



टिपणी

सा.बा. विभागाच्या विद्युत शाखेच्या द्वारे विद्युत संच मांडणी करतांना त्यातील लागणाऱ्या बाबीसाठी दरवर्षी बाबवार दरसुची मंजूर केली जाते. दरसुची मधील बाबीचे सविस्तर विनिर्देश (Specification) यापुर्वीच या विभागाने मुख्य पुस्तिकेद्वारे सन २००८ मध्ये प्रकाशीत केलेले आहे.

तदनंतर २००८ ते २०११ पर्यंतच्या कालावधीमध्ये उद्भवलेल्या प्रसंगानुसार व अनुभवानुसार दरसुचीतील बाबीतील संख्येमध्ये वाढ करण्यांत आलेली आहे. त्या अनुषंगाने वाढ करण्यांत आलेल्या बाबीचे सविस्तर विनिर्देश (पृ.क्र. १ ते ३१) तयार करून अंमलात आणण्याकरिता अतिरिक्त प्रकाशीत करण्यांत येत आहे.


Development Engineer (Ele./Mech.)
Pimpri-Chinchwad Municipal Corporation
Pimpri - 411 018,

प्रिय प्रकाश,

खोबत बदलतेते/सुधारणा देतेते तांमिड विवरण पम
पानांनु १ ते ३१ माहीतीकरिता





Chapter 2 Lamps (FG-LP)

2.1 Tubular Fluorescent Lamps (TFL- as per BEE spec.)

Specification No. (FG-LP-TFL)

Scope:

Supplying and fixing Tubular Fluorescent lamps for General lighting service suitable for 230 volts, and of specified wattage, as per Indian Standard IS 2418 (part I) and (part II) – 1977 including all the amendments. The lamp shall meet with the requirements mentioned in BEE specification

Material:

Lamp: This standard specifies the requirements for participating in the energy labeling scheme for Tubular Fluorescent lamps for General lighting service. 1.2 The referred Indian Standard are IS 2418 (part I) and (part II) – 1977 including all the amendments. It shall covers 4 feet tubular fluorescent lamps for wattages upto 40W, and shall cover 6500K colour temperature for halo-phosphates and 6500K, 4000K & 2700K for tri-phosphate category.

Star rating plan:

Lumens per Watt at 0100 hrs of use $<61 \geq 61$ & $<67 \geq 67$ & $<86 \geq 86$ & $<92 \geq 92$

Lumens per Watt at 2000 hrs of use $<52 \geq 52$ & $<57 \geq 57$ & $<77 \geq 77$ & $<83 \geq 83$

Lumens per Watt at 3500 hrs of use $<49 \geq 49$ & $<54 \geq 54$ & $<73 \geq 73$ & $<78 \geq 78$

The measured values will be converted to star ratings for each point i.e. at 100 hours, 2000 hours, 3500 Hours and the average of the 3 ratings will be taken. This will be rounded of (<0.5 to lower level and ≥ 0.5 to higher level) to the nearest integer which will be the star rating for the product.

- The products should conform to minimum requirements of IS 2418 (part I) and (part II) – 1977 to participate in BEE S&L Programme.
- BIS product certification or at-least, Quality Certification such as ISO - 9000 should be required to participate in BEE S&L Programme.

The star marking as per the rating is required to be stamped on the lamp. The size of the stamp for the star marking is 14.5 mm height x 8.5 mm width. The same shall be stamped in a separate column. For example for a three star lamp the same need to be marked on the lamp as mentioned in IS 2418 (part I) and (part II) – 1977 including all the amendments.

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)

2.6 Fans (FG/FN)

Ceiling Fans (As per BEE spec.)

Specification No (FG-FN/CF)

Scope:

Supplying and erecting Ceiling fan of 1200 mm sweep with all accessories and necessary materials, erected in provided hook/clamp.

Material:

Ceiling Fan:

1) This Fan specifies the requirements for participating in the energy efficiency standards and labelling for ceiling fans covering 1200mm sweep. The referred Indian Standard are IS 374 : 1979 (Specification for Ceiling Type fans and regulators) with all amendments, as applicable



2) Parameters for initial, verification and challenge testing are the mandatory type tests listed under clause 10 of IS 374: 1979 and including all amendments as of date relevant to the determination of service value. These tests would generally include- Air delivery Fan speed & power input

3) The performance requirements will be in accordance with clause 8 of prevalent IS 374:1979. For compliance with the requirements of this standard, the values of service factor & air delivery are as listed in table below for 1200mm sweep operating at rated voltage and rated frequency at full speed.

4) **Star Rating Index Calculation for Ceiling Fans**

Star Rating Service Value for Ceiling Fans*

1 Star _ 3.2 to < 3.4

2 Star _ 3.4 to < 3.6

3 Star _ 3.6 to < 3.8

4 Star _ 3.8 to < 4.0

5 Star _ 4.0

*Where x is the base service value as per IS 374:1979. BEE has proposed a base service

*All ceiling fans covered under this standard shall comply with minimum Air Delivery of 210 cu m/min.

5. Tolerance limits:

The performance values are minimum values & shall subject to any tolerance as per IS 374.1979. The products should conform to all the requirements of IS 374:1979 with all its amendments to participate in BEE labelling Program.

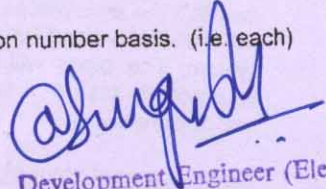
Method of Construction:

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)


Development Engineer (Elec./Mech.)
Pimpri-Chinchwad Municipal Corporation
Pimpri - 411 018,



Chapter 2 Lamps (FG-LP)

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Specification No. (FG-LP-TFL)

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Material:

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The measured values will be converted to star ratings for each point i.e. at 100 hours, 2000 hours, 3500 Hours and the average of the 3 ratings will be taken. This will be rounded of (<0.5 to lower level and ≥ 0.5 to higher level) to the nearest integer which will be the star rating for the product.

- The products should conform to minimum requirements of IS 2418 (part I) and (part II) – 1977 to participate in BEE S&L Programme.
- BIS product certification or at-least, Quality Certification such as ISO - 9000 should be required to participate in BEE S&L Programme.

The star marking as per the rating is required to be stamped on the lamp. The size of the stamp for the star marking is 14.5 mm height x 8.5 mm width. The same shall be stamped in a separate column. For example for a three star lamp the same need to be marked on the lamp as mentioned in IS 2418 (part I) and (part II) – 1977 including all the amendments.

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)

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Ceiling Fans (As per BEE spec.)

Specification No (FG-FN/CF)

Scope:

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Material:

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*All ceiling fans covered under this standard shall comply with minimum Air Delivery of 210 cu m/min.

5. Tolerance limits:

The performance values are minimum values & shall subject to any tolerance as per IS 374.1979. The products should conform to all the requirements of IS 374:1979 with all its amendments to participate in BEE labelling Program.

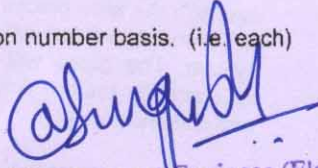
Method of Construction:

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)


Development Engineer (Ele./Mech.)
Pimpri-Chinchwad Municipal Corporation
Pimpri - 411 018.



Chapter 3 Appliances (AP)

3.2 Air Conditioners (AC)

C) Copper Pipes for Air-conditioning & Refrigeration System (AP-AC/CP)

Specification No (AP-AC/CP)

Scope:

Supplying & erecting Soft Copper pipes of specified diameter from Indoor to Outdoor units with necessary straightening, bending, flaring, swaging and coupling including Oxy-Acetylene Brazing on wall or flooring or both by fixing with clamps in an approved manner.

Material:

Semi-flexible Soft Copper Pipes made specifically from Copper tubes having Standard specification ASTM B-68/B-75 that are Billet heated, extruded, drawn, process annealed, eddy current tested and finally hydrostatically tested & inspected to have uniform grain size 0.015-0.004, controlled hardness, elongation (40% Min) & tensile strength having symbol C12200 with or without internal grooves and uniform thickness 22 gauge shall be used. The specified diameter of the pipes shall refer to the inside diameter of the pipes.

Pressure Testing:

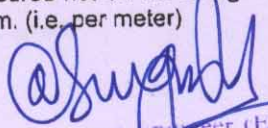
All piping shall be factory tested to hydrostatic test pressure of atleast one and a half times the maximum operating pressure. Once installed, the pressure test will be conducted on site at minimum pressure 200psig for a period not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer-in-charge. Piping repaired subsequent to the above pressure test shall be re-tested in the same manner. System may be tested in sections and such sections shall be securely capped. Pressure gauges may be capped off during pressure testing of the installation.

Method of Construction:

Soft Copper pipes of specified diameter, thickness, and fittings with Oxy-Acetylene Brazing shall be erected on wall or flooring using clamps and duly pressure tested as specified. Before preparing the piping, exact measurement shall be taken. The pipes shall be of single length as much as possible and laid on site lower than electrical pipes or DBs. The pieces of pipes will be swaged as required for proper fitting of joints wherever required, loaded into brass flare nuts of appropriate sizes at each end, expanded & flared to perfection without any cracks using flaring tool. Each joint will be cleaned with a file and the burr removed out. If possible (for pipe size over 3/4") the pipe pieces will be cleaned internally with a soft muslin cloth. The pieces of pipes will then be welded whilst taking proper care that no burr is left and no dust enters in the system. The pipes will be adequately supported by clamps and the entire system will be satisfactorily tested. Any surplus material shall be disposed off satisfactorily without causing any nuisance.

Mode of measurement:

Measurement shall be for one meter of each type and diameter of pipe laid complete with fittings, clamps, etc. as specified. The length shall be measured net on the straight and bends along the centre line of the pipe and fitting correct up to a cm. (i.e. per meter)


Development Engineer (Elec./Mech.)
Pimpri-Chinchwad Municipal Corporation
Pimpri - 411 018.



Chapter 3 Appliances (AP)

3.3 Refrigerators (RF- as per BEE spec.)

Frost Free (No-Frost) Refrigerator

Specification No (AP-FF-RF)

Scope:

Supplying, erecting, testing and commissioning Frost Free (No-Frost) Refrigerator with specified storage capacity & cooling capacity, and marking S No and date of erection.

Material:

Frost Free (No-Frost) Refrigerator

- 1) The Frost Free (No-Frost) Refrigerator shall be suitable for operation on 230 V +/- 10% , 50 Hz, single phase / Three-phase AC supply with hermetically sealed type suction cooled compressor with overload protection as per IS 15750:2006.
- 2) A household refrigerator appliance in which all frozen food storage space is cooled by a frost-free system. Unfrozen food storage space may or may not be cooled by a frost-free system but all storage spaces in the appliance whether frozen or unfrozen are automatically defrosted with automatic disposal of water. In a frost-free system:
 - a. Cooling is provided by forced air circulation.
 - b. The system is automatically operated to prevent permanent formation of frost on all refrigerated surfaces and
 - c. No accumulation of ice or frost forms on stored food
- 3) The rated storage volume of a compartment adjusted to compensate for heat loadings on spaces which are at temperature other than that of fresh food type space. The adjusted volume shall be calculated on the basis of the STORAGE VOLUME of each compartment.
- 4) The value of energy consumption as determined by IS 15750:2006. This is calculated for a period of 24 hours. (Units: Wh)
- 5) The estimated energy used by a single unit during one year's use. This is calculated from Tested Energy Consumption (Et) (refer 2.1.1 of this Annexure of BEE spec.). (Units: kWh/Year)

General Specifications:-

This Standard shall be read in conjunction with IS 15750:2006.

In particular, this schedule specifies the following:

- (a) Frost Free (No-Frost) Appliance
- (b) Projected Annual Energy Consumption (PAEC)
- (c) Tested Energy Consumption (Et)
- (d) Comparative Energy Consumption (CEC)
- (e) Total Adjusted Storage Volume for No Frost (Vadj_tot_nf)
- (f) Star Rating Plan
- (g) Printing requirements for refrigerating appliances energy labels

$$\text{Star Rating Band (SRB)}_{nf} = knf * \text{Vadj_tot_nf} + cnf$$

Where,

knf = Constant Multiplier (kWh/Litre/Year)

Vadj_tot_nf = Total Adjusted Storage Volume for No Frost (Litre)

cnf = Constant Fixed Allowance (kWh/Year)

Constant Fixed Allowance

1 Star * 0.8716 759

2 Star ** 0.6973 607

3 Star *** 0.5578 486

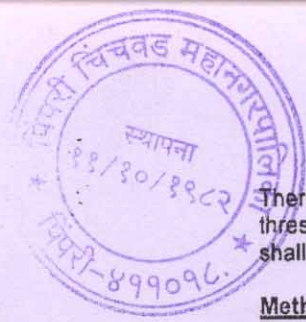
4 Star **** 0.4463 389

5 Star ***** 0.3570 311

The above equation provides for the value of the various Star Rating Bands for a particular model. The CEC of the model as determined from 2.3.1 will be compared with the various Star Rating Bands. The Star Rating chosen for the model will be based on the above comparison. CEC will be compared to the lower and the upper limits of each Star Rating Band. The Star Rating corresponding to the band whose lower rating is less than CEC and upper limit is greater than or equal to CEC will be assigned to the model.

Lower Limit of SRB < CEC ≤ Upper Limit of SRB

Signature
Development Engineer (Ele./Mech.)
Municipal Corporation



There is no tolerance for the Star Rating Bands. All tested products must meet the minimum threshold for each Star Rating Band. The scope for manufacturing tolerance and other variations shall be accounted for when determining the Star Rating.

Method of Construction:

The water cooler shall be fixed at designated place or as directed by the site engineer, duly connected with inlet and drain by leak proof joints. The water cooler is to be erected on stand and tested.

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

3.6 (B) Inverter for Lifts (LFT-INV)

TECHNICAL SPECIFICATION for Lift Inverter

Sr No.	Item	Description
1	MODEL	paradigm LU-OR4 to paradigm LU-OR20
2	Input voltage / frequency	415 +/- 20% ,50 Hz
3	output voltage / frequency	415 +/- 5 % ,50 Hz
4	Technology	IGBT
5	Output current capacity BACKUP mode	In surge current delivery capacity greater than 350%
6	Excess current	Continuous control on inverter mode
7	Frequency regulation	0.1 % on backup mode
8	Phase sequence	Phase sequence regulation on backup mode
9	Load handling	Resistive & inductive
10	Protection	Short circuit, single phase failure, over load, battery low/high ,over voltage / under voltage,
11	display	LCD
12	Indication	Input / output frequency, input / output voltage, battery voltage ,backup time ,battery status, Mains high, mains low, phase fail, charger, overload, battery low, inverter on , load type
13	Acoustic sound	< 5Db at 1 meter
14	Inverter efficiency	>85-90 %
15	Charger	Boost & trickle
16	Charger current	15 amps
17	Cabinet	Sheet metal power coating
18	Contacto type	4 no 4 nc
16	External wire type	ISI mark
17	Input protection	MCB
19	Battery type	TUBULAR
20	temperature	5 deg C to 45 deg C
21	isolation & cooling	ultra isolation with inbuilt forced air cooling
22	Guarantee	30 months from the date of commissioning

Development Engineer (Ele./Mech.)
Pimpri-Chinchwad Municipal Corporation
Pimpri - 411 018,



Emergency Lift Operating Systems					
Sr.No.	load	lift quantity	KVA	VDC	1 Hr backup . (Practical usage upto 5 hr for residential buildings)
	lift motor				AH x BATTERY Nos
1	3.5 hp motor	1	5	72	100x6
	3.5 hp motor	1	4	72	80x6
2	5 hp motor	1	6	180	100x15
	5 hp motor with	1	5	72	120x6
3	7.5 hp motor	1	10	180	120x15
	7.5hp motor with	1	8	180	120x15
4	9 hp motor	1	12	180	150x15
	9 hp motor with	1	10	180	120x15
5	5 hp motor	2	15	180	150x15
	5 hp motor with	2	12	180	120x15
6	7.5 hp motor	2	18	240	150x20
	7.5 hp motor	2	15	180	150x15
7	9 hp motor	2	20	240	180x20
	9 hp motor with	2	18	240	120x20
8	5 hp motor	3	20	240	180x20
	5 hp motor with	3	18	240	120x20
9	7.5 hp motor	3	25	240	210x20
	7.5 hp motor	3	20	240	180x20
10	9 hp motor	3	35	360	180x30
	9 hp motor with	3	30	360	150x30

Emergency Lift Operating Systems					
Sr.No.	load	lift quantity	KVA	VDC	1 Hr backup . (Practical usage upto 5 hr for residential buildings)
	lift motor capacity				AH x BATTERY Nos.
1	3.5 hp motor	1	5	72	100x6
	3.5 hp motor with vvf drive	1	4	72	80x6
2	5 hp motor	1	6	180	100x15
	5 hp motor with vvf drive	1	5	72	120x6
3	7.5 hp motor	1	10	180	120x15
	7.5hp motor with vvf drive	1	8	180	120x15
4	9 hp motor	1	12	180	150x15
	9 hp motor with vvf drive	1	10	180	120x15
5	12.5hp motor	1	15	180	180x15
	12.5 hp motor with vvf	1	15	180	150x15



Chapter 4 Energy Saving Devices (ESD)

4.3 Solar Lighting (ESD-SOL)

C) Solar Cell for Street Light (SOL/CELL)

Specification No (ESD-SOL/CELL)

Scope:

Supplying and erecting Solar panel comprising high efficiency mono-crystalline / multi crystalline Photo Voltaic Cell 20 W per Single module suitable for 4-5 hrs backup with necessary clamps and module frame.

Material:

PV Cell: PV Cell of specified output as mentioned in specification no. (ESD-SOL/STL)

Module Frame: - A metallic frame structure is coated with corrosion resistance paint is fixed on the pole to hold the solar photovoltaic module. The frame structure is inclined at an angle of 20° with the horizontal.

Hardware: MS Nuts & bolts with washers, etc.

Clamps: MS Clamp of required width & minimum 3 mm thick.

Method of Construction: The PV Cell for solar light with all accessories shall be installed at designated place and giving necessary testing.

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

D) Battery for Solar Street Light (SOL/BAT)

Specification No (ESD-SOL/BAT)

Scope :-

Supplying and erecting approved make battery with capacity of 12 V 25/40/75 AH with duty cycle 8-10/10-12 hrs suitable to charge on PV cell with necessary wiring connections erected in powder coated protection box with stand and nut bolts.

Material

Battery: The battery shall be of flooded electrolyte type, positive tubular plate, and low-maintenance lead acid battery. The battery will have a minimum rating of 12V, 25 or 40 or 75 Ah, the discharge rate of 1/10th of the AH capacity of the battery. 75% of the rated capacity of the battery should be between fully charged & load cut off conditions.

Leads: PVC insulated multi stranded copper wire of adequate size.

Enclosure / Box: CRCA sheet 20 SWG or as directed by the Engineer-in-charge, with powder coating.

Hardware: MS Nuts & bolts with washers, etc.

Method of Construction:

The battery for solar light with all accessories shall be installed at designated place, duly wired and giving necessary testing.

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



E) Solar Power Generator (SOL/GEN)

Specification No (ESD-SOL/GEN)

Scope:

Supplying and erecting Solar Power Generator up to 100 WP 230V, 50 Hz for connecting between battery and light fixture.

Material: Solar Power Generator (SPG):

SPG shall give O/P to CFL with input at 12V applied from the module and output rating shall be up to 100 WP, at put 230 to 260V, AC ($\pm 5\%$), controlled either manually or automatically. The body of solar power generator shall be powder coated form outside and inside.

Method of Construction:

The SPG for solar light with all accessories shall be installed at designated place, duly wired and giving necessary testing.

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

4.5 Miscellaneous Intelligent Energy Saver for AC Units (ESD-AC)

Specification No (ESD-AC)

Scope:

Supplying and erecting Intelligent Energy Saver suitable up to 5 TR Window / Split Type Air Conditioning Unit and Packaged type Air conditioning units working on voltage of 230V single phase solid state microprocessor based intelligent control wall mounting connected to indoor unit.

Material: As per manufacturer's standard specification.

Method of Construction:

The Energy saver unit with all accessories shall be installed at designated place, duly wired and giving necessary testing.

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

4.6 LED Fittings (ESD-LED) A) Surface / Recessed Mounting LED Luminaries

Specification No (ESD-LED/IDF)

Scope:

Supplying & erecting approved make, Surface / recessed mounting indoor fitting of specified wattage to provide specified lux level at specified height with p.f. > 0.95, complete as per manufacturer's specification, with appropriate driver.

Material:

Fitting: Scientifically designed highly polished & anodized Aluminum reflector ensures precise light control with optimum light utilization either with clear glass / frosted glass cover with ring or as per manufacturer's specification, leading to substantial savings in energy cost and excellent ambient conditions. Frame is fabricated from CRCA/MS sheet and epoxy powder coated white. Percolated frame ensure corrosion free life. Retaining clips for recess mounting fittings to facilitate mounting in false ceilings. Luminaries comprises of a deep drawn MS sheet canopy along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of



IS: 10322. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver: The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's: The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt.

Metal Core PCB's: The PCB should be of metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

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

Method of Construction:

The fitting shall be fixed firmly in the designated place (False ceiling / unspecified ceiling) with the help of swinging bracket, and making the connection. In case where fittings are to be installed flush with /on false ceiling; layout shall be given to civil wing and work shall be done in co-ordination with civil wing e.g. making recesses in false ceiling.

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

B) Bulk Head type LED Luminaries

Specification No (ESD-LED/BHF)

Scope:
Supplying & Erecting LED bulkhead Fitting of appropriate size with 8 W with minimum 50-70 lux level at ground level with p.f. > 0.95 with frosted glass.

Material:

Fitting:

Luminaries comprises of a deep drawn MS sheet body with clear acrylic cover of 3mm thickness or as per manufacturer's specification, along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322. The surface of the canopy should be powder coated / stove enameled. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver:

The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's:

The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.

Metal Core PCB's: The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

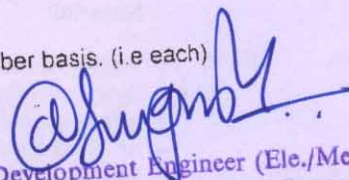
Wooden board: As per (WG-PW/PW) 1.6 specified in chapter for Point wiring.

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

Method of Construction:

The complete fitting with all the above accessories shall be erected as directed by Site engineer, duly connected and giving necessary testing.

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


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C) Halogen type LED Luminaries

Specification No (ESD-LED/HAL)

Scope:
Supplying & erecting Halogen type LED fitting of specified wattage to provide specified lux level at specified height, complete with acrylic cover and gaskets, with appropriate driver circuit and erected on provided bracket.

Material:

Fitting: Scientifically designed highly polished & anodized Aluminum reflector ensures precise light control with optimum light utilization either with clear glass / frosted glass cover with ring, leading to substantial savings in energy cost and excellent ambient conditions. Reflector is fitted into the frame with decorative screw arrangement. Frame is fabricated from CRCA/MS sheet and epoxy powder coated white. Precoated frame ensure corrosion free life. Retaining clips facilitate mounting in false ceilings.

Luminaries comprises of a deep drawn MS sheet canopy along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V AC. It should conform to class 1 of IS: 10322. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver: The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.

LED's: The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.

Metal Core PCB's : The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Method of Construction:

The complete fitting with all the above accessories shall be erected as directed by Site engineer, duly connected and giving necessary testing.

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

D) LED Street Light / Flood Light Luminaires

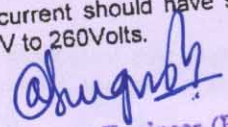
Specification No (ESD-LED/ODF)

Scope:
Supplying & erecting Street Light fitting of specified wattage to provide specified lux level at specified height, complete with acrylic cover and gaskets, with appropriate driver circuit and erected on provided bracket.

Material:

Fitting: Luminaries comprises of a deep drawn MS sheet canopy with clear acrylic cover of 3mm thickness, along with LED's with 100 lumens per watt mounted on top of aluminum heat sink of appropriate size for excellent thermal dissipation. The constant current driver circuit should be inside the luminary and can be driven between 80V to 260V-AC. It should conform to class 1 of IS: 10322 and Ingress Protection IP-55. The surface of the canopy should be powder coated / stove enameled. Fitting shall be wired with multi stranded copper wire terminating on suitable connectors.

Driver: The constant current driver driven at 600mA of constant current should have short circuit protection, thermal protection & should work in the range of 80V to 260Volts.


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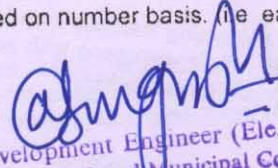


LED's: The LED's of approved make having life of minimum 50000 burning hours, must have a color temperature between 5000 - 7000 and of 100 lumens per watt. The angle of illumination of each LED should be 90degrees and should be mounted on star type of metal core PCB's.
Metal Core PCB's: The PCB should be a metal core, copper clad laminate composed of 1 oz Electro deposit copper and 1.5mm 5052 Aluminum Alloy Laminated by 60 um high thermal conductive adhesive of modified epoxy.

Method of Construction:

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

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


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Chapter 5 Switchgears (SW)

B. Distribution Board suitable for MCCB as Incomer (MCBDB1)

Vertical type DB's

Specification No. (SW-SWR/MCBDB1)

Scope:

Supplying of Distribution board suitable for 415 V, vertical, with door of specified ways (poles),

surface / flush mounting to house 3 Pole, 16 KA, MCCB as incomer & SP/TP MCB's as

outgoing and erected on iron frame.

General Specifications:

DB's shall be prewired and shall be fabricated as per IS: 8623, IS: 13032.

Suitable for flush mounting & surface mounting, with 200 A copper bus bar, neutral bar, earth bar & cable ties for cable management.

DB's shall be of IP – 42 degree of protection.

All the distribution boards shall be fabricated out of 18 SWG thick sheet steel duly rust inhibited through a process of degreasing, pickling, phosphating & powder coating to an approved colour over primer & shall be of the totally enclosed dust proof type suitable for wall mounting.

All components shall be mounted on DIN rails & covered totally with a sheet steel cover rendering it finger-safe. Access to the internal connections shall be only through removing the cover sheet.

All DB's shall be internally prewired using copper insulated high temperature PVC wires.

Bus bars & neutral bar shall be fully insulated with standard colour code.

Bus bar withstanding capacity shall be 10kA.

DB's must have facility of reversing door without modification, pan assembly for ease of installation & convertible locking.

Material:

Vertical type DB: ISI marked as per IS 8623, of specified ways (poles), surface/flush mounting, with door, suitable for 415 V.

Iron work: Suitable size of angle/flat.

Hardware: SM screws, rawl plug, gutties, etc.

Method of Construction:

DB shall be erected at designated location and directed by site engineer and terminating the provided wires by copper lugs (crimping type) and connecting the same.

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

C. MCCB Panel Board (MCCBPB)

Specification No (SW-SWR/MCCBPB)

Scope:

Supplying & erecting Floor / Wall mounting type Panel board suitable for 415 V, of specified rating with provided MCCB's as incomer & outgoing side of specified ways complete erected on provided iron frame. (Excluding MCCB's)

General Specifications

Panel boards shall be fabricated as per IS: 8623, IS: 13947, IS: 2147.

PB's shall be of IP – 31/41 degree of protection.

All the panel boards shall be fabricated out of 1.6 mm thick CRCA sheet steel duly rust inhibited through a process of degreasing, pickling, phosphating & powder coating to an



approved colour over primer & shall be of the totally enclosed dust proof type suitable for floor / wall mounting.

Panel boards shall be fabricated in Modular type for coupling future system/Metering Module/Add on Module, etc.

Bus bar shall withstand 25/35 KA short time current having rating of 250 A/400 A respectively.

Incoming Module:

Suitable for accommodating incoming Three/Four Pole MCCB up to 400 A with preformed copper interconnections.

Outgoing Module:

Suitable for mounting Single/Three/Four Pole MCCB's up to 250 A.

Copper bus bar of specified rating with shielded by transparent polycarbonate shrouds with extension tags and with adequate space for termination of cables onto MCCB's.

Material:

Panel Board: ISI marked as per IS 8623, of specified ways (poles), wall / floor mounting, suitable for 415 V.

Hardware: MS nuts & bolts, washers, etc.

Method of Construction:

Panel board shall be erected at designated location and directed by site engineer and terminating the provided wires/cables by lugs (crimping type) and connecting the same.

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

5.8 LT - Air Circuit Breakers (ACB)

Specification No (SW-SWR/ACB)

Scope:

Supplying, erecting, and commissioning of Air Circuit breaker of specified rating, confirming to IS 2516/IES157 manually operated non draw out type/draw out type erected at position in provided panel board in approved manner.

Material:

Air Circuit Breaker:

Draw out type/non draw out type manually quick make quick break type front operated mechanical indication for ON/OFF position. Trip free mechanism with high performance characteristic based on modular construction and should be compact. The breaker shall have following accessories.

- **Auxiliary Switch:** Auxiliary switch shall consist of 2 NO & 2 NC contacts. The total Auxiliary switch block shall have minimum six auxiliary. In case of draw out breakers two sliding contacts should be provided.
- **Alarm Switch:** For breaker with thermal and magnetic trip units the indication should be direct from trip unit through micro switch with necessary wiring.
- **Shunt Release:** Shunt trips are used for remote control. Shunt trip coil should operate through an auxiliary switch. The operating ranges should be normally 50-110 % of the rated voltage.
- **Under voltage Release:** Under voltage release must be energized before closing breaker. This should be provided for remote control.
- **Over current release:** Over current release shall consist of Current Transformer with slides on each current carrying path of a bi-metal relay common to all transformers. The transformer shall have a fix ratio suited to particular setting range. Overload releases



- shall be thermal time lagged. Overload relay range shall be 50 % to 100 % of CT ratio. Frame shall facilitate site adjustment from 25-100% of ACB rating to match the load requirement.
- RA unit - given for 0-110% operating range of SHT-ensures supply available to shunt trip from same AC source in short circuit condition.
 - RC unit - for up to 3secs. Time delay with U/V trip. Ideal for protection against transient voltage dips and nuisance tripping continuously adjustable time delay range of 40-500 ms with S/c trip ideal for selective interruption co-ordination of ACB's.
 - ACB shall be totally shrouded, for eliminating access to live parts.
 - Short Circuit release pick up shall be adjustable for closer protection.
 - Breaker shall be compact in size, for saving space in the cubicle and as far as possible shall be light weight for easy handling.
 - Thermal over load and magnetic short circuit protection shall be provided.

Method of Construction:

The breaker should be erected on provided panel board or cubicle as the case may be, complete with connecting to bus bar by means of provided insulated copper strip of suitable rating as per the rating, complete.

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

5.9 HT -- SFU's, Load Break Switch (HTS)

B) Ring Main Unit: (RMU)

Specification No (SW-HTS/RMU)

Scope:

Supplying and erecting Indoor type ring main unit with 1 or 2 incoming and 2 or 1 outgoing with HRC fuses and with IP 55 protection class, complete erected on provided CC foundation/ MS channels/ trench in an approved manner.

Recommended Standards:

IS 9920 (Latest Revision):- Rating, performance, testing of Ring Main Unit
IS 9921:- Standards for temperature of electrical parts exposed to air

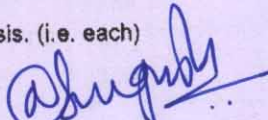
Material: Steel Sheet, Electrolytic copper Bus bar of 400 A, Arc Chutes, Epoxy Resin Cast Type Insulators, H.T. Fuses of adequate capacity, Shunt Trip Coil, Manual trip push button, Auxiliary contacts, Earth switch, Earth Bus bar copper (25x3)

Method of Construction:

Ring main unit should be erected on provided MS channels/ trench/foundation as per approved drawing by site in charge. Manufacturer's certificate for type test should be obtained. Routine Type test should be carried out at site. An earth switch having separate operating handle should be interlocked with main switch should be checked. An operating handle with correct sequence device having ON and OFF position and arrangement for pad locking provided should be checked.

Application: Ring Main Unit is suitable mainly for underground distribution system. It can be used for switching of transformers, overhead lines, capacitors, ring mains and cables

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


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C) Vacuum Circuit Breaker: (VCB)

Specification No (SW-HTS/VCB)

Scope:

Supplying and erecting approved make 11kV / 22 kV, 630A, Vacuum Circuit breaker of required rating, on provided MS channels / trench / foundation in an approved manner.

Material: Steel Sheet, Aluminum Bus bar Arc Chutes, Epoxy Resin Cast Type CT's & PT's, Earth Bus bar aluminum (25x6), Panel comprising the above manufactured as per Manufacturer's standard specifications. General Specifications for 11kv / 22 Kv 630A 350MVA VCB Switchboards Panels shall be suitable for Indoor Free Standing Floor mounting Dust and Vermin proof type complying with IS3427, VCB Panels shall be extensible on either sides and fully compartmentalized with separate chambers for breakers, bus bars, current and voltage transformers relays & instruments and cable chambers. Each cubicle shall be provided with Pressure Relief Flap at top, The panel shall be fabricated with 2mm-sheet steel and 2.5mm-sheet steel shall be used for load bearing members. The panel shall be finished with Electrostatic Powder Coating of LIGHT GREY or with any other colour suggested by the Engineer-in-charge. Panel shall be suitable for rear side bottom cable entry for incoming and outgoing for 11KV panels. Bus bars shall be PVC sleeved or tapped. Vacuum Circuit breakers shall be horizontal Isolated and Horizontal draw out type. Vacuum Circuit breakers shall be fully type tested at CPRI and comply with IS 13118. Vacuum Circuit breakers shall be suitable for Manual/Motor Spring Charging operation. HT Switchgear shall be housed in separate vertical sections for each circuit.

Panel shall be provided with the following:-

Panel space heater controlled by thermostat with On/Off Switch, Cubicle illumination lamp with On/Off switch, 240V AC, 15A Plug & Socket. Panel shall be suitable for degree of protection IP55 as per IS 2147 for Indoor. Current Transformers shall be of Epoxy Resin Cast fixed type. Potential transformer shall be of draw-out type and shall be provided in the rear side of the panel.

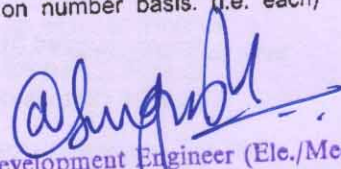
MAIN BUSBARS: 630A TP Aluminium, Bus bar size: 50mm X 10 mm X 2 Run per phase.
Earth bus bar: 25mm X 6mm FLAT

Method of Construction:

VCB Panel shall be erected on provided MS channels/ trench/foundation as per approved drawing by site in charge. Manufacturer's certificate for type test should be obtained.

Testing: Routine Type test should be carried out at site.

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


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Chapter 8 Overhead Systems (OH)

8.1 Steel Poles (OH-PL)
Steel Tubular Poles (OH-PL/STP)



Specification No (OH-PL/STP)

Scope:

Supply of steel tubular swaged pole (Swan type or other wise) as per IS 2713: Part 2 1980, fabricated with earthing stud, pole base plate with required numbers of holes as per drawing and erecting the pole, including painting in provided foundation as per method of construction.

Material:

Pole: Steel tubular swaged pole (Swan type or other wise) as per Table No 8/1

Base plate: MS Base plate of 30x30x0.6 cms.

Pole Cap: Pole cap 4 mm thick with inside diameter equal to outside Dia. of the pole and minimum height shall be 100 mm and welded or fixed with set screws.

Earth Stud: Earth stud 5/8"mm Dia. bolt welded to pole with required size nut and double G.I./M.S. washers

Paint: Red oxide paint as primer, bituminous paint, Aluminum paint/ any other paint as per the instructions of engineer-in-charge.

Method of construction:

Before erection of pole base plate of size 30x30x0.6 cm shall be full length welded or fixed with 4 set screws at the bottom of the pole, a suitable hole of required diameter and at specified height shall be drilled and welded with knock out nipple for laying wires for street light poles at required height. The pole shall be then painted by 2 coats of red oxide paint and one coat of bituminous paint before erection for min 1/6th length which is to be buried in ground & after erection remaining portion to be painted by two coats of aluminum paint. The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plumb. (As per drawing)

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each)

Table 8.1/1
Swaged Poles Made From Steel of Ultimate as per IS: 2713 (Part-II) 1980

Designation	Overall Length in mtr	Planting Depth in mtr	Height above Ground in mtr	Length of Sections in mtr			Outside Diameter / Thickness of Sections			Approx Weight of Pole. Kg
				Bottom h3	Middle h2	Top h1	Bottom	Middle	Top	
410 SP-19 (8-1-1)	8.50	1.40	7.10	5.00	1.75	1.75	139.7 x 4.50	114.3 x 3.65	88.9 x 3.25	109
410 SP-28 (8-1-2)	9.00	1.50	7.50	5.00	2.00	2.00	139.7 x 4.50	114.3 x 3.65	88.9 x 3.25	113
410 SP-31 (8-1-3)	9.00	1.50	7.50	5.00	2.00	2.00	165.1 x 4.50	139.7 x 4.50	114.3 x 3.65	147
410 SP-43 (8-1-4)	10.00	1.70	8.30	5.00	2.50	2.50	165.1 x 4.50	139.7 x 4.50	114.3 x 3.65	160
410 SP-52 (8-1-5)	11.00	1.80	9.20	5.60	2.70	2.70	165.1 x 4.50	139.7 x 4.50	114.3 x 3.65	175
410 SP-60 (8-1-6)	12.00	2.00	0.60	5.80	3.10	3.10	165.1 x 5.40	139.7 x 4.50	114.3 x 3.65	208



8.2 PSC / Spun / GRP Poles (OH-PL/PSC/ SPN / GRP)
Spun Poles (SPN)
PSC Poles (OH-PL/PSC)

Specification No (OH-PL/PSC)

Scope:

Supply and erection of PSC Rectangular pole in provided foundation as per IS 13158 1991, and as per method of construction mentioned below.

Material:

PSC Rectangular Poles as per Specifications in Table 8/3 and as per satisfactory tests minimum required as per IS.

Table 8.2/3
A) Specifications for PSC Poles

Top Cross section	Bottom Cross section	Length in meter	Weight in kg
90x105 mm	90x275	8	345
105x115 mm	105x315	9	510

Method of construction:

The pole shall be erected in provided pit with cement concrete foundation and muffing or as instructed by site-in-charge in perfect plum. 1/6th of the total length of pole shall be buried in ground. The poles shall not to be used for end pole, large angle pole (angle more than 30^o), cut point or span length more than 65 mtr length, where heavy vehicular traffic exists and to be used for straight poles or small angle pole. (As per drawing)

Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each)

B) Specification No (OH-PL/SPN)

Scope:

Supplying and erecting pre stressed concrete PSC spun tubular pole on provided foundation as per IS 13158/1991 and as per method of construction.

Material:

PSC spun poles are as per specification in the table below and as per satisfactory tests minimum required as per IS. Poles are manufactured by centrifugal compaction process of concrete grade M-50.

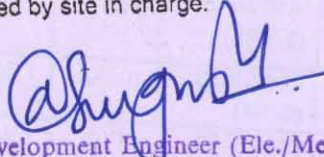
Top cross section in mm	Bottom cross section in mm	Length in meter	Weight in kg
160	266	8	300
160	280	9	300
206	353	11	300
206	353	11	500
206	366	12	500

Method of Construction:

The pole shall be erected in provided concrete foundation having circular cavity matching with outer diameter of the pole and of requisite depth as per instructed by site in charge.

Mode of Measurement:

Executed quantity will be measured on number basis.


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C) Glass Reinforced Polymer Composite Poles (GRP)

Specification No (OH-PL/GRP)

Scope:

Supplying and erecting glass reinforced polymer composite (GRP) with high impact strength in square / conical with specified top & bottom diameter and thickness, length, etc designed to withstand wind load up to 180 km/ hr.

Material: Poles: Poles shall be as per standard manufacturer's specification.

Technical Specifications for GRP Poles

Sr.No	Details	Units
1	Specific Gravity	1.65 Kg/dm ³
2	Glass content (percentage by weight)	45 - 55%
3	Water absorption	0.5%
4	Tensile strength	400 + 50 MPa
5	Flexural strength	350 + 50 MPa
6	Compressive strength	200 + 50 MPa
7	Impact strength	>180 KJ/ m ²
8	Dielectric strength	3 - 7 KV/mm
9	Thermal conductivity	0.2 - 0.3 Kcal/mH ⁰ C

Method Of Construction:

The pole shall be erected at designate location and at requisite depth as instructed by site in charge.

Mode of Measurement:

Executed quantity will be measured on number basis

D) Octagonal Poles (OPL)

Specification No (OH-PL/OPL)

Scope:

Supplying and erecting galvanized octagonal pole of required length, as per details specified in table mentioned below:

Material:

Galvanized Octagonal pole manufactured with steel as per BSEN 10025 grades S355 Jo.
Yield strength = Min. 355 N/mm² and Tensile strength = 490-630 N/mm²

Height (meter)	Top Dia. (A/F) (mm)	Bottom dia. (A/F) (mm)	Sheet thickness (mm)	Base plate dimensions (L x B x T) (mm)	Foundation bolt			
					Bolt size (no. x dia) (mm)	Pitch circle dia. (mm)	Bolt length (mm)	Projected bolt length (mm)
3	70	130	3	200x200x12	4x16	200	450	80
4	70	130	3	200x200x12	4x16	200	450	80
5	70	130	3	200x200x12	4x16	200	600	80
6	70	130	3	200x200x12	4x20	205	600	100
7	70	130	3	200x200x12	4x20	205	700	100
8	70	135	3	225x225x16	4x20	210	750	100
9	70	155	3	260x260x16	4x24	250	750	125
10	70	175	3	275x275x16	4x24	270	750	125
11	90	210	3	300x300x20	4x24	300	750	125
12	90	240	3	320x320x20	4x24	325	850	125



Method of construction:

The pole shall be erected in provided cement concrete foundation specially designed, as per item mentioned in chapter 17-4. Erection shall be in plum.

Mode of Measurement:

Executed quantity will be measured on number basis (i.e. each)

E) Conical Poles (CPL)

Scope:

Specification No (OH-PL/CPL)

Supplying and erecting galvanized conical pole of required length, as per details specified in table mentioned below:

Material:

Galvanized Conical pole manufactured with steel as per BSEN 10025 grade S355 Jo.

Yield strength Min. 355 N/mm²
Tensile strength 490-630 N/mm²

Height (meter)	Top Dia. (mm)	Bottom dia. (mm)	Sheet thickness (mm)	Base plate dimensions (L x B x T) (mm)	Foundation bolt			
					Bolt size (no. x dia) (mm)	Pitch circle dia. (mm)	Bolt length (mm)	Projected bolt length (mm)
3	65/75	115/107	3	200x200x12	4x16	200	450	80
4	65/75	130/118	3	200x200x12	4x16	200	450	80
5	65/75	145/129	3	200x200x12	4x16	200	600	80
6	65/75	165/140	3	200x200x12	4x20	205	600	100
7	65/75	175/151	3	200x200x12	4x20	205	700	100
8	65/75	190/162	3	225x225x16	4x20	210	750	100
9	65/75	200/173	3	260x260x16	4x24	250	750	125
10	65/75	220/184	3	275x275x16	4x24	270	750	125
11	70/85	245/206	3	300x300x20	4x24	300	750	125
12	80/96	260/228	3	320x320x20	4x24	325	850	125

Method of construction:

The pole shall be erected in provided cement concrete foundation specially designed, as per item mentioned in chapter 17-4. Erection shall be in plum.

Mode of Measurement:

Executed quantity will be measured on number basis (i.e. each)

(Signature)
Development Engineer (Electrical)
Pimpri-Chinchwad Municipal Corporation
Pimpri - 411 018.

8.4 Brackets (BKT)

Pole Bracket (Cross arm) (OH-PL/BKT)



Specification No (OH-PL/BKT)

Scope:

Supply and erection of MS Pole Bracket for erection of L T insulators on provided pole.

Material:

Pole Bracket: MS pole bracket fabricated as per specifications in Table 8.4/1. Thickness and size of channel is to checked from the steel table.

Table No 8.4/1
Details of Pole Brackets

Item No	Material of bracket	Length	No of Insulator	No of Insulator	Guarding Extension piece	Remark
8-4-1	Angle iron 50x50x6 mm	550 mm	2	2		For LT guarding for vertical formation
8-4-2	Angle iron 50x50x6 mm	750 mm	2	2		For LT guarding for horizontal formation
8-4-3	ISMC Channel 75x40x 4.7mm		4	4		For LT 3 phase 4 wire vertical formation
8-4-4	ISMC Channel 75x40x 4.7mm		5	5		For LT 3 phase 5 wire vertical formation
8-4-5	ISMC Channel 75x40x 4.7mm	550 mm	2	2		
8-4-6	ISMC Channel 75x40x 4.7mm	1100 mm	4	4		
8-4-7	ISMC Channel 75x40x 4.7mm	550 mm	2	2	300mm of same channel	
8-4-8	ISMC Channel 75x40x 4.7mm	1100 mm	4	4	300mm of same channel	

D' type Clamps: MS Flat of 50x6mm, 15 mm MS nut bolts
Paint: Silver paint, Red oxide paint

Method of construction:

The cross arm shall be made up of size of channel mentioned in above table. The length shall be as stated above table. The cross arm shall be complete with pole clamp of size 50X6 mm MS flat and holes required for pin / shackle insulator. For MS pole bracket with guarding extension, a extension piece of same size of length 300 mm shall be welded to bracket as per drawing attached herewith. The cross arm and pole clamp shall be painted with one coat of red oxide and two coat silver enamel paint any other colour paint (as per the instructions of engineer in-charge).
Cross arm shall be fabricated as per drawing no. -----

Mode of Measurement: Executed quantity will be measured on number basis. (i.e. Each)

(Signature)
Development Engineer (Elec./Mech.)
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Pimpri - 411 018.



Chapter 9 Earthing (EA)

Early Streamer Emission Lightning Arrestor (ESE-LA)

Specification No (EA-LAP)

Scope:

Supply, installation of early streamer emission (ESE) type lightning protection air terminal, supporting mast, maintenance free earth electrode with earth enhancing chemical at specified location as per drawing and design.

Design System:

Protection Radius:

h = height from the top most point of the infrastructure to be protected to the tip of the lightning arrestor. Triggering time (ΔT) for the ESE should be a minimum of 60 μsec .

When h is $\leq 5\text{m}$ radius of protection provided should be as per table shown in 2.2.3.3 c of NFC 17 102 (below)

Protection Level	Height (h) in mtr			
	2	3	4	5
Level I (lightning current > 2.8 kA)	32	48	64	79
Level II (lightning current > 9.5 kA)	40	59	78	97
Level III (lightning current > 14.7 kA)	44	65	87	107

As a minimum, the ESE should be capable of providing a protection of 107-meter radius in Level III when mounted on a mast of 4.5m. System with triggering time less than 60 μsec is NOT acceptable

[A] Material require for ESE Air termination

1) ESE Lightning Arrestor (Air Termination work)

The lightning arrestor should be Early Streamer Emission (ESE) type conforming to the French standard NFC 17 102 (July 1995) for ESE lightning conductors.

Its working principle should evolve from local electrostatic field that develops naturally around the system as a thunderstorm begins to gather. In the event of a descending lightning, an in-built triggering device should generate high-tension pulses at the conductor tip, causing a 'Corona effect'. When the downward leader approaches the ground powerful upward streamers should get triggered aided by a strong venture effect that is built in the system.

The early synchronization between the downward and upward leaders should meet the triggering advance time of "60 μsec ". As laid down in NFC 17-102 the protection level of such a system should be as mentioned below.

The ESE lightning arrestor should be tested as per guidelines written in Appendix C of NFC 17 102. The ESE should also be tested at CPRI for physical deformation with an impulse current test 8/20 μsec at 40 kA for five positive and five negative impulses.

2) Counter: It is electromechanical device for counting the lightning flashes up to 100 KA Model should be IP 65. It should have equal or more than 6 digits.

3) Supporting Mast: It should be of 4.5 mtr. Height made of SS304 with necessary arrangement of fittings of base plate and Lightning Arrestor.

4) Supporting Guy Wire: It should be of 25 mtr made of GI for fitting to Supporting Mast for various wind velocities.

5) Test Clamp: It should be made of copper for disconnection between Lightning Arrestor and Earth Pits for Earth test.

6) Protective Sheath: It is used for insulation purpose. It should be 2 mtrs. from the ground level to cover the down conductor.



[B] Material Require for Earth pit appropriate for ESE air Termination.

- 1) **TEREC+ compound:** TERC+ maintenance free ground enhancing compound (1 bag of 5 kg.) for one earth pit. One ESE air termination requires three earth pits as per NFC - 17102
- 2) **Copper bonded rod:** 250 micron molecularly copper bonded rod with steel core threading at both end, 1.2 m long, 14mm dia - 2 nos. rods per earth pit as per IS 3043
- 3) **Tape clamp (Gun metal/GI):** 25x3mm to rod which connects the earth electrode to the down conductor
- 4) **C.I. Cover for Chamber:** Manual chamber of CI cover mean to provide a cover to the earth pit and enable access for inspection and maintenance 1 no required for one earth pit. One ESE air termination requires three

[C] Down Conductor (The provision of this item has to be made separately)
The ESE air terminal should be equipped with at least one down conductor. Two down conductors should be installed on opposite side of the building if the protected structure is higher than 28 meter or if the horizontal length of the down conductor is greater than vertical length. The down conductor should be high conductivity bare copper or GI strip with a minimum size of 75(25 x 3) sq. mm.

The down conductor should be connected to the air terminal by means of specific clamp, which do not damage the building waterproofness. It should then run down the elevation pole and take shortest viable path down the outside of the building to the earth termination system avoiding any sharp corner, thereby providing the low impedance path from air termination system to earth termination system. Any metal works locate in the way of down conductor with in distance of 1 meter must be connected for equipotential between down conductor and metal work.

A test clamp should be installed at a height 2 meter height from ground level so that down conductor may disconnect from earth termination network to check the earth resistance value at a regular interval. At the down conductor base, a lightning chocks counter will be installed above the test joint. This counter must be electromechanical and work without any external power supply.

The down conductor should protect from accidental knock and other damages by means of protection sheath of P.V.C or steel up to 2 meter from ground level. A tape protection sheath will be placed under the test joint in order to protect the copper tape of any mechanical check.

Method of Installation:

The lightning arrester air terminal is preferably to be mounted on roof top according to drawing and design; it must contain the supporting mast (height as per radius of protection table above) with base plate, if required guying rope wire to protect against the wind load. The down conductor should be 70 sq mm-single core copper flexible cables properly connected between the air terminal final to earthing system or 25 x 3 mm GI / copper strip. The counter is fixed at eye level on down conductor. Each down conductor should be connected to three earth pits in accordance with clause 4.2 of NFC 17 102 and the figure 4.2 therein. Use of Earth enhancing compound as per IEEE clause 80 2000 clause 14.5 d is recommended using compound like Terec + or equivalent. The earth-enhancing compound used should be tested at CPRI for long-term stability vis a vis conventional earth pits. The lightning protection earth should than be connected with general earth of the site in order to achieve an equi-potential earth network. A special coil should do the connection of electric earthing and lightning protection earthing, which allow flow of charge on only one direction. This connection should be housed in concrete or P.V.C inspection pit.

Mode of Measurement:

Executed quantity will be measured on number basis.

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Table showing Earth Enhancing compound require for earthing station with respect to Soil Resistivity

Earth Pit Resistance : below 1 ohm		
Electrode Type : GI Pipe 100mm x 3 m		
Soil Resistance (Ω mtr)	Terec+ / Pit (Kg)	Number of Pits
0-12	5	1
12-18	10	1
18-24	20	1
Soil Resistance (Ω mtr)	Terec+ / Pit (Kg)	Number of Pits
0-25	5	2
25-38	10	2
38-50	20	2
Soil Resistance (Ω mtr)	Terec+ / Pit (Kg)	Number of Pits
0-40	5	3
40-60	10	3
60-75	20	3
Soil Resistance (Ω mtr)	Terec+ / Pit (Kg)	Number of Pits
0-50	5	4
50-75	10	4
75-95	20	4
Soil Resistance (Ω mtr)	Terec+ / Pit (Kg)	Number of Pits
0-65	5	5
65-90	10	5
90-120	20	5

Early Streamer Emission Lightning Arrestor (ESE-LA)		
Electrode Type : GI Pipe 100mm x 3 m		
Soil Resistance (Ω mtr)	Terec+ / Pit (Kg)	Number of Pits
0-65	5	1
65-92.5	10	1
92.5-120	20	1
Soil Resistance (Ω mtr)	Terec+ / Pit (Kg)	Number of Pits
0-130	5	2
130-185	10	2
185-210	20	2

Earth Pit Resistance : below 10 ohm		
Electrode Type : GI Pipe 100mm x 3 m		
Soil Resistance (Ω mtr)	Terec+ / Pit (Kg)	Number of Pits
0-100	5	1
100-160	10	1
160-210	20	1

NOTE:

- 1) Minimum separation between pits should be 3 m
- 2) Terec + should be mixed with water in 1:1 proportion to make a slurry
- 3) Stable earth pit value will be obtained after 21 days.
- 4) Above Specification of Early Streamer Emission Lightning Arrestor (ESE-LA) shall be used as a reference only.

9-1-6 Earthing system

B) SPECIFICATION FOR EARTH ENHANCING COMPOUND



Specification No (EEC-EA)

Scope:

Supplying and Testing, maintenance free earth enhancing chemical at specified location as per drawing.

Material:

The earth-enhancing compound should conform to IEEE 80 2000 Clause 14.5 d. similar to TERC+ (Duval Messien) or equivalent

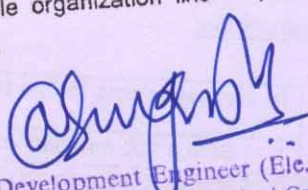
It should have following properties:

- | | |
|---------------------|--|
| Ionic: | To create ions for easy conduction. |
| Dispersion: | To enable spread of the ions equally in the earth pit. |
| Expansion: | The compound should expand 18-20 times to remove entrapped air (bad conductor of electricity) and create a strong connection between electrode and soil. |
| Diffusion: | Ensures the compound diffuses into the ground to create conductive silicate roots. The conductive roots should expand into the soil with age of the earth pit and result in progressive reduction of earth pit resistance. |
| Hygroscopic: | This property assists in absorbing humidity from the neighboring soil to keep the earth pit moist. The presence of moisture helps ionization and better conduction. |
| Moisture Retention: | Special chemicals to ensure moisture is retained throughout the year irrespective of the weather condition without ADDITION of water during the life of the earth pit. |

Method of Application:

The product should be tested and certified at CPRI for long-term stability of the earth pit measurement vis-à-vis conventional salt / charcoal earth pits. The testing has to be carried out for minimum continuous duration of 2 years.

The earth-enhancing compound should be certified by a credible organization like 'Department of Environmental Science - Bangalore University' for eco-friendliness.


Development Engineer (Ele./Mech.)
Pimpri-Chinchwad Municipal Corporation
Pimpri - 411 018,



9-1-5 Earthing system

Mobilized Earth (Mob-EA)

Specification No (Mobi-EA)

Scope:

Supply, installation and testing of Mobilized Earthing system at specified location as per drawing and design.

Mobilized Earth is a respite to all mobile Electrical, Electronic & Communication equipments. Mobilized Earth provides quick & efficient earthing. Proper or effective earthing ensures reference voltage (GND) for its functional needs. It is also the only safe path to conduct VHF, Harmonics, Surges, Spikes, Unbalances, Short Circuit current & other faults into the ground mass.

Technical Parameters

Resistance in vertical setting	32.45 % of soil resistivity
Resistance in horizontal setting	21.05 % of soil resistivity
Unbalance withstand capability	6.28 A
Short term duty for 1 sec.	596.60 A

Material

Body	SS 304L 250 μ Molecularly Bonded Copper cover
Central Conduction	Steel

Infill Compound

Presentation	In granular form
Granulometry	0.85 mm to 4 mm
Colour / Smell	Grey / Indorous
Volumetric Mass	500 to 650 Kg/m ³ compressed 450 to 500 Kg/m ³ uncompressed
Solubility in Water	Partially miscible
PH Value	6.9 to 7.2 of 1000 gm/lit at 20° C
Number of operations	75 Times or 2 Years whichever is earlier

Installation:

In Vertical setting follow the following steps		In Horizontal setting follow the following steps	
1	Bore a 100 mm dia hole in the ground	1	Make a trench 300 mm wide & 600 mm depth
2	Place Mobi Earth inside the Bore such	2	Place the Mobi Earth inside the trench.
3	Fill the bore with loose earth slurry	3	Fill the bore with loose earth slurry.
4	After operations is over pull the Mobi	4	After operations is over pull the Mobi Earth
5	Clean it mildly & repack for further usage.	5	Clean it mildly & repack for further usage.

(Signature)
 Development Engineer (Ele./Mech.)
 Pimpri-Chinchwad Municipal Corporation
 Pimpri - 411 018.

Chapter 10 Sub Station (SS)

10.1 Transformer (TR-1PH)



Specification No (SS-TR-1PH)

Scope:

Supplying and erecting AC single phase 6350/250v 50 Hz oil immersed and naturally cooled outdoor type aluminium wound distribution transformer of specified capacity with additional neutral brought out on load side.

Recommended standards:

The following list shows Indian Standards which are acceptable as good practice and accepted standards.

I.S.335:1963	Di-electric Strength of oil
I.S.2026 part I 1977	Specification for Transformer
I.S.2026 part II 1977	Specification for type of cooling and permissible temp. rise of transformer.
I.S.2026 part III 1981	Specification for insulation level and di-electric strength of Transformer
I.S.2026 part IV 1977	Specification for terminal marking and connections
I.S.10028 part I 1985	Code of practice for selection installation and maintenance of Transformer

Material:

- 1) Alluminium wound Transformer complete with manufacturer's test certificates
- 2) Standard mountings required for transformer are shown below.
 - i) 1 no of H.V.Porcelain Bushing
 - ii) 1 no of H.V.Porcelain Bushing
 - iii) Drain valve
 - iv) Lifting Arrangement
 - v) Earthing terminal
 - vi) Rating / Terminal marking plate
 - vii) Separate neutral terminal for Earthing
 - viii) Conservator with oil gauge including oil filling hole ,cap etc.
 - ix) Lightening arrestor
 - x) Silica gel breather with first filling of silica gel
 - xi) Thermometer pocket
 - xii) Diagramme and rating plate

Method of Construction:

The contractor should intimate name of manufacturer and make of the Transformer and location of the manufacturer factory to engineer in charge prior to delivery of Transformer. After manufacturing of transformer , the agency / contractor shall intimate the engineer in-charge for carrying out the inspection.

After receipt of intimation ,engineer in-charge or his representative should inspect the Transformer at manufacturer factory and shall carry out the following tests jointly in presence of concern contractor.

- 1) Open Circuit test
- 2) Short Circuit test
- 3) Specific Resistance test
- 4) Insulation Resistance of HV ,LV, in between HV and LV ,Winding and body
- 5) Di-electric strength test of Transformer oil

The test results of joint inspection shall be recorded on the test report of Transformer with its Sr. No. prior to delivery of the Transformer on site.

Necessary work of Plinth/ D.P. Structure with DO Set, L.A, AB Switch should be completed before dispatch of the Transformer. Earthing arrangement should be completed. The



Transformer should be installed on plinth /double pole structure by arranging chains pulley block, crane etc. as per I.S. norms.

After installation of Transformer the stopper /lock should be provided to rollers of the Transformer.

The connection of H.T./L.T. side should be completed by provided wire / cable with necessary lugs to avoid loose connection .The earthing (1 no for Neutral and 1 no for body) should be connected from distinct electrodes. The earthing should be connected by lugs /proper size of strips.

The Engineer in charge or his representative should check all connection on H.T.side ,L.T. side and earths and insulation and earth resistance test should be carried out and results obtained shall be recorded.

Statutory Permissions to be obtained by the Agency / Contractor:

Before commencement of work, the drawing of the installation shall be got approved from the Electrical Inspector , I.E.&L. Department.
The installation should be got inspected from Electrical Inspector and obtain written permission to charge the Transformers.

Commissioning:

After above formalities the Transformer , should be charged / commissioned in presence of Engineer in-charge or his representative along with load trials and shall be handed over to the department for beneficial use.

After charging the Transformer ,line,phase voltage and line current shall be measured and the same shall be submitted.

Following test certificate shall be submitted :

- 1) Manufacturer's original certificate of Transformer as stipulated in I.S.
- 2) Test certificate for di-electric strength of oil as per I.S.
- 3) Test results of I.R. values.
- 4) Test results of all earth electrodes.
- 5) Readings of Voltages and Currents at the time of commissioning.

Mode of Measurement:

Executed quantity will be measured on number basis (i.e. each)

10.1 Transformer (TR)

Specification No [SS-TR (As per BEE spec.)]

Scope:

Supplying and erecting AC three phase 11 or 22 kV/0.44 kV, 50 Hz, for oil immersed, naturally air cooled, three phase, and double wound non sealed type outdoor distribution transformer of specified capacity, connected delta on HV side and star on LV side with additional neutral brought out on load side.

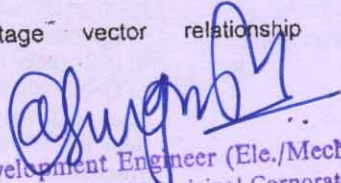
Technical Specifications - Distribution Transformer

The referred Indian Standard are IS 1180 (part I) Out door type three- phase distribution transformers upto and including 200 kVA, 11 kV – specification, IS 2026 (part 2) Specifications of power transformers – for Temperature-rise and IS 2500 (part-I) -2000: 1.3 The standard ratings covered under the pilot energy labelling scheme is 16, 25, 63, 100, 160 and 200 kVA and non standard ratings from 16 kVA to 200 kVA.

Parameters to be tested:

Parameters for initial testing the type test parameters set out in IS 1180 (part 1) and the same is reproduced below:

- a. Measurement of winding resistance [IS 2026 (part I):1977]
- b. Measurement of voltage ratio and check of voltage vector relationship [IS 2026 (part I):1977]


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- c. Measurement of impedance voltage/short circuit impedance and load loss 2026 (part I):1977
- d. Measurement of no-load loss and current [IS 2026 (part I):1977]
- e. Measurement of insulation resistance [IS 2026 (part I):1977]
- f. Induced over-voltage withstand test [IS 2026 (part 3):1981]
- g. Separate-source voltage withstand test [IS 2026 (part 3):1981]
- h. Lightning impulse test [IS 2026 (part 3):1981]
- i. Temperature-rise test [IS 2026 (part 2):1977]
- j. Short-circuit test [IS 2026 (part I):1977]
- k. Air pressure test [IS 1180 (part 1): 1989]
- l. Permissible flux density and over fluxing [IS 1180 (part 1): 1989]

No positive tolerance shall be allowed on the maximum losses displayed on the label for both 50% & 100% loading values.

The existing efficiency or the loss standards are specified in IS 1180 (part 1). This standard defines load losses and no load losses separately. For the BEE labelling programme total losses at 50% and 100% load have been defined. The highest loss segment is defined as star 1 and lowest loss segment is defined as star 5. The existing IS 1180 (part 1) specification losses are the base case with star 1.

The basis for star rating plan is as follows: Case Basis of losses (Total at 50% Load Condition)

Base case

Star 1 Current purchasing practice (IS 1180 (part 1)Max Losses)

Star 2 Some utility purchase specs like AP, NDPL

Star 3 Losses from TOC design (Moderate)

Star 4 Losses from lowest TOC design

Star 5 High efficiency design

Star Rating plan:

The total losses at 50% and 100% loading shall not exceed the values given below:

kVA rating	Star Rating									
	1 Star		2 Star		3 Star		4 Star		5 Star	
	Max Losses at 50% (Watts)	Max Losses at 100% (Watts)	Max Losses at 50% (Watts)	Max Losses at 100% (Watts)	Max Losses at 50% (Watts)	Max Losses at 100% (Watts)	Max Losses at 50% (Watts)	Max Losses at 100% (Watts)	Max Losses at 50% (Watts)	Max Losses at 100% (Watts)
16	200	555	165	520	150	480	135	440	120	400
25	290	785	235	740	210	695	190	635	175	595
63	490	1415	430	1335	380	1250	340	1140	300	1050
100	700	2020	610	1910	520	1800	475	1650	435	1500
160	1000	2800	880	2550	770	2200	670	1950	570	1700
200	1130	3300	1010	3000	890	2700	780	2300	670	2100

Method of Construction:

The contractor should intimate name of manufacturer and make of the Transformer and location of the manufacturer factory to engineer in charge prior to delivery of the transformer. After manufacturing of the transformer, the agency/contractor shall intimate the engineer-in-charge for carrying out the inspection.

After receipt of intimation engineer-in-charge or his representative should inspect the Transformer at manufacturer factory and shall carry out the following tests jointly in presence of concern contractor.

Open Circuit test

Short Circuit test

Specific Resistance Test

Insulation Resistance of HV, LV, in between HV and LV, Winding and Body.





Dielectric Strength and acidity test of Transformer oil.

The test results of joint inspection shall be recorded on the test report of Transformer with its Sr. No. prior to delivery of the Transformer to site. Necessary work of plinth and or for D.P. structure with D.O. set, L.A., A.B. switch should be completed before dispatch of the transformer. The channel arrangement on plinth is to be done. Earthing arrangement should be completed. The Transformer should be installed on plinths / double pole structure/floor by arranging chains pulley block, crane etc as per IS Norms. After installation of Transformer the stopper/lock should be provided to rollers of the Transformer. The connection of H.T./L.T. side should be completed by provided Copper wire/ cable with necessary lugs to avoid loose connection. The earthing (2 Nos for Neutral & 2 Nos for Body) should be connected from distinct electrodes. The earthing should be connected by lugs/proper size of strip. The Engineer in charge or his representative should check all connections on H.T. side, L.T. side and earths and insulation and earth resistance test should be carried out and results obtained shall be recorded.

Statutory Permissions to be obtained by the Agency/Contractor:

Before commencement of work, the drawings of installation shall be got approved from the Electrical Inspector, I E & L Department. The installation should be got inspected from Electrical Inspector and obtain written permission to charge the Transformers.

Commissioning:

After above formalities the Transformer, should be charged/commissioned in presence of Engineer in charge or his representative along with load trials and shall be handed over to the department for beneficial use

After charging the Transformer, line, phase voltages and line current shall be measured, and the same shall be submitted.

Following test certificates shall be submitted:

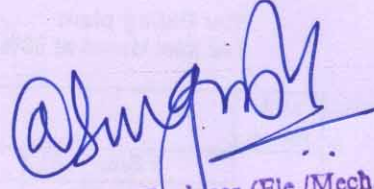
Manufacturer's original certificate of Transformer as stipulated in IS.

Test certificate for dielectric strength of oil as per IS.

Test results of IR values.

Test results of all earth electrodes.

Readings of Voltages & currents at the time of commissioning.


Development Engineer (Ele./Mech.)
Pimpri-Chinchwad Municipal Corporation
Pimpri - 411 018,

Chapter 13 Fire Fighting & Fire Alarm (FF)

Fire Alarm Accessories (FF-FAAS)

E) Mineral Insulated Copper Cable (MIC)



Specification No (FF-FAAS/MIC)

Scope:

Supply and erecting Mineral Insulated copper cable of specified size with an overall (LSF) covering, 500 Volts, to withstand temp. 950 Deg C for period of 3 hrs, Mechanical shock and High Pressure water stream used during the fire fighting.

General:

Mineral Insulated Copper Cable, Light Duty – 500 Volt Grade and Heavy Duty 750 Volts Grade for Fire and performance wiring applications.

All material shall conform to relevant BIS standard and shall have LPCB approval. If any particular category of material for which ISI mark is not available in market, it shall be included in approved list. Work shall be carried out as per method of construction specified hereunder and shall be carried out to the satisfaction of the Engineer in Charge.

Cables (MIC)

To provide the client with the highest standard in performance cables for fire alarm, life safety, fire fighting, and critical systems applications. The cable system should be mineral insulated, robust, 100% screened, and space saving in order to meet the demands of modern building design. The cable should also be capable of surviving fire conditions without loss of integrity (without burning) and without providing an additional fuel load. This specification should be strictly adhered to in order to provide maximum conformity with the Regulatory Reform (Fire Safety) Order 2005.

Material:

Conductor: Copper

Outer Sheath: Copper

Insulation: MgO (Mineral Insulated)

Terminations:

Gland: All terminations shall be supplied by the cable manufacturer and shall comply with the requirements of BS EN 60702: Part 2. They shall be fitted in accordance with the manufacturers recommended termination procedures,

Seals: The following types of seal are available and shall be utilized as appropriate to suit the environment. Standard 105°C and Fire Resistant Seal Increased Safety seal for EEXe Hazardous Area 250°C High Temperature Glazed Insulator

Technical Specifications:

All cables shall carry LPCB approval to specific and relevant standards, BS60702-1, BS6387, BS8434-2, BS5839-1 Clause 26.2, BS EN 50257-2-1, and must be registered by the LPCB to this effect. The supplier shall be accredited and approved to ISO 9001.

The MI wiring system shall be approved by the LPCB to BS8434-2, BS5839-1 Clause 26.2 (Enhanced) and BS EN 50200 Class 'PH 120, BS EN 50257-2-1, and be documented in the LPCB Red Book.

Light duty grade cables are rated to 500V and are suitable for use where the voltage between the conductor and sheath and between conductors does not exceed 500V r.m.s. A.C. or 500Vd.c. The MI cable shall also be available with an overall LSF covering. This may be employed to protect the copper sheath from corrosive environments, to provide identification by colour, or for other aesthetic reasons. When cables are to be buried in the ground, the type having this outer covering should be specified.

Heavy duty grade cables are rated to 750V and are suitable for use where the voltage between the conductor and sheath and between conductors does not exceed 750V r.m.s. A.C.



or 750Vd.c. The MI cable shall also be available with an overall LSF covering. This may be employed to protect the copper sheath from corrosive environments, to provide identification by colour, or for other aesthetic reasons. When cables are to be buried in the ground, the type having this outer covering should be specified. The MI cable system must be capable of the following installation types: - Buried in the ground, Underground ducts, conduit or pipes, Buried in concrete, Buried in plaster, Surface mounted, On cable tray, Outdoor and wet conditions, High ambient temperature environments (continuous temperature of 250°C.) Higher continuous ambient temperatures are also possible with Mi., Low temperature environments (where the cable needs to operate at temperatures down to approaching absolute zero.)

Product, Technical, and Performance requirements:

The MI cable system must, as a minimum requirement:

- Be manufactured, tested, and LPCB approved to BS EN 60702-1.
- Be complete with terminations tested and approved to BS EN 60702-2,
- Be approved by the LPCB (and clearly documented in the "Red Book") to:
 - BS8434-2 (120 Minute)
 - BS5839-1 Clause 26. (Standard and Enhanced.)
 - BS EN 50200 Class PH 120.
 - BS EN 50257-2-1
- Have a loss of mass under fire conditions of less than 0.5%. Cables losing mass under fire conditions greater than 0.5% suggest the addition of a fuel load.
- Have a life expectancy in excess of 100 Years.
- Be unaffected in fit, form, and function, to the effects of power system harmonics, including but not limited to, continuous operation at elevated temperatures without premature aging.
- Meet and exceed the requirements of IEC60331 – tests for electric cables under fire conditions.
- Be approved for use with London Underground Ltd. (LUL), and compliant with Fire survival cable (MICC) EME-SP-14-028-A1.
- Carry CE marking on cable drums, reels, termination packaging as required by the directive.
- Demonstrate compliance, where applicable; in the following standards.
 - BS5588 – Fire precautions in the design, construction and use of buildings.
 - BS5266 – Emergency lighting.
 - BS5454 – Storage and exhibition of archival documents.
 - BS5839 – Fire detection and alarm systems in buildings.
 - C.I.O – Lighting and wiring for churches.

Installation, Testing and Commissioning:

The Mineral insulated (MI) cable, shall be specifically designed for ultimate performance and compliance with the current version of BS7671 ("Requirements for electrical installations") and shall be supplied and tested, in accordance with BS EN 60702: Part 1.

BS7671 – Requirements for Electrical Installations (IEE)

Installation, testing and commissioning shall be carried out in strict compliance with all current electrical standards and regulations.


When required by the consultant or specified, cables may be tested prior to installation using a suitable insulation resistance test.

The MI system shall be installed in accordance with all current electrical standards and regulations.

The system shall be compliant with BS7671 (Requirements for electrical installations.)

The MI wiring system shall be tested to BS EN 60702-1 for cables

Mode of Measurement: Executed quantity will be measured on running meter basis.


Development Engineer (Elec./Mech.)
Pimpri-Chinchwad Municipal Corporation
Pimpri – 411 018.