



MAZAGON DOCK SHIPBUILDERS LIMITED

(Formerly known as Mazagon Dock Ltd.)

CIN : U35100MH1934GOI002079

(A Government of India Undertaking)

Shipbuilders to the Nation

Dockyard Road, Mazagon,

Mumbai 400 010.

INDIA

**Biennial Rate Contract for Electrical Works
including minor civil works within MDL
Premises located at Dockyard Road, Sewree,
Anik Chembur, Gavan, Residential Quarters
at Dockyard & Navi Mumbai including works
at Naval Dockyard**

VOL-IV

GENERAL TECHNICAL SPECIFICATIONS

&

PREFERRED MAKES

GENERAL TECHNICAL SPECIFICATIONS**ELECTRICAL WORK**

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CHAPTER-1**WIRING**

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Chapter 1:WIRING (WG)

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 ant 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.

Epecially 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

pipings 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. ½ 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

PART 1 - **Lugs:** Copper lugs of appropriate type and size.

PART 2 - **Other material:** Flexible PVC conduit, gland coded ferrules, etc.

PART 3 -

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:

to All wiring shall be tested with 500V Meggar between phases, phase – neutral and 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 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 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; 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.

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.

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.

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 mm²		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						
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
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Note 1: Cu- applicable to only copper cable; Al- applicable to only Aluminium cable

Table No. 1/4

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

Colour Coding For Conduits in Wall Entry

Colour Code for Wires

Table No 1/5

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 I 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 75° 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-snap 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.

3.2 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 - 70^o C, crush resistance of 44N/m, as per table 1.12/3.

Table 1.12/3

04/ 06/ 12/ 24 fibres

Physical Specifications:

Fiber Count	Subunits	Outer Diameter in. (mm)	Weight lbs/kit kg/km	Minimum Bend		Max. Tensile Load		Max. Vertical Rise Feet (Meter)
				Radius In. (cm)		lbs. (Newtons)		
				Loaded	Unloaded	Short Term	Long Term	
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

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 coated steel tape and constructed with industry standard 3mm buffer tubes, stranded around a central strength member.
3. The armor layer shall provide crush protection meeting the Telcordia requirements for Superior Armored cable.
4. 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 ± 3.0 µm
8	Cladding Diameter should be 125.0 ± 1.0 µm
9	Max. Attenuation, Loose Tube Cable 3.0 dB/km
10	Coating/Cladding Concentricity Error should be =< 6 µm
11	Clad Non-Circularity ≤ 1%
12	Zero Dispersion Wavelength 1297-1316 nm
13	Water Immersion, 73.4°F (23°C) should be ≤ 0.20 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 retenti on strengt h	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.

A.

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 Diameter:	Outside 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 Change:	Loss <0.2 dB
Temperature Stability:	-40 to + 75 °C
Insertion Change:	Loss <0.3 dB

B.

C.

Method of Construction:

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

D.

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 (CANAs)
- 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 (CANA)
- 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
				Horizont	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.
6. 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

1. 24 and 48 port patch panels with 110 IDC connector terminations on rear
2. 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.
3. 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:

		High Performance Solution	Premium Performance Solution
	Category 6 Patch Panel		
		Category 6 Channel (4 Connectors)	
	Typical Worst	Guaranteed	Guaranteed
	Pair Margin*	Margin**	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 includes 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.

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

K) 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	

Chapter 2: Fittings (FG)**2.1 Lamps (FG-LP)****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	Gas filled	Coiled coil		1380
150				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 t (W)	Lamp volt (V)	Operatin g lamp current (A)	Nomin al lumino us flux (lm)	Starti ng 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 t (W)	Min. main s Volta ge (V)	Lamp current (A)	Nomin al lumino us flux (lm)	Averag e 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 dia-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 polish 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 onwall/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:

- 1) 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.

2)

3)

4)

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:**

- 5) 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 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 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	Minimum Service Value
			at Rated Voltage	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 weep 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 m³/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****Chapter 3 Appliances: (AP)****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 then 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)

CHAPTER-4

ENERGY SAVING DEVICES

4.1 Solar Lighting

ESD-SOL

Chapter 4 :Energy Saving Devices (ESD)

4.1 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)

CHAPTER-5

SWITCHGEARS

<p>5.1 LT --I/C M/C Switches, ATS, Bus Bar, Feeder Pillar</p>	<p>SW-SWR</p>
<p>5.2 I/C M/C Distribution boards</p>	<p>SW-DB</p>
<p>5.3 LT -- MCB</p>	<p>SW-MCB</p>
<p>5.4 LT -- MCBDB</p>	<p>SW-MCBDB</p>
<p>5.5 LT -- MCCB</p>	<p>SW-MCCB</p>
<p>5.6 LT -- RCCB</p>	<p>SW-RCCB</p>
<p>5.7 LT – Oil Circuit Breakers</p>	<p>SW-OCB</p>
<p>5.8 LT – Air Circuit Breakers</p>	<p>SW-ACB</p>
<p>5.9 HT – SFU, LBS</p>	<p>SW-HTS</p>
<p>5.10 HT – Breakers (VCB)</p>	<p>SW-VCB</p>
<p>5.10 Drawings</p>	

Chapter 5 Switchgears (SW)

5.1 LT—I/C M/C Switches, ATS, Feeder Pillar (SWR)

General

All material shall confirm 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)

PART 4 - ***Packing material:*** Rubber / Neoprene gasket

PART 5 - ***Paint:*** Red oxide paint /Primer, Enamel paint

PART 6 - ***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	Aluminium/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-6

CABLES

6.1 LT Cables (Aluminium)	CB-LT/AL/
6.2 LT Cables (Copper)	CB-LT/CU
6.3 HT Cables	CB-HT/
6.4 Cable Joints, Termination Kit (LT)	CB-JT/LT
6.5 Cable Joints, Termination Kit (HT)	CB-JT/HT
6.6 Cable Enclosure (Pipes)	CB-CE/
6.7 Cable Glands	CB-GL/
6.8 Cable Lugs (Copper)	CB-CL/CU
6.9 Cable Lugs (Aluminium)	CB-CL/AL

Chapter 6:PVC/XLPE Cables (CB)

6.1, 6.2, & 6.3 Armoured Cables (HT & LT)

1. General

- 1) 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.
- 2) 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.
- 3) Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

2. Cables: (Armoured)

- 1) 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.

k 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).

Chapter 7

EARTHING

7.1 Plate, Pipe	EA-EP/
7.2 Accessories	No Specs

Chapter 7 Earthing (EA)

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 ----- --->		Galvanise d cast iron earth plate type without C.I cover	Copper earth plate type with C.I cover	Galvanise d 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.l. pipe 40mm. dia. 2.5 mtr. Long or 20 mm dia. G.l. 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.l. wire 8 SWG	Double G.l. 8 SWG	Double G.l. 6 SWG	double G.l. 8 SWG
5)	Wire enclosure	12mm. dia. G. 1. pipe 2 mtr. Long	12mm. dia. G. 1. pipe 2 mtr. Long	12mm. dia. G. 1. 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.l.	19mm. dia. G.l.	19mm. dia. G.l.	N A

		pipe	pipe	pipe	
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, reverting, 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 unavoidable, 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 8

PUBLIC ADDRESSE SYSTEM

8.1 P. A. System

FF-PAS

Chapter 8

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

Chapter 9

CIVIL WORK

9.1 Excavation CW-EXN

Chapter 9 Civil Work (CW)

9.1 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:

- 2)
3) **(For cables of size 25 Sqmm. and above shall be covered by min. 150 mm. dia. of RCC Hume pipe)**

4)

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

Chapter 10

OTHER TECHNICAL SPECIFICATIONS

1. Wireless Call Bell System.

wireless call system is an innovative and simple solution. It helps to summon a peon or attendant from a distant location, with mere press of a remote. The call system works on latest wireless technology and needs no installation. User needs to press a remote controller to call the attendant. The range of communication is 20-30 meters indoors, and around 100-120 meters outdoors. Every remote has a number that is displays on the receiver when pressed. The call bell system comes in numbers of 2 to 10 remotes. The system is simple to use and easy to understand.

Every remote has a CALL and CANCEL button. The receiver has 2 to 10 indicators (depending on various models). To call the attendant simply press the CALL button on the remote controller. This will send a wireless signal to the receiver unit. The respective indicator on the receiver will start to blink. Along with a beeping sound to alert the attendant or peon.

Advantages of wireless call bell system:

- Absolutely no wiring needed
- Ready to use system (just out of the box, plug and play)
- No hassles of installation (plugin the receiver to the adapter and distribute the remotes)
- Each remote has a separate indicator on the receiver to allow the attendant to know exact room location
- System needs no line of sight communication. Remote controller signals can penetrate through walls as well
- System operates on cutting edge wireless RF technology
- The battery life of the remotes is around 1 year (operates on 23A batteries)
- Each indicator glows along with a beep sound to alert the attendant

2. Fire Alarm System

2.1 *Scope of Work and Exclusions*

The work shall comprise entire labour including supervision and all materials necessary to make a complete installation to the entire satisfaction of the Client /Consultant. The term complete installation shall mean, not only major items of equipment covered by these specifications, but also incidental sundry components necessary for complete execution and satisfactory performance of the installation, with all labour charges, whether or not these have been mentioned in detail in the tender documents. The work shall include data entry, programming, start-up test and demonstration, training of personnel for maintenance and operation, submission of construction and installation drawings and wiring diagrams, as built documents and system guarantee and for approval by the Statutory Authorities.

The Contractors' scope of work will include all items of work as per these specifications, drawings, terms and conditions of contract etc. and briefly

described in schedule of quantities. This shall include, but not be restricted to the following: -

- Intelligent Addressable Optical Smoke & Heat Detectors
- Manual Call Points
- Microprocessor Based Intelligent Addressable Main Fire Alarm Control Panel for connecting and monitoring the Fire Detectors and other devices.
- Low and High Intensity Hooters activated from the Panel.
- Providing suitable compatibility in the Main Fire Alarm Control Panel for the Public Address System, audio Amplifiers, speakers & required wiring.
- Providing suitable compatibility in the Main Fire Alarm Control Panel with inbuilt Talk Back System having loop connection with jacks with compatible to portable Handset at each floor and Exist & required wiring.
- Electrical works, including Cabling, Earthing etc. for the installation.
- All other works associated with above items as per specifications, drawings and conditions of contract and the Mumbai Fire Brigade requirements except those specifically excluded in Schedule of Quantities.

Unless otherwise indicated in Schedule of Quantities and drawings, the Contractor's scope of work will exclude only the following items of work and services, which will be arranged by the Engineer-In-charge through other contractors, if required: -

Provisions of adequate AC, single/ three phase, 230/415 V, 50 HZ supply with earthing for Fire Control Panels etc.

2.2 General Description of Intelligent Fire Alarm System

The detectors shall be Addressable Intelligent optical detectors.

2.2.1 The number of detectors and location shall confirm to relevant standards but not less than one detector per 49-sq. meter area. Addressable intelligent optical detectors shall be used. The detectors shall give the visual and audible alarm at the respective control Panel. The panels shall be located in the respective ground floor control rooms.

2.2.2 The fire alarm panel shall operate 240V+ 10% 50Hz. The FDAS shall also be provided with a dedicated standby power supply system (battery and charger) capable of maintaining the system for a period of not less than 24 hours after failure of ac power supply after which sufficient battery shall remain to provide full load operation for at least 30 minutes in line with IS 2189.

2.2.3 Armoured FRLS cables shall be used from detectors to the alarm panel confirming to the relevant IS and from reputed manufacture.

The system should be able to detect any type of smoke, fire and heat in the respective site/area.

2.3 Detailed Description of the System Components:

2.3.1 Basis of Design

- An Intelligent Modular/ Expandable Fire Alarm System (IFAS) shall be provided to effect total control over the life safety services required in the building.

- The system shall be provided with Addressable fire alarm initiating, annunciating and control devices.
- The addressable and intelligent system shall be such that smoke sensors, thermal sensors, manual call points, etc., can be identified with point address.
- The FAS shall be able to recognize normal and alarm conditions, below normal sensor values that reveal trouble condition, and above normal values that indicate either a alarm condition or the need of maintenance.
- Read-out or address an actual detector location. The operator shall also be able to adjust alarm and alarm thresholds and other parameters for the smoke sensors.
- Provide a maintenance/pre-alert alarm capability at smoke sensors to prevent the detectors from indicating a false alarm due to dust, dirt etc.
- Provide alarm verification of individual smoke sensors. Systems that performs alarm verification on a zone basis shall not be acceptable. Alarm verification shall be printed on the printer at the Control Station's printer to enhance system maintenance and identify possible problem areas.
- Provide local numeric point address and LED display of device and current condition of the point.
- Each detector shall use state-of-the-art Microprocessor Circuitry with error, detector self-diagnostics and supervision programs.
- The detection of the fire shall be taken at the detector level.
- Multi-Criteria Detectors shall be offered whereby the system logic activation is based on any three inputs from the detector i.e. smoke, heat or neural network.
- Provide outputs that are addressable, i.e. outputs shall have point address. The operator shall be able to command such points manually or assign the points to Logical Point Groups (Software Zones) for pre-programmed operation.
- In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.
- The System Alarm LED on the main fire alarm control panel shall flash.
- A local sounder shall be sounded.
- The LCD display on the main fire alarm control panel shall indicate all information associated with Fire Alarm condition including the type of alarm point and its location within the premises.
- Printing and history storage equipment shall log the information associated with the Fire Alarm Control Panel condition, along with the time and date of occurrence.
- All system output programs assigned via control-by-event programs that are to be activated by a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

2.3.2 FIRE ALARM CONTROL PANEL (FACP)

- The Addressable Fire Alarm Control Panel (FACP) shall function as fully stand-alone panel as well as providing a communication interface to the central station where many such panels will be in a network. FACP shall have its own microprocessor, software and memory. In the event of failure of the central or communication breakdown between the central station and the FACP, the FACP shall automatically operate on stand-alone mode without sacrificing any functions.
- The panel should be modular microprocessor based in nature and should be 4 loop or Mention in the Bill of Quantity & expandable upto 32 loops (4000 devices – addresses).
- FACP shall supervise detection circuits and shall generate an alarm in case of abnormal conditions.
- FACP shall provide general purpose inputs for monitoring such functions as low battery or AC power failure. FACP shall have tamper protection and programmable outputs, which can operate relays or logic level devices.
- Smoke detectors / Multi-Criteria Detectors shall be powered using the FACP-based smoke detection circuits. FACP shall provide for resetting smoke detectors, fault-isolation and sensor loop operation. It shall be possible to mix different fire devices within the same FACP to optimize field wiring.
- It shall be possible for the panel to have a minimum loop length of 1 km of length of devices from the panel.
- FACP shall provide monitoring and control of one floor or area or for multiple floors or areas. FACP shall meet the following requirements to assure the integrity and reliability of the system:
 - The FACP shall be UL /VDS listed independently as a fire alarm control panel.
 - The FACP should have integrated power distribution module and fixed cabling done internally to guarantee a clear and tidy cable feed.
 - The panel should preferably have a LCD touch screen of 5/7 inches size (320 x 240 dpi) is used as display and keypad. The touch display should enable a flexible design of the operating menu with variable keys and message windows. 23 fixed keys should be used for standard operating steps. The current status of the system should be displayed by 11 LEDs. 3 interfaces (RS232,) enable the connection to a PC.
- All materials and components used in the panel are specified as per UL94 V- 0 or higher.
- The panel should have a 240 V AC power supply unit in plug-in design with rack and panel connector is a 24V DC/6A single output power supply. The module should be protected against over-voltage and reverse polarity. The output voltage is monitored and regulated externally.

- LCD display at the FACP shall be provided to indicate point in alarm or trouble. In such systems, means for manually scanning the points in trouble shall be provided and a trouble and alarm LED shall be used to indicate that there are points in alarm/trouble. The alarm/trouble LED shall only extinguish when all alarm/troubles are cleared from the loop.
- It shall be possible to command test, reset and alarm silence from the FACP.
- FACP switches shall allow authorized personnel to accomplish the following, independent of the central console:
 - Acknowledge a general alarm condition.
 - Silence the local audible alarm.
 - It shall be possible to Silence the alarm indicating devices (hooters).
 - Reset all zones (Logical Point Group) / points, after all initiating devices have returned to normal.
 - Perform a complete operational test of the memory with a visual indication.
 - Test all panel LEDs for proper operation without causing a change in the condition of any zone (Logical Point Group)

Walk Test

- Software zones/loops shall be circuited and protected by Fault Isolation Modules such that in the event of a zone/loop short-circuit, Intelligent Smoke and thermal sensors shall be located as shown and shall report alarm
- Monitoring modules shall be provided to monitor and address contact-type input devices. The monitor module shall be housed in the FACP supervised by FACP.
- The FACP detectors shall have Drift Compensation facility to compensate for environment.
- The FACP should be UL / EN / Vds listed approved to provide the sensitivity measurement and documentation required. FACP shall be backed up with its built in UPS power.
- The display on FACP shall provide indication for AC Power, System Alarm, System Trouble/Security Alarm, Display Trouble and Signal Silence. This would mean that in the event of change of any logic, detector / zone sequence alteration, the operator can initiate these by use of the LCD touch pad & alpha-numeric keys on the FACP panel to reconfigure the above parameters.
- Power supply unit of FACP shall have following characters:
 - The main power supply shall be 230 VAC±10%, 50 Hz±3% and shall in turn provide all necessary power of the FACP.
 - It shall provide a separate battery control module with charger.
 - For ease of service, all wiring terminal blocks shall be plug-in type.

- The Fire Alarm Panels shall have a possibility of being interlinked either by direct connectivity or an optical cable link between the various locations and should further have connectivity to the main control centre.

2.4 MANUAL CALL POINT: -

Each manual call point unit shall comprise of a push button of reputed make enclosed in box. The push button shall have minimum 1 NC and NO contacts. The push button assembly is enclosed in the M.S. box enclosure with all sides covered except the front side. The front side shall be sealed with breakable glass cover using neoprene or equivalent gasket. In case of fire, when the glass cover is broken to give the fire warning the push button will be released due to spring action hence giving remote fire alarm through the NC contact. Call points can be reset with the test key & then by replacing the glass.

The box enclosure shall be completely dust, vermin damp and weather proof. They shall be made of steel sheet of 16 swg. The complete unit shall be suitable for wall mounting with necessary mounting Accessories. The complete unit and the push button shall be painted signal red. The internal surface of the enclosure of the box shall be painted of white colour. The external painting shall be synthetic enamel.

Break Glass in case of Fire shall be written on each MCP unit, either on the enclosure or on a separate metal plate mounted behind the glass cover. Each unit shall be equipped with an iron hammer with a hook fixed to the external enclosure.

2.5 HOOTER:

Two different types of hooters have been provided on the installation.

- a. Simple 24 volt D.C. operated Electronic Hooter. This are connected directly to the main control panel by switch twin wires, if desired in a ring circuit. This can be activated automatically or manually, as desired by the switches provided at additional control panel for P.A. system etc.
- b. P.A. Speaker cum Hooter, working on 0 – 100-volt line through a suitable line matching transformer. This will automatically give the evacuation alarm in case of fire condition and can subsequently be used for public announcements through the P.A. system when provided. These are also connected directly to the Main Control Panel preferably by the ring circuit.

2.6 SMOKE DETECTOR:

Two major types of Smoke Detectors are available.

One is an ionization device that contains a small radioactive source (AM 241 less than 1 micro curie) for ionizing the air molecules between a pair of electrodes, permitting a very small current to flow between the pair. If smoke particles from a fire enter this space, they reduce the flow of current by adhering to the ionized molecules. The drop in current sets off a buzzer or other alarm.

The second type of smoke detector uses a photoelectric cell. In some of these detectors, smoke that enters obscures a steady beam of light; in others, the smoke scatters a light ray from a diode so that the cell can detect it. In either case the change sets off an alarm. The alarm may sound locally, or it may be designed to alert a central station with notification of fire department.

Photoelectric detectors are slower than ionization detectors, and sometimes both principles are combined.

2.7 HEAT DETECTOR:

Rate of rise / fixed temperature rating detector are designated for applications where a rapid rise in temperature may be expected during and outbreak of fire. The detector should incorporate both the rate of rise / fixed temperature operating principles. The detector will react quickly to a rapid rise in temperature, but even if the increase is very slow, signal will be transmitted to the control panel when the maximum temperature sensors gets actuated. The rate of rise sensor shall get actuated when the rate of rise in temperature exceeds the rate of 150 F per minute the detector should sense the fire and transmit a signal to the control panel. The fixed temperature element should sense the fire when the temperature reaches 680 C.

3 LED Lamps:

lamp is a light-emitting diode (LED) product which is assembled into a lamp (or light bulb) for use in lighting fixtures. LED lamps have a lifespan and electrical efficiency which are several times longer than incandescent lamps, and significantly more efficient than most fluorescent lamps. LEDs come to full brightness without need for a warm-up time; the life of fluorescent lighting is also reduced by frequent switching on and off.

LEDs are “directional” light sources, which means they emit light in a specific direction, unlike incandescent and compact fluorescent bulbs, which emit light and heat in all directions.

The chart below shows the amount of brightness in lumens you can expect from different wattage light bulbs. The LED bulbs require much less wattage than the CFL or Incandescent light bulbs.

Incandescent Watt	CFL Watts	LED Watts	Lumens (Brightness)
40	8 - 12	6 - 9	400 - 500
60	13 - 18	8 - 12.5	650 - 900
75 - 100	18 - 22	13+	1100 - 1750
100	23 -30	16 - 20	1800+
150	30 - 55	25 - 28	2780

16-20 W ROUND LED DOWNLIGHT

Features

- Aluminum pressure die cast (PDC) body with decorative trim
- Industry best light output with LM80 tested SMD LEDs
- Effective thermal management with aluminum PDC heat sink

- Robust driver with wide voltage range 100-240VAC and inbuilt protection
- Recessed mount, protected from dust and insects

Specifications

Code	D521665	D522065
Wattage	16	20
Colour Temp. (K)	6500	6500
Lumens (lm)	1200	1450
Voltage (VAC)	240	240
Cut Out Φ (mm)	140	140

5W-9W LED BULB

Features

- Saves 80% energy with life up to 10 years
- Industry best light output with wide light distribution > 200°
- Robust driver with wide voltage range 100-240VAC and inbuilt protection
- Light weight and decorative look fits in CFL sockets

Specifications

• Code	N50001	N90002
• Wattage	5	5
• Colour Temp. (K)	6500	6500
• Lumens (lm)	450	840
• Voltage (VAC)	240	240
• Beam Angle	240°	220°

5W LED Mirror Light

Features

- Slim LED Batten in Aluminum housing and decorative end caps
- Industry best light output, with spot free illumination
- Effective heat dissipation with extruded aluminum heat sink

- Robust driver with wide voltage range 100-240VAC and inbuilt protection
- Wall mounted, protected from dust and insects

Specifications

Code	D530565	D530527
Wattage	5	5
Colour Temp. (K)	6500	2700
Lumens (lm)	380	360
Voltage (VAC)	240	240

LED Strip Light

An LED Strip Light (also known as an LED tape or ribbon light) is a flexible circuit board populated by surface mounted light-emitting diodes (SMD LEDs) and other components that usually comes with an adhesive backing. Traditionally, strip lights had been used solely in accent lighting, backlighting, task lighting, and decorative lighting applications. Increased luminous efficacy and higher-power SMDs have allowed LED strip lights to be used in applications such as high brightness task lighting, fluorescent and halogen lighting fixture replacements, indirect lighting applications, Ultra Violet inspection during manufacturing processes, set and costume design, and even growing plants.

Application

Strip lights are designed for both indoor and outdoor use depending on whether they're water resistant. Since the strip is flexible and can be divided at any point between LEDs, it is extremely versatile and can be used in a number of installations. Outside of traditional lighting, strip lighting is extensively used in DIY projects or lighted clothing.

4 Wall-mounted PIR Occupancy Sensor for A.C

Wall-mounted PIR Occupancy Sensor employs passive infrared (PIR) technology will scan the room for occupancy using Passive Infra-Red (PIR) technology to accurately detect occupancy. As the sensor will only detect body heat it will not therefore be affected by items such as ceiling fans, or curtains. When no occupancy has been detected, after a preset time delay (either 15, 30 or 45 minutes), a signal will be transmitted to the AC to switch it off. On re-entering the room, if air conditioning is required, the occupant simply turns the air conditioner back on using the normal remote control.

After the occupant has left the room, Sensor will continue to scan the room for a preset time - 15.30 or 45 mins before sending the signal to turn off the Air Conditioner

5 UV Mosquito Lamp.

Mosquito Lamp, more formally called an electrical discharge insect control system, electric insect killer or (insect) electrocutor trap, is a device that attracts and

kills flying insects that are attracted by light. A light source attracts insects to an electrical grid, where they are electrocuted by touching two wires with a high voltage between them. The name comes from the characteristic onomatopoeic zap sound produced when an insect is electrocuted.

CHAPTER -11**LIST OF APPROVED MATERIALS**

Unless otherwise mentioned specifically only the following approved make / brands of various electrical accessories will be used. In case, there are two types of product under one brand name, then product having I.S.I mark shall be used. In case, the approved brands are not available in the market then, equivalent product conforming to relevant standards, as approved by the Engineer In charge shall be used. The contractors should distinctly understand that it would not be their prerogative to insist on using a particular make/brand amongst the approved ones.

Sr. No	Item Description	Makes/ Brand
1	Transceiver	DLINK/ CISCO/ HP switches
2	Light fitting	Crompton/ Philips/ Havells/ Bajaj
3	HPMV lamp	Crompton/ Philips/Havells /Bajaj
4	Fans	Almonard/ Crompton/ Bajaj
5	Water heater (geyser)	Almonard, Crompton, Racold,Bajaj
6	UV Mosquito Lamp	Balaji/Super trap
7	Flexible Cables	Polycab/ RR Cable/ Havells/ Finolex,
8	FRLS cables	Rallison/ Finolex/ Polycab
9	G.I. Cable tray	Bravo Trays / SV Metal
10	MCCB/MCB Vari-depth handle (Rotary handle)	Legrand/ Havells/ Schneider/ L&T/ Indo Asian
11	MCB Terminals	Elemex/ Connectwell /KEW/ Bentec
12	MCCB spreaders link	Legrand/ Havells/ Schneider/ L&T/ Indo Asian
13	Indication LED	Teknic// L&T
14	Flameproof/Weatherproof Tube light fitting	Crompton Greaves/ Sudhir switchgear/ Bajaj/ Baliga/ FCG
15	Flameproof/Weatherproof Junction Box	Connectwell/ Phoenix/ Sudhir switchgear/ Bajaj/ Baliga/ FCG
16	Flameproof/Weatherproof Single Phase Exhaust fan	FCG/ Sudhir/ Crompton Greaves/ Bajaj/ Baliga
17	Flameproof/Weatherproof MCB PLUG AND SOCKET COMBINED	FCG/ Sudhir/ Crompton Greaves/ Bajaj/ Baliga
18	L.T. Switchgear	
	A) Enclosed in sheet steel with H.R.C. fuses for 63A and above	L&T/ Siemens/Schneider
	B) Cast Iron with rewirable fuses	KEW/ CPL/ Kalki
	C) Circuit Breakers (Moulded Case)	Legrand/ Havell's/ Schneider

	D)	Miniature Circuit Breakers	Legrand/ Havell's/ Schneider
	E)	Cubical Panel Switchgear Accessories	
	I)	TPN / DP Switches / Isolators	Legrand/ Havell's/ Schneider/ L&T
	II)	Rotary CAM type, Selector Switch	Siemens / AEI/ Kaycee
	III)	Start / Stop push Button stations	L&T/ Siemens/ Havell's
	IV)	Contactors	L&T/Siemens
	V)	Indicating Lamp	Siemens/ Vaishno/Teknic
	VI)	Earth Leakage Circuit Breakers	Legrand/Havell's/Schneider/L&T
	VII)	HRC Fuse	Siemens/ L&T/ GE
19		Distribution Boards with MCB's	Legrand/ Havell's/ MDS/ L&T
20		Cables	Polycab/ Havell's/Finolex/RR Cable
21		Socket / Lugs	Dowells/Jainson/ Braco
22		PVC wires	Polycab/ Havell's/Finolex
23		Conduit	
	A)	M.S. Black and G.I. Conduit	Precision/ Diamond/ BEC
	B)	Rigid PVC Conduit and accessories	Precision/ Asian/ Diamond/ BEC
24		PVC casing-n-capping and PVC casing-n-capping accessories	Precision/ Modi's/ Presto-plast
25		Screws	Precision Fastners
26		Piano switches flush mounting (5 to 15 A) / wall sockets & plugs (surface mounting), Modular switches (5 to 15 A) holder pendant / batten / angle, three plate ceiling rose (for 3 core twisted flexible wire), 30 A D.P. Ticcino type switch fuse with indicating lamp, bell push surface mounting, flush mounting	Legrand/ Roma/ Anchor
27		Wall Socket and plug Metal clad (ray roll type)	Legrand/ Crompton Greaves/ Havell's
28		PVC Boards	Presto-Plast ISI marked
29		Special Accessories concealed / decorative (plate switches)	Roma/ Precision/CPL/ Anchor
30		Two / Three core flexible wires	Polycab/ Havells/ Finolex
31		Storage Heater with thermostatic control	Almonard/Crompton/ Racold
32		Lamps	
	A)	Fluorescent, HPMV, HP/LP-SV, Halogen / MLL	Crompton/ Philips/ Havells
	B)	Halogen / MLL& Metal Halide	Philips/ Crompton/GEC

	C)	CFL 8 to 24 W upto 36W, Groove type, pin type	Philips/Crompton/ Wipro, GE/Bajaj	Anchor/
	D)	LED	Philips/ Bajaj/ Havells	
33		Fittings for fluorescent HPMV lamps and LP / HPSV lamps with copper wound chokes and condensers. Bulkhead fittings, Duoflux / dispersive reflectors, flood light fittings. Recessed mounted CFL 36W & low watt. Fittings which use energy saving light source like CFL, TL-5 and LED.	Crompton/ Bajaj/ Halonix	Philips/Havells/
34		Bell		
		Call Bell / buzzer	Anchor/ Rider/ Cona	
35		Exhaust Fans / Pedestal Fans air circulators	Crompton/ Almonard/ Bajaj	
36	A)	Ceiling Fans with double ball bearings	Crompton/ Almonard/ Bajaj	
	B)	Table Fans wall mounting Fans / cabin fans	Crompton/ usha	
37		Terminal Block	Elmex/ Everest/ Jyoti	
38		Meters: Ammeter & Voltmeter (Analog)	Automatic Electric/ Meco	
39		G.I. Pipes	Zenith/ Diamond	
40		Electronic Ballast	Philips/ Asian	
41		Fan's Electronic Regulator	Rider/ Anchor/ Cona	
42		Fluorescent Tube 28W T5 (4 ft or 3 ft or 2 ft)	Philips/ GE/Osram	
43		Cable Trays and its accessories	Legrands/ Corporation	Asian Anciliary
44		PA SYSTEM SPEAKERS	BOSCH/ BOSE	
45		FIRE ALARM SYSTEM	Schreck/ Notifier / Simplex / Fire finder / Bosch / L&T	
46		NETWORK SWITCH	CISCO/SIEMENS/D-Link	
47		NETWORK RACK	PENDUIT/RITAL/PRESIDENT	
48		PATCH PANEL	MOLEX PREMIUM /PENDUIT	
49		CAT 6	ENERCON / LAPP INDIA/MOLEX	
50		TELEPHONE CABLE	DELTON /POLYCAB/FINOLEX	
51		Occupancy Sensor	Wipro/Philips /Honeywell	
52		Call Bell System	Forbix semicon/SBI/NN	