

	Odisha Power Generation Corporation Ltd.	Technical Specification for WorkshopPackage	IB TPS – 2 X 660 MW Units 3 & 4, Jharsuguda, Odisha
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PART D: TECHNICAL SPECIFICATION OF EOT CRANE

1.00.00 GENERAL INFORMATION


This section covers the one no of 10 Tonne capacity Electric Overhead Traveling (EOT) Cranes, which will be required for handling various workshop equipments in new workshop building of OPGC. EOT crane should be able to move in existing and proposed workshop complex. Hence, the crane bus bar needs to be extended towards the existing workshop side also . So the length of the bus bar will be **approximately** 84 mtr (48 +36)

2.00.00 CODES AND STANDARDS

The design, manufacture and testing of the crane shall conform to the latest editions of the following codes and standards

- 2.01.00 IS : 807 - Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.
- 2.02.00 IS : 3177 - Code of Practice for Design of Overhead Traveling Cranes and Gantry Cranes other than Steel Works Cranes.
- 2.03.00 IS : 1835 - Round Steel Wires for Ropes.
- 2.04.00 IS : 2266 - Steel Wire Ropes for General Engineering Purposes.
- 2.05.00 IS : 3443 - Crane Rail Sections.
- 2.06.00 IS : 15560 -Point Hook with Shank up to 160 tones - Specification.
- 2.07.00 IS : 5749 - Forged Ramshorn Hooks.
- 2.08.00 IS : 816 - Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel.
- 2.09.00 IS : 1323 - Code of Practice for Oxy-Acetylene Welding for Structural Work in Mild Steel.
- 2.10.00 IS : 9595 - Recommendations for metal arc welding of carbon & carbon - manganese steel.
- 2.11.00 All electrical installation work shall comply with the provisions of Indian Electricity Act and Indian Electricity Rules as amended up to date.

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- 2.12.00 ANSI-830.2.0 - Safety codes for overhead and Gantry Cranes.
- 2.13.00 IS 3815: Point hook with shanks for general Engineering purpose.
- 2.14.00 IS 823: Code of practice for use of metal arc welding of mild steel.
- 2.15.00 IS 1181: Qualifying tests for metal arc welders (Engaged in welding structure other than pipe).
- 2.16.00 CMNA - Crane manufactures association of America.

In case of any contradiction between the above-mentioned codes and standards (item 2.01.00 thru' 2.16.00 above) and this technical specification, the later will prevail. However, nothing in this specification shall be construed to relieve the Seller of his responsibility to comply with what is mentioned against item 2.11.00 above.


3.00.00 SCOPE OF WORK

3.01.00 Scope of work includes supply of the following:

- 3.01.01 The one no. of 10 tonnes E.O.T cranes as having duty and service conditions as specified hereinafter along with all accessories.
- 3.01.02 Runway rails for entire runway length along with rail clamps, all inserts, insert plates, anchor bolts, nuts, buffers & stops, limit switches etc. as required.
- 3.01.03 Runway conductors for the entire runway length complete with all insulators, supports, support brackets, fixing clamps, bolts, nuts etc. as specified and as required to complete the installation. Power supply cabling including isolating switch complete along with electrical items, attachments and accessories as required to feed power to the runway conductor.
- 3.01.04 All protective devices, anti-collision limit switches etc. as required for the crane.
- 3.01.05 All facilities, accessories and attachments for operation of the cranes.
- 3.01.06 Bridge and trolley current collectors and bridge cross conductors along with all wirings etc. for the crane as specified and as required to complete the scope of work.
- 3.01.07 Crane components shall be provided with lifting lugs, eye-bolts etc. at suitable locations for handling assembling, lifting and placing into position.

4.00.00 SPECIFIC PERFORMANCE REQUIREMENTS

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4.01.00 Capacity

4.01.01 The safe working load (X) for each EOT crane shall be computed as

$$X = 1.25 \times a$$

where a = Single heaviest equipment expected to be handled by the crane.

4.02.00 Highest Position

4.02.01 The highest position reached by the lifting hooks should be such that during operation, the minimum vertical critical clearance between bottom of the equipment being handled and the top of any permanent structure or equipment in the operating area should be at least one metre.

4.03.00 Lowest Position

4.03.01 The lifting hooks should reach up to the floor of its operating area or sump pits as necessary.

4.04.00 Horizontal clearance

4.04.01 The lifting hooks in vertical position should reach at least up to 2.5 m from the end stopper.

4.04.02 Either the main or the auxiliary hook in vertical position should reach at least upto 1.0 m from the runway rails.

4.05.00 If safe and reliable handling necessitates more operating space for the E.O.T. cranes, the same shall be provided.


5.00.00 DESIGN & CONSTRUCTION

5.01.00 General

5.01.01 In the design of components on the basis of strength, factor of safety shall not be less than five (5) based on ultimate strength. Impact, fatigue, wear and stress concentration factors shall be taken into account, wherever applicable. Mechanism class shall be as indicated in the Data Specification Sheet.

5.01.02 The crane shall be rigid in construction and all movements shall be smooth and non-jerky.

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5.01.03 Drives shall be designed with adequate margin to give best performance and efficiency. Safety arrangements shall be incorporated to prevent damage to motors on account of mechanical overload and electrical faults and to gearing, shafts, etc. due to over-stressing and other detrimental conditions.

5.01.04 All materials shall be of tested quality and shall conform to the specification requirements and standards mentioned and shall be new and first class in all respects.

5.01.05 Castings and forgings shall be of tested quality and shall conform to their respective material specifications and shall be free from flaws and objectionable imperfections, machined true and in a workman like manner.

5.01.06 No wood or other combustible material shall be used unless specifically approved by the Buyer/Consultant.

5.01.07 Proposals for repair or any similar operations involving plugging, welding, boring or addition of metal to the original castings or forgings shall be submitted to the Buyer and his approval must be obtained before any such work is carried out. Drawing showing details and location of such repairs shall be submitted to the Buyer.

5.01.08 All fabrication by welding shall be carried out by qualified and certified welders.

5.01.09 Design shall provide for easy maintenance of all parts, particularly the wheel bearings on end-trucks.

5.01.10 Temperature Effects


Where any portion of the structure is not free to expand or contract under variation of temperature, allowance shall be kept for stress resulting from these conditions; the co-efficient of expansion for each degree centigrade variation of temperature above and below normal being taken as 0.000012 for mild steel. The maximum range of variation of temperature shall be as given in the Lead Specification. Clause 3.4 of Section 3 of IS: 800-2007 Code of practice for use of structural steel in General Building construction - shall also apply.

5.01.11 Maximum use shall be made of shop fabricated sub-assemblies.

5.01.12 Material of Construction

The material of construction of the major components of the crane shall be as indicated in the Data Specification Sheet. Manufacturers are however free to use alternative material, which are superior for the intended service. But in all cases they are required to obtain prior concurrence of Buyer after furnishing chemical and physical properties of the offered material and any other information that may be asked for by the Buyer.

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5.01.13 Load Indication

The crane bridge shall have permanent inscription in English on each side, readily legible from operating floor, stating manufacturer's name, serial no., the year of manufacture and the safe working load.

5.02.00 Structural Design Consideration

5.02.01 Minimum thickness of metal

For load carrying members the component plates, bars, angles and other rolled sections shall be minimum 8 mm thick.

For tubes having both ends sealed the minimum thickness shall be 4.9 mm (6 SWG). For unsealed tubes the minimum thickness shall be 8 mm. The chequered plates for platforms shall be minimum 6 mm thick over plain.

5.02.02 Accessibility for maintenance

All structural parts shall be designed so that they are accessible for periodic cleaning, brushing and painting. All rivets/bolts shall also be accessible for periodic checking.

5.02.03 Ruling dimensions and ratio

a) For compression members, the slenderness ratio shall not exceed 120. In case of other load carrying members and subsidiary members the slenderness ratio shall not exceed 180.

b) For girders, the following values of maximum span to depth ratio shall be governing:


Plate girders	:	Span/depth = 18
Lattice girders	:	Span/depth = 12

5.02.04 Connections

a) Unless otherwise specified, only rivetted or welded joints shall be used.

b) Where welding is not practicable, turned and fitted bolts shall be used, preferably as per IS-1364 and IS-1367.

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- c) Minimum number of turned and fitted bolts in a connection shall not be less than two.
- d) Black bolts shall not be used in main structures and high tensile bolts shall not be used unless approved by the Buyer. Bolts shall preferably be not used in tension.
- e) Where bolts pass through sections having tapered flanges, tapered flats shall be welded to inside of the flanges. Tapered washers shall not be used.
- f) Transverse fillet welds on load carrying members shall be avoided. If side fillets are used in end connections, the length of each side fillet should not be less than the edge distance between the fillets.
- g) Butt welds on structural members under tensile stress shall be checked by Radiographic examination as and when directed by the Buyer.
- h) Splices shall be designed to resist one and half times the forces and moments to which it is subjected, but in no case it shall be less than 2/3rd of the effective strength of the material spliced except that splices in the webs of the plate girders shall be designed for full strength of the web in shear as well as bending.

For splicing tension members, the net section of the splice plate shall be ten percent more than that of the material spliced. Splices shall be proportioned and arranged, so that the gravity axis of the splices is in line with the gravity axis of the member to avoid eccentricity.

5.02.05 Deflections and Camber

- a) The total maximum vertical deflection of the girders produced by the dead load, weight of trolley and the rated load shall not exceed limit of Span/900.
- b) The girders shall be cambered by an amount equal to the maximum deflection due to dead load plus one half the live load and trolley.

5.03.00 Bridge Girder and End Carriage

5.03.01 The crane shall have double girder 10 Tonnes SWL, and above that it shall have double girder.

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5.03.02 The bridge girder shall be box section type or braced I beam type as per standard design of the manufacturer. The exterior surface shall be smooth and as free from projections etc. as possible to minimise dust collection on it.

5.03.03 double girder cranes shall be provided with suitable truss for supporting the bridge drive machinery and motor.

5.03.04 The crane bridge shall be carried on end trucks of suitable design. Each end truck shall be built up from steel plates welded together to form a closed box section with opening at each end to receive the wheels. Welded to the trucks shall be steel sections to form bearings for the wheel axles and the driving shaft. End trucks shall be provided with rail sweep and bumper. They shall also be provided with suitable jacking pads for maintenance of the wheel and bearings. The location of the jacking pads shall be such that it will not interfere with the maintenance of the wheels and its bearing.

5.03.05 Driving wheels shall be of the double flange and taper tread type and shall be ground to equal diameter in pairs. Wheel axles may be either of the stationary or rotating type as per standard of the manufacturer. If stationary type, they shall be prevented from turning in the truck by means of a key plate fitting into a slot in the end of the axle and if rotating type, wheels shall be keyed to them.


5.03.06 Where more than two bridge wheels are used per end truck, the end truck shall be split into two sections, each carrying one bridge independent of other. Two sections of the end truck shall be joined by suitable joining device that will ensure uniform wheel loading. Steel pads shall be welded on the top of end trucks where the girder rests and shall be machined to receive the girder ends.

5.03.07 Trolley travel rail ends shall be curved upwards to stop the trolley smoothly and prevent it from leaving the rails in case of over travel at its maximum speed.

5.03.08 End trucks shall be equipped with spring/rubber buffers and rail sweep for bridge travel. The rail sweep shall be such that it can push away any object that may fall on the runway. The buffers shall be of substantial design and suitable for engaging the stops at the end of runway.

5.03.09 Breathing holes shall be provided in completely enclosed welded box type girders. Drain holes shall be provided in all places where water or oil is likely to collect. Where practicable, means of access shall be provided for inside inspection of completely enclosed box girders.

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5.03.10 In bridge girder strength calculations, the trolley rails and chequered plates shall not be considered as load carrying members.

5.04.00 Trolley Frame

5.04.01 The trolley frame shall be built up from heavy steel plates, angles and channels adequately braced to resist vertical, lateral and torsional strains, welded to form a rigid one piece frame. Alternatively, it may be of cast steel construction.

On bottom of trolley frame, on each side shall be a double spring bumper to engage stops at each end of the bridge.

5.04.02 Equalizer sheaves shall be mounted on the trolley frame in such a manner that deflection resulting from the force on the sheaves is not directly transmitted to the hoisting mechanism.

5.04.03 Sheaves shall be so arranged on the trolley that rope-revving arrangement resulting there from will ensure a lifting of the load in almost a vertical line with minimum of swing or side movement.

5.05.00 Platforms and Ladders

5.05.01 Safe means of access shall be provided to the operator's cab and to every place where any person engaged in the examination or maintenance of the crane has to work. Adequate handholds and footholds shall be provided as necessary.

5.05.02 One metre high double tier handrail and suitable toe-boards shall be provided along the entire length of platform (on the bridge), which shall not be less than 750 mm wide.

5.05.03 Every platforms shall be provided with steel chequered plate top and be securely fenced with one metre high double tier hand rails and toe boards. Platforms shall be of sufficient width to enable normal maintenance work to be undertaken safely.

5.05.04 Not used,.

5.05.05 Access to operator's cabin from bridge girder platform shall be by staircase having adequate width and proper sloping.

5.06.00 Operation

The crane shall be operated or from a pendant control station as specified in Data Specification Sheet.

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5.06.02 Pendant Station

- a) The pendant station shall locate the push buttons for controlling the various motions of the crane and shall be hung from the crane trolley to a height of approximately 1 metre above the operating floor.
- b) With pendant operation, foot operated bridge travel brake and the drum controllers need not be provided.

5.07.00 Repair Cage

5.07.01 A repair cage shall be provided on the inside of the end carriage for attending the main current collectors. In case, the trolley current collectors are located below trolley rail level on the inside webs of the bridge girders, guards shall be provided on the trolley to prevent the hoisting ropes from coming in contact with conductors as well as a repair cage shall be provided on the trolley to attend these conductors.

5.07.02 Repair cages shall also be provided at the corners of the crane, if required, to facilitate removal and replacement of long travel wheels.

5.07.03 The repair cages shall be adequately sized, guarded for safety and correctly located for the intended service. Suitable access to the cages shall be provided.

5.08.00 Lifting Hook Block Assembly

The lifting hook block assembly shall be ramshorn type or approved equal for capacity greater than 40 Tonnes and point hook with shank for capacity below 40 Tonnes and shall be of steel construction. Each hook shall be supported on ball or roller thrust bearing and shall rotate freely on its bearings.


The sheaves of the hook block shall be encased in an oil tight casing permitting generous lubrication of wire ropes and sheaves and also preventing accidental tapping of hands.

All sharp edges on the hooks shall be eliminated to prevent damage to the sling ropes. The hooks shall conform to the requirements of IS: 3177.

5.09.00 Gearing

5.09.01 Gears in the speed reducer unit for bridge drive and also all hoists and trolley drive gearing shall be enclosed in substantial housing and shall operate in oil bath. The oil shall have additives of approved quality and shall be of approved viscosity at standard temperature (say 60°C). The housing shall be of sufficient design not to

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permit a temperature in excess of 90°C for the oil bath and shall be adequately supported and readily removable without disturbing the gear assembly.

5.09.02 Gears shall be of cast or forged steel and pinions shall be forged steel and shall be machine cut. Gear and pinion teeth shall be treated for resistance to wear.

5.09.03 Gears shall have tooth form and modules as recommended in IS-3681 and they shall be adequately designed to stand shock load and vibration and shall not be excessively noisy in operation. The ratings of gears shall be established as per IS : 4460.

5.09.04 Spur and helical gears only shall be used for reduction gearing.

5.09.05 Mounting of the gears shall be such that axial thrust on the bearing is minimum. Centre distance of the connecting shafts shall be as close as possible to the theoretical value. Shafts shall be designed to keep their deflections within permissible limits.

5.10.00 Bearing

5.10.01 The type of bearings for various parts shall be as per IS-3177 and standard of manufacturer.

5.10.02 Provision shall be made for service lubrication of all bearings. Bearing enclosures shall be designed as far as practicable to exclude dirt and prevent leakage of oil or grease. Arrangement for centralized lubrication of bearings shall be tried to the maximum extent possible and a detailed scheme for the same shall be furnished by Seller.

5.10.03 Suitable drip pans shall be provided as required to collect oil and grease, which may drop, from operating parts. All drip pans shall be accessible for draining and cleaning.

5.10.04 All bearings of the gearing shall be antifriction type. Angular contact ball or taper roller bearings shall be used wherever necessary. The bearings shall correctly locate the shafts while allowing for thermal expansion of the shafts.

Bearings shall be enclosed in suitable housing with proper holes and plugs to prevent any ingress of dirt and to permit easy lubrication of the bearings.


5.11.00 Guarding

5.11.01 Guards of an approved design, which will push forward or off the rail track any object placed across it, such as person's foot or arm, shall be attached to each end of the end carriage.

5.11.02 Protection guards to live electrical wirings/conductors shall be provided.



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5.11.03 Suitable guards to revolving shafts and coupling, long travel cross shafts and gears, shall be provided.

5.11.04 The sheaves of the hook block fitted with two sheaves or fewer shall be guarded to prevent tapping of a hand between a sheave and the running rope.

5.11.05 Effective means of guiding the wire ropes over the sheaves shall be provided so as to prevent dismounting of rope from the sheave grooves even when a slack rope condition is developed.

5.11.06 All openings in foot walk flooring, for access to bottom chord platform, if any, and to other inspection platforms, shall be provided with covers having suitable locking means to avoid any accidental opening.

5.11.07 All electrical panels, resistance boxes shall have suitable rain/ dust hoods over them to prevent water and building construction material falling on them, as it is apprehended that erection and commissioning of the crane might have to be taken up before completion of the building roof.

5.12.00 Runway Rails

5.12.01 Crane runway rails with bolts and nuts and complete with shims, anchor bolts, inserts and other fixtures for fixing the rails to crane girders shall be under the scope of supply of the present specification.

5.12.02 The length of the rail supplied shall be sufficient to cover the whole of runway length. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.

5.12.03 The rail section shall be as per IS: 3443.

5.13.00 Trolley Rail


5.13.01 The specification includes the supply of trolley travel rails complete with fixtures for fixing the rails to the body of crane.

5.13.02 The length of the rail supplied shall be adequate for maximum permissible trolley travel. Gap between successive rails shall not exceed 2 mm and end rails shall be provided with stoppers to prevent longitudinal shifting.

5.14.00 Rail Joints and Fixing

5.14.01 The rails shall be butt jointed by either thermit welding or fusion welding process. The Seller shall get his proposal for edge-preparation of rails, welding procedure and sequence, approved in advance by the Buyer/Consultant.

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5.14.02 The schemes of securing the rails to the gantry girder/bridge structure with clamps, bolts and nuts, their alignment etc. shall be subject to the approval of the Buyer/Consultant.

5.15.00 Tolerances

The limits of tolerance as specified in the Data Specification Sheet shall be observed.

5.16.00 Rail End Stops

Rail end stops of adequate design shall be provided on both ends of the runway. The end stop location and arrangement shall be such that the unavailable length of runway (for crane operation) on any end is a minimum.

5.17.00 Drive Mechanism

5.17.01 Equal driving effort shall be applied at each drive wheel of bridge and trolley to prevent one end from travelling faster than the other.

5.17.02 For bridge, the torsional deflection in the cross shaft shall be limited to safe value as per applicable code.

5.17.03 For bridge drive, the motor shall be located at mid position of the span. If twin motors are used for drive, motors shall be equidistantly located at each wheel end. Suitable interlock shall be provided to prevent single motor operation at any time.


5.17.04 Trolley drive shall be achieved by single motor in which the motor shall drive a common output shaft through proper gearbox and tractive power shall be transmitted to the geared wheels by means of pinions mounted on both ends of the output shaft.

5.17.05 All machineries for the drive unit shall be properly aligned. Self-aligning type gear couplings shall be used between connection shafts to take care of transverse as well as axial movement wherever necessary.

Wherever components of considerable amount of inertia is directly mounted on the high-speed shaft (e.g. brake drum, couplings, etc.) they shall be balanced statically to minimise vibration.

5.17.06 Motor ratings shall be calculated keeping margin of at least 25% over the maximum power requirement. Further, the hoist motors shall be rated to lift 120% of the design load on the hook at the rated speed. For other details the Clause no. 5.19.00 below shall be referred to.

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5.17.07 Along with the drive mechanisms adequate brakes shall be provided as detailed in Clause no. 5.20.00 below. Selection and design of brakes shall be complete responsibility of the manufacturer. The brakes shall be of accurate rating to stop each motion within a very short distance and in a safe and smooth manner.

5.18.00 Crane Electricals

5.18.01 The crane(s) shall be furnished complete with all electrical equipment, accessories (like drive motors with VVVF Drives, conductors, insulators, protective & operating devices, cables, current collectors etc.) and cabling/wiring as may be necessary for the efficient and safe operation of the crane.

5.18.02 The crane electricals shall be designed for satisfactory operation from the available power supply as given in the Data Specification Sheet.

5.18.03 If power supply other than that specified is required, the Seller shall have to make his own arrangement by furnishing all necessary conversion, rectification and transformation equipment and accessories.

5.18.04 Unless otherwise specified, the crane electricals shall be designed for ambient air temperature of 50°C relative humidity of 100% and site elevation less than 1000 metres above mean sea level.

5.18.05 All electrical equipment, accessories and wiring shall have tropical protection involving special treatment of insulation and metal against fungus, insects and corrosion.

5.18.06 All electrical equipment shall be laid out so that they are readily accessible for inspection and maintenance.

5.18.07 The hoist structures, motor frames & metal comes of all electrical equipment on EOT crane/hoist shall be effectively grounded as per Indian Electricity Rules.

5.18.08 If the pendent control is of metal, it shall be earthed.


5.18.09 All equipment offered shall have suitable provisions for termination and connection of Buyer's power and control cable inclusive of cable end box, brass compression glands terminal lugs and terminals. Incoming switch-fuse shall be provided at each panel for incoming AC/DC power supplies.

5.19.00 Drive Motors

5.19.01 All crane motors shall be totally enclosed, fan cooled type, having class-F insulation with temperature rise limited to class-B operation in all cases.


5.19.02 Motor enclosures shall conform to the degree of protection IP-55.

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- 5.19.03 Motors shall be Squirrel Cage type, designed for crane duty requirement of frequent starting. Reversing and plugging motors of single girder EOT crane shall also be squirrel cage type. All motors shall be suitable for VVVF operation.
- 5.19.04 Motors shall suit the duty class S4, cyclic duration factor (CDF) 40% and number of cycles per hour 150. Motor pull out torque shall not be less than 2.75 times rated torque.
- 5.19.05 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. Motor shall not stall during operation at voltage dip of 70% for 2 sec.
- 5.19.06 The motor shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage.
- 5.19.07 Starting current shall not exceed 6 times full load current.
- 5.19.08 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.
- 5.19.09 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.
- 5.19.10 The starting torque developed by motor at minimum permissible voltage at start i. e. 80% of rated voltage shall be more than the starting torque requirement of driven equipment by margin of at least 10% throughout the range of starting in order to account for higher starting torque required during service due to wear and tear.
- 5.19.11 Motors shall be suitable for both forward and reverse rotation.
- 5.19.12 Motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energised shaft rotating at 125% rated speed in reverse direction.
- 5.19.13 The motor shall start smoothly and rapidly and maintain steady operation. The motor characteristic such as speed, starting torque, acceleration time etc. shall be properly coordinated with requirement of driven equipment. Maximum torque shall not generally be below 200% of full load torque.
- 5.19.14 Breakaway torque and pullout torque shall be properly coordinated with speed torque characteristic of the driven equipment. The torque speed characteristic of motor super imposed thereon, driven equipment torque speed characteristic at

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100%, 90%, 80% and 110% of rated voltage shall be furnished to establish capability to start the motor successfully with load connected.

- 5.19.15 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3.0 seconds for motors up to 20 seconds starting time.
- 5.19.16 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.19.17 Hot thermal withstand curve shall have a margin or at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.
- 5.19.18 Each motor rated 30 KW and above shall be provided with space heater, sized to maintain motor internal temperature above dew point when the motor is idle.

5.20.00 Brakes

Selection and design of brakes shall be such as to meet the following requirements:

5.20.01 Service Brake

- a) Double-shoe type service brakes shall be provided for each motion of the crane and its hoists. The service brakes shall apply automatically when power supply to the drive motor is cut-off or fails.
- b) Service brakes for main hoist motion shall be electro-hydraulic thruster type, for all double girder cranes either cabin or pendant operated and electromagnetic disc. type for single girder crane; adequately sized to arrest motion and hold at rest any load up to and including test load at any position of the lift.

5.21.00 Main Disconnect Switch


5.21.01 Main disconnect switch shall be metal-clad, 3-pole, load-break type in IP-54 enclosure, complete with compression brass glands and lugs.

5.21.02 The switch shall be provided with "Power On" red indication lamp (LED type) and shall be suitably located so that it can be manually operated from the operating floor level.

5.21.03 Power leads shall run from the main disconnect switch to the runway conductors.

5.22.00 Runway Conductors (Down Shop Leads)

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5.22.01 The runway conductors shall be four (4) in number for three phase supply and ground.

5.22.02 The runway conductors shall be of M.S. angle sections, liberally sized so as not to exceed current density of 0.42 Amps/sq.mm. Alternatively, shrouded bus bar with copper type DSL may be used.

5.22.03 Sufficient allowance (minimum 20%) for wear and tear shall be provided over the calculated conductor size.

5.22.04 The runway conductors shall be supported on brackets and insulators from the crane girder with sufficient spacing in between the conductors.

5.22.05 The collector system per conductor shall be top-running type having spring loaded cast iron/carbon metallic shoes to maintain adequate contact pressure.

5.23.00 Cross-Conductors on Bridge

5.23.01 Cross conductors on bridge shall be flexible trailing cable system mounted on retracting supports (festoon type).

5.23.02 Alternatively cross conductors of M.S. angles with shoe collectors, similar to the arrangement of runway conductors may be offered.

5.24.00 Power Distribution Equipment


5.24.01 From the main collector shoes, wiring shall be extended to two (2) nos., 3-pole, load-break, safety disconnect switches -one at the bridge near the collector and the other in operator's cabin within easy reach.

5.24.02 The safety switches shall be capable of cutting-off the supply to all power driven and associated equipment of the crane but not the auxiliary loads such as fans, lights etc.

5.24.03 From the safety disconnect switches, wiring shall be extended to a protective panel, containing the following as a minimum :

- a) One triple pole incoming supply disconnect switch.
- b) One triple pole main magnetic contactor with HRC fuse backup, ON-OFF push buttons and RED-GREEN indication lamps (LED type).

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c) Motor feeders, each comprising of triple pole fuse switch unit with thermal overload (hand reset) relays for short circuit and over load protection in all three phases of the motor.

d) Outgoing feeders with double-pole switch fuse units for auxiliary loads such as control supply, lights, fans, etc. with at least one spare feeder.

5.25.00 Voltage Drop

5.25.01 All conductors and cables/wires shall be so sized that the voltage drop measured between the main disconnect switch and motor terminals shall not exceed 3% of rated voltage.

5.25.02 The voltage drop shall be computed using the total running current of all crane motors that can operate simultaneously and with rated crane load.

5.26.00 Safety Interlocks

5.26.01 Disconnect Switch

- a) The operating handle of the main/ safety disconnect switch shall be mechanically interlocked with enclosure cover such that the same can not be opened unless the switch is in OFF position.
- b) Main/ safety disconnect switch shall have provision of pad-locking in OFF position.

5.26.02 Main Contactors


- a) The main contactor shall be electrically interlocked so that it cannot close unless all the motor overload relays are RESET and all controllers are in OFF position.
- b) The main contactor shall be also opened by means of emergency push buttons and hoist limit switches.

5.27.00 Emergency Switch

Mushroom type emergency STOP push buttons to open the main contactor shall be furnished - at least one in operator's cabin and two on bridge platform within easy reach.

5.28.00 Crane Controls

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The VVVF Drive control shall be used for control of each motion. The VVVF drive shall be provided with step less speed control from 0 to 100%. The VVVF Drive shall be equipped at least with 1024 Pulse in card, droop control for synchronization and crane software. The rating of VVVF shall be decided considering 250% of full load current of respective drive motor.

The VVVF drive shall be suitable for continuous operation. For long travel, motor shall be grouped in two groups and one VVVF drive for each group shall be considered.

5.29.00 **Controllers**

5.29.01 Master controllers for all motions shall be so arranged in the operator's cabin as to provide maximum convenience and view of the operator.

5.29.02 All controllers shall be provided with spring return to OFF position feature. When in OFF position, the controller shall disconnect power supply to the respective motor.

5.29.03 Each controller shall bear suitably engraved inscription of motions controlled in English and of direction of motions by arrows.

5.30.00 **Limit Switches**

5.30.01 The limit switches shall be totally enclosed type IP-55 with properly designed actuators and shall be readily accessible for adjustment and repair.


5.30.02 Each hoist shall be furnished with two (2) limit switches:

- a) A screw type limit switch with self-resetting features, which will act in case of over-hoisting.
- b) A gravity operated hand-reset type limit switch as a back-up protection against over-hoisting.

5.30.03 Track type limit switches shall be provided on the bridge and trolley to prevent over-traveling in either direction.

5.31.00 **Panels**

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5.31.01 Protective and control panels shall have IP-54 gasketed enclosure, fabricated from sheet steel, minimum 2 mm thick, suitably reinforced to provide structural rigidity.

5.31.02 The panels shall be front connected type with front hinged door for access to wiring and terminals. Engraved nameplates shall be furnished for all panels and also for the equipment and device mounted thereon.

5.31.03 All panels shall be factory wired and terminated on suitable terminal blocks for external cable connection. All internal wiring shall be identified with numbering ferrules at both ends as per relevant wiring diagram. Terminal blocks shall have 20% spare terminals.

5.31.04 Control wiring shall be carried out with 1100 Volt grade flexible, heat resistant, insulated switchboard wires with minimum 2.5 sq.mm stranded copper conductor.

5.31.05 Incoming switch-fuse shall be provided at each panel for incoming AC/DC power supplies.

5.31.06 Each panel shall have internal illumination with LED lamp and thermostat controlled space heater, suitable for operation on 240V 1-ph 50 Hz supply. Lamps and heater circuits shall have individual ON-OFF switches.

5.32.00 Switch

5.32.01 All switches shall be hand operated, air break, heavy duty, quick make-quick break type, capable of safely breaking the full load current of connected motor/feeder.

5.32.02 Incoming supply disconnect switch shall be interlocked with panel door so that the same cannot be opened unless the switch is in OFF position. Device to defeat this interlock shall also be included.


5.33.00 Fuse

5.33.01 All fuses shall be of HRC cartridge type, mounted on plug-in fuse base and provided with visible operation indicator.

5.33.02 All accessible live parts shall be adequately shrouded so as to eliminate the danger of accidental contacts with live parts while changing the fuse.

5.34.00 Contactors

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5.34.01 Contactor shall be suitable for crane duty, with current rating not less than connected motor full load current. All reversing contactors shall be mechanically and electrically interlocked.

5.34.02 Contactors shall have facility for easy inspection and replacement of parts. Arc chutes shall be provided where necessary.

5.34.03 Each contactor shall be provided with three positive acting, ambient temperature compensated, thermal overload relays with adjustable settings to suit the motor current.

5.34.04 The relays shall be hand reset type, suitable for resetting with compartment door closed.

5.35.00 Push Button and Lamp

5.35.01 Push button shall be spring return type, with 2 NO + 2 NC contacts, rated 10A 240V A.C.

5.35.02 Indicating lamps shall be LED type with series resistor. Lamps and lens shall be replaceable from front.

5.36.00 Illumination

5.36.01 Crane lighting and space heating systems shall be designed for 240V 1ph 50 Hz supply and receptacle system 24V 1ph 50 Hz supply. Suitable dry type transformers shall be furnished for the purpose, complete with isolation facility and primary/secondary fuses.

5.36.02 The lighting distribution board shall be located in the operator's cabin. Branch circuits for lighting and receptacles shall be individually protected by switch fuse units.


5.36.03 40W LED fixtures shall be used for lighting operator's cabin and bridge platform. Four (4) 250W high-bay sodium vapour fixtures shall be provided below bridge for illumination of the working zones.

5.36.04 All lighting fixtures shall be mounted with anti-vibration mounting and shall be easily accessible for maintenance.

5.36.05 24V - 5A - 3 pin industrial socket outlets shall be provided – two (2) in operator's cabin and minimum four (4) on the bridge along the walkway.

5.36.06 One (1) portable 40W hand lamp with plug shall be furnished with adequate length of flexible cable for inspection of crane components.

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5.36.07 Operator's cabin shall be provided with one (1) electric fan.

5.36.08 One (1) heavy-duty type industrial siren shall be provided with each crane. The siren shall be operated from foot-switch in the operator's cabin.

5.36.09 Conduit wiring system shall be used for lighting circuits.

5.37.00 Wiring

5.37.01 All power, control and auxiliary circuit wiring shall be furnished and installed as per best installation practice. The design shall be such as to maximise shop wiring and minimise field wiring.

5.37.02 All wiring shall be done with 1100V grade PVC insulated wire in conduits or by 1100V grade PVC cables with extruded inner sheath.

5.37.03 Conductors shall be stranded aluminium for power and stranded copper for control. Minimum conductor size shall be not less than 2.5 sq.mm copper or equivalent. For selecting the cable rating, motor duty, ambient temperature, grouping, position of cables, voltage drop etc. shall be considered.

5.37.04 Conduits shall be heavy gauge, rigid steel, hot-dip galvanised, cut square, reamed, threaded and screwed tight at all joints. Conduit entry to pull box or enclosure shall have double locknuts and insulating bushing. No running thread shall be used.

5.37.05 Solderless connectors shall be used for all connections. No splices shall be permitted in wire or cable. No taps or connections shall be made in fittings or junction boxes.

5.37.06 All wires and cables shall be identified with permanent markers at terminations as per approved wiring diagram.

5.38.00 Grounding

5.38.01 The crane rails, structures, motor frames, metal enclosures of all electrical equipment, conduit and tray system shall be effectively grounded in accordance with Indian Electricity Rules.

5.38.02 Bonding of structures and crane rails shall be provided as required to ensure electrical continuity.

5.38.03 The crane grounding system shall be connected to station ground mat.

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6.00.00 INSPECTION AND TESTING

6.01.00 The Seller shall submit his Shop and Field Quality Plan for OPGC review and approval as per stipulations of Volume IIA of this specification. The Quality Plan shall indicate all the tests to be carried out in line with the relevant codes. All forgings and castings shall be subjected to ultrasonic examination. DPT/MPI shall be carried out where-ever necessary.

6.02.00 Tests at shop

6.02.01 The cranes shall be subject to no load, full load and overload tests as per IS-3177. Otherwise the crane shall be subject to 'no-load' test after complete assembly and wiring.

6.02.02 The crane shall be subject to deflection test as per IS : 3177.

6.02.03 If the hoisting drum offered is of welded construction, the seams shall be fully radiographed.

6.02.04 The inspection and testing of butt welded joints shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. But welded joints subject to direct tension shall be 100% radiographed. All 'T' joints shall be covered with spot radiography. Should any of the spots be found defective then radiography to be extended to 100% area.

6.02.05 All electrical equipment and components thereof shall be subject to routine tests as per relevant Indian Standards. Type test certificate on any electrical equipment shall be submitted if desired by the Buyer. Otherwise, type tests shall have to be performed on the equipment to prove the design.


6.02.06 Reports of all shop tests shall be submitted to the Buyer/Consulting Consultant for review.

6.03.00 Tests at site

6.03.01 After assembly and erection at site, the crane shall be subject to the following tests:

- a) All tests as per IS-3177, including insulation test and tests for operation.
- b) Deflection tests as per IS-3177
- c) Overload tests at 125% of working load as per IS-3177

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6.03.02 Dead loads as required for conducting the tests at site shall have to be arranged by the Seller at his own cost.

7.00.00 DRAWINGS, DATA AND INFORMATION

7.01.00 The following drawings and data shall be submitted for review of Buyer/ Consultant by the Seller.

7.01.01 Drawings showing general arrangement, clearance requirement, assembly, cross sectional data and materials of construction for:

- a) E.O.T. Crane Unit
- b) Bridge Assembly and Components
- c) Bridge End Trucks and Wheel Assembly
- d) Trolley
- e) Trolley Wheel Assembly
- f) Drive and Transmission Unit for Bridge Travel, Trolley Travel, Main Hoist and Auxiliary Hoist.
- g) Suspension Unit for Main Hook Block and Auxiliary Hook Block.
- h) Main Hook Block
- i) Auxiliary Hook Block

7.01.02 Drawing showing layout of controllers and protective panels inside the operator's cabin/pendant station.

7.01.03 Leaflets on proprietary items such as motors, brakes, gear box, coupling etc.

7.01.04 Design calculation of the following:

Bridge girder, Rope drum, Machinery shafts, Gear box, Motor rating, Brake capacity, Bearing life, Wheel loading etc.

7.01.05 Drawings, characteristics curves and other data for each drive motor.

7.01.06 Material test certificates for all items including hooks and wire rope.

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7.01.07 Reports on various tests at shop and at site.

7.01.08 Control and protection scheme along with crane wiring drawing as well as a schematic drawing of control wiring indicating ratings and specifications for motors, contactors, resistors, fuses, etc.

7.01.09 As built drawing/electrical control schematic.

7.02.00 Instruction Manual

7.02.01 The Instruction manuals shall present the following basic categories of information in a comprehensive manner prepared for use by operating and/or maintenance personnel:

- i) Instruction for erection
- ii) Instruction for pre-commissioning check up, operation, abnormal conditions, maintenance, repair and protection.
- iii) A detail write up on the crane control system and also on the interlocks provided.
- iv) Recommended inspection points and periods of inspection.
- v) Schedule of preventive maintenance.
- vi) Replaceable part's list with ordering information.
- vii) Recommendation for type of lubricants, lubricating points, frequency of lubrication and lubricant changing schedule.
- viii) GA & Cross-sectional drawing with BOM
- viii) Manual for all bought out items

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DATA SPECIFICATION SHEET

GENERAL INFORMATION

Location : As per Annexure I.

Working condition : Indoor

GUARANTEED PERFORMANCE REQUIRED

Capacity : (Safe working load)

a) Main Hoist (T) : 10 Tonnes.

b) Aux. Hoist (T) : 5 Tonnes.

Rated Speed : (for any load from zero to SWL)

Main hoist : 3 m/min.

Aux. hoist : 5 m/min.

Trolley travel : 15 m/min.

Bridge travel : 25 m/min.

Creep speed : 0.3 m/min

Range of speed control
for main and auxiliary
hoist each motions : 0 to 100% of
(for any load from corresponding
zero to SWL) rated speed.



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Note: Safe working load shall be 125% of weight of the heaviest equipment to be lifted.

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(TECH SPC FOR EOT-PART -D)



SCOPE OF SUPPLY

Crane structures complete	:	Yes
All drive motors and driving gears	:	Yes
Running rails including all clamps, anchors, bolts, nuts, sheams, inserts, end stops and other fixtures	:	Yes
Operator's Cabin	:	No
Pendant Station	:	Yes
Portable fire extinguisher/CO ₂ bottle in operator's cabin	:	Not applicable
Runway conductors (DSL) and power collectors complete with all supports, insulators, brackets, fixtures etc.	:	Yes
Complete electrical work including main disconnect switch, all controls and interlocks, with necessary wiring, grounding, protective panels etc.	:	Yes
Lower limit switches for hoists	:	Yes
Illumination of crane	:	Yes
Fan in operator's cabin	:	Not Applicable
Lifting lugs, eye bolts etc. for handling of crane parts	:	Yes
Erection and commissioning service	:	Yes, Supervision by Crane Manufacturer
All equipment, accessories and consumables required for erection, testing and commissioning	:	Yes



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Final painting : Yes

First charge of oil, lubricants, grease etc. : Yes

DESIGN AND CONSTRUCTION

Duty Class : Mechanism class - M5 as per IS-3177 and IS-807

Electrical Service class - 4 as per IS-3177

Operation : Pendant station for all cranes

No. of Trolleys : One

Span between runway rail centres : }

Net runway length : }

Elevation of top of runway rails : } To be decided by the Seller.

Elevation of bottom of building roof structures : }

Main hook positions -

a) Elevation - Highest : }

- Lowest : }

b) Minimum approach from runway rail centre lines : }

c) Minimum end approach from runway rail stops : }

Auxiliary hook positions - } To be decided by the Seller as per } guidelines of the specification.

a) Elevation - Highest : }

- Lowest : }

b) Min. approach from runway rail centre lines : }

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- c) Min. approach from runway rail stops : }
- Clear space between runway rail centre line and nearest side obstruction/wall }

Runway conductors -

- a) Material : As specified earlier
- b) Maximum allowable current density : Seller to indicate.

DESIGN AND CONSTRUCTION

End Truck

- a) I-Section acceptable : No
- b) Single flanged wheels acceptable : No

Permissible tolerance -

- a) Difference in levels of crane rail top measured between two adjacent columns : 2.0 mm
- b) Crane rail gauge : ± 3.0 mm
- c) Relative shift of ends of adjacent rails in plan and elevation after welding : 1.0 mm
- d) Deviation of crane rail axis from centre line of web of supporting girder : ± 3.0 mm

Schedule of Brakes

Holding torque for control brake shall be 150 % of rated torque and that of service brake shall be 150% The schedule of brakes shall be as under:

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Sl.No.	Service	Type & No.
1.	Main Hoist	Two (2) nos. Electro hydraulic thruster type brake.
2.	Auxiliary Hoist	Two (2) nos. Electro hydraulic thruster type brake.
3.	Cross Traverse	Two (2) nos. Electro hydraulic thruster type brake..
4.	Long Traverse	Two (2) nos. Electro hydraulic thruster type brake.. Two (2) nos. Hydraulic thruster (foot operated)

The aforesaid brake schedule is applicable for double girder either cabin or pendent operated crane. Foot operated hydraulic thruster type brake need not be provided for pendant station operated cranes. For single girder cranes and single girder under slung cranes, one (1) electromagnetic disc brake for each motion shall be provided.

MATERIAL OF CONSTRUCTION

Bridge girder	:	IS-2062 Gr. B.
Other structural members	:	IS-2062 Gr. B.
Lifting hooks	:	Steel (Main hook as per IS-5749 and Aux. hook as per IS-15560).
Sheaves	:	Forged Steel.
Drum	:	Seamless pipe to ASTM A106 or fabricated rolled section to IS-2062. Gr. B
Wire ropes	:	As per IS-2266. (Usha Martin Make)
Gear	:	Cast or Forged Steel (EN-9).
Pinion	:	Cast alloy steel (EN-24).



Final Inspection After Assembly at Shop and Site

Final Assembly Check	:	Visual, Dimensional and Alignment
Performance Test motion	:	a) No Load Test b) Safe Working Load Test (SWL) c) Overload Test (125 % of SWL) d) Idle run test for wheels for long travel e) Specific speed for all motion f) Deflection Test g) Electrical Fail Safe Test h) Other tests as per IS: 3177
Identification	:	Marking & Stamping
Painting Paint DFT	:	Surface Preparation, Final Finish and
Verification of Documents	:	As per approved MQP & FQP

Note: Contractor shall submit MQP & FQP of Crane for OPGC review and approval.

List of vendors

Crane Greaves, Century	:	Anupam Industries, Electromech, Crane, REWA, WMI
Motors	:	Marathon, BBL, CGL, Siemens,
VVVF Drive	:	Siemens, Schneider, ABB, Alstom, Yokogawa
Wire Ropes	:	Usha Martin



Geared Brake Motor	:	Siemens (Flender), SEW, Bongfiglioli, NORD
Brakes	:	SOC, Electromag, Kakku, BCH, Magco Control
Bearing	:	SKF, FAG, TIMKEN, TATA, NBC
Contactors/MCCB/MCB/FUSES /Overload Relays/Isolators	:	Siemens, L&T, Telemecanic, ABB
Push Button	:	Siemens, L&T, Telemecanic,
Cable	:	KEI, Finnolex, Polycab, Universal
Limit Switch	:	Siemens, BCH, EPCC (KAKKU)
Time Relay	:	Siemens

Note: Any deviation from the above list shall be subjected to OPGC approval.