-----------------------------------|--------------|
| 1. Main Fire Pumps (Single Stage) | (FF-MFP/SSC) |
| 2. Main Fire Pumps (Multi Stage) | (FF-MFP/MSC) |
| 3. Jockey Pumps | (FF- MFP/JP) |
| 4. Booster Pumps | (FF-MFP/BP) |

Scope:

Supplying, installing, testing, perfect aligning, proper levelling and commissioning of Fire service main/jockey/booster pump single/multi stage having specified discharge and head with required HP or similar to with minimum parameters, confirming to IS: 1520 with specified size of suction and delivery pipes, coupled with squirrel cage A.C. induction motor. The pump set shall be erected in alignment on cement concrete foundation.

The Main Fire pumps should be able to deliver minimum operating pressure of 3.5 kg/cm² at highest and farthest hydrant.

Selection of Main Fire Pumps (Single & Multi Stage Centrifugal type) shall be as per Table No. 13.1/1, & 13.1/2 and, whereas the selection of Jockey Pump (Centrifugal type) & Booster Pump (Centrifugal type) shall be as per Table No. 13.1/3 & 13.1/4 respectively.

Material:**Pump Body:**

The centrifugal pumps shall conform to IS 1520. The pump casing shall be of heavy section close grained cast iron and designed to withstand 1.5 times the working pressure. The casing shall be provided with shaft seal arrangement as well as flanges for suction and delivery pipe connections as required.

Impeller:

The impeller shall be bronze. This shall be shrouded type with machined collars. Wear rings, where fitted to the impeller, shall be of the same material as the impeller. The impeller surface shall be smooth finished for minimum frictional loss. The impeller shall be secured to the shaft by a key.

Shaft:

The shaft shall be of stainless steel EN-8/ C – 40 and shall be accurately machined. The shaft shall be balanced to avoid vibration at any speed within the operating range of the pump.

Shaft Sleeve:

The shaft sleeve shall be of bronze.

Bearing:

The bearing shall be of stainless steel and of ball or roller type suitable for duty involved. These shall be grease lubricated and shall be provided with grease nipples /cups. The bearings shall be effectively sealed against leakage of lubricant or entry of dust or water.

Shaft seal:

The shaft seal shall be mechanical type so as to allow minimum leakage. A drip well shall be provided beneath the seal.

Motor:

Suitable HP squirrel cage induction motor, TEFC (totally enclosed fan cooled) synchronous speed 2900 RPM, suitable for operation on 415 volts, 3 phase 50 Hz. AC with IP 55 protection for enclosure, horizontal foot mounted type with Class-'F' insulation, conforming to IS-325.

Body: Cast iron

Rotor Shaft: Stainless steel

Bearing: Refer specification for bearing under Pump above.

Winding: Class 'F' insulated copper winding.

Base plate: Fabricated from Mild Steel, foundation bolts etc.

Cement Concrete Foundation: Cement, Sand, and Water, in 1:2:4 ratio.

Anti Vibrating Pads: Made from high quality rubber of specified grade and strength.

Hardware: Mild Steel

Method of Construction:

The surface of the pump foundation should be chipped with pneumatic hammer or sharp pointed chisel. The teak wood box of appropriate size shall be placed and filled with cement concrete in 1:2:4 ratio with 20 to 25 mm stone metal and required size and strength of foundation nut & bolts. The necessary curing & finishing shall be done in approved manner. The M.S. fabricated base plate of suitable size & strength should be fixed with anti-vibration rubber pads. Proper levelling and alignment shall be observed before tightening of foundation bolts. Both the pump and motor shall be placed on common base plate frame with perfect alignment, proper levelling. The pump should be connected to pipe line with M.S. flanges, gaskets, nut bolt etc and shall be checked for the leakages. The coupling guard shall be provided with nut bolts of required size. The pump shall be tested for 3.5 kg/cm² pressure at highest and farthest point of the building for minimum 2 hours. The necessary test certificate from manufacturer of pump and motor shall be produced. The motor should have efficiency more than 90% and power factor above 0.80.

Mode of Measurement:

Executed quantity shall be measured on number basis.

**Table No. 13.1/1
Fire Fighting pump (Single Stage Centrifugal)**

Capacity in HP	Speed in RPM	Discharge in LPM	Head in metre	Suction/Delivery Size in mm
30	2900	1400	56	80/65
50	2900	1800	76	80/65
75	2900	2400	76	100/80

**Table No. 13.1/2
Fire Fighting pump (Multi Stage Centrifugal)**

Capacity in HP	Speed in RPM	Discharge in LPM	Head in metre	Suction/Delivery Size in mm
30	1450	1400	56	80/65
50	1450	1800	76	100/80
75	1450	2400	88	125/100
75	1450	2800	76	125/100
120	1450	2800	105	150/125

**Table No. 13.1/3
Jockey Pump (Centrifugal type)**

Capacity in HP	Speed in RPM	Discharge in LPM	Head in metre	Suction/Delivery Size in mm
15	2900	240	56	50/32
20	2900	240	105	50/32

**Table No.13.1/4
Booster Pump (Centrifugal type)**

Capacity in HP	Speed in RPM	Discharge in LPM	Head in metre	Suction/Delivery Size in mm
7.5	2900	450	35	50/32
10	2900	468	40	50/32

13.3 Main Fire Pumps (Submersible) (FF- MFP/SBM)

13.4 Jockey Pumps (FF-MPF/JP)

Specification No

1. Main Fire Pumps (FF- MFP/SBM)

2. Jockey Pumps (FF- MFP/JP)

Scope:

Supply, installation, testing & commissioning of fire pump (submersible) of required stages having specified discharge and head with min. HP or equivalent for design parameters. Submersible pump sets shall be manufactured in accordance with IS: 8034 specifications.

Selection of Main Fire Pumps (Submersible type) shall be as per Table No. 13.1/5

Material:

Pump bowls & casings: Closed grained C.I. coated with special Epoxy resin paint or high corrosion resistance.

Impeller: Made form Gun metal & dynamically balanced for smooth and silent operations.

Strainer: Stainless steel

Bearing Bushes: Lead bronze

Bearing sleeves: High quality stainless steel

Pump shaft: High quality stainless steel & dynamically balanced for smooth and silent operations.

Motor body: Cast iron

Rotor shaft: High quality stainless steel & dynamically balanced for smooth and silent operations.

Stator Housing: MS Seamless tube.
Thrust bearing: Bronze
Thrust bearing plate: High quality fiber sheet
Windings: PVC insulated copper

Method of Construction:

The provided M.S. frame shall be erected at inclined level at bottom of sump in rigid manner. The submersible pump shall be erected on this frame & shall be clamped properly & shall be connected to delivery pipe line with M.S. flanges, gaskets, nut-bolts, water level guard connections, etc. The pump shall be checked for the leakages. The proper electrical connection shall be made. The pump shall be tested for 3.5 Kg/ cm². Pressure at highest & furthest point building for minimum 2 hours. The test certificate from manufacturer of pump and motor shall be submitted. The motor should have efficiency more than 90% and power factor above 0.80.

Mode of Measurement: Executed quantity shall be measured on number basis.

**Table No-13.1/5
 Fire Fighting pump (Submersible pump)**

Capacity in HP/ No. Of stages	Speed in RPM	Discharge in LPM	Head in metre	Delivery/Size in mm
30/2	2900	1400	56	130
45/3	2900	1800	76	130
75/5	2900	2400	88	
30/2	2900	1800	56	
105/7	2900	2800	105	
60/4	2900	2800	76	

13.6 Pipes (FF-PP)

Pipes

Specification No **(FF-PP)**

Scope:

Supplying erecting C class (Heavy Duty) galvanized iron pipe, ISI mark of specified diameter with screwed sockets, Joints & necessary G.I. fittings such as sockets, check nuts, elbows, bends, tees, reducers, enlarger, plugs, etc. including electric resistance welding (ERW), fixing with clamps & all connected works such as excavation, drilling holes in wall, slabs, backfilling & making good the damages.

Material:

The galvanized iron pipes shall be of type and diameter as specified and shall comply with I.S. 1239--1973 and 1969 for the specified type. The specified diameter of the pipes shall refer to the inside diameter of the bore pipes. The fittings of which the galvanizing has been damaged shall not be used. For the firefighting works, the C Class pipes and accessories shall be used.

Anti-Corrosive Protection On Under Ground Pipe:

Corrosion protection tape shall be wrapped on M.S. Pipes to be buried in ground. This corrosion protection tape shall comprise of coat tar/asphalt component supported on fabric of organic or inorganic fiber and minimum 4 mm. thick and conform to requirement of IS: 10221-Code of practice for coating and wrapping of under ground mild steel pipe line. Before application of corrosion protection tape all foreign matter on pipe shall be removed with the help of wire brush and suitable primer shall be applied over the pipe thereafter. The primer shall be allowed to dry until the solvent evaporates and the surface becomes tacky. Both primer and tape shall be furnished by the same manufacturer. Corrosion protection tape shall then be wound around the pipe in spiral fashion and bounded completely to the pipe. There shall be

no air pocket or bubble beneath the tape. The overlaps shall be 15 mm. and 250 mm. shall be left uncoated on either end of pipe to permit installation and welding. This area shall be coated and wrapped after the pipe line is installed.

The tapes shall be wrapped in accordance with the manufacturer's recommendations. If application is done in cold weather, the surface of the pipe shall be pre-heated until it is warm to touch and traces of moisture are removed and then primer shall be applied and allowed to dry.

No joint shall be located in the thickness of the walls.

If the pipe is required to be cut and the end threaded, the burns of the cut end shall be filled smooth and any obstruction in the bore shall be entirely eliminated. The rate includes wastage in cutting etc.

When the pipe is to be fixed to walls it shall be fixed with standard bracket, clips or holder bates keeping the pipe about 12mm clear of the wall. The pipe shall be fixed to the wall horizontally and vertically and parallel to one another when more than one pipe is laid unless unavoidable. The supporting clips, etc., for the pipe shall be spaced at about two meters or so as necessary. When holes are not left during construction they shall be cut into the walls or slabs, etc., to pass the pipe through or to fix clamps. etc., after fixing of the pipes, clamps etc., these shall be neatly made good.

Pressure Testing:

All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 10 kg/cm² for a period not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-Charge. Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

System may be tested in sections and such sections shall be securely capped.

Pressure gauges may be capped off during pressure testing of the installation.

Method of Construction:

Galvanized iron pipes of specified diameter and type and galvanized iron fittings with ERW shall be erected on MS angle support with one coat of red oxide primer and two coats of Post Office fire red enamel paint duly tested to 1.5 times of working pressure.

Excavating and back filling trenches including dewatering, cutting through walls, floor, etc., and making site good.

Laying, jointing, and fixing the pipe with the fittings including cutting pipes, wastage and threading the ends.

At all the road crossings the pipes shall be laid lower than the crust of the road.

During excavation if, any other service pipes (Water, electric, telephone, etc) come across, these shall be carefully protected and supported. Any damages done shall be made good.

The pipe shall be laid on a well compacted bed in the trench. The trench after laying the pipe shall be refilled except at the joints in layers and manually rammed. Care shall be taken to see that no earth, etc., gets inside the pipes.

The filling shall be kept raised by about 5 cm. for subsequent settlement. Bedding and cushioning of murum, good earth, or sand shall be provided for the pipe in case of trench through rock. The trench at the joints shall be filled similarly after satisfactory testing of the pipe. Any surplus excavated stuff shall be disposed of satisfactorily without causing nuisance.

Mode of Measurement:

Measurement shall be for one metre of each type and diameter of pipe laid complete with fittings, clamps etc., as specified.

The lengths shall be measured net on the straight and bends along the center line of the pipes and fittings correct up to a cm.

13.7 Valves (FF-VL)

A) Foot Valve with Strainer (-ve suction)

Scope:

Specification No (FF- VL/FV)

Supplying and installing cast iron foot valve of specified diameter with strainer conforming to IS: 4038 with Gun metal seat (flapper), nut bolts, gasket, washers etc. for negative suction.

Material:

Housing, seat discs and disc plates: Grey cast iron

Hinge pins and disc guide: High tensile Stainless Steel bars

Strainers: a) Grey cast iron, b) Galvanized steel

Disc faces: a) Vegetable tanned leather (Min. 3 mm. thick), b) Leaded tin bronze, c) Natural rubber (with reinforcement of cotton canvas), d) Synthetic rubber (with reinforcement of cotton canvas)

Flange jointing nature: a) Compressed fibre board or rubber minimum 1.5 mm thick. The fibre board shall be impregnated with chemically neutral oil and shall have a smooth and hard surface. b) Compressed asbestos fibre.

Method of Construction:

The footwall with strainer shall be fitted with provided flange, gaskets, nut bolts to be erected at required position and fitted firmly to pipe with proper alignment so as the joints should be leak proof with shellac and other material required including necessary labour and required tools and plants

Mode of Measurement:

Executed quantity shall be measured on number basis.

B) End line strainer (+ ve suction)

Specification No (FF- VL/ELS)

Scope:

Supplying and installing end liner strainer of specified diameter as per IS: 907, fabricated out of brass perforated sheet of 14 SWG (2.0 mm. thick) duly with brazing to flange or pipe with nut bolts, gaskets, washers etc, in position for only suction in an approved manner.

Material:

Body: Cast Iron

Strainer screen: Stainless steel/Brass screen of 1mm thick perforated sheet with 3 mm diameter holes.

Flange: Cast iron / M.S. sheet

Method of Construction:

End line strainer with strainer shall be fitted with provided flange, gaskets, nut bolts etc, and to be erected at the end of suction pipe, including labour and required tools and plants.

Mode of Measurement:

Executed quantity shall be measured on number basis.

C) Sluice valve

Specification No (FF- VL/SV)

Scope:

Supplying and installing cast iron double flange sluice valve of specified diameter conforming to IS: 780, ISI mark, having cast iron body and gun metal working parts with nut bolts, gaskets etc. and tested to 1.5 times of working pressure, in an approved manner.

Material:

Body: a) Brass, b) Leaded tin bronze

Bonnet or cover: a) Leaded tin bronze, b) Forged brass, c) Brass

Stuffing box, disc hinge, check nut, stem nut, disc retaining nut, gland, gland nut, gland flange, body seat rings and disc or wedge facing rings (where renewable): a) Leaded tin bronze, b) Extruded brass rod, c) Forged brass, d) Brass

Stem, hinge pin and plug: a) Extruded brass rod, b) High-tensile brass, c) Forged Brass

Ball (for ball type check valves): Chromium steel

Nut bolts: Mild steel

Hand wheel: Cast iron

Gasket: Compressed asbestos fibre

Gland packing: a) Hemp and jute, b) Asbestos

Spring: Phosphor bronze wire

Seating ring: Synthetic rubber

Method of Construction:

The double flange sluice valve shall be fitted with provided flange, gaskets, Nut bolts, etc. to be fitted to pipe, accessories with washers, spring washers, check nuts as required with proper alignment so as to be leak proof including necessary labour and required tools and plants.

Mode of Measurement:

Executed quantity shall be measured on number basis.

D) Butterfly valves

Specification No (FF- VL/BFV)

Scope:

Supplying & installing cast iron double flange butterfly valve of size 75/80mm.dia confirming to IS: 13095 having cast iron body, FG 220 Nitrite rubber replaceable seat with Moulded 'O' ring, C.I. powder coated disc flow control complete & tested to 1.5 times of working pressure in an approved manner.

Material:

Body: Cast iron Spheroid graphite iron Carbon steel

Disc: a) Cast iron Spheroid graphite iron carbon steel, b) Stainless steel Gun metal c) Aluminum bronze

Shaft: a) Stainless steel, b) Carbon steel Aluminum bronze Nickel copper alloy

Seating ring/Seal retaining ring: a) Stainless steel, b) Gun metal aluminum bronze deposited metal suitable for duty or resilient material

Seat: Elastomers

Shaft bearing seals: Manufacturer's standards suitable for duty

Internal fastenings: Stainless steel

External bolting: Carbon steel: tensile strength 390 n/mm or MPa

Method of Construction:

The double flange butterfly valve shall be fitted with provided flange, gaskets, Nut bolts etc. to be fitted to pipe, accessories with washers, spring washers, check nuts as required with proper alignment so as to be leak proof including necessary labour and required tools and plants.

Mode of Measurement:

Executed quantity shall be measured on number basis.

E) Non Return Valves

Specification No (FF- VL/NRV)

Scope:

Supplying and installing double flange NRV of specified diameter conforming to IS: 5312 (Part-I), ISI mark, having cast iron body and gun metal working parts with nut bolts, gaskets, etc. and tested to 1.5 times of working pressure in an approved manner.

Material:

Body, cover, door, bearing holder: Grey cast iron

Hinge pin, door pin and door suspension pin: Stainless steel

Body seat rings: Leaded tin bronze
Door face ring: Leaded tin bronze
Bearing bushes/ Bearing block: Leaded tin bronze
Plugs for hinged pin/Air release plug: Leaded tin bronze
Bolts: Carbon steel
Nuts: Carbon steel
Gaskets: Rubber
Hinges: Grey cast iron

P N Rating and Test Pressure:

S No.	PN Rating	Test for	Test Pressure (Gauge) MPa	Test Duration in minutes
1	PN 1.0	Body	1.5	5
		Seat	1.0	2
2	PN 1.6	Body	2.4	5
		Seat	1.6	2

Method of Construction:

The double flange NRV shall be fitted to pipe with provided flange, gaskets, and Nut bolts etc, accessories with washers, spring washers, and check nuts as required with proper alignment so as to be leak proof including necessary labour and required tools and plants.

Mode of Measurement:

Executed quantity shall be measured on number basis.

F) Gate Valves

Specification No (FF- VL/GV)

Scope:

Supplying & installing gun metal gate valve of specified diameter having threaded ends, conforming to IS: 778, ISI mark, along with G.I. threaded nipple.

Material:

Body: a) Brass, b) Leaded tin bronze

Bonnet or cover: a) Leaded tin bronze, b) Forged brass, c) Brass

Stuffing box, disc hinge, check nut, stem nut, disc retaining nut, gland, gland nut, gland flange, body seat rings and disc or wedge facing rings (where renewable): a) Leaded tin bronze, b) Extruded brass rod, c) Forged brass, d) Brass

Stem, hinge pin and plug: a) Extruded brass rod, b) High-tensile brass, c) Forged Brass

Ball (for ball type check valves): Chromium steel

Nut bolts: Mild steel

Hand wheel: Cast iron

Gasket: Compressed asbestos fibre

Gland packing: a) Hemp and jute, b) Asbestos

Spring: Phosphor bronze wire

Seating ring: Synthetic rubber

Method of Construction:

The Gate Valve shall be fitted to pipe with provided flange, gaskets, and Nut bolts etc, accessories with washers, spring washers, and check nuts as required with proper alignment so as to be leak proof including necessary labour and required tools and plants.

Mode of Measurement:

Executed quantity shall be measured on number basis.

G) Hydrant Valves (Landing Valves)

Specification No (FF- VL/HV)

Scope:

Supplying and installing gun metal single outlet hydrant valve Morris pattern, oblique type, conforming to IS:5290, ISI mark, with G.M. blanks cap and M.S. or G.I. chain in an approved manner.

Material:

Valve Body, bonnet, stop valve, Check nut, female outlet: Bronze/ Aluminium alloy or Stainless Steel

Valve spindle: Bronze/ Aluminum alloy or Stainless Steel

Hand Wheel: M.S. or C.I. (Black painted)

Spring: Made of phosphor wire.

Washer, Gasket: Rubber

Blank Cap: ABS plastic.

Method of Construction:

The hydrant valve shall be connected with provided flange, gaskets, Nut bolts etc. with use of required tools and plants.

The water discharge shall be not less than 900 lpm for single head and 1800 lpm for double head valves at 7 kg / cm²

Mode of Measurement:

Executed quantity shall be measured on number basis.

13.8 Fire Fighting Accessories (FF-FFA)

A) **Priming Tank**

Specification No (FF- FFA/PT)

Scope:

Supplying & Installing One piece Moulded HDP / Fibre water tank of required capacity with necessary plumbing material on provided M.S. structural supports in an approved manner.

Material:

Priming Tank: HDPE/ Fiber of good quality material

Gate Valves: As per (FF- VL/GV) above.

Method of Construction:

The Priming tank shall be installed on provided M.S. structural supports with 20/25 mm dia. inlet valve and 50 mm dia. outlet valve with provided necessary G.I. piping up to delivery of main fire pump before non-return valve.

Mode of Measurement:

Tank capacity will be measured on litre basis. (i.e. per litre)

B) **Hose Reel**

Specification No (FF-FFA/HRD)

Scope:

Supplying and installing wall mounting swinging Hose reel drum as per IS: 884 and fitted with 19 mm dia 22.5 meter long high pressure polypropylene (Polyhose) pipe as per IS: 444 (type III) G.M. chrome plated nozzle and 19 mm dia and G.M. gate valve on the inlet pipe with necessary M.S. Bracket for holding Hose reel drum fitted in position with wall fasteners, in an approved manner.

Material:

Hub and sides: Aluminum Alloy/Mild steel/ Aluminum sheet

Wall Bracket: Cast iron / Mild steel.

Hose tube (20 mm): Thermoplastic (Textile Reinforced) Type-2, (Nominal internal dia) as per IS- 12585

Nozzle with branch Pipe: Brass as per IS 8090

Stop Valve (Ball Valve): Gun metal.

Method of Construction:

The Wall Mounting swinging Hose reel drum with Gun Metal Nozzle, gate valve, shall be connected on M.S. bracket with provided flange, gaskets, Nut bolts etc. with use of required tools and plants. The water flow rate shall be not less than 24 LPM and the range of jet shall be not less than 6 metre.

Mode of Measurement:

Executed quantity shall be measured on number basis.

C) **Hose pipe for Hose reel**

Specification No (FF-FFA/HOP)

Scope:

Supplying & erecting high pressure polypropylene hose pipe 20 mm. dia as per IS 444- type III & IS 446-1980 type I fabricated from polyester core braided with high tensile textile yarn suitable for erection of 19 mm Gun Metal Chrome plated nozzle.

Material:

Hose pipe material: Polypropylene, the lining and the cover shall be of uniform thickness, reasonably concentric and free from air blisters, porosity and splits. The tensile strength shall be minimum 5.00 MPa and shall withstand for 10.2 kg/cm²

Nozzle: Chrome plated gun metal

Method of Construction:

The hose pipe shall be connected with provided couplings.

Mode of Measurement:

Executed quantity shall be measured on per meter basis.

D) **Rubber Hose Pipe**

Specification No (FF-FFA/RHP)

Scope:

Supplying & erecting high pressure rubber hose pipe 20 mm. Dia as per IS 446- 1978 (type I) & IS 444- 1978 (type II) fabricated lead moulded with high tensile yarn braided rubber hose pipe suitable for erection of 19 mm gun metal Chrome plated nozzle.

Material:

Hose pipe material: Rubber. The lining and the cover shall be of uniform thickness, reasonably concentric and free from air blisters, porosity, and splits. The tensile shall be minimum 5.00 MPa and shall withstand pressure of 10.2 kg/cm²

Nozzle: Chrome plated gun metal

Method of Construction:

The hose pipe shall be connected with provided couplings.

Mode of Measurement:

Executed quantity shall be measured on per meter basis.

E) **Controlled Percolation Hose Pipe**

Specification No (FF-FFA/CPH)

Scope:

Supplying fire fighting C P (Controlled Percolation) Hose pipe of 63 mm in diameter, conforming to IS: 8423, and 15 metre in length, fitted with male and female G.M. coupling conforming to IS: 903, ISI mark.

Material:

Hose pipe material: Synthetic cotton yarn conforming to IS 8423 and shall be made of jacket or cotton or synthetic material or their combination. It shall be tested as specified in IS and shall withstand for pressure 10.2 kgf/cm² and should not burst before a pressure of 35.7 kg/ cm² is reached.

Coupling: Gun metal conforming to IS 903

Method of Construction:

Hose pipe of 15 metre length with male and female Gun metal coupling shall be connected as per direction.

Mode of Measurement:

Executed quantity shall be measured on number basis.

F) **R.R.L Hose Pipe**

Specification No (FF-FFA/RRL)

Scope:

Supplying fire fighting R.R.L. Hose pipe, conforming to IS: 636 (Type-A) 15 metre length, fitted with male and female G.M. coupling confirming to IS: 903, with ISI mark.

Material:

Hose pipe material: Rubber lined woven jacketed & 63mm in dia., the lining and the cover shall be of uniform thickness, reasonably concentric and free from air blisters, porosity and splits. The tensile shall be minimum 5.00 MPa and shall withstand pressure of 10.2 kg/ cm²

Coupling: Gun metal

Method of Construction:

Hose pipe of 15 metre length with male and female Gun metal coupling shall be connected as per direction.

Mode of Measurement:

Executed quantity shall be measured on number basis

G) **Canvas Hose Pipe**

Specification No (FF-FFA/CHP)

Scope:

Supplying fire fighting canvas Hose pipe, conforming to IS: 4927 and 15 metre length, fitted with male and female G.M. coupling confirming to IS: 903, with ISI mark.

Material:

Hose pipe material: Canvas

Coupling: Gun metal

Method of Construction:

Canvas hose pipe 15 metre in length with male and female Gun metal coupling including necessary labour, material and use of required tools and plants.

Mode of Measurement:

Executed quantity shall be measured on number basis

H) **Nozzles**

Specification No (FF-FFA/NZ)

Scope:

Supplying G.M. branch pipe of 63 mm diameter with specified length fitted with 20 mm diameter detachable hexagonal nozzle confirming to Is: 903, ISI mark.

Material:

Nozzle: Chrome plated Gun metal

Method of Construction:

Gun metal hexagonal nozzle fitted with required tools and plants including necessary labour, material, etc.

Mode of Measurement:

Executed quantity shall be measured on number basis.

I) **Fire Brigade connection**

Specification No (FF-FFA/FBC)

Scope:

Supplying and installing fire brigade Header of 150 mm Ø, G.I. 'C' class pipe having 2 Nos. of 100 mm 'T' outlet with 100 mm Ø flange, fitted with 2 Nos. of G.M. fire branching inlet connection, each consisting of 2 Nos. 63 mm dia. G.M. male inlet for supplying water in fire tank.

Material:

Pipe material: G.I. 'C' class (Heavy duty)

Branching Inlet: Gun metal

Male Inlet: Gun metal

Method of Construction:

In case under ground storage tank is not approachable by fire tenders, a 4 way 63 mm diameter instantaneous male inlet connection is provided at street level and connected to UG tank with 1 meter length of 150mm. diameter under ground pipe.

The whole unit shall be placed in provided MS box made of 2 mm thick MS sheet with openable glass cover.

Mode of Measurement:

Executed quantity shall be measured on number basis

J) Siamese connection (Fire service Inlet)

Specification No (FF-FFA/SMC)

Scope:

Supplying and installing fire brigade Header (Siamese Connection) of 150 mm Ø, G.I. 'C' class pipe having 2 Nos. of 100 mm 'T' outlet with 100 mm Ø flange, fitted with 2 Nos. of G.M. male inlets with spring type NRV for supplying water to Wet riser.

Material:

Pipe material: G.I. 'C' class

Branching Inlet: Gun metal

Male Inlet: Gun metal

Non Return Valve: As per (FF- VL/NRV) above.

Method of Construction:

In order to facilitate feeding of water in the system by fire service, a 4 way 63 mm diameter collecting head shall be provided and connected with each riser/down comer and the ring main with non return valve and with provided butterfly/slucice valve. This should be located at a place where fire brigade tender can reach.

The whole unit is placed in provided MS box made of 2 mm thick MS sheet with open-able glass cover.

Mode of Measurement:

Executed quantity shall be measured on number basis

K) Air Cushion Tank (Air Vessel)

Specification No (FF-FFA/ACT)

Scope:

Supplying and installing Air Vessel of 300 mm Ø 1.5 mtr. in height M.S. Tank fabricated from M.S. black ERW pipe, conforming to I.S.: 3589, having 6mm thickness, dish end at both ends, duly welded with 300 mm Ø pipe, having inlet of 100 mm Ø, duly fitted with 100 mm Ø sluice valve and 20/25 mm Ø draw in with G.M. gate valve, to be installed inside pump house along with provided M.S. angle tripod.

Material:

Air Vessel: MS ERW pipe confirming to IS 3589

Tripod: MS angle of size 75 x 75 x 5mm

Method of Construction:

300mm dia, 1.5 metre height air vessel, Gate Valve, flanges, MS angle Tripod including necessary labour, material and use of required tools and plants.

Mode of Measurement:

Executed quantity shall be measured on number basis

L) **Air Release Valve**

Specification No (FF-FFA/ARV)

Scope:

Supplying and erecting Air release cock of 20/25 mm Ø made from G.M. with necessary G.I. coupling for fixing on top of Air vessel or on wet riser.

Material:

Air release Valve: Gun metal

Coupling: G.I.

Method of Construction:

Air release Valve with necessary GI Coupling shall be fixed on top of wet riser with required labour, tools, etc.

Mode of Measurement:

Executed quantity shall be measured on number basis

M) **Pressure Gauge**

Specification No (FF-FFA/PG)

Scope:

Supplying and installing pressure gauge of 100 mm Ø. 0-300 PSI or 0-21 kg/cm² square fitted with 12/15 mm Ø. pad cock valve, and G.I. pipe, elbow etc. as per requirement in an approved manner.

Material:

Pressure Gauge: 100 mm diameter made from Brass metal.

Cock valve, elbow, and pipe: G.I

Method of Construction:

The 100 mm dia pressure gauge with G I cock valve, erected with GI Pipe including accessories, with required labour, tools, etc, as directed by the Engineer-in-charge.

Mode of Measurement:

Executed quantity shall be measured on number basis

N) **Pressure Switch**

Specification No (FF-FFA/PS)

Scope:

Supplying and installing pressure switch with 12/15 mm Ø isolation valve, G.I. nipple, elbow etc. in an approved manner.

Material:

Pressure switch: Brass metal

Isolation valve, elbow, Nipple: G.I

Method of Construction:

The Pressure switch with G I isolation valve, and necessary GI fittings (elbow, Nipple) fitted with required labour, tools, etc.

Mode of Measurement:

Executed quantity shall be measured on number basis

O) **Orifice plate**

Specification No (FF-FFA/OP)

Scope:

Supplying and erecting one no. Brass orifice plate having 6 mm. thick with specified outer diameter and suitable inner diameter to reduce the pressure between 3.2 kg/cm² to 5.5 kg/cm²

Material:

Body: Stainless steel 6 mm thick

Method of Construction:

The Orifice plate shall be placed before the hydrant valve.

Mode of Measurement:

Executed quantity shall be measured on number basis

13.9 Fire Alarm System (FF-FAS)

A) Heat detector

Specification No (FF-FAS-HD)

Scope:

Supplying, erecting, and testing heat detector with base erected on 16 gauges M.S. sheet box of 100 x 100 x 75 mm size duly painted.

Material:

Heat detector: UL listed / LPCB marked with 360⁰ blinking LED & having 68⁰ C/78⁰ C fixed temperature.

Box: CRCA/MS sheet of 16 gauges

Red oxide paint: Superior quality

Enamel paint: Superior quality of specified colour

Hardware: Sheet metal screws

Plugs: Plastic

Method of Construction:

The Heat Detector shall be fixed on the CRCA/MS sheet box duly painted with one coat of red oxide & 2 coats of enamel paint of specified shade with necessary SM screws, plugs, etc on ceiling, duly terminating the provided cable with provided glands and making the connection.

Mode of measurement:

Executed quantity shall be measured on number basis

B) Optical type Photo electric smoke detector

Specification No (FF-FAS/SD)

Scope:

Supplying, erecting and testing optical type smoke detector complete with base erected on 16 gauge CRCA/MS sheet box of 100 x 100 x 75 mm duly painted.

Material:

Smoke detector: UL listed / LPCB marked

Box: CRCA/MS sheet of 16 gauge

Red oxide paint: Superior quality

Enamel paint: Superior quality of specified colour

Hardware: Sheet metal screws

Plugs: Plastic

Method of Construction:

The Smoke Detector shall be fixed on the CRCA/MS sheet box duly painted with one coat of red oxide & 2 coats of enamel paint of specified shade with necessary SM screws, plugs, etc on ceiling, duly terminating the provided cable with provided glands and making the connection.

Mode of Measurement:

Executed quantity shall be measured on number basis.

C) **Beam type Photo-Thermal/Thermal Smoke detector** (Optical Beam Detector)

Specification No (FF-FAS/OBSD)

Scope:

Supplying, erecting and testing Optical Beam Detector (Beam type Photo-Thermal Smoke detector) complete with Transmitter and receiver unit erected on wall/ceiling with base.

Material:

Detector: Comprising Transmitter & Receiver unit, UL listed / LPCB marked, with BS 5839 part 1 2002, compliance and duly tested & certified as per EN54-12: 2002.

The detector shall have following features:

- Automatic drift compensation
- Dust tolerance chamber to provide optimum detection performance and minimal nuisance alarms to minimize maintenance
- Digital addressing capability
- Photoelectric and Photo-thermal multi criteria
- Operating voltage range 8 to 30 V DC
- Operating temperature range -30 to +70⁰ C
- Multi-function Alarm- Normal bi-colour LED indicator.

Hardware: Sheet metal screws

Plugs: Plastic

Applications:

- Photo-Thermal detector to be used in General purpose halls, auditoriums, and at spaces where the ceiling **height is more than 4.0 metre**.
- Thermal detector with combination of fixed and rate of rise heat shall be used in kitchens, pantry and bars and at similar spaces where the ceiling **height is more than 4.0 metre**.

Method of Construction:

The Detector consisting of Transmitter (Detector) and receiver shall be mounted / fixed at designated place duly connected with provided cable/wires and tested.

Mode of Measurement:

Executed quantity shall be measured on number basis.

13.10 Fire Alarm Accessories (FF-FAAS)

A) **Pill Box (Manual Call Point [MCP])**

Specification No (FF-FAAS/MCP)

Scope:

Supplying, erecting, testing, and commissioning pill box with break glass, push button. MCP is manually operated device used to initiate an alarm signal

Material:

Push Button: Plastic

Enclosure: CRCA/MS with 100/150 mm round/square with Glass cover

Hammer with chain: Brass

Enamel paint: Superior quality Post Office red colour

Hardware: S.M. Screw

Plugs: Plastic

Method of Construction:

The pill box with break glass cover, push button in circular/ square enclosure with push button kept inside per set with a glass outside marked "IN CASE OF FIRE BREAK GLASS" provided with a small hammer and chain fixed to the pill box shall be mounted on wall or any other place as directed and provided with cable entry with suitable terminal inside and painted with two coats of red oxide and two coats of post office red enamel paint.

Mode of Measurement:

Executed quantity shall be measured on number basis

B) Hooter

Specification No (FF-FAAS/HTR)

Scope:

Supply and erecting hooters with CRCA enclosure duly connected to main amplifier to radiate two tone sounds for public.

Material:

Hooter: Electronic type with 6W output, Line matching transformer

Enclosure: CRCA sheet of 14 SWG with perforation

Enamel paint: Superior quality Post Office red colour

Hardware: S.M. Screw

Plugs: Plastic

Gitties: Wooden

Method of Construction:

The electronics hooter with Line matching transformer shall be enclosed in suitable size perforated CRCA enclosure and installed as per instructions and shall be connected and fixed at suitable site to ensure that the alarm is heard anywhere in the protected area. The minimum sound level shall be 80 dB.

Mode of Measurement:

Executed quantity shall be measured on number basis

C) Remote Response Indicators

Specification No (FF-FAAS/RRI)

Scope:

Supplying, erecting, and testing of remote response indicators.

Application: *Remote Response Indicators shall be fixed for closed rooms, cabins, or for inaccessible rooms, etc.*

Material:

Indicator: 5 mm LED (2 Nos) / 10 mm LED (1 No) in Red colour

Enclosure: CRCA sheet of 14 SWG with perforation

Enamel paint: Superior quality of specified colour

Hardware: S.M. Screws

Plugs: Plastic

Gitties: Wooden

Method of Construction:

Remote response indicator housed in enclosure shall be fitted out side the rooms, cabins at accessible height and shall be clearly visible.

Mode of Measurement:

Executed quantity shall be measured on number basis

D) Fire Alarm Control Panel

Local Control Panel

Specification Nos

Fire Alarm Control Panel (FF-FAAS/FACP)

Local Control Panel (FF-FAS/LCP)

Scope:

Supplying, erecting, testing, & commissioning of Fire Alarm Control Panel with all accessories.

Material:

Panel: Microprocessor based Conventional Main Fire Alarm Control Panel (FACP) with necessary Test Certificate from ERTL as per IS 2189-1999 provided with SMPS (Switch Mode Power Supply) of suitable battery (2x12V) 24V, 24 AH capacity maintenance free battery as standby supply to switch over automatically for a period of 8 hours in case of A.C. supply failure to panel with 7 AH capacity battery charger, panel shall have following features.

- a) Visual zone indication in which fire has emerged.
- b) Audio alarm devices.
- c) Acknowledge reset and test devices.
- d) Visual indication (2x20 character LCD display) incorporating following indications:
 - (i) Fire condition
 - (ii) Fault condition
 - (iii) A.C. Pilot indication
 - (iv) Low battery indication
 - (v) Blown fuse indication A.C. as well as D.C.
 - (vi) Built in electronic hooters of 2 tone round for fire condition and single tone for fault condition.
 - (vii) Open and short circuit fault.
 - (viii) Push button switch for checking each zone.
 - (ix) Push button to disable audio alarm.
 - (x) Reset push button.
- e) Fire protection and alarm circuit shall have modular design using electronic plug in type printed circuit boards (PCB) with spare cards.

Method of installation:

The microprocessor based main fire Alarm control panel designed as per IS 2189-1999 with ERTL Test certificate shall be fixed at accessible place so that security or fire personal can attend to the fault immediately.

Testing:

The control shall be tested for following features:

- 1) Alarm cancel Test
- 2) Reset 1 lamp
- 3) Fire Test
- 4) Open Test (for detector & hooter)
- 5) Short circuit Test (for detector & hooter)
- 6) Walk Test(one man test)
- 7) Sounder Test

Mode of Measurement:

Executed quantity shall be measured on number basis

E) Mineral Insulated Copper Cable (MIC)

Specification No (FF-FAAS/MIC)

Scope:

Supply and erecting Mineral Insulated copper cable of specified size with an overall (LSF) covering, 500 Volts, to withstand temp. 950 Deg C for period of 3 hrs, Mechanical shock and High Pressure water stream used during the fire fighting.

General:

Mineral Insulated Copper Cable, Light Duty – 500 Volt Grade and Heavy Duty 750 Volts Grade for Fire and performance wiring applications.

All material shall conform to relevant BIS standard and shall have LPCB approval. If any particular category of material for which ISI mark is not available in market, it shall be included in approved list. Work shall be carried out as per method of construction specified hereunder and shall be carried out to the satisfaction of the Engineer in Charge.

Cables (MIC)

To provide the client with the highest standard in performance cables for fire alarm, life safety, fire fighting, and critical systems applications. The cable system should be mineral insulated, robust, 100% screened, and space saving in order to meet the demands of

modern building design. The cable should also be capable of surviving fire conditions without loss of integrity (without burning) and without providing an additional fuel load. This specification should be strictly adhered to in order to provide maximum conformity with the Regulatory Reform (Fire Safety) Order 2005.

Material:

Conductor: Copper

Outer Sheath: Copper

Insulation: MgO (Mineral Insulated)

Terminations:

Gland: All terminations shall be supplied by the cable manufacturer and shall comply with the requirements of BS EN 60702: Part 2. They shall be fitted in accordance with the manufacturers recommended termination procedures,

Seals: The following types of seal are available and shall be utilized as appropriate to suit the environment. Standard 105°C and Fire Resistant Seal Increased Safety seal for EEXe Hazardous Area 250°C High Temperature Glazed Insulator

Technical Specifications:

All cables shall carry LPCB approval to specific and relevant standards, BS60702-1, BS6387, BS8434-2, BS5839-1 Clause 26.2, BS EN 50257-2-1, and must be registered by the LPCB to this effect. The supplier shall be accredited and approved to ISO 9001.

The MI wiring system shall be approved by the LPCB to BS8434-2, BS5839-1 Clause 26.2 (Enhanced) and BS EN 50200 Class PH 120, BS EN 50257-2-1, and be documented in the LPCB Red Book.

Light duty grade cables are rated to 500V and are suitable for use where the voltage between the conductor and sheath and between conductors does not exceed 500V r.m.s, A.C, or 500Vd.c. The MI cable shall also be available with an overall LSF covering. This may be employed to protect the copper sheath from corrosive environments, to provide identification by colour, or for other aesthetic reasons. When cables are to be buried in the ground, the type having this outer covering should be specified.

Heavy duty grade cables are rated to 750V and are suitable for use where the voltage between the conductor and sheath and between conductors does not exceed 750V r.m.s, A.C, or 750Vd.c. The MI cable shall also be available with an overall LSF covering. This may be employed to protect the copper sheath from corrosive environments, to provide identification by colour, or for other aesthetic reasons. When cables are to be buried in the ground, the type having this outer covering should be specified. The MI cable system must be capable of the following installation types: - Buried in the ground, Underground ducts, conduit or pipes, Buried in concrete, Buried in plaster, Surface mounted, On cable tray, Outdoor and wet conditions, High ambient temperature environments (continuous temperature of 250°C.) Higher continuous ambient temperatures are also possible with MI., Low temperature environments (where the cable needs to operate at temperatures down to approaching absolute zero.)

Product, Technical, and Performance requirements:

The MI cable system must, as a minimum requirement:

- Be manufactured, tested, and LPCB approved to BS EN 60702-1.
- Be complete with terminations tested and approved to BS EN 60702-2,
- Be approved by the LPCB (and clearly documented in the "Red Book") to:
 - BS8434-2 (120 Minute)
 - BS5839-1 Clause 26. (Standard and Enhanced.)
 - BS EN 50200 Class PH 120.
 - BS EN 50257-2-1
- Have a loss of mass under fire conditions of less than 0.5%. Cables losing mass under fire conditions greater than 0.5% suggest the addition of a fuel load.
- Have a life expectancy in excess of 100 Years.
- Be unaffected in fit, form, and function, to the effects of power system harmonics, including but not limited to, continuous operation at elevated temperatures without premature aging.
- Meet and exceed the requirements of IEC60331 – tests for electric cables under fire conditions.
- Be approved for use with London Underground Ltd. (LUL), and compliant with Fire survival cable (MICC) EME-SP-14-028-A1.
- Carry CE marking on cable drums, reels, termination packaging as required by the directive.

- Demonstrate compliance, where applicable, in the following standards.
- BS5588 – Fire precautions in the design, construction and use of buildings.
- BS5266 – Emergency lighting.
- BS5454 – Storage and exhibition of archival documents.
- BS5839 – Fire detection and alarm systems in buildings.
- C.I.O – Lighting and wiring for churches.

Installation, Testing and Commissioning:

The Mineral insulated (MI) cable, shall be specifically designed for ultimate performance and compliance with the current version of BS7671 (“Requirements for electrical installations”) and shall be supplied and tested, in accordance with BS EN 60702: Part 1. BS7671 – Requirements for Electrical Installations (IEE)

Installation, testing and commissioning shall be carried out in strict compliance with all current electrical standards and regulations.

When required by the consultant or specified, cables may be tested prior to installation using a suitable insulation resistance test.

The MI system shall be installed in accordance with all current electrical standards and regulations.

The system shall be compliant with BS7671 (Requirements for electrical installations.)

The MI wiring system shall be tested to BS EN 60702-1 for cables

Temperature Range

Mode of Measurement: Executed quantity will be measured on running meter basis.

13.11 P.A. System (FF-PA/AFR)

A) Amplifier for P A System

Specification No (FF-PA/AFR)

Scope:

Supplying, erecting, testing, and commissioning amplifier 120 W / 250W for Public address system.

Material:

Amplifier: Amplifier unit with wall mounted closed cabinet having rated output wattage 120 W / 250W with 4 Nos input channels (2 Nos for Microphone & 2 Nos Auxiliary), 4/8/16 Output lines, suitable to work on 230 V AC supply / 12 V DC supply, and necessary protection circuit.

Method of Construction:

Amplifier unit shall be installed as per guide lines of manufacture and shall be tested for rated output.

Mode of Measurement:

Executed quantity shall be measured on number basis

B) Sound Column

Specification No (FF-PA/SOC)

Scope:

Supplying, erecting, testing, and commissioning 15 watts Sound Column.

Material:

Sound Column: Wall mounted Sound column shall give 15 watts output, with necessary fixing arrangement.

Method of Construction:

Sound column shall be installed as per guide lines of and connected to the amplifier duly tested.

Mode of Measurement:

Executed quantity shall be measured on number basis

C) **Microphone**

Specification No (FF-PA/MIC)

Scope:

Supplying, erecting, testing, and commissioning hand shield microphone

Material:

Microphone: Microphone unit as per manufacturer's standard specifications.

Method of Construction:

Microphone unit shall be connected with cord to amplifier unit as per guide lines of manufacture and shall be tested.

Mode of Measurement:

Executed quantity shall be measured on number basis

D) **Microphone Cable**

Specification No (FF-PA/MCC)

Scope:

Supplying erecting, testing to 2 core shielded Microphone cable.

Material:

Microphone cable: 2 core microphone cable, PVC insulated with copper conductor.

Method of Construction:

Microphone cable shall be connected to microphone and tested.

Mode of Measurement:

Executed quantity shall be measured on meter basis

13.12 Sprinklers (FF-SPR)

A) **Sprinklers**

Specification No (FF-SPR)

Scope:

Supplying and erecting 15 mm (1/2") dia. NBCM Body chrome finished, pendent type quartzoid bulb sprinkler.

Material:

Chrome plated sprinkler bulb having 68⁰ / 78⁰C fixed temperature rating UL listed.

Method of Construction:

The sprinklers bulb shall be fitted to sprinklers pipe line and tested for required pressure.

Mode of Measurement:

Executed quantity shall be measured on number basis.

Chapter 14

LIFTS

14.1 Lifts

LFT-LFT

14.2 Drawings

14.1 Lifts**Scope:****Specification No (LFT)**

Supplying erecting and commissioning passenger lift, hospital lifts and goods lift with technical requirements of lift installation, its components, safety devices various type of controls and methods of operation. The selection of a particular type of control and method of operation will be guided by the requirements in individual case such as nature of building, usage, occupancy, traffic pattern, etc. and has to be decided in individual case considering quality and quantity analysis of service.

(Refer drawing no. LFT-1, LFT-2, LFT-3)

Recommended Standards:

The following list is for Indian Standards which are acceptable as good practice and accepted standards;

IS 14665 part I	:	Guidelines for outline dimensions of passenger, goods, service and hospital lifts.
IS 14665 part II	:	Code of practice for installation, operation and maintenance of lifts.
IS 14665 part III	:	Safety rules
IS 14665 part IV	:	Components
Development Control Rules	:	Of concerned Corporation or Local Authority
National Building Code 2005		
Bombay Lift Act 1939		
Bombay Lift Rules 1958		
I. E. Rules 1956	:	Reprint as per 2005

Material:

- **Electric Supply:**

Three phase, 50 c/s, 415 V electric supply shall be made available by owner. The entire lift equipments should be suitable for operation at +10% to - 20% of the rated supply voltage.

- **Gearless machine:**

The gearless machine shall consist of a motor, traction sheave and break-drum or brake disc completely aligned on a single shaft. Gearless machine shall be AC. gearless with VVVF drive.

- **Geared machine;**

The lift machine shall be of worm gear reduction type with motor, brake, worm gearing and driving sheave and suitable for type of control specified.

- **Electric motor:**

Energy efficient Electric motor of suitable HP with class F insulation and S-4 duty cycle

- **Car:**

As per IS 14665 part IV with MS Girders, bracings of adequate size and strength at the bottom and top with angle iron frame and side panels of CRCA/MS of 16 gauge duly powder coated paint or SS sheet of 18 gauge with mirror or hairline finish with safety factor more than 5.

- **Signals:**

FPI in car and CPI at all landings are to be provided with up / down direction indicators with call registration facility.

- **Variable Voltage Variable Frequency:**

Incoming mains AC power is first rectified to DC and then inverted to provide controlled AC current to the elevator drive. Precision monitoring is required for motor speed, car direction, position and load to enable the pulse width of the AC power supplied to the motor and to be adjusted to ensure that elevator speed is maintained very accurately to an ideal profile. Energy saving through reduced power consumption should be achieved.

- **Controls:**

Microprocessor based Control panel duly wired with proper size and strength of copper wire.

▪ **Control panel box:**

Control panel box of MS sheet of 16 gauge with duly power coated of MS sheet of 16 gauge.

▪ **Driving / traction pulley:**

Sheaves and pulleys shall be of hard alloy, cast iron, SG iron or steel and free from cracks, sand holes and others defects. They shall have machined rope grooves. The traction sheave shall be grooved to produce proper traction and shall be of sufficient dimension to provide for wear in the groove. The deflector sheave shall be grooved so as to provide a smooth bed for the rope.

▪ **Over speed governor:**

The car safety shall be operated by speed governor located overhead and driven by governor rope suitably connected to the car and mounted on its own pulleys. Governor shall be provided for lifts with a travel of more than 5.5 meters. The governor rope shall be not less than 6mm in dia and shall be made of steel or phosphor bronze. These shall be in accordance with IS 14665 (part 4)sec-4): 2001.

▪ **Electromagnetic breaks:**

The lift drive machinery shall be provided with an electro-magnetic brake or motor operated brake normally applied by means of springs in compression when the operating device is in off position. The brake shall be suitably curved over the brake drum or brake disc and provided with fire proof friction lining. The operation of brake shall be smooth, gradual and noiseless. The brake shall be designed to be of sufficient size and strength to stop and hold the car at rest with rated load. The brake should be capable of operation automatically by the various safety devices.

▪ **Automatic Rescue Devices (ARD)**

ARD should monitor the normal power supply in the main controller and shall activate rescue operation within 10 seconds of normal power supply failure. It should bring the elevator to the nearest floor at a slower speed than the normal run. While proceeding to the nearest floor the elevator will detect the zone and stop. After the elevator has stopped, it automatically opens the doors and parks with door open. After the operation is completed by the ARD the elevator is automatically switched over to normal operation as soon as normal power supply resumes.

In case the normal supply resumes during ARD in operation the elevator will continue to run in ARD mode until it reaches the nearest landing and the doors are fully opened. If normal power supply resumes when the elevator is at the landing, it will automatically be switched to normal power operation.

All the lift safeties shall remain active during the ARD mode of operation.

The battery capacity should be adequate so as to operate the ARD for duration of at least 30 minutes.

▪ **Suspension wire rope:**

Round strand steel wires ropes made from steel wire ropes having a tensile strength not less than 12.5 tones / cm² and of good flexibility shall be used for lift. Lubrications between the strands shall be achieved by providing impregnated hemp core.

▪ **Guide rails:**

The guide rails shall be continuous throughout the entire travel and shall withstand without any deformation by the action of safety gear with a fully loaded car. Generally the guide rails shall be supported by brackets secured to the hoist way frame at each floor. The rails shall be securely fastened to the brackets or other supports by approved heavy rail clamps. Guide rails shall extend from pit floor to the underside of concrete slabs or grafting at top of the lift well. They shall be erected in plumb and parallel with a maximum deviation of 3mm.

▪ **Buffers:**

Buffers shall be suitable for installation in the space available. Buffer anchorage at pit floors shall be installed avoiding puncturing of water proofing. Oil buffers of the car and counter weight shall be of the spring return type or of gravity type. The contractor must indicate the name of buffer manufacturers, buffer stroke & certified maximum loads.

Method of Construction:

▪ Bar chart shall be prepared as per tender condition and requirement.

Lift hoist way measurement shall be done before finalizing the material quantity.

▪ Drawing should be prepared according to tender specification considering hoist way size and permission from Lift Inspector for erection of lift should be taken prior to commencement of erection.

▪ White wash in lift well shall be carried out by the client.

- Site in full readiness shall be handed over to the agency.
- Minor civil work pertaining to front wall architraves internal / external plastering etc. shall be done by the lift agency.
- Prepare and install scaffolding and template by adjustment required.
- List of components / finished items those are not manufactured by lift manufacturer shall be informed by the agency.
- Brackets are to be erected and fixed in to plum line.
- Put the fasteners (16 mm dia x 100 mm) if the brackets are to be fixed on RCC wall / beam / lintel or fix rig bolts if brick work found in RCC.
- After fixing brackets and guides with adjustment fix the car and counterweight
- Fix the landing door frame / door bottom with sill and suitable brackets to with stand the load of passenger / freight as per specification
- Fix metal trunking / PVC pipe as per IS requirement
- Complete civil work such as fixing up hoist way, push button, buffers, machine room I beams for resting machine, foundation for control panel, minor civil work, making holes in bottom slab of machine room to pass traction rope, speed governor rope / wiring and complete finishing according to sizes and specification.
- Electrical wiring in lift shaft and supply cable shall be carried out from electrical agency as per requirement of lift rules.
- Fix machine with complete gear box unit, suitable rubber pad / anti vibrating pad, diverter if required with alignment as per norms.
- Fix the control panel at accessible height from floor level to inspect, connect, and operate easily.
- Put wires in accordance with the control panel connection diagram according to colour code in metal trunking with insulating paper on all bends, corners. Metal trunking shall be duly earthed from top to bottom according to IS specifications.
- Mid way junction boxes are to be fixed according to size but it should be marked by every wire with nos. (Ferrules) Traveling cables should be fixed with suitable hanger to take load of travelling cable and put extra wire of 20 % approximately
- Fix the car and counterweight frame according to sizes, adjustment of safety block wedges shoes as per requirement.
- **Toe Guard Aprons:**
- The toe guard apron of gauge not less than 1.6mm sheet steel may be provided extending at least 15mm beyond entrance jams at each side. The guards shall have a straight vertical face extending below the level of the finished car floor and not less than the depth of the levelling zone plus 7.5mm. It shall be seamed to car platform construction and be reinforced and braced.
- **Car Apron, Landing Thresholds and Sills:**
- An apron shall be fitted to the car platform such that no dangerous gap exist at any time when the landing door is opened, Thresholds and sill plates shall be provided at the landings also. The distance between landing sill and the sill on car platform shall not be more than 30mm.
- **ARD should be provided**
- **Emergency Power Supply for lift car, fan and intercom system:**
- This shall include suitable secondary battery with trickle/Boost charge arrangement and inverter power pack with necessary contactors for supply to light fixtures in the lift car, fresh air fan in lift car. The same battery shall also feed the alarm bell and communication equipment.
- **Inter-communication system:**
- Intercom system shall be provided in car to have communication in case of an emergency and shall be connected to re-chargeable battery supply.
- **Ratings and Instructions:**
- Inside the lift car, the lift supplier shall also provide a stainless steel metallic plate indicating the rated load and detailed instructions for the passengers. This shall be mounted at a suitable place.

- **General:**
- a) Put main traction ropes from car to counterweight with rope tension adjustment.
- b) Put counterweight i.e. of CI blocks in counter weight frame for suitable equilibrium.
- c) Put car platform and car with adjustment.

- d) Fix car door and panels / car push button/ fall ceiling light, fan.
- e) Fix landing panels and put in lock in circuit.
- f) Fix hoist way accessories like drum reels terminators, final limits, levelling
- g) Removing the scaffolding.
- h) Connect three phase supply from main switch along with earthing to controllers as per instruction given.
- i) Wiring from controller to motor along with earth wire is to be completed.
- j) Check motor / gear oil.
- k) Start lift in maintenance mode.
- l) Check adjustment of hoist way switch/ safety doors and check all parameters of shaft.
- m) Put controller on normal mode.
- n) Test run to be taken and & service inspection of lift with all safeties shall be done in presence of site in charge.
- o) Pre commissioning work such as cleaning of shaft, pit etc shall be done.
- p) After completion of work, NOC shall be obtained from lift inspector
- q) by the agency before putting LIFT in to operational use.

Testing of Lift Installation:

Tests at site:

(a) Levelling Test:

Accuracy of the floor levelling shall be tested with the lift empty, fully loaded. The lift shall be run to each floor while travelling both in upward and downward directions and the actual distance of car floor above, below landing floor shall be measured. In each case there shall not be any appreciable difference in these measurements for levelling at the floors when the car is empty and when it is fully loaded. The tolerances for levelling shall be as specified in para 8 of chapter IV, section I.

(b) Safety Gear Tests:

Instantaneous safety gear controlled by a governor should be tested with contract load and a contract speed, the governor being operated by hand. Two tests should be made, however, with wedge clamp or flexible clamp safeties, one with contract load in the car and the other with 68 kg (equivalent to one person) in the car. The stopping distance obtained should be compared with the specified figures and the guides, car platform, and safety gear should be carefully examined afterwards for signs of permanent distortion.

Counterweight safety gear should be tripped by the counter weight governor and the stopping distance noted. In this case, however the governor tripping speed may exceed that of the car safety governor but by not more than 10 percent.

During the safety gear tests, car speed (from the governor or the main sheave) should be determined at the instant or tripping speed with that stated in IS. The governor jaws and rope should be examined for any undue wear.

(c) Contract speed:

This should be measured with contract load in the car, with half load, with no load, and should not vary from the contract speed by more than 10 percent. The convenient method is by counting the number of revolutions, made by the sheave or drum in a known time, Chalk mark on the sheave or drum and a stop switch will facilitate timing but care must be exercised to ensure that no acceleration or retardation periods are included. If the roping is 2 to 1 the sheave speed is twice the car speed. Alternatively, the speed can be measured by a tachometer applied directly to shaft immediately below the sheave.

(d) Lift balance:

After the above test, some of the weight shall be removed until the remaining weights represent the figures specified. With this condition at half way travel the effort required to move the lift car in either direction with the help of winding wheel shall be as nearly as can be judged by the same.

(e) Car and landing doors interlock:

The lift shall not move with any door open. The car door relay contact and the retiring release cam must be tested. The workings of the door operation and the safety edges and light equipment if any provided shall also be examined.

(f) Controllers:

The operation of the contactors and interlocks shall be examined and it shall be ascertained whether all the requirements laid down in the specifications have been met.

(g) Normal terminal stopping switches:

These shall be tested by letting the car run to each terminal landing in turn, first with no load and then with contract load and by taking measurements, top and bottom over travels can be ascertained.

(h) Final terminal stopping switches:

The normal terminal stopping switches shall be disconnected for this test. It shall be ensured that these switches operate before the buffers are engaged.

(i) Insulation Resistance:

This shall be measured (after removing the electronic PCB's and their connection) between power and control lines and earth and shall not be less than 5 mega-ohms when measured with D.C. voltage of 500 volts. The test shall be carried out with contactors so connected together as to ensure that all parts of every circuit are simultaneously tested.

(j) Earthing:

Earthing continuity of all conduits, switches, casing and similar metal work shall be tested.

(k) Ropes:

The size, number construction and fastenings of the ropes should be carefully examined and recorded.

(l) Buffers:

The car should be run on to its buffers at contract speed and with contract load in the car to test whether there is any permanent distortion of the car or buffers. The counter weight buffers should be tested similarly. Test report shall be intimated after testing at works.

Service Temperature Test:

A continuous run of one hour should be made with number of starts and stops to reproduce as nearly as practical the anticipate duty in service. (The standard duty cycle is for 180 starts per hour). It is very difficult in practice to carry out this test with alternate starts at full load and no load and it is necessary therefore to simulate these cycles. A suitable test for all motors except squirrel cage motors is to run the car up from the bottom landing with contract load and stop at each floor. From the top floor a non stop run is made to the lowest floor and the upward journey with stop is then repeated. The time intervals between stops and starts at the floors should be uniform and such as to give about 150 starts in one hour. At the end of this run the temperatures of the armatures and fields of the motor and generator are recorded. The temperature rise should, not exceed 55 deg C or 75 deg C for class A or B insulation respectively.

Method of Construction: Executed quantity will be counted on number basis. (i.e. each)

Chapter 15

TEMPORARY ILLUMINATION

15.1 Temporary Illumination	TE-IL
15.2 Hiring of DG Set	TE-DG

Chapter 15 Temporary Illumination (TE)

15.1 Temporary Illumination (TE/IL)

Scope:

Specification No (TE/IL)

This work is to be carried out within municipal premises or as instructed by Engineer- in-charge.

Method of Construction:

Wires shall be used of copper conductor with one continuous length and with minimum joints and of good insulation quality.

All switchgears and panels must be checked, tested with earth test, IR test Polarity, continuity prior to commencement or charging of installation. The results for the same shall be maintained in the logbook at site.

Termination shall be done with copper lugs at an important place such as in main switchgears and in panel.

Necessary ancillary works such as making holes in brick wall or concrete wall, scaffolding or wood work, mechanical work, civil work etc. to be done and again have to make good as original with no extra cost if required.

Maintenance personnel shall be made available for the entire period of function.

Safety Code:

All the safety codes under different statutory authorities shall be observed strictly while doing the work.

Full load testing shall be given prior to trial day with all necessary latest testing equipment.

15.2 Hiring of DG Sets (TE/HDG)

Scope:

Specification No (TE/HDG)

This work is to be carried out within municipal premises or as instructed by Engineer- in-charge and for temporary functional programs.

Method of Construction:

The DG Set on hire basis shall be fully equipped with all accessories, four pole changeover, etc and shall be filled with fuel. The connections of the changeover shall be made in presence of site engineer. Necessary testing on full load or on available load shall be taken in presence of site engineer. As far as possible load balancing shall be done. In case of switches with interlocking neutral isolation should be confirmed.

The set shall be properly earthed and earth connection are to be connected to body & neutral as per IE rules.

Termination shall be done with copper lugs at an important place such as in main switchgears and in panel.
Agency must have sufficient quantity of fuel and oil to be stored at site with tools for necessary maintenance, arrangement of first aid and fire extinguishing system.
Maintenance personnel along with Operator of DG Set shall be made available for the entire period of function.

Safety Code:

All the safety codes under different statutory authority shall be observed strictly while doing the work.

Full load testing shall be given prior to function day with all necessary latest testing equipment.

Certificate:

Commencement certificate shall be obtained by the agency from concerned Electrical Inspector of I.E. & L. Department.

Chapter 16

SIREN

16.1 Siren & Accessories

SRN-SRN

16.1 Siren & Accessories (SRN-AS)

A) **Weather Shade** (WS)**Scope:****Specification No** (SRN-AS/WS)

Supplying and erecting weather shade for protection of Siren motor, with louvers from all sides for ventilation and clear sounding of siren, duly painted with one coat of red oxide paint and two coat of approved enamel paint.

Material:**MS Sheet:** 18 SWG.**Fabrication:** MS angle iron**Paint:** Primer & Enamel paint**Anti vibrating Pads:** High density, heavy duty class rubber pads, with nut, bolts.**Method of Construction:**

Weather shade for covering Siren motor shall be fabricated from 18 SWG MS sheet with necessary cutting, bending & welding. Shade shall have louvers from all sides for ventilation & clear sounding of Siren. Shade of size 91 cm height x 91 cm length x 60 cm width, top having hollow trapezium of size 91 cm x 35 cm x 35 cm with angle iron frame work of size 25 x 25 x 3 mm shall be fabricated and painted with one coat of red oxide & two coats of approved enamel paint from both sides i.e., from inside & outside. The weather shade shall be firmly erected on anti vibrating pads.

Mode of Measurement: Executed quantity will be measured on number basis (i.e., each)

B) **Scrapping & Painting of Shade** (PTG)**Scope:****Specification No** (SRN-AS/PTG)

Scrapping the existing paint and repainting the weather shade of Siren motor to withstand all weather conditions.

Material:**Surface cleaning material:** Iron brush and emery paper.**Paint & Red Oxide:** Epoxy red oxide, Epoxy Enamel paint, and Special thinner for painting.**Method of Construction:**

Scrapping the existing paint of outer and inner surface of the weather shade with cleaning powder (Shade having an area of 3.5 Sq. mtr approx. on one side) and applying one coat of special primer red oxide mixed in special type thinner (844) in 1:3 proportion. After curing time of 6 hours, apply two coats of epoxy air dry paint (anticorrosive) of approved colour mixed in special type thinner complete (the job is to be carried out on site).

Mode of Measurement: Executed quantity will be measured on number basis (i.e., each)

C) **Siren Motor** (SM)**Scope:****Specification No** (SRN-AS/SM)

Supplying & erecting Siren Motor of specified HP 1 ph / 3 ph AC, 50 Hz. 230/415 Volt type and as per IS 1941 (Part I) 1976, at the rated speed of 2800 RPM within 10 seconds of start for the range up to 3.25/8 Km.

Material:

Motor:

The stator & rotor shall be of aluminium alloy or similar material. The siren motor shall be compact in design and reliable in operation and stable for installation in open as well as in exposed position any where in the country. The electric motor with Class 'F' insulation shall be totally enclosed with greased sealed ball bearing and shall conform to IS 325 of 1970. If housing is provided for protection against rains, it shall not affect the sound output at the specified distance. The siren motor shall be fitted with two blowers (double mounted) horizontally properly balanced and mounted on opposite side of motor shaft and having unequal numbers of slots on the stators capable of producing a basic note from 400 to 1000 Hz.

Anti vibrating Pads: High density, heavy duty class rubber pads, with nut, bolts.

Method of Construction:

The Siren motor complete assembly shall be erected on designated plate on provided cement concrete foundation with anti-vibration pads nut-bolts etc. as directed by the engineer in-charge.

Mode of Measurement: Executed quantity will be measured on number basis (i.e., each)

Chapter 17

CIVIL WORK

17.1	Excavation	CW-EXN
17.2	Masonry work	No Specs
17.3	C.C. Foundation	No Specs
17.4	Painting	CW-PTG
17.5	Plumbing	CW-PLB
17.6	Plumbing Accessories	No Specs

17.1 Excavation (EXN)A) Cable Trench (CTR)1. General

This part of specification deals with the preparation of trenches in soft soil, hard murum, BT road, and laying of cables inside the trench, etc as per IS: 1255.

2. Scope:**Specification No (CW-EXN/CTR)**

Excavating in all types of soil strata and making trench for laying cable/cables, providing sand bed for laying the cable, covering cable with specified material as per requirement, and finishing the same by making the surface proper with crown on top of the trench.

The following list shows Indian Standards, which are acceptable as good practice, and accepted standards.

SP 30: 1984	:	National Electrical Code
SP 7 (Group 4): 2005	:	National Building Code
IS 1255: 1967	:	Code of practice of Installation & Maintenance of armoured cables up to 33 kV.

3. Material:

Bricks: Solid Clay bricks of minimum size 225x110x62.5 mm (L x B x H), burnt in the kiln, of good quality.

Sand: Screened sand of good quality.

4. Method of Construction:**Trench in Soft soil / Hard Murum / Tar road: Single run of cable**

Before excavating the soil for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum 300 mm width shall be excavated up to minimum depth below the ground surface as per Table No 17.1/1 Bottom of the trench should be carefully levelled and freed from stones. Cable duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand at the bottom of the trench. Bricks shall be laid all over the run of cable as specified below:

Lengthwise for cable up to and including 10 Sqmm of all cores.

Width wise for cable above 10 Sqmm of all cores.

Remaining portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150 mm shall be provided over the trench. The remaining excavated material shall be removed from site and dumped in scrap yard of Local authorities or at suitable place.

Trench in Soft soil / Hard Murum / Tar road: Two or more cables run of cable

Before excavating the soil for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum required width more than 300mm. shall be excavated up to minimum depth as per Table No 5, below the ground surface. Bottom of the trench should be carefully levelled and freed from stones. Cables duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand. The inter-axial distance between two cables shall be between 230 and 400 mm. at the bottom of the trench. Bricks shall be laid all over the run of cable as specified below:

Lengthwise for cable up to and including 10 Sqmm of all cores.

Width wise for cable above 10 Sqmm of all cores.

Remaining portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150

mm shall be provided over the trench. The remaining excavated material shall be removed from site and dumped in scrap yard of Local authorities or at suitable place.

Trench in Soft soil/Hard Murum/Tar road with half round Hume pipe:

(For cables of size 25 Sqmm. and above shall be covered by min. 150 mm. dia. of RCC Hume pipe)

Before excavating the soil for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum required width more than 300mm. shall be excavated up to minimum depth as per Table No 5, below the ground surface. Bottom of the trench should be carefully levelled and freed from stones. Cables duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand. The inter-axial distance between two cables shall be between 230 and 400 mm. at the bottom of the trench. Inverted 150mm. dia. Half round RCC Hume pipe shall be laid above full length of cable. For more than one cable higher size or more number of Hume pipes are to be provided.

Remaining portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150 mm shall be provided over the trench. The remaining excavated material shall be removed from site and dumped in scrap yard of Local authorities or at suitable place.

As per 3.1 above, in place of bricks, the cable of size 25 sq.mm and above shall be covered with 150 mm dia. half round Hume pipe.

4.4 Mode of Measurement:

Executed quantity shall be measured on the basis of running meter per run of cable.

Table No 17.1/1

Minimum laying Depth of cables (IS: 1255)

S.No	Voltage level of cables	Minimum depth from top of the cable
1	Up to 1.1 kV	750 mm
2	3.3 kV to 11 kV	900 mm
3	22 kV to 33 kV	1050 mm
4	At road crossing	1000 mm
5	At railway crossing (from Bottom of sleepers to Top of pipe)	1000 mm

17.4 Painting (PTG)

General:

This part of specification deals with the painting of all types of Fans, Poles, Fluorescent fittings, Panel type lift doors, Collapsible gates of lift, Transformer, Fencing & Gate of transformer sub station, Feeder pillar, etc.

A) Painting of Fans (PTF)

Specification No (CW-PTG/PTF)

Scope:

Spray painting of table fan / pedestal fan / cabin fan / ceiling fan / exhaust fan including guards etc., shall be carried out in the workshop by adopting following method:

Method of construction:

- a) Existing paint on the surface of the fan body and its accessories shall first be scrapped off with the help of Emery paper of required grade or by heating the surface with blowlamp. One coat of primer shall then be uniformly applied with spraying gun and same shall be allowed to dry out. The body of fan then shall be spray painted with 2 coats of enamel paint of specified colour. When the colour is completely dried, rubbing Wax compound shall be applied. With a smooth cloth, the surface shall then be vigorously rubbed, until the painted parts starts shining. Same method shall be adopted for fan blades, base & stand of pedestal fan, mounting frame of exhaust fan. After complete drying, fan shall be covered in paper, to avoid abrasion.
- b) Grills of the fan shall be soaked and then cleaned with solvent and pressure dried. Paint shall be applied either by brush or with by spraying. After complete drying, it shall be covered in paper, to avoid abrasion.
- c) The agency shall have to make arrangement of transportation of fans from site to workshop & back to site, after completion of painting job.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

B) Painting of Poles/Channels (PTP)

Specification No (CW-PTG/PTP)

Scope:

Painting of channel / steel tubular / Rail / RSJ / pipe pole along with street light / pole brackets / clamps completely & providing one coat of red oxide paint and two coats of aluminum paint (Black paint up to 1.5 m from plinth is recommended)

Method of construction:

- a) Existing paint of the pole/channel shall be scrapped completely by emery paper/wire brush. Then one coat of red oxide shall be applied on cleaned surface. After drying out of the red oxide two coats of aluminium paint shall be uniformly applied to the pole/channel. In case of pole, it is recommended to apply black paint for the portion, which shall get embedded in soil/foundation. Remaining portion of the pole shall then be painted with two coats of aluminium paint as per instruction.
- b) The agency shall make arrangement of ladders, tools, spares, etc. required for carrying out painting at site.

Mode of Measurement: Executed quantity shall be measured on running meter basis. (i.e per meter)

C) Painting of Fluorescent fittings (PFT)

Specification No (CW-PTG/PFT)

Scope:

Spray painting of fluorescent fitting with flat reflector for ½ - 4' FTL completely from inside and outside after dismantling inside wiring / accessories and providing one coat of red oxide and two coats of best quality enamel paint of required colour and duly wired with accessories complete with re-erection as original.

Method of construction:

- a) Fitting shall be dismantled from its location. All wiring shall then be dismantled and stored in safe place, so as to reuse it after the painting.
- b) Existing paint of the metal surface of both the surfaces (inside & outside) shall be scrapped completely by using emery paper. After cleaning the scrapped surface, one coat of red oxide shall be applied by spraying gun. When the red oxide is completely dried out, two coats of white or any other specified colour shall be uniformly applied with spraying gun.
- c) The fitting duly painted then shall be erected at its location with necessary required hardware.
- d) The agency shall make necessary arrangements of tools/ladders required for executing the above job.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

D) Painting of Panel type doors of Lift (PLD1)

Specification No (CW-PTG/PLD1)

Scope:

Spray Painting of Panel type lift doors of MS, complete with scrapping the existing paint preparing the surface, painting the door with one coat of red oxide paint, white primer and finally with two coats of best quality paint of colour specified by engineer in-charge & polishing with rubbing compound & final polish of surface painting of doors etc.

Method of construction:

- a) Existing paint on the surface of the door and its accessories shall first be scrapped off with the help of Emery paper of required grade or by heating the surface with blowlamp.
- b) One coat of primer shall then be uniformly applied with spraying gun and same shall be allowed to dry out. Then all parts shall be spray painted with 2 coats of enamel paint of specified colour. When the colour is completely dried, rubbing Wax compound shall be applied. With a smooth cloth, the surface shall then be vigorously rubbed, until the painted parts starts shining.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

E) Painting of lift door of Collapsible type (PLD2)

Specification No (CW-PTG/PLD2)

Scope:

Painting lift door of collapsible type complete by scrapping the existing paint & preparing the surface, applying one coat of red oxide, white primer & two coats of approved quality enamel paint of required colour.

Method of construction:

Existing paint collapsible door of lift shall be scrapped completely by emery paper/wire brush. Then one coat of red oxide shall be applied on cleaned surface. After drying out of the red oxide, two coats of best quality paint of colour specified by engineer in-charge shall be uniformly applied to the door.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

F) Spray painting of Distribution Transformer (PDT)

Specification No (CW-PTG/PDT)

Scope:

Spray painting of distribution transformer of specified capacity with one coat of red oxide & two coats of approved quality enamel paint after scrapping the existing paint without any damages, in an approved manner as per direction.

Method of construction:

Existing paint of the transformer body, radiator fins, conservator tank, along with cable end boxes if any, shall be scrapped with emery paper of required grade. Sufficient care shall be taken while scrapping the paint at joints, so as to avoid leakage of oil. All the oil stains shall be removed. After preparing the surface, one coat of red oxide shall be applied with spray gun. After drying out of red oxide two coats of superior quality paint shall then be uniformly applied as instructed by site in charge.

Mode of Measurement: Executed quantity shall be measured on job basis. (i.e. job)

17.5 Plumbing (PLB)

A) Galvanized Iron Pipes (GP)

1. General

This part of specification deals with the Galvanized Iron pipes of different Class (Heavy, Medium & Light) used for water supply, or for any other purpose.

The guidelines for the use of pipes are as under:

- Heavy gauge pipes shall be used for delivery line of Submersible pumps/Ejecto Jet pumps/Open well submersible pumps.
- Medium gauge shall be used for suction pipe of Centrifugal pumps, (Except for Centrifugal pumps meant for Fire fighting purpose.) and shall be used enclosure for cables while meant for laying underground at road crossing, or any other location as directed by engineer in-charge, etc.
- Light gauge shall be used as enclosure for cables on wall, pole, or for other purpose wherever specified.

2. Scope:

Specification No (CW-PLB/GP)

Supplying and erecting GI Pipes of specified class, with necessary accessories, (such as: bends, tees, couplings, unions, sockets, enlargers, reducers, check nuts, plugs, etc.) at designated place, having relevant ISI mark, complete to the satisfaction of the department.

3. Material:

Pipe: The galvanized iron pipes shall comply with IS: 1239--1973 and 1969 for the specified class. The specified diameter of the pipes shall refer to inside diameter.

Fittings & Accessories: Bends, Tees, Couplings, Unions, sockets, bends, tees, enlargers, reducers, back nuts, plugs, unions, etc shall made of galvanized iron and shall comply IS: 1239-1973 and 1969.

Plumbing material: Hemp, Linseed oil.

MS Clamps: Clamps fabricated of required length and shape, of 3/6 mm thick mild steel having 25/50 mm width.

Hardware: MS nuts & bolts of required size and strength, Sheet Metal (SM) screws of required sizes, plugs/wooden gitties, etc.

4. Method of Construction:

4.1 **Pipes to be used as Enclosure:**

4.1.1 **Erection of Pipe on wall:**

The required length of pipe shall be machine cut, without any sharp edges, burrs, etc.

The pipe duly enclosing the specified material, shall be erected on wall in plum, and fixed with required size of MS clamps on wall with plugs, gitties, etc.

When the pipe is to be fixed to walls it shall be fixed with standard bracket, clips or holder by keeping the pipe about 12mm clear of the wall. The pipe shall be fixed to the wall horizontally and vertically and parallel to one another, when more than one pipe is to be laid, unless unavoidable. The supporting clips, etc. for the pipe shall be spaced at about two meters or so as necessary. Holes cut during construction shall not be left out; they shall be filled and finished after passing of the pipe through it.

4.1.2 **Erection of Pipe on pole:**

The required length of pipe shall be machine cut, without any sharp edges, burrs, etc.

The pipe duly enclosing the specified material, shall be erected on pole in plum, and fixed with required size of MS clamps with MS nuts & bolts of required size and strength.

When the pipe is to be used as cable enclosure and is to be terminated on street light pole(s), the pipe at the trench level should be placed at least 30 cm above the cable level for avoiding damage to the insulation of cable.

4.1.3 **Laying the Pipe underground:**

The excavation for laying the pipe underground shall be done as required, and in advance of laying, so as to cause least damage to the trench and least inconvenience to traffic and in other respects. The trench for laying the pipe shall be excavated to the lines and levels as directed by the site engineer. The bed shall be made even. Unless otherwise

specified in the special provisions, the excavation shall be about 30 cm. wide and not less than 45 cm. deep. The trench shall be excavated through all strata met with. Where necessary, sides may be shored or sloped. In case rock is met with the section of the trench, the depth may be slightly reduced but shall be sufficient to receive the pipe and the cushioning with a safe margin. Dewatering shall be done where necessary.

During excavation, if any, pipes, water mains, cables. etc. are met, these shall be carefully protected and supported; any damage done shall be made good by the contractor at his own cost.

4.3 Pipe used for Plumbing purpose:

The required length of pipe shall be machine cut and threaded (threading shall be done by machine only), without any sharp edges, burrs, etc. The pipe shall then be properly aligned with the accessory and tightening by applying hemp, linseed oil, so as to make it leak proof. During the erection, wherever required, correct accessory shall be used. When holes are not left during construction they shall be cut into the walls or slabs, etc., to pass the pipe through. The necessary clamps, supports shall be provided wherever required.

5. Mode of Measurement:

Executed quantity shall be measured on running meter basis, including the entire accessory. The lengths shall be measured net including the straight and bends along the center line of the pipes and fittings correct up to a cm. (i.e. per meter)