

हाई मास्ट विद्युत प्रणाली के लिए विनिर्देश

SPECIFICATION FOR HIGH MAST LIGHTING SYSTEM

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Abbreviations:

A	:	Ampere
BIS	:	Bureau of Indian Standards
BS	:	British Standard
ELCB	:	Earth Leakage Circuit Breaker
EPR	:	Ethylene Propylene Rubber
FGL	:	Finished Grade Level
GI	:	Galvanized Iron
ICAO	:	International Civil Aviation Organisation
IEC	:	International Electrotechnical Commission
IEEE	:	Institute of Electrical and Electronics Engineers
IP	:	Ingress Protection
IS	:	Indian Standard
LED	:	Light Emitting Diode
LM-6	:	Light Metal Alloy
MCB	:	Miniature Circuit Breaker
NEMA	:	National Electrical Manufacturers Association
NGL	:	Natural Ground Level
PO	:	Purchase Order
PVC	:	Poly Vinyl Chloride
QAP	:	Quality Assurance Plan
TMT	:	Thermo Mechanically Treated
TPN	:	Three Phase and Neutral
V	:	Volt
VDE	:	Verband Deutscher Elektrotechniker

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1.0 SCOPE

This specification defines the requirements for design, fabrication, testing at manufacturer's works, supply, installation at site, testing and commissioning of high mast lighting system, including supply and installation of associated cables and materials, design of civil and structural foundation and supply of all related materials.

2.0 CODES AND STANDARDS

2.1 The equipment shall comply with the requirements of latest revision of the following standards issued by BIS, unless otherwise specified.

IS-325	:	Three-phase induction motors
IS-383	:	Specification for coarse and fine aggregates from natural sources for concrete
IS-455	:	Specification for Portland slag cement
IS-456	:	Plain & reinforced concrete – code of practice
IS-875	:	Code of practice for design loads (other than earth quake) for buildings and structures: Part-III- Wind loads
IS-1363	:	Hexagon Head bolts, screws and nuts of product Grade 'C' Part-1: Hexagon Head Bolts (size range M5 to M64)
IS-1489 PT-1	:	Specification for Portland Pozzolana cement (Fly Ash based)
IS-1554	:	PVC insulated (Heavy-duty) electrical cables
IS-1786	:	High strength deformed steel bars and wires for concrete reinforcement – Specification
IS-2062	:	Specification for steel for general structural purposes
IS-2309	:	Code of practice for protection of buildings and allied structures against lightning
IS-2629	:	Recommended practice for hot dip galvanising of iron and steel
IS-3043	:	Code of practice of earthing
IS-3138	:	Specification for Hexagonal Bolts and Nuts (M42 to M150)
IS-3618	:	Specification for Phosphate treatment of iron and steel for protection against corrosion
IS-4691	:	Degree of protection provided by enclosure of rotating electrical machinery
IS-4759	:	Hot dip zinc coating on structural steel and other allied products
IS-8112	:	43 Grade ordinary Portland cement-specification
IS-9103	:	Concrete Admixtures – Specification
IS-9968	:	Elastomer insulated cables (Part-1) for working voltage upto and including 1100V.
IS-12269	:	Specification for 53 grade Ordinary Portland cement
IS-12330	:	Specification for Sulphate Resisting Portland cement
IS-13947	:	Specification for Low voltage switchgear and control gear

2.2 In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.

2.3 The equipment and the installation shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.

2.4 In case Indian standards are not available for any equipment, standards issued by IEC/BS/VDE/ IEEE /NEMA or equivalent agency shall be applicable.

2.5 In case of any contradiction between various referred standards/specifications/data sheet and Statutory Regulations, the following order of priority shall govern:

- a. Statutory regulations
- b. Project data sheets
- c. Job specification
- d. This specification
- e. Codes and standards

3.0 GENERAL REQUIREMENTS

- 3.1 The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.
- 3.2 Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply.
- 3.3 Vendor shall give a notice for at least one year to the end user of equipment and EIL before phasing out the product/spares to enable the end user for placement of order for spares and services.
- 3.4 The high mast lighting system shall have a minimum design life of 25 years unless otherwise specified.

4.0 SITE CONDITIONS

The equipment and materials to be supplied & installed by the vendor shall be suitable for continuous and trouble free operation at 40° C unless specified otherwise in the data sheet.

5.0 EQUIPMENT SPECIFICATIONS

The high mast and other equipment and materials shall be of the best quality and shall conform to the specifications given hereunder.

5.1 Mast

- 5.1.1 The high mast shall be of continuously tapered, polygonal cross section construction. Minimum height of mast shall be 30 meters unless otherwise specified. The mast shall be fabricated from steel plates in suitable number of sections, telescopically jointed giving a continuous tapered profile and presenting good visual appearance. The base flange shall be provided with gaskets and high tensile anchor bolts. The bottom section shall have adequate sized opening with a hinged door to accommodate electric drive for winch, cable, plug socket, etc. The opening shall be such as to permit clear access to the above components inside the mast. The opening shall be complete with a close fitting, dust and vermin proof door, weather protected with gaskets of durable material and provided with a heavy-duty double locking arrangement.
- 5.1.2 The means for natural ventilation of the mast shall be provided.
- 5.1.3 Both the inner and the outer surfaces of the entire fabricated mast shall be hot dip galvanized. The amount of galvanizing shall be 610gm per sq.metre unless otherwise specified.
- 5.1.4 The whole head frame assembly shall be covered and protected by an aluminum/ galvanised sheet steel canopy secured to the frame by stainless steel bolts and nuts. The canopy shall have suitable prevention arrangement against entry of birds etc.

- 5.1.5 The mast shall have integral power tool for winch drive unless otherwise specified in the datasheet.
- 5.1.6 The mast shall have stainless earthing terminals at convenient location in the base compartment and these shall be suitable for connection with 40x5mm GI strip to the plant-earthing network unless otherwise specified.
- 5.1.7 Lightning rod at the top of the mast for the lightning protection of the lighting mast system as per standard: IS-2309 shall be provided.
- 5.1.8 The complete design of the mast and associated foundation shall be such that mast is structurally and mechanically safe.

5.2 Lantern Carriage

- 5.2.1 The Lantern carriage shall be of steel tubular ring type construction designed to accommodate the specified number of lighting fixtures and balance counter weights shall be provided wherever required. The carriage shall be fabricated in two halves jointed by bolted flanges to enable easy removal from the erected mast for replacement and maintenance purpose.
- 5.2.2 The complete lantern carriage assembly shall be hot dip galvanized after fabrication. It shall have perfect self-balance arrangement so as to avoid swing and to prevent damage to mast surface or other installed parts, during lowering/raising operation of carriage.
- 5.2.3 All hardware used shall have necessary corrosion protection. The carriage shall have weather protected IP-55 cast aluminum junction box with required number of terminals (phase, neutral and earth) for connection to the designed number of flood light fittings and associated control gear boxes fixed on the carriage.
- 5.2.4 Unless otherwise specified, Lantern carriage shall be suitable for accommodating a minimum of 12 numbers of flood light fixtures. The number, wattage and type of lighting fixture of the high mast shall be supplied as specified in job specification/data sheet.
- 5.2.5 The flood light fixtures shall have die cast aluminum body with facility for lamp centering and focusing and shall be provided with angle indicator for aiming, and also with anodized and polished aluminum reflector with control gearbox.
- 5.2.6 Each high mast shall have minimum two numbers aviation obstruction lighting fixtures. The lighting fixtures shall have cluster LED lamps of medium intensity (as per ICAO regulations) and of red color.
- 5.2.7 Provision shall also be available to test the luminaries while lantern carriage is in lower position by connecting the plug to the receptacle provided on the lantern carriage.

5.3 Winch Assembly

- 5.3.1 For lowering and raising of lantern carriage assembly, a winch arrangement shall be fixed in the bottom of the mast. This shall have provision to operate both manually and electrically.
- 5.3.2 The winch shall be suitable to handle the weight of the lantern carriage assembly with lighting fixtures and all other accessories, with factor of safety not less than two unless otherwise specified.
- 5.3.3 Minimum two number of winch drums shall be provided for the winch assembly. The winch shall be of self-sustaining type with positive locking arrangement without the need for brake shoe, springs or clutches.

- 5.3.4 The winch shall be self-lubricating type by means of an oil bath.
- 5.3.5 The mast shall be fitted with flexible stranded high tensile strength stainless steel wire ropes, which shall have a factor of safety not less than five times the safe working load of winch.
- 5.3.6 Particular care shall be exercised in all aspects of design, manufacture, testing and installation arrangements of the system to ensure safety under all operation conditions.
- 5.3.7 The material of construction for top pulley block shall be non-corrosive and preferably made up of die cast LM-6 aluminum alloy, with self-lubricating bearing. The design shall ensure that the operation of pulleys is maintenance-free.

5.4 Power Tool for Winch Drive

The rating and capacity of the electric motor used in power tool shall be compatible to lift the design load of lantern carriage with design margin of minimum 20%. The winch drive shall incorporate torque limiter. Manual handle shall also be provided for hand operation of winches. Power tool shall have self-alignment arrangement.

5.5 Feeder Pillar Distribution Box

- 5.5.1 Each high mast shall be supplied with one power supply feeder pillar distribution box, which shall be located near it.
- 5.5.2 The feeder pillar distribution box shall be metal enclosed, freestanding type made out of 2mm thick mild sheet steel, epoxy painted and IP-55 weather protected. Additional canopy for rain protection shall be provided as an integral part of feeder pillar distribution box.
- 5.5.3 The feeder pillar distribution box shall be complete with incomer Switch, HRC fuse/MCB, ELCB, motor starters for winch drive, MCB for lighting control and a 3 pin 5/15A socket alongwith 15A MCB. MCB and ELCB shall be separate unit.
- 5.5.4 Motor starter shall be complete with switch, HRC fuse, contactor, and bimetal relay with single phasing prevention feature.
- 5.5.5 LEDs for indication of incoming power supply healthy for feeder pillar distribution box incomer shall be provided. Feeder pillar shall also have provision to receive emergency power supply for aviation fixtures in case specified in the data sheet.
- 5.5.6 Adequately rated space heater with MCB, thermostat shall be provided for the feeder pillar distribution box.
- 5.5.7 Feeder pillar distribution box shall have adequate space to receive incoming and outgoing cable terminations for 415V, TPN supply loop in and loop out arrangement. The feeder pillar distribution box shall be complete with double compression nickel-plated brass cable glands and tinned copper lugs.
- 5.5.8 The feeder pillar distribution box shall have two numbers external earthing terminals.
- 5.5.9 The feeder pillar distribution box shall have required wiring interface for taking signals from hand held external control push button station for raising and lowering of lantern carriage.
- 5.5.10 The feeder pillar distribution box shall be installed on a raised concrete foundation block and foundation shall be up to the level of minimum 300mm above ground level.

5.6 Local Control Station

- 5.6.1 Local control station shall be hand held type. This control station shall have necessary raise/lower pushbuttons, emergency stop push button etc.
- 5.6.2 The hand held control Pushbutton station shall be supplied with minimum of 5 meters length of 5Cx2.5 sq mm flexible cable and cable shall be with copper conductor, PVC insulation, metal braiding and overall PVC sheath.
- 5.6.3 The hand held control station and associated cable shall be kept inside feeder pillar distribution box when not in use and suitable arrangement shall be provided for the same.

5.7 Cable and Cable Connections

- 5.7.1 All power and control cables including flexible trailing cables shall be supplied laid and terminated by the high mast vendor.
- 5.7.2 The electrical connections from base compartment to the junction box on the lantern carriage shall be made through special multicore trailing cable of minimum size 4 sq.mm copper conductor, EPR insulated, metal braided and sheathed in heavy duty Polychloroprene.
- 5.7.3 Minimum 5 cores shall be provided unless otherwise specified. Separate cores shall be used for lighting fixtures, aviation fixtures and one dedicated core shall be kept for earthing. Suitable chemicals shall be added to outer sheath of cable to protect the cable against birds, rodent and termite attack.
- 5.7.4 All power and control cables shall be 1100V grade and shall conform to IS-1554 and all flexible-trailing cables shall also comply with requirement of IS-9968.
- 5.7.5 The trailing cable shall be terminated by means of metal cased plug and socket, which shall be provided at the base compartment to enable easy disconnection.
- 5.7.6 The cable for connection to flood lighting fixtures /aviation lighting fixtures from junction box provided on lantern carriage shall be through 3C x 2.5 sq.mm copper conductor, PVC insulated, armoured and overall PVC sheathed cable. The trailing cable at the lantern carriage shall be taken in flexible metal conduit.
- 5.7.7 Connection to the power tool motor inside mast at the bottom shall be through metal cased plug and socket arrangement to enable easy disconnection.
- 5.7.8 All cabling from feeder pillar distribution box to high mast shall be laid in directly buried trenches.

6.0 CIVIL STRUCTURAL WORKS

6.1 Scope of Work

The scope of work under this specification includes design, detailing, supply and construction of foundations for high mast lighting system works. The work shall in general be executed as per IS-456 and all referred codes therein.

6.2 Materials

6.2.1 Cement

The cement used shall be any one of the following types unless otherwise specified in project data sheet:

- a. Portland Pozzolana Cement (Fly Ash based) conforming to IS: 1489 Pt-1.
- b. 43 Grade ordinary Portland cement conforming to IS-8112.
- c. Portland slags cement conforming to IS-455.
- d. Sulphate resisting Portland cement conforming to IS-12330.
- e. 53 grade Ordinary Portland cement conforming to IS: 12269.

6.2.2 Aggregates

- a. Only natural existing aggregates conforming to IS-383 shall be used.
- b. Coarse aggregate shall be 20mm down graded as per IS-383.
- c. Fine aggregate shall be graded evenly from fine to coarse as per Zones II and III of IS-383. Zone IV aggregate shall not be used.

6.2.3 Water

Water used for manufacture and curing of concrete shall be clean and free from injurious amounts of oils, acids, alkalies, salts, sugar, organic materials or other substances that may be deleterious to concrete or steel as specified in IS-456. Potable water shall be considered satisfactory.

6.2.4 Chemical Admixtures

- a. Chemical admixtures, if used, shall conform to IS-9103.
- b. Criteria of use of chemical admixtures shall be as per IS-456.

6.2.5 Reinforcing Steel

- a. Only high strength deformed steel bars of grade Fe 500 (TMT)/ Fe 500 D conforming to IS: 1786 shall be used.
- b. Minimum diameter of main reinforcing bars in foundation and pedestal shall be 12mm. Links shall be of minimum 8mm diameter.

6.2.6 Anchor / Foundation Bolts

Mild steel bars for turning anchor bolts shall conform to IS-2062 Grade A. Nuts shall conform to IS-1363 and IS-3138.

6.2.7 Grout

Premix free-flow non-shrink cementations grout, with a minimum compressive strength of 40N/mm² at 28 days, shall be used.

6.3 Concrete

The concrete shall be design mix of minimum grade M25 as per Geotechnical Document and other requirements as mentioned in project data sheet. 75mm thick lean concrete shall be provided under the structural foundation of proportion 1:5:10 using 40mm down aggregates. The mud mat of lean concrete shall project 50mm beyond all sides of the structural foundation slab.

6.4 Design of Foundation

- a. The foundation shall be placed minimum 1.5 meters below Finished Grade Level (FGL) or as per Geotechnical Document No. XXXX-16-48-GD-0001.

- b. Factor of safety against overturning and sliding shall be considered as 2.0 and 1.5, respectively. Only 50% of the overburden weight of backfilled soil over base slab of the foundation shall be accounted for checking of over-turning and sliding. All design parameters for foundation shall be as per IS-456 and referred BIS codes. Limit state method shall be used.
- c. Foundation design shall be as per Geotechnical Document No. XXXX-16-48-GD-0001.

6.5 Loadings

Loading in general shall be as per IS-875. The basic wind speed shall be as per the Project/site location and as called for in IS-875. The value of K_1 , K_2 and K_3 shall be as follows:

$$K_1 = 1.0$$

$$K_2 = 1.0$$

K_3 shall be appropriate to topography but not less than 1.0.

6.6 Review of Foundation Design/Drawing

Design and drawing shall be prepared on standard size sheets and submitted for review/approval prior to execution of works. Construction shall not be taken up prior to documents/drawings reviewed in code 1 or 2.

6.7 Construction Requirements

Construction shall be done following all safe practices required in IS-456 and other referred codes.

7.0 INSPECTION, TESTING AND ACCEPTANCE AT WORKS

- 7.1 During fabrication, the High mast lighting system equipment and materials shall be subject to inspection by EIL / Owner, or by an agency authorized by the Owner, to assess the progress of work, as well as to ascertain that only proven raw material is used. The manufacturer shall furnish all necessary information /data concerning the supply to EIL / Owner's inspectors. The vendor shall give at least 15 days notice to the purchaser regarding the date of testing to enable him or his representative to witness the tests.
- 7.2 Tests shall be carried out at the manufacturer's works under his care and expense. All routine tests as specified by the applicable standard codes shall be conducted. Type test certificates for the high mast lighting system equipments used shall be furnished from a recognized testing organization.
- 7.3 Inspection and testing requirements for high mast system shall be as per Inspection and test plan, specification no. 6-81-1039 and owner-approved vendor's QAP to check mechanical and electrical operation.
- 7.4. All tests shall be conducted as per relevant applicable standards.

8.0 PACKING AND DESPATCH

The equipment shall be divided into several shipping sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polyethylene sheets before being placed in wooden crates/cases to prevent damage to the finish. Crates/cases shall have skid bottoms for handling. Special notations such as 'Fragile', 'This side up', 'Weight', 'Owner's particulars', 'PO nos.' etc., shall be clearly marked on the package together with other details as per purchase order.

The equipment may be stored outdoors for long periods before installation. The packing should also be suitable for outdoor storage areas with heavy rains/ high ambient temperature unless otherwise agreed.

9.0 FIELD TESTING AND COMMISSIONING

9.1 Supervision during installation, testing and commissioning shall be carried out by vendor's experienced and trained engineer/supervisor. Any defect pointed out by EIL/Owner shall be rectified by vendor at no extra cost to the owner.

9.2 Before any part of the High mast lighting system is energised, the pre-commissioning tests shall be carried out. This shall include but not be limited to the following:

- a. Insulation resistance tests
- b. Continuity test
- c. Earth continuity check and measurement
- d. Load current in all phases shall be measured in each mast
- e. All safety interlocks
- f. Feeder pillar distribution box wiring schematics and functional requirements

All pre-commissioning checks and tests both for power distribution and lighting system shall be carried out by vendor in the presence of Engineer-in-charge of EIL/Owner.

9.3 After completion of job, vendor shall carry out the measurement of achieved illumination level in different areas and shall furnish test reports. The focusing angle of fixture shall be changed/ adjusted where required.

9.4 After inspection and pre-commissioning tests are carried out, vendor shall obtain necessary statutory approval of the system from Central Electricity Authority or any other statutory body as specified in the specification. All test results shall be recorded and submitted to EIL/owner.