



حديد الإمارات  
emirates steel  
إحدى شركات صناعات SENAAT company

Integrated Management System

Engineering Standards

## Cranes Engineering Standards

PRD-CR-GS-001

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## 1. PURPOSE

The purpose of the ES Engineering Standards is to provide information and guidelines for the design, erection, installation and commissioning of plant and equipment across ES Sites.

## 2. SCOPE

The standards referenced in this document are issued to all contractors and form an integral part of the contract documentation.

Compliance is mandatory by all Contractors, ES Departments and personnel, whilst designing, erecting, installing and commissioning plant and equipment within ES sites, and any deviations require the explicit written approval of ES.

## 3. DEFINITIONS / ABBREVIATIONS

ES - Emirates Steel

MOC - Management of Change

## 4. RESPONSIBILITIES

**VP of Marketing & Strategy** - Is responsible for approving the Standards, and delegating members of his department to review them on a periodical basis, and / or write new standards when deemed necessary.

**Projects Construction Manager** - Is responsible for ensuring that all projects undertaken within ES comply with these standards.

**Engineering Manager Projects** - Is responsible for revising the Standards as requested by the projects and operations departments.

## 5. DESCRIPTION

### 5.1 General Requirements

#### 5.1.1 DEFINITIONS

1. ES: Emirates Steel
2. Crane: A machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism as an integral part of the machine. Cranes whether fixed or mobile are operated manually or by power.
3. Overhead Crane: A crane with a movable bridge carrying a movable or fixed hoisting mechanism and travelling on an overhead fixed runway structure.
4. Overhead Travelling Crane: A crane comprising of a bridge supported by end carriages capable of travelling along elevated tracks.
5. Top Running Crane: An overhead travelling crane supported, for its cross-travel motion, on the top surface of elevated tracks on which it travels.

6. Under slung Crane: An overhead travelling crane supported, for its cross-travel motion, from the bottom flanges of tracks on which it travels.
7. Single Girder Crane: An electric / manual overhead crane having one main girder which supports a hoist mounted on a top running / trolley.
8. Double Girder Crane: An electric / manual overhead crane having two main girders which supports a hoist mounted on a top running trolley.
9. Gantry Crane: A crane similar to an overhead crane except that the bridge for carrying the trolley of trolleys is rigidly supported on two or more legs running on fixed rails or another runway.
10. Cantilever Gantry Crane: A gantry or semi-gantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one or both sides.
11. Remote-Operated Crane: A crane controlled by an operator not in a pulpit or in the cab attached to the crane, by any method other than pendant or rope control.
12. Cabin Operated Crane: A crane controlled by an operator in a cab located on the bridge or trolley.
13. Semi-Gantry Crane: A gantry crane with one end of the bridge rigidly supported on one or more legs that run on a fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway.
14. ANSI: American National Standards Institute.
15. Appointed: Assigned specific responsibilities by the employer or the employer's representative.
16. Auxiliary Hoist: A supplemental hoisting unit of lighter capacity and usually higher speed than provided for the main hoist.
17. Brake: A device used for retarding or stopping motion by friction or power means.
18. Bridge: Part of a crane consisting of girders, trucks, end-ties, foot walks, and drive mechanisms, which carries the trolley or trolleys.
19. Bridge Travel: Crane movement in a direction parallel to the crane runway.
20. Buffer: An energy absorbing device for reducing impact when a moving crane or trolley reaches the end of its permitted travel; or when two moving cranes or trolleys come in contact.
21. Cab or Cabin: The operator's compartment on a crane.
22. Clearance: The distance from any part of the crane to a point of the nearest obstruction.
23. Conductors, Bridge: The electrical conductors located along the bridge structure of a crane to provide power to the trolley.

24. Conductors, Runway: The electrical conductors located along the bridge structure of a crane to provide power to the crane.
25. Control Braking: A method of controlling crane motor speeds when in the overhauling condition.
26. Controller, Spring Return: A controller which when released will return automatically to a neutral position.
27. Counter Torque: A method of control by which the power to the motor is reversed to develop torque in the opposite direction.
28. Current Collectors: Contacting devices for collecting current from the runway or bridge conductors.
29. Designated: Selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.
30. DIN: Deutsche Institut Für Normung (German Institute for Standardisation).
31. Drum: The cylindrical member around which the ropes are wound for raising or lowering the load.
32. Dynamic: A method of controlling crane motor speeds when in the overhauling condition to provide a retarding force.
33. Electric Hoist: An overhead hoist, operated by electric motor(s), used for vertical lifting of material (not people) that is freely suspended (unguided).
34. Emergency Stop Switch: A manually or automatically operated electric switch to cut off electric power independently of the regular operating controls.
35. Equaliser: A device, which compensates for unequal length of stretch of a rope.
36. Exposed: Capable of being contacted inadvertently. Applied to hazardous objects not adequately guarded or isolated.
37. Fail-Safe: A provision designed to automatically stop or safely control any motion during which a malfunction occurs.
38. Foot walk: A walkway with handrail, attached to the bridge or trolley for access purposes.
39. Hoist: An apparatus which may be a part of a crane, exerting a force for lifting or lowering.
40. Hoist Chain: The load bearing chain in a hoist.
41. Hoist Motion: That motion of a crane that raises and lowers a load.
42. Holding Brake: A brake that automatically prevents motion when power is off.
43. Jib Crane: A crane with a cantilevered arm (Jib) which can slew to the required angle with under slung trolley hoist running over the bottom flange of the jib arm.

44. Limit Switch: A switch that is operated by some part or motion of a power-driven machine or equipment to alter the electric circuit associated with the machine or equipment.
45. Load Block: The assembly of hook or shackle, swivel, bearing, sheaves, pins, and frame suspended by the hoisting rope.
46. Main Hoist: The hoist mechanism provided for lifting the maximum rated load.
47. Main Switch: A switch controlling the entire power supply to the crane.
48. Man Trolley: A trolley having an operator's cab attached thereto.
49. Master Switch: A switch, which dominates the operation of contactors, relays, or other remotely operated devices.
50. Monorail Hoists: A hoisting unit fixed to an under running trolley (standard or articulated) that travels along the bottom flange of a fixed monorail beam.
51. Pillar / Column Mounted Jib Crane: A crane with a cantilevered arm (Jib), mounted on a self-standing pillar (column) that is fixed to a foundation, and which can slew to the required angle with under slung trolley hoist running over the bottom flange of the jib arm. The jib arm can slew 0 – 360 degrees.
52. Rated Load: The maximum load for which a crane or individual hoist is designated and built by the manufacturer and shown on the equipment nameplate(s).
53. Regenerative: A form of dynamic braking in which the electrical energy generated is fed back into the power system.
54. Rope: Wire rope, unless otherwise specified.
55. Running Sheave: A sheave that rotates as the load block is raised or lowered.
56. Runway: An assembly of rails, beams, girders, brackets, and framework on which the crane or trolley travels.
57. Shall: Signifies mandatory requirements.
58. Should: Signifies recommended/optional requirements.
59. Side Pull: That portion of the hoist pull acting horizontally when the hoist lines are not operated vertically.
60. Span: The horizontal distance between center to center of runway rails.
61. Stop: A device to limit travel of a trolley or crane bridge. This device normally is attached to a fixed structure and normally does not have energy absorbing ability.
62. Switch: A device for making, breaking, or for changing the connections in an electrical circuit.

63. Travelling Electric Hoist: An overhead hoist with trolley travel mechanism operated by electric motor(s), used for vertical lifting of material (not people) that is freely suspended (unguided).
64. Travelling Jib Crane: A crane with a cantilevered arm (jib), which can slew to the required angle with under-slung trolley hoist running over the bottom flange of the jib arm and mounted on a column structure that comprises of three end trucks running on three runways fixed to a side wall / structure.
65. Trolley: The unit that travels on the bridge rails or monorail beam, and carries the hoisting mechanism.
66. Truck (Carriage): The unit consisting of a frame, wheels, bearings, and axles that support the bridge girders or trolleys.
67. Wall Mounted Jib Crane: A crane with a cantilevered arm (jib) mounted to a building wall / steel column, and which can slew to the required angle with under slung trolley hoist running over the bottom flange of the jib arm. The jib arm can slew 0 – 180 degrees.

### 5.1.2 CODES AND STANDARDS

Generally, DIN standards shall be used for engineering, design, calculation and manufacturing of EOT cranes and hoists. However, other international standards like CEN, CENELEC, FEM, AISE, ASME etc. shall also be applicable, if written acceptance is provided by ES. In particular the following codes and standards shall be applied:

DIN 536	:	Specification for Crane Rail
DIN 1055	:	Basis of Design & Action on Structures - Actions Induced By Cranes
DIN EN 12385	:	Lifting Ropes; Steel Wires
DIN 3064	:	Lifting Ropes; Steel Wires
DIN 3091	:	Solid Thimbles for Wire Ropes
DIN 3404	:	Specification for Grease Nipples
DIN 3975	:	Cylindrical Worm Gear Pairs
DIN 4132	:	Design & Erection of Steel Structure for Crane Runway
DIN 5685	:	Round Steel Link Chains Non-Proof Loaded
DIN 5688	:	Chain Slings with Hooks or End Links; Grade 8
DIN 8927	:	Rating of Air-Conditioning & Refrigeration Equipment
DIN 15001	:	Vocabulary of Terms
DIN 15018	:	Principles for Steel Structures

DIN 15019	:	Stability of Cranes
DIN 15020	:	Principles for Rope Reeving
DIN 15021	:	Lifting Appliances; Capacities
DIN 15022	:	Cranes; Lifting Heights; Operating Speeds
DIN 15023:	:	Cranes; Slewing and Portal Cranes with Cantilever; Radii
DIN 15024	:	Cranes; Track Gauges (Centre To Centre) For Double Girder Crabs
DIN 15025	:	Operating Direction & Arrangement of Controls in Crane Cabins
DIN 15026	:	Lifting Appliances -Marking of Points of Hazard
DIN 15030	:	Principle of Testing of Crane
DIN 15049	:	Cranes with Electric Hoist; Crane Rail Wheels W/ Plain Bearings
DIN 15050	:	Hand Driven Crane -Track Wheels with Roller Bearings
DIN 15053	:	Specification for Gear Box
DIN 15055	:	Steelworks Cranes - Interference Fits Using Oil under Pressure
DIN 15057	:	Covers for Ball and Roller Bearings; Connecting Dimensions
DIN 15061	:	Dimensions for Groove Profiles for Wire Rope
DIN 15062	:	Rope Pulleys; Dimensions of Hubs and Bearings
DIN 15063	:	Lifting Appliances; Sheaves; Technical Conditions
DIN 15069	:	Lifting Appliances; Washers
DIN 15070	:	Basic Calculation of Crane Rail Wheels
DIN 15071	:	Design Calculation for Crane Track Wheel
DIN 15072	:	Thread Profile of Crane Rail Wheels and Table of Rails
DIN 15073	:	Table of Crane Rail Wheels
DIN 15074	:	Flanged Wheel with Plain Bearings, Without Gear
DIN 15076	:	Flanged Wheel with Plain Bearings, With Gear
DIN 15077	:	Flanged Wheel with Tyre, With Plain Bearings, With Gear
DIN 15078	:	Flanged Crane Rail Wheels; With Roller Bearings without Gear Wheel
DIN 15079	:	Flanged Crane Rail Wheels; With Roller Bearings; With Gear Wheel
DIN 15080	:	Flanged Wheel with Tyre, With Roller Bearings, Without Gear
DIN 15081	:	Flanged Wheel with Tyre, With Roller Bearings, With Gear
DIN 15082	:	Crane Wheels - Screwed-On & Pressed-On Gear
DIN 15083	:	Crane Wheels -Machined Tyres
DIN 15084	:	Crane Wheels with Roller Bearings - Bearing Covers
DIN 15085	:	Lifting Appliances; Rail Wheels Technical Conditions
DIN 15090	:	Specification for Crane Wheel Set

DIN 15091	:	Driving Wheel Units and Idler Wheel Units; Travelling Wheel Shafts
DIN 15092	:	Driving Wheel Units and Idler Wheel Units; Sealing Covers
DIN 15093	:	Specification for Flangeless Wheel
DIN 15094	:	Driving Wheel Units and Idler Wheel Units; Bearing Cage Rings
DIN 15095	:	Driven and Rotating Axles; Securing Discs; Bushes; Nipples
DIN 15100	:	Serial Lifting Equipment; Nomenclature
DIN 15106	:	Safety Catch for Simple Load Hook
DIN 15400	:	Specification for Lifting Hook
DIN 15401	:	Specification for Standard Hook
DIN 15402	:	Specification for Rams horn Hook
DIN 15404	:	Technical Conditions for Laminated Hooks
DIN 15405	:	Lifting Hooks – Technical Delivery Conditions for Laminated Hooks
DIN 15407	:	Specification for Laminated Hook
DIN 15408	:	Specification for 2 Sheave Bottom Block
DIN 15409	:	Specification for 4 Sheave Bottom Block
DIN 15410	:	Single & Twin Sheave Bottom Blocks for Electric Hoists – Assembly.
DIN 15411	:	Specification for Hook Suspension
DIN 15412	:	Bottom Hook Blocks; Crossheads for Cranes
DIN 15413	:	Bottom Blocks for Lifting Appliances; Lifting Hook Nuts
DIN 15414	:	Bottom Blocks for Lifting Appliances; Securing Plates
DIN 15417	:	Bottom Blocks – Type D Pulleys with Plain Bearings
DIN 15418	:	Bottom Blocks – Type C Pulleys with Ball Bearings
DIN 15421	:	Bottom Blocks – Type B Pulleys with Ball Bearings
DIN 15422	:	Bottom Blocks – Type A Pulleys with Cylindrical Rolling Bearings
DIN 15431	:	Brake Drums; Main Dimensions
DIN 15432	:	Brake Discs; Main Dimensions
DIN 15435	:	Specification for double Shoe Brake
DIN 15450	:	Evaluating of Cardan Shafts for Travelling Drives
DIN 15451	:	Cardan Shafts – Dimensions
DIN 15452	:	Coupling Flanges for Cardan Shafts
DIN 15453	:	Cardan Shafts – Installation, Maintenance, Handling & Storage
DIN 18800	:	Design & Erection of Steel Structure for Crane Runway
DIN 40050	:	Safety Guards for Rotating Equipment
DIN 42681	:	Surface Cooled 3 Phase Motor for Intermittent Duty-Dimension
DIN EN 1492	:	Lifting Slings made from Natural & Man-Made Fibre Ropes



DIN EN 10025:	Specification for Carbon Steel
DIN EN 10222:	Specification for Carbon Steel
DIN EN 10250:	Specification for Carbon Steel
DIN EN 12077:	Cranes – Limiting & Indicating Devices
DIN EN 12385:	Specification for Wire Ropes
DIN EN 12644:	Cranes – Information for Use & Testing
DIN EN 13001:	Cranes – General Design
DIN EN 13135:	Safety Requirements for Electro & Non-Electro Technical Equipment.
DIN EN 13155:	Cranes, Non-Fixed Load Lifting Attachments
DIN EN 13411:	Shaped Steel Thimbles for Wire Ropes
DIN EN 13414:	Wire Rope Slings for Attaching Loads to Hooks
DIN EN 13557:	Cranes – Controls & Control Stations
DIN EN 14238:	Cranes – Manually Controlled Load Manipulating Devices
DIN EN 14492-2:	Cranes – Power Driven Hoists
DIN EN 14985:	Cranes – Slewing Jib Cranes
DIN EN 60204-32:	Safety; Electrical Equipment; Requirements for Hoisting Machines
ISO 4309 :	Wire Ropes – Care, Maintenance, Installation, Examination & Discard
ISO 10823 :	Guidance on Selection of Roller Chain Drives
EN ISO 12100:	Cranes & Lifting Equipment – Design Principles
ISO 10245 :	Jib Crane – Limiting & Indicating Devices
ISO 12488 :	Jib Crane – Tolerance for Wheels & Travel & Traversing Tracks
DIN EN 13586:	Cranes – Access
BGV D6 :	Accident Prevention Regulation for Cranes
VBG 20 :	Safety Regulation for Air-Conditioning & Refrigeration Equipment
VDE 0100/IEC 64:	Method of Installation & Protection of Electrical Apparatus
VDE 0110 :	Specification for Electrical Switchgear and Control Gear
VDE 0165 :	Method of Installation of Electrical Apparatus in Hazardous Area
VDE 0170/0171:	Specification for Explosion-Proof Electrical Apparatus
VDE 0530 :	Specification for Rotating Electrical Machines
VDE 0660 :	Specification for Electrical Switchgear & Control Gear
VDI 3571 :	Manufacturing Tolerance for Bridge Crane
VDI 3576 :	Manufacturing Tolerance for Crane Runway
VDI 4468 :	Electronic Anti-Sway for Cranes
DIN 15003 :	Lifting Appliances; Load Suspending Devices

DIN 15422-1 : Cranes bottom blocks Type A rope pulleys

Relevant IEC, VDE and DIN Standards, Regulations and Specifications for Electrical Equipment.

### 5.1.3 LIFTING DEVICES

#### 5.1.3.1 GENERAL REQUIREMENTS

Lifting devices are designed specifically for a particular application, e.g. whether they are required as roll lifters, spreader frames, lifting beams, jib spreaders, pallet lifters, etc. They can be pivoted, articulated, have a scissor action or be fixed. They may be provided with slings, standard hooks or lamellar hooks, they can have chocks, etc. They can be reeved directly to the crane or a hook attachment. Therefore, there can be no hard and fast standard for lifting devices as each application is different.

However, in general, the following points need to be followed: -

- All safety regulations for Load Suspension Devices according to DIN 15003, DIN 15428, DIN 1529 and VGB 9a shall be observed.
- Wherever pivoting actions are taking place and/or for all moving parts, an adequate lubrication system shall be provided. All static grease points shall be grouped together via grease lines. The minimum requirement is for the grease lines to be individually fed via AR 3/8 - DIN 3404 grease nipples, mounted on a common block.
- The grease nipples shall be standardised pull-on type wherever possible.
- The device shall be painted with RAL 1023 (Traffic Yellow) colour. SWL (in English and Arabic) shall be clearly marked in large print, in a prominent position on a minimum of two sides.
- A metallic reference plate shall be attached, stating Manufacturer's Name, Year of Construction, Lifting Capacity (Permissible load) and Weight (Mass) of lifting device.
- Warning Stripes shall be painted at the extreme end of each spreader and lifting beam as per DIN 15026 'Marking of Points of Hazard'
- A Rotating Warning Beacon shall be provided (if specified in the enquiry)
- Rubber stops/buffers to be fitted (if limited rotation/movement is required)
- Two (2) sets of information packs shall be supplied for each individual device. These packs shall include all the detailed drawings, general arrangement drawing, drawings of

all individual parts, and bill of materials. For more complex designed (specialised) devices, manufacturer's operation and maintenance manual shall also be provided.

The following are typical examples of lifting attachments and the descriptions included shall be adapted to meet the specific requirements of the lifting device

### **5.1.3.2 HOOK BLOCK**

This is the most common type of lifting device used in crane. The hook block shall mainly consist of a set of rope sheaves and a lifting hook.

Rope suspension shall be made through a trunnion mounted equalising lever. Alternatively, equalising sheaves may also be used. The sheaves shall be designed as per DIN 15422. The rope sheaves shall be preferably be made from cast steel. Rope groove profile shall conform to DIN 15061. The rope sheaves shall be mounted on suitable ant-friction bearings. Bearing life shall be minimum 50,000 hours.

Each individual pin for sheave mounting shall have a lubrication point. The grease nipple will be pull-on type wherever possible. Each lubrication point shall have easy access.

Grease lines shall be made from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

The rope sheave guard design shall be such that the distance will cover over half of the center distance of the rope sheaves to prevent accidental rope removal.

The lifting hook shall conform to DIN 15400/15401/15402, depending on the hook type. All hooks shall be made from forged steel. The hook shall be either free swiveling type, or lockable at 90° interval, depending upon the operational requirements. Safety latch shall be provided on the hook. The hook shall be suspended from the crosshead by means of thrust and radial anti-friction bearings. Bearing life shall be minimum 50,000 hours.

### **5.1.3.3 SPREADER BEAM WITH MAGNET**

The beam shall be of a suitable rated capacity. In general, the beam design shall be identical to existing beams used within the client's works.

It shall be supplied with sheaves, ramshorn hooks with counterbalanced latches, semi-circular impact protection plates and, if specified, a centrally positioned forged steel lifting

hook, suitable for the rated lifting capacity. Anti-swing type rope reeving shall be provided, if specified. The rope sheaves shall be preferably be made from cast steel.

Design of the rope sheaves shall conform to DIN 15422 Type A. Rope groove profile shall conform to DIN 15061. The rope sheaves shall be mounted on suitable ant-friction bearings. Bearings shall be SKF make. Bearing life shall be minimum 50,000 hours.

The lifting magnets shall preferably be suspended from the beam by means of hook & chain arrangement. If this type of arrangement cannot be met due to certain requirements and through hole connections are required on the beam for the magnet chains, then the holes shall be provided with sacrificial wear bushes. The lifting beam shall be suspended from the hoist ropes at two points, by means of equalising sheaves. The lifting beam shall be positioned at exact middle of the crane length (buffer to buffer).

If the spreader beam extends further than the lifting beam they are mounted upon, warning stripes as per DIN 15026 'Marking of Points of Hazard' shall be painted at the extreme end of each magnet spreader beam.

#### **5.1.3.4 MAIN LIFTING BEAM FOR TEEMING AND CHARGING CRANE**

(LAMELLAR HOOKS–7 LAMINATIONS)

The beam will be similar to the one used on the existing Steel Plant cranes. The beam shall be protected from thermal radiation and flames. The design shall ensure ease of maintenance of both beam and rope sheaves.

The rope sheaves shall be preferably be made from cast steel. Design of the rope sheaves shall conform to DIN 15422 Type A. Rope groove profile shall conform to DIN 15061. The rope sheaves shall be mounted on suitable ant-friction bearings. Bearings shall be SKF make. Bearing life shall be minimum 50,000 hours.

Each individual pin for sheave mounting shall have a lubrication point. The grease nipple will be pull-on type wherever possible. As there are numerous moving parts, each individual lubrication point shall be of easy access. Grease lines shall be made from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

The rope sheave guard design shall be such that the distance will cover over half of the center distance of the rope pulleys to prevent accidental rope removal. An additional wire rope guard bar will be attached to either side of each pulley pack assembly.

Heat protection shields shall be incorporated into the design of the Teeming and Charging cranes lifting beam.

To reduce spare parts consumption and ensure standardisation, the lamellar hooks shall if possible be identical to existing hooks in service. The lamellar hooks shall conform to DIN 15407.

#### **5.1.3.5 MAIN LIFTING BEAM FOR REFRACTORY CRANES (LAMELLAR HOOKS – 2 LAMINATIONS)**

The beam will be similar to the existing beams on the Steel Plant Refractory facility cranes. The design shall include one rotary center hook.

The rope sheaves shall be preferably be made from cast steel. Design of the rope sheaves shall conform to DIN 15422 Type A. Rope groove profile shall conform to DIN 15061. The rope sheaves shall be mounted on suitable ant-friction bearings. Bearings shall be SKF make. Bearing life shall be minimum 50,000 hours.

Each individual pin for sheave mounting shall have a lubrication point. The grease nipple will be pull-on type wherever possible. As there are numerous moving parts, each individual lubrication point shall be of easy access. Grease lines shall be made from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

The rope sheave guard design shall be such that the distance will cover over half of the center distance of the rope pulleys to prevent accidental rope removal.

To reduce spare parts consumption and ensure standardisation the lamellar hooks shall be identical to existing hooks in service. The lamellar hooks shall conform to DIN 15407. Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.

#### **5.1.3.6 AUXILIARY HOIST BOTTOM BLOCK FOR TEEMING & CHARGING CRANE**

The auxiliary hoist bottom block will be similar to the existing one on the Steel Plant facility cranes. The design shall ensure ease of maintenance for all items, especially the rope sheaves.

Design of the rope sheaves shall conform to DIN 15422 Type A. Bearings shall be SKF/INA make. Bearing life shall be minimum 50,000 hours.

Each individual pin for sheave mounting shall have a lubrication point. The grease nipple will be pull-on type wherever possible. Each lubrication point shall have easy access. Grease lines shall be made from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

The rope pulley guard design shall be such that the distance will cover over half of the center distance of the rope pulleys to prevent accidental rope removal. An additional wire rope guard bar will be permanently attached either side of the assembly.

The lifting hook shall include a long shank and anti-rotation device acting on a square shank of hook, conforming to DIN 15400/15401/15402. The hook shall be made from forged steel. The hook shall be lockable at 90° interval. A heavy-duty type safety latch shall be provided on the hook. The hook shall be suspended from the crosshead by means of thrust and radial anti-friction bearings. Bearing life shall be minimum 50,000 hours.

#### **5.1.3.7 COIL TONG (MOTORISED)**

Coil tong classification shall be as per DIN 15010. Classification shall determine whether the tong is for hot or cold work application. Capacity of the tong shall be determined by the load to be lifted.

In case of motorised vertical coil tong, the drives shall be provided with a load limiting clutch mechanism to avoid overloading the motor. The drive motor shall be fitted with brake mechanism to maintain the compression tension. A suitable end stopper or limit mechanism shall be provided to prevent the arms override more than the requirement. A suitable indication system shall be provided in the operator's cabin to indicate status of the arms positions. The arm tension shall be controlled through motor's current feedback or tension sensors, and it shall be interlocked with the indication (yellow coloured signal). A suitable load sensor system shall be fitted with the load carrying arms to ensure and indicate the operator with green signal.

Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.

#### **5.1.3.8 SLAB TONG LIFTER**

The EOT Crane which incorporates a slab tong lifter as its handling device shall utilise a scissor action to grip the load and it is classed as an 'Automatic Mechanical Coupling'.

For multi-slab lifter (two or more slabs of same dimensions), a suitable selector for selection of single or multi-slabs shall be provided.

The lifter shall be suspended on 12 rope falls. Four separate wire ropes will be provided on the rope drum, each reeved through a rope sheave on the lifter to the top sheave block and back again to the rope anchor on the lifter, thus making 3 falls. The angular spread of the wire ropes shall be such as to ensure a non-sway suspension in long travel direction.

Special consideration towards improvements shall be given to the gripping shoes / pads locking arrangements and all wear bushes installed shall be of the highest grade applicable for the application.

Each individual pin for sheave mounting shall have a lubrication point. The grease nipple shall be pull-on type wherever possible. Each lubrication point shall have easy access.

Grease lines shall be made from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.

#### **5.1.3.9 PLATE / SHEET LIFTER (HORIZONTAL)**

This is used to pick up different length plate/sheet lifting devices by means of the two hooks. There is also one magnet lifting beam which can be utilised. The main hook is used for picking up a coil tong.

Drives shall be with a load limiting clutch mechanism to avoid overloading the motor. The drive motor shall be fitted with brake mechanism to maintain the compression tension. A suitable end stopper or limit mechanism shall be provided to prevent the arms override more than the requirement. The rotary mechanism for the plate lifter also requires a suitable end stopper and limit mechanism to prevent the beam rotation more than 360 degree.

A suitable indication system shall be provided in the operator's cabin for indicating status of the arms positions. The arm tension shall be controlled through motor's current feedback and it shall be interlocked with the indication (Green colour).

Warning stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.

#### **5.1.3.10 PLATE/SHEET LIFTING DEVICES**

The lifters shall conform to Load Suspension Devices according to DIN 15003, DIN 15428, DIN 1529 and VGB 9a. To improve spare parts consumption and ensure standardisation the plate/sheet lifter(s) shall be similar if not identical to existing lifters in service.

Each individual pin for sheave mounting shall have a lubrication point. The grease nipple shall be pull-on type wherever possible. As there are numerous moving parts, each individual lubrication point shall be of easy access. Grease lines shall be made from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.

#### **5.1.3.11 SLAB HANDLING VERTICAL COIL TONG (MANUAL)**

Tong classification shall be as per DIN 15010. The tong is not permanently reeved to the crane but is suspended from the bottom block. Since manual vertical coil tong is purely a mechanical device and does not have any electrical equipment, then regarding personal safety, every aspect shall be handled by manual controls under the visual observations of the crane operator.

The device utilises a scissor action to grip the load and it is classed as an 'Automatic Mechanical Coupling'.

Each individual pin for sheave mounting shall have a lubrication point. The grease nipple shall be pull-on type wherever possible. As there are numerous moving parts, each individual lubrication point shall be of easy access. Grease lines shall be made from suitable stainless-steel pipe and piped to areas where safe access can be ensured. All wear bushes installed shall be of the highest grade applicable for the application.

Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.

#### **5.1.3.12 ROTARY BOTTOM BLOCK (MOTORISED)**



If the crane is required to be equipped with a (two or four-sheave) bottom block with a motor driven hook, then the drive shall be with a load limiting clutch mechanism to avoid overloading the motor. The drive motor shall be fitted with brake mechanism to prevent uncontrolled hook rotation. A suitable end stopper or limit mechanism shall be provided to prevent the hook rotating more than 360 degrees in one direction.

All mechanical parts of the bottom block and driven hook shall be easily accessible for maintenance.

If a motorised cable reeling drum is used, then the drive for the reeling drum shall be through either a magnetic clutch or brake attached to the motor or magnetic clutch with ratchet bearing mounted on the motor shaft.

Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'. All other aspects of the bottom block shall be as per clause 11.2 above.

#### **5.1.3.13 HYDRAULIC GRAB BUCKET (MOTORISED)**

If the crane is required to be equipped with motorised grab bucket then the bucket shall be a compact unit consist of hydraulic cylinder-controlled bucket, with hydraulic power pack, complete with motor, integrated to the bucket unit. The opening and closing of the bucket shall be controlled by reversing the motor's direction of rotation. The power cable feeding to the power pack (motor) shall be through a standard motorised cable reeling drum system. If motorised cable reeling drum is used, then the drive for the reeling drum shall be with magnetic clutch and brake fixed on the motor or magnetic clutch with ratchet bearing mounted on the motor shaft to avoid over stretching and sagging of the main power feeding-cable. A suitable load sensing/ slack rope limit system shall be used as lower limit function.

If the application of the grab bucket is for underwater service, then the grab bucket and hook block shall be of a design suitable for the specified application. All moving parts shall be lubricated with water resistant grease, such as Renolite CA-FG 50.

Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.

#### **5.1.3.14 REQUIREMENTS FOR SCALE PIT APPLICATION**

##### **a. Bottom Block**

The bottom block DIN 15409 shall be provided with a forged eye bar, specifically for grab connection. The block shall be suitable for underwater service and have a suitable locking device. The block shall be lubricated with water resistant grease, such as Renolite CA-FG 50.

**b. Hydraulic Grab Bucket (Motorised)**

If the crane is required to be equipped with motorised grab bucket then the bucket shall be a compact unit consist of hydraulic cylinder-controlled bucket, with hydraulic power pack, complete with motor, integrated to the bucket unit. The opening and closing of the bucket shall be controlled by reversing the motor's direction of rotation. The power cable feeding to the power pack (motor) shall be through a standard motorised cable reeling drum system. If motorised cable reeling drum is used, then the drive for the reeling drum shall be with magnetic clutch and brake fixed on the motor or magnetic clutch with ratchet bearing mounted on the motor shaft to avoid over stretching and sagging of the main power feeding-cable. A suitable load sensing/ slack rope limit system shall be used as lower limit function.

The grab bucket and hook block shall be of a design suitable for the underwater services application. All moving parts shall be lubricated with water resistant grease, such as Renolite CA-FG 50.

Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.

**c. Cable Reeling Drum**

The trolley shall be provided with a motorised cable reeling drum for the grab bucket.

**d. Special Features**

1. Suitable overload protection arrangement shall be provided.
2. Slack rope protection limit switch shall be provided.
3. Hoist over winding protection limit switch shall be provided.
4. Pressure rollers shall be provided (instead of rope guide).
5. Suitable guide rollers shall be provided for cables from cable reeling drum to the grab.
6. The pendant controller station shall be provided with additional buttons for grab operation.
7. An additional arrangement shall be provided that ensures that the grab will remain attached to the crane even if the hoist wire rope snaps/fails

**5.1.4 AIR CONDITIONING SYSTEM**

**5.1.4.1 HEAVY DUTY CRANES & CRANES IN VERY HIGH AMBIENT TEMPERATURE AREA**

1. The air conditioning systems for the control of the environment in the electrical rooms and operating cabin shall be either direct expansion (DX) split type. Two separate air-conditioning systems shall be provided, one for electrical rooms and another for operating cabin. Two (2) nos. Air conditioning units, one working and one stand-by, shall be provided for each system.
2. Split type or package air conditioning system shall consist of condensing units, air handling units and insulated refrigerant piping. The condensing units shall be suitably mounted at girder level. The air handling units shall be located inside operator's cabin/electrical room inside girder. Arrangement shall be provided so that any combination of condensing unit or air handling unit can be selected for operation or stand-by.
3. The systems shall be suitable for continuous operation at design ambient temperature of 85°C to 90°C. The design inside temperature shall be 25±1°C for electrical rooms and 24±1°C for operating cabin. The system capacity shall match both sensible as well as total capacity. The systems shall have 15% additional cooling capacity over the design capacity.
4. The condensing units shall be air cooled type, and shall be provided with compressors, cooling coils & fans. Each condensing unit (operating or stand-by) shall be provided with its own compressor.
5. The compressors will be semi-hermetic reciprocating type, with 50% - 100% capacity control. The compressors shall be located in the condensing unit an accessible location. Each compressor shall have protection against overload, high pressure, low pressure and low oil pressure. Suitable protection against ambient temperature of more than 90°C shall also be provided. Crank case heater shall be provided. The crank case heater shall automatically start when the compressor stops. Adequately sized suction accumulator shall be provided.
6. Braided flexible hoses, suitable for flare connection, shall be provide in the suction and discharge lines of the compressors. They will be insulated with cell foam and shall be vapour sealed. They will be provided with isolation valves and pressure gauges. The gauge lines shall be provided with isolation valves.
7. Solid core desiccant type refrigerant dryer shall be provided in the liquid line. The desiccant shall be suitable for specified ambient temperature. Stainless steel mesh screen type refrigerant strainer shall be provided. Screen sizes shall be suitable for the corresponding line sizes. Bypass arrangement shall be provided for the strainers.
8. Expansion valves shall be provided as per manufacturer's recommendation.

9. Pressure gauges, sight glasses and adjustable safety control equipment shall be provided in the oil supply line.
10. The liquid line shall be provided with vertically mounted sight glass with moisture indicator.
11. The refrigerant piping shall be insulated with 136 kg/m<sup>3</sup> density foam glass with metal cladding. Insulation K value shall be 0.036 W/m-°C. All refrigeration equipment, having surface temperature below ambient, shall be provided with suitable insulation and metal cladding.
12. All gauges and indicators shall be mounted on a panel and properly labelled. All such gauges and indicators shall be provided with isolation valves & anti-pulsation devices.
13. Refrigerant for all air conditioning systems shall be CFC-free type, and suitable for an ambient temperature of 90°C. The material safety data sheet (MSDS) and details of proposed refrigerants shall be submitted.
14. Cooling coils shall be made of enhanced copper tubes with copper flat plate fins. Fin thickness shall be 0.3 mm. Fin spacing shall be 300 fins per metre (max). Face velocity shall not exceed 2.5 metres/second.
15. The fans shall be centrifugal, direct drive type. Fan motors shall be suitable for operation at specified design ambient temperature and shall be provided with internal overload protection.
16. For balancing the fluctuation in supply & return line, a receiver for refrigerant shall be suitably connected to the refrigerant piping. The receiver shall be adequately sized and shall be provided with inlet & outlet isolation valves, charging connection, pressure relief valve, purge valve and all other necessary accessories required for safety & operational control.
17. Air handling units shall consist of inlet filters, evaporator coils, fans and casing. The units shall be all stainless-steel construction. Electrical heaters will be provided for air handling units for operator's cabin.
18. Two stage inlet filters shall be provided. First stage filter shall be disposable, dry media, 50 mm thick, enclosed in a rigid frame. Pressure drop across filter shall not exceed 70 Pascal. 100 mm deep activated carbon shall be provided for second stage filtration. Face velocity shall not exceed 2.5 metres/second. Magnetic differential pressure gauge shall be provided for each filter.
19. Fresh air make-up shall be provided. For electrical room, fresh air quantity shall be 4% of total air supply. For operator's cabin, fresh air quantity shall be 120 m<sup>3</sup>/hr.

20. Evaporator coils shall be made of either enhanced copper or electro-tinned copper tubes with copper flat plate fins. Header shall be made of copper Frames shall be made of stainless steel. Fin thickness shall be 0.2 mm. Fin spacing shall be 400 fins per metre (max). Face velocity shall not exceed 2.5 metres/second.
21. Insulated drain tray, made from either copper or stainless steel, shall be provided for collection of condensate. In case of split units, the condensate shall be discharged outside the cabin/girder.
22. The fans shall be centrifugal, direct drive, vertical plenum discharge type. Fan motors shall be suitable for operation at specified design ambient temperature and shall be provided with internal overload protection.
23. The casing of air handling units shall be of modular construction, double skin, with minimum 25 mm thick insulation. The casing shall be made from stainless steel, including all mountings and fittings.
24. Suitable facilities shall be provided for isolation of all components that require maintenance/replacement. This will include check valves, safety valves, solenoid valves etc.
25. The supply and return lines for refrigerant shall be provided between condensing units and air handling units. The refrigerant pipes shall be of copper and shall be provided with suitable insulation and cladding. The refrigerant pipe work must be suitably supported and routed into the cabin/girder in a manner that will avoid potential damage.
26. Supply & return air ducts shall be provided. The ducts inside the conditioned space shall be insulated with 25 mm thick semi-rigid mineral wool of minimum 48 kg/m<sup>3</sup> density and shall be provided with suitable cladding. The ducts outside the conditioned space shall be insulated with 80 mm thick semi-rigid mineral wool of minimum 48 kg/m<sup>3</sup> density and shall be provided with suitable cladding. Insulation K value shall be 0.036 W/m-°C.
27. Cold air shall be distributed in operator's cabin or electrical room uniformly by plenum discharge through grilles suitable for high throw. The grilles will be located on the side or face to suit the room layout.
28. Operator's cabin and electrical rooms shall be insulated with 100 mm thick rigid minimum 90 kg/m<sup>3</sup> density mineral wool sandwich panel. All exposed surfaces, including floors, walls, ceiling, doors etc. shall be insulated.
29. All motors, electrical equipment and cables exposed to ambient shall be rated for specified ambient temperature. All cabling outside conditioned space shall have thermal protection sheathing and run through conduit.

30. The electrical control panel shall preferably be located at one side of the unit, at an accessible location. The panels shall not be located below the unit. In case it is necessary to locate the panels below the unit, it shall be of water-proof construction.
31. The control panels shall be microprocessor based. They will have motor starters with suitable circuit breakers and overload devices. Suitable anti-short cycle safety cut-outs with start limiter shall be provided. Local & remote start/stop buttons, hour run meter, fault indicators, indicating lights and other necessary instruments shall be provided on the panels. The panels will be pre-wired at manufacturer's works. Panel doors shall be secured by chains.
32. Suitable thermostatic temperature regulator shall be provided on each panel, as well in the operator's cabin and electrical rooms. Digital temperature indicator shall be provided on each panel, as well as in the operator's cabin and electrical rooms.
33. All units shall be easily accessible. Suitable platform shall be provided around each unit for repair and maintenance. The drain lines shall be provided with inspection point, which shall be easily accessible.

#### **5.1.4.2 MEDIUM DUTY CRANES & CRANES IN HIGH AMBIENT TEMPERATURE AREA**

1. The air conditioning systems for the control of the environment in the electrical rooms and operating cabin shall be either direct expansion (DX) split (preferred) or package type. Two separate air-conditioning systems shall be provided, one for electrical rooms and another for operating cabin. Two (2) nos. air conditioning units, one working and one stand-by, shall be provided for electrical rooms. Requirement of stand-by unit for operator's cabin shall be decided depending on the usage and criticality of the area.
2. Split or package unit type air conditioning system shall consist of condensing units, air handling units and insulated refrigerant piping. The condensing units shall be suitably mounted at girder level. The air handling units shall be located inside operator's cabin/electrical room inside girder. Arrangement shall be provided so that any combination of condensing unit or air handling unit can be selected for operation or stand-by.
3. Package type air conditioning system shall consist of condensing-cum-air handling package units and insulated ducting. The package units shall be suitably mounted at girder level.
4. The systems shall be suitable for continuous operation at design ambient temperature of 60°C to 70°C. The design inside temperature shall be 25±1°C for electrical rooms and 24±1°C for operating cabin. The system capacity shall match both sensible as well

as total capacity. The systems shall have 15% additional cooling capacity over the design capacity.

5. The condensing units shall be air cooled type, and shall be provided with compressors, cooling coils & fans. Each condensing unit (operating or stand-by) shall be provided with its own compressor.
6. The compressors will be semi-hermetic reciprocating type, with 50% - 100% capacity control. The compressors shall be located in the condensing unit an accessible location. Each compressor shall have protection against overload, high pressure, low pressure and low oil pressure. Suitable protection against ambient temperature of more than 90°C shall also be provided. Crank case heater shall be provided. The crank case heater shall automatically start when the compressor stops. Adequately sized suction accumulator shall be provided.
7. Braided flexible hoses, suitable for flare connection, shall be provide in the suction and discharge lines of the compressors. They will be insulated with cell foam and shall be vapour sealed. They will be provided with isolation valves and pressure gauges. The gauge lines shall be provided with isolation valves.
8. Solid core desiccant type refrigerant dryer shall be provided in the liquid line. The desiccant shall be suitable for specified ambient temperature. Stainless steel mesh screen type refrigerant strainer shall be provided. Screen sizes shall be suitable for the corresponding line sizes. Bypass arrangement shall be provided for the strainers.
9. Expansion valves shall be provided as per manufacturer's recommendation.
10. Pressure gauges, sight glasses and adjustable safety control equipment shall be provided in the oil supply line.
11. The liquid line shall be provided with vertically mounted sight glass with moisture indicator.
12. The refrigerant piping shall be insulated with 136 kg/m<sup>3</sup> density foam glass, with metal cladding. Insulation K value shall be 0.036 W/m·°C. All refrigeration equipment, having surface temperature below ambient, shall be provided with suitable insulation and metal cladding.
13. All gauges and indicators shall be mounted on a panel and properly labelled. All such gauges and indicators shall be provided with isolation valves & anti-pulsation devices.
14. Refrigerant for all air conditioning systems shall be CFC-free type, and suitable for an ambient temperature of 70°C. The material safety data sheet (MSDS) and details of proposed refrigerants shall be submitted.

15. Cooling coils shall be made of enhanced copper tubes with copper flat plate fins. Fin thickness shall be 0.3 mm. Fin spacing shall be 300 fins per metre (max). Face velocity shall not exceed 2.5 metres/second.
16. The fans shall be centrifugal, direct drive type. Fan motors shall be suitable for operation at specified design ambient temperature and shall be provided with internal overload protection.
17. For balancing the fluctuation in supply & return line, a receiver for refrigerant shall be suitably connected to the refrigerant piping. The receiver shall be adequately sized and shall be provided with inlet & outlet isolation valves, charging connection, pressure relief valve, purge valve and all other necessary accessories required for safety & operational control.
18. Air handling units shall consist of inlet filters, evaporator coils, fans and casing. The units shall be all stainless-steel construction. Electrical heaters will be provided for air handling units for operator's cabin.
19. Two stage inlet filters shall be provided. First stage filter shall be Aluminium filters enclosed in a rigid frame. Bag type or pleat type or box type filters shall be provided for second stage filtration. Face velocity shall not exceed 2.5 metres/second. Magnetic differential pressure gauge shall be provided for each filter.
20. Fresh air make-up shall be provided for all air handling units. Fresh air quantity shall be 5% of total air supply.
21. Evaporator coils shall be made of either enhanced copper or electro-tinned copper tubes with copper flat plate fins. Header shall be made of copper Frames shall be made of stainless steel. Fin thickness shall be 0.2 mm. Fin spacing shall be 400 fins per metre (max). Face velocity shall not exceed 2.5 metres/second.
22. Insulated drain tray, made from either copper or stainless steel, shall be provided for collection of condensate. In case of split units, the condensate shall be discharged outside the cabin/girder.
23. The fans shall be centrifugal, direct drive, vertical plenum discharge type. Fan motors shall be suitable for operation at specified design ambient temperature and shall be provided with internal overload protection.
24. For split units, the casing of air handling units shall be of modular construction, double skin, with minimum 25 mm thick insulation. The casing of air handling units shall be made from stainless steel, including all mountings and fittings.



25. Suitable facilities shall be provided for isolation of all components that require maintenance/replacement. This will include check valves, safety valves, solenoid valves etc.
26. For split units, the supply and return lines for refrigerant shall be provided between condensing units and air handling units. The refrigerant pipes shall be of copper and shall be provided with suitable insulation and cladding. The refrigerant pipe work must be suitably supported and routed into the cabin/girder in a manner that will avoid potential damage.
27. For package units, the supply & return air ducts shall be provided. The ducts inside the conditioned space shall be insulated with 25 mm thick semi-rigid mineral wool of minimum 48 kg/m<sup>3</sup> density and shall be provided with suitable cladding. The ducts outside the conditioned space shall be insulated with 80 mm thick semi-rigid mineral wool of minimum 48 kg/m<sup>3</sup> density and shall be provided with suitable cladding. Insulation K value shall be 0.036 W/m-°C.
28. Cold air shall be distributed in operator's cabin or electrical room uniformly by plenum discharge through grilles suitable for high throw. The grilles will be located on the side or face to suit the room layout.
29. Operator's cabin and electrical rooms shall be insulated with 100 mm thick rigid minimum 90 kg/m<sup>3</sup> density mineral wool sandwich panel. All exposed surfaces, including floors, walls, ceiling, doors etc. shall be insulated.
30. All motors, electrical equipment and cables exposed to ambient shall be rated for specified ambient temperature. All cabling outside conditioned space shall have thermal protection sheathing and should run through conduit.
31. The electrical control panel shall preferably be located at one side of the unit, at an accessible location. The panels shall not be located below the unit. In case it is necessary to locate the panels below the unit, it shall be of water-proof construction.
32. The control panels shall be microprocessor based. They will have motor starters with suitable circuit breakers and overload devices. Suitable anti-short cycle safety cut-outs with start limiter shall be provided. Local & remote start/stop buttons, hour run meter, fault indicators, indicating lights and other necessary instruments shall be provided on the panels. The panels will be pre-wired at manufacturer's works. Panel doors shall be secured by chains.
33. Suitable thermostatic temperature regulator shall be provided on each panel, as well in the operator's cabin and electrical rooms. Digital temperature indicator shall be provided on each panel, as well as in the operator's cabin and electrical rooms.

34. All units shall be easily accessible. Suitable platform shall be provided around each unit for repair and maintenance. The drain lines shall be provided with inspection point, which shall be easily accessible.

#### **5.1.4.3 LIGHT DUTY CRANES & CRANES IN NORMAL AMBIENT TEMPERATURE AREA**

1. Air conditioning unit shall be provided for the control of the environment in the operator's cabin, if specified. The air conditioning system shall be either package (preferred) or window type, to be decided during finalisation of order. Stand-by unit will not be required.
2. The unit shall be suitably mounted inside the operator's cabin.
3. The unit shall be suitable for continuous operation at design ambient temperature of 50°C to 60°C. The design inside temperature shall be 24±1°C. The unit capacity shall match both sensible as well as total capacity. The unit shall have 15% additional cooling capacity over the design capacity.
4. The condensing unit shall be air cooled type, and shall be provided with compressors, cooling coils & fans. The condensing unit shall be provided with at least two (2) compressors. They shall be connected to the system in such a way that if one compressor fails or is removed for maintenance, the system can be operated by the second compressor.
5. The compressors will be semi-hermetic reciprocating type, with 50% - 100% capacity control. The compressors shall be located in the condensing unit an accessible location. Each compressor shall have protection against overload, high pressure, low pressure and low oil pressure. Crank case heater shall be provided. The crank case heater shall automatically start when the compressor stops.
6. Expansion valves shall be provided as per manufacturer's recommendation.
7. Pressure gauges, sight glasses and adjustable safety control equipment shall be provided in the oil supply line.
8. The liquid line shall be provided with vertically mounted sight glass with moisture indicator.
9. All gauges and indicators shall be mounted on a panel and properly labelled. All such gauges and indicators shall be provided with isolation valves & anti-pulsation devices.
10. Refrigerant shall be CFC-free type, and suitable for an ambient temperature of 60°C. The material safety data sheet (MSDS) and details of proposed refrigerants shall be submitted.

11. Cooling coils shall be made of enhanced copper tubes with copper flat plate fins. Fin thickness shall be 0.3 mm. Fin spacing shall be 300 fins per metre (max). Face velocity shall not exceed 2.5 metres/second.
12. The fans shall be centrifugal, direct drive type. Fan motors shall be suitable for operation at specified design ambient temperature and shall be provided with internal overload protection.
13. Air handling unit shall consist of inlet filters, evaporator coils, fans and casing. Electrical heaters will be provided for adjustment of outlet air temperature.
14. Inlet filters shall be 50 mm thick disposable type. Face velocity shall not exceed 2.5 metres/second.
15. Fresh air make-up shall be provided for air handling unit. Fresh air quantity shall be 5% of total air supply.
16. Evaporator coils shall be made of either enhanced copper or electro-tinned copper tubes with copper flat plate fins. Fin thickness shall be 0.2 mm. Fin spacing shall be 400 fins per metre (max). Face velocity shall not exceed 2.5 metres/second.
17. Insulated drain tray, made from either copper or stainless steel, shall be provided for collection of condensate. The condensate shall be discharged outside the cabin.
18. The cold air discharge fans shall be centrifugal, direct drive type. Fan motors shall be suitable for continuous operation at specified design ambient temperature.
19. The control panel shall be microprocessor based. They will have motor starters with suitable circuit breakers and overload devices. Suitable anti-short cycle safety cutouts with start limiter shall be provided. Local & remote start/stop buttons, hour run meter, fault indicators, indicating lights and other necessary instruments shall be provided on the panels. The panels will be pre-wired at manufacturer's works.
20. Suitable thermostatic digital temperature regulator shall be provided on the unit.
21. All units shall be easily accessible. Suitable space shall be provided around each unit for repair and maintenance.
22. The dimension of the air conditioning unit shall be suitable for removal through the door of the operator's cabin.

## **5.1.5 FIRE DETECTION AND ALARM SYSTEM**

### **5.1.5.1 STANDARDS**

1. The equipment & installation shall comply with the latest edition of the following standards: -

NFPA 70	-	National Electric Code
NFPA 72	-	National Fire Alarm Code
NFPA 90A	-	Air Conditioning Systems
UL 864	-	Control Units for Fire Protective Signaling Systems.
UL 268	-	Smoke Detectors for Fire Protective Signaling Systems.
UL 268A	-	Smoke Detectors for Duct Applications.
UL 217	-	Single and Multiple Station Smoke Alarms
UL 521	-	Heat Detectors for Fire Protective Signaling Systems.
UL 228	-	Door Closers-Holders, With or Without Integral Smoke Detectors.
UL 464	-	Audible Signaling Appliances. Factory Mutual (FM) approval

2. The Fire Detection & Alarm Systems shall also conform to Section 6 of ES SITE CONDITIONS & ENGINEERING STANDARDS.
3. The Fire Detection & Alarm System shall comply in respects with all pertinent codes, rules, regulations and laws of the authority, and local jurisdiction. The system shall comply in all respects with the requirements of this specification, manufacturer's recommendations and Underwriters Laboratories Inc. (ULI) listings. The materials, appliances, equipment and devices shall be tested and listed by an internationally recognised approval agency for use as part of a protective signaling (fire detection & alarm) system.
4. The Fire Detection & Alarm System shall be of NOTIFIER make, control panel model AFP-100. All equipment and components shall be of the manufacturer's current model. All equipment shall be as per Underwriters Laboratories Inc. (ULI) listings and Factory Mutual (FM) approved.
5. System requirement : The system & equipment shall be arranged and programmed to provide the early detection of fire and smoke, notification to crane operator and other occupants, automatic summoning of the ES fire department, and activation of other auxiliary systems to prevent spreading of smoke and fire, and to facilitate safe evacuation of crane occupants.
6. The fire detection & alarm system shall consist of, but not limited to, the following: -
  - a. Control panels.
  - b. Smoke detectors.

- c. Heat detectors.
- d. Manual pull stations.
- e. Strobes.
- f. Sirens/horns.
- g. Magnetic door holders.

The crane shall be divided into several zones and accordingly the type & location of each equipment shall be decided. It will be the responsibility of the contractor to design and install complete fire detection & alarm system suitable for the crane.

#### **5.1.5.2 SYSTEM OPERATION**

1. Upon alarm activation of any area smoke/heat detector or manual pull station etc., the following functions shall occur automatically: -
  - a. The internal audio device in the control panel shall sound.
  - b. The LCD display on the control panel shall indicate all necessary information associated with the alarm condition, including name of the zone, device type, device location and time/date.
  - c. Any remote or local enunciator LCD/LEDs associated with the alarm zone shall be illuminated.
  - d. In case of fire alarm, all announcement devices (Horn/strobes, Sirens, flashlights) shall be operated.
2. Upon alarm activation of any area smoke/heat detector or manual pull station etc., the following audio messages and actions shall occur simultaneously:
  - a. An evacuation message shall be sounded on the crane "It is the intent of this message to advise occupants hearing this message that they are near danger and should leave the crane via the nearest exit immediately".
  - b. Activate visual strobes on the crane. The visual strobe shall continue to flash until the system has been reset. The visual strobe shall operate till the "Alarm Silence" button is pressed.
  - c. An alert message shall be sounded on the operator's cabin.
  - d. All drive motions, magnets etc. shall be de-activated. However, in case the crane magnets are already in loaded condition, the hoist drive shall lower down the load to the floor level and then de-activate.
  - e. Activate automatic smoke control sequences.

- f. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
- g. All staircases, doors & crane access system shall unlock.
- h. All self-closing fire/smoke doors held open shall be released.

#### **5.1.5.3 TROUBLE OPERATION**

1. Upon activation of a trouble condition or signal from any device on the system, the following functions shall automatically occur: -
  - a. The internal audio device in the control panel shall sound.
  - b. Display the event on the graphical workstation and display a pictorial image. This shall be offered as optional.
  - c. The LCD display on the control panel shall indicate all necessary information associated with the trouble condition, including name of the zone, device type, device location and time/date.
  - d. Any remote or local enunciator LCD/LED's associated with the trouble zone shall be illuminated.
  - e. Any remote or local enunciator LCD/LEDs associated with the status zone shall be illuminated.

#### **5.1.5.4 CONTROL PANEL**

1. The control panel shall be UL listed and FM approved as per NFPA requirements. It shall be of industrial design suitable for the dusty & hot environment of the area of installation. The control panel shall contain all notification appliance circuits, controls for all the field devices (detectors, pull stations, strobes, horns etc.), displays and all necessary command buttons.
2. The notification appliance circuits shall be of class A category. The notification appliance circuits shall have a minimum circuit output rating of 2 amps @ 24 VDC; 50 Watt @ 25V radio, and 35 Watt @ 70V audio. The notification circuits shall be power limited. Non-power limited circuits shall not be accepted.
3. The main display interface shall show the first and most recent highest priority system events without any operator intervention. All system events shall be directed to one of four message queues. To eliminate operator confusion, messages of different types shall never be intermixed. A "Details" switch shall be provided for showing additional information about any device highlighted by the operator.
4. Battery Back-up for Power Supply: The Fire Detection & Alarm System shall be connected to power supply of the crane. For emergency operation during power failure, Back-up/Standby power supply shall be provided through a set of electrical batteries.

The battery system shall have sufficient capacity to operate the system under maximum supervisory load for 24 hours, and capable of operating the system for fifteen (15) minutes of evacuation alarm on all devices, operating at maximum load. The battery back-up system shall include a charging circuit to automatically maintain the electrical charge of the batteries. The system shall automatically adjust the charging of the battery to compensate for temperature. The battery system shall be located inside the electrical room.

5. Smoke Detector: The smoke detectors shall be analogue/addressable multisensor photo thermal type. The quantity of smoke detectors shall be selected to match the location of installation on the crane. Alarm condition shall be based upon the combined input from the photoelectric and thermal detection elements. Each smoke detector may be individually programmed to operate at any one of the available five sensitivity settings.
6. Heat Detector: The heat detectors shall be analogue/addressable combination fixed temperature / rate-of-rise detectors. The quantity of heat detectors shall be selected to match the location of installation on the crane. The heat detectors shall have a nominal fixed temperature alarm point rating of 135°F (57°C) and a rate-of-rise alarm point of 15°F (9°C) per minute. The heat detectors shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centres and shall also be suitable for wall mount applications.
7. Fire Alarm Bell: Red colour vibrating fire alarm bells shall be provided. The quantity of alarm bells shall be selected to match the location of installation on the crane. Bells shall be the under-dome type, utilize a heavy-duty mechanism, and be polarised for supervised operation. Diameter and sound level combination shall be either of 6"/83 dB(A), 8"/84 dB(A) and/or 10"/86 dB(A). Red coloured weatherproof wall boxes shall be provided for outdoor mounting. Flush wall mounted enclosures shall be provided as required.
8. Enclosure grills shall be finished with prime coat or stainless steel as required.
9. Horn-Strobes: The horn/strobes shall be low profile wall mount type. The quantity of horn/strobes shall be selected to match the location of installation on the crane. Horn/strobes, in addition to other locations, shall also be installed inside the cabin, inside electrical rooms and on both sides of the crane bridge to provide warning from both sides. The horn/strobes shall provide an audible output of 84 dB(A) at 10 feet distance when measured in reverberation room as per UL-464. Strobes shall provide synchronized flash outputs. The strobe output shall be determined as required by its specific location and application from a family of 15cd, 30cd, 60cd, 75cd & 110cd

devices. The horns shall have a selectable steady or synchronized temporal output. Screwed terminals shall be provided for wiring.

10. Manual Pull Stations: Manual Pull stations shall be addressable type. They shall be installed inside the operator's cabin, electrical rooms, on crane bridge and other places on the crane as required.
11. Cables should be fireproof and installed inside rigid conduits. Cabling and installation shall be carried out as per NFPA standards and Section 5 of ESI SITE CONDITIONS AND ENGINEERING STANDARDS.
12. Portable Fire Extinguishers: The portable fire extinguishers shall be provided as per the following requirements: -

Location on Crane	Quantity	Type & Model
Electrical room	2 nos. in each room	Type: Carbon Dioxide (CO2) Make: ANSUL, Brand Name: SENTRY Model: CD15A-1 (Aluminium shell) UL Rating: 10-B:C Part no.: 431555 Bracket part no.: 79456 Agent capacity: 15 pound (6.9 kg)
Operator's cabin	1 No.	Type: Dry Chemical Powder (DCP) Make: ANSUL, Brand name: RED LINE Model: 1-10-G Bracket part no.: 30886 UL rating: 30-B:C Agent capacity: 10 pounds (4.5 kg)
Staircase	1 no. for each staircase	Type: Dry Chemical powder (DCP) Make: ANSUL, Brand name: RED LINE Model: 1-20-G Bracket part no.: 30759 UL rating: 40-B:C Agent capacity: 20 pounds (9.1 kg) Note: Fire extinguisher shall be kept in proper fire & weatherproof Cabinet (Red colour)

## 5.1.6 ELECTRICAL EQUIPMENT AND INSTALLATION

### 5.1.6.1 STANDARDS

The electrical equipment and installation shall be in accordance with the following technical standards:

IEC - Recommendations VDE - Regulations



DIN - Norms

VBG9 - Accident Prevention Regulations for Cranes (or other standard agreed pre-contract) Section 5 of ES SITE CONDITIONS & ENGINEERING STANDARDS (Electrical Equipment)

#### **5.1.6.2 POWER SUPPLY**

##### **1. SUPPLY VOLTAGE**

Where the process plant nominal low voltage is declared, the crane power supply shall be the same and supplied from the same distribution transformers as the process plant. Otherwise the nominal voltage shall be  $400\pm 5\%$  Volt,  $50\pm 3\%$  Hz, 3 phase AC with the system neutral solidly grounded. The crane supplier shall satisfy himself regarding the suitability of the power supply system as part of the design phase.

The power supply for the electrical equipment shall be as follows:

Motors and drives                       $400V\pm 5\%$  Volt,  $50\pm 3\%$  Hz. three phase AC

Lighting, air con. and sockets -     $230\pm 5\%$  Volt,  $50\pm 3\%$  Hz. single phase AC

Controls                                      -     $110\pm 5\%$  Volt max.,  $50\pm 3\%$  Hz. single phase AC

#### **5.1.6.3 LIGHTING, AIR-CONDITIONING, FIRE DETECTION & COMMUNICATION DEVICES**

The lighting voltage shall be 400/230V AC, 50 Hz, 3-phase via transformer with the neutral grounded.

The operating voltage for air-conditioners shall be 400 VAC, 50 Hz, 3-phase.

Fire detection & communication power supply shall be 110V or 230 VAC.

##### **1. AIR-CONDITIONING AND LIGHTING FOR OPERATOR'S CABINS**

The operator's cabin, if provided, shall be suitably air-conditioned (if specified) and suitable lighting shall be provided. It shall be possible to adjust the lighting so that the operator can see the control console clearly and at the same time be able to see outside the cabin. The air-conditioning system shall be designed to maintain the specified temperature under ambient temperature in the operator's cabin. The air-conditioning system for the operator's cabin shall be separate from other air-conditioning systems (control panels etc.) or must be capable of being isolated from the main air-conditioning system during maintenance. If the cabin air-conditioning system is part of the main system, thermostatic temperature control of the cabin shall be completely independent of the main air-conditioning system.

A battery-operated portable emergency light, connected to a permanently installed charger, shall be installed in the operator's cabin to allow the operator to leave the crane safely in case of power failure or emergency.

## **2. Cabin Lighting**

Fluorescent lamps shall have electronic ballast. Air-conditioned rooms shall be equipped with fluorescent lamps. A minimum of 250 Lux shall be maintained. The fluorescent lamp fittings shall be shock proof (vibration resistant) and suitable for steel plant environments.

## **3. GANTRY LIGHTING**

Where applicable for workplace lighting, heavy duty 400 W floodlights with high pressure sodium vapour (HPSV) lamps of Siemens make shall be used with the choke/ballast units mounted in the lighting panel. The number of floodlights shall depend on the span of the crane and these will be arranged only on a wide crane girder or on a walkway platform. The floodlights will be arranged at about 3 m spacing from the beginning to the end of the crane crossbeam. Push-in connectors on electrical components shall not be acceptable. All wire connectors must be screw compression type. The flood light mounting fasteners shall be provided with rubber type shock absorbers. The flood light fittings shall be guarded with meshed supporting structure as well as guard wire to prevent them falling in the event of fastener breakage/failure.

Crane walkway lighting shall be of heavy-duty high-pressure sodium or fluorescent luminaires. A minimum of 250 Lux shall be maintained. Fluorescent light fittings shall be shock proof (vibration resistant) and suitable for steel plant environments. Fluorescent lighting in the walkways shall have electronic starters mounted in the lighting panel. Halogen type lighting on the walkways is unacceptable.

## **4. FIRE DETECTION SYSTEM**

The enclosed areas (operator's cabin, electrical panels etc.) shall have a fire detection and alarm system with sensors to detect smoke and to detect abnormal rate of temperature rise. The alarm will sound in the operator's cabin and externally. The alarm sound level will be suitable to be heard above the background noise of the steel plant.

The fire detection and alarm system shall conform to Section 11, Part 1 of this standard.

### **5.1.6.4 CONTROLS**

Cranes shall be controlled by either of the following means, as required by their duty:

- From operator's cabin mounted on the crane (all double girder cranes)

- From a control pulpit on the ground
- From a radio remote controller
- From a movable pendant controller mounted either on the crane (either on the trolley or at a fixed location), or on a separate festoon cable system.

Electrical switching and circuit protection shall be of fuse less design, employing Moulded Case Circuit Breakers (MCCBs) and/or Miniature Circuit breakers (MCBs) to provide graded short circuit and overload protection.

Control supplies shall be provided through suitably rated double wound (isolated) control voltage transformers, protected by an MCCB on the primary side and MCCB or MCB on the secondary.

The emergency stop button on the operator's console shall be of the twist lock type and shall stop and immobilise all drives.

Emergency stop pushbuttons shall also be placed:

- near entry/exit doors in electrical rooms
- on control panels facing outside
- on the cross-travel carriage

Emergency stop push buttons shall not be located in any other position on the crane unless otherwise agreed by ES in writing.

Wherever possible, all relays, contactors and other components shall be mounted on standard DIN rail for ease of replacement. All components in any case shall be easily accessible and replaceable. To facilitate maintenance, the number of relays, timers, and other control devices shall be kept to an absolute minimum by utilizing the PLC where possible.

Control and instrument cables shall be segregated from power cables. Communications cables shall be segregated from power, control and signal cables.

All instrument cables for encoder signal, reference signals, low voltage control signals etc. shall be of twisted pair type with overall screen. All other control cables shall be multicore

with minimum cross section 1.5 sq. mm. A minimum of 25 % spare cores shall be provided in each cable.

## 1. CONTROL PANELS

Where electrical switchgear is mounted on open contactor frames in an enclosed electrical room inside the crane girder, the panel shall be minimum IP 21 degree of protection and finger proof to IPXXB. Cable ducts inside the electrical room shall be protected to prevent the spread of fire.

Walkways inside electrical rooms shall be provided with anti-static rubber matting. The doors for the electrical rooms/control panels shall be provided with suitable sealing to protect from entering humidity, dust etc. All cable entries to electrical panels will be through correctly sized cable gland for the cable in question. All unused holes shall be blanked. Switchgear locations shall be chosen carefully to allow for the minimum bending radius specified for the cables. See-through insulated removable mechanical safety barriers shall be placed on both sides of walkways where necessary to protect against accidental contact with live electrical equipment. The barriers shall only be removable using a spanner or a screwdriver.

Electrical rooms shall be air-conditioned in order to protect the equipment and to provide a reasonable working environment for maintenance personnel. The room shall be pressurised with filtered make-up air. The temperature inside the electrical room shall be maintained at the specified temperature throughout the girder uniformly.

Electrical room air-conditioning system shall be connected separately from the auxiliary power supply. The air-conditioning shall be able to protect the equipment at all times but in the event of over temperature due to a failure of the air-conditioning unit, the equipment shall shut down in a safe manner, in order to protect it from damage.

Where control cubicles are mounted on the crane girder or walkway platform, the cubicle enclosure shall have IP 55 degree of protection. Dust covers shall be provided over the top of all external panels to prevent dust accumulation and ensure continued efficient cooling. All cable entries to electrical panels will be via the correctly sized cable glands. All unused holes shall be blanked. Panel locations must be chosen to allow for the minimum bend radius specified for the cables. The cubicles shall be provided with a

fluorescent lamp and switch in each cubicle. The lamps shall be lit automatically when the cubicle doors are open. A minimum of 250 lux shall be maintained.

Switch cubicles shall have individual air-conditioning where temperature sensitive equipment such as variable frequency drives and PLCs are used. The air-conditioning shall be able to protect the equipment at all times but in the event of over temperature due to a failure of the air conditioning unit, the equipment shall shut down in a safe manner, in order to protect it from damage.

A suitable temperature display unit shall be provided inside each electrical room, on the door of control panels and in the operator's cabin.

The electrical room's entry doors shall be provided with automatic door closures as well as electrical interlocks to notify the crane operator when the door(s) are opened.

All incoming and distribution panels shall conform to the following control hardware requirements: -

- Incoming isolator interlocked with the panel doors comprising unarmed MCCB with Voltmeter and Ammeter with phase selector switch.
- Suitably sized and pre-drilled earth bar shall be provided.
- All panels shall be designed for safe operation. All live bus bars, terminals and other electrical components shall be protected against finger contact to IP XXB minimum.
- Neutral and grounding bus bars shall be of same rating as phase bus bars.
- All indication lights shall be 110 VAC or 24 VDC LED cluster type.
- Thermistor protection relays shall be provided for all drives and motors.
- Internal wiring shall be run in perforated steel channels with snap-on lids. Fasteners shall be permanent type. Self-adhesive type shall not be accepted.
- Wiring termination shall use crimp-on pin ferrules and each wire shall have a slip-on type wiring number corresponding with the schematic diagrams. The crimp-on pin ferrules shall be correctly sized for the wire section. Only one wire shall be crimped per ferrule.
- Minimum 25% spare wiring terminals shall be provided in each panel.
- Control and instrument cables shall be segregated from power cables.

Nameplates shall be provided for all electrical equipment. Equipment nameplates shall include operating voltages. All name plates shall be in both English and Arabic.

All panels, components inside the panels, external equipment etc. shall be properly labelled. Additionally, the names of all drives, panels and external equipment shall have a clear indication to be easily identified.

Engraved labels shall be attached to all panels. All circuit breakers, and control equipment shall be labelled with labels corresponding to circuit numbering. All lettering shall be 13mm high minimum.

All terminal box colours shall be to RAL 7032. Fire detection and alarm panels shall be red.

An A4 size drawing pocket (cubicle) shall be provided, and permanently attached to the inside of the panel door. A final “As-built” copy of the diagrams shall be installed in the drawing pocket in a durable folder. Drawings shall be of A4 size and shall be housed in transparent pocket files.

## **2. DRIVE CONTROLS**

### **i) Heavy and Medium Duty Production Cranes**

Stepless variable speed drives shall be provided for all motions. The drives shall be variable voltage variable frequency (VVVF) converter drives with squirrel cage motors. Closed loop feedback control systems shall be provided for all motions (hoist, cross travel & long travel).

Drive system braking will be electronically controlled via regenerative braking into the local supply network. Parking and emergency braking will be via suitable drum, caliper disc or band brake.

To facilitate maintenance, individual motor isolation shall be provided between the inverter drive units and the drive motors. This isolation shall be interlocked with the control equipment to protect the drive units. Fuse less type isolating mechanism shall be used.

The setting for slow speed of each drive shall be adjustable at site. However, slow speed shall be considered as approx. 10% of full speed.

Sequencing and interlocking of all motions shall be controlled by an appropriate Programmable Logic Controller (PLC). In the event of PLC failure, all motions shall be fail safe and all safety interlocks such as emergency stops, overspeed devices, overload devices, slack rope devices etc. shall be to the appropriate Safety Integrity Level (SIL) in compliance with IEC 61508

Special attention shall be given to the operating environment for the PLC regarding ambient temperature, contamination by dust, vibration and mechanical shock. The PLC input/output modules shall be housed in a filtered force ventilated location on resilient mountings inside the air-conditioned electrical rooms. Where the PLC panel is mounted in a walkway, it shall be filtered air-conditioned to maintain the required temperature. PLC logic charts shall be provided in laminated form inside the electrical room/control panel.

All drives and control equipment, including the PLC, shall be mounted so that a maintenance engineer has complete unrestricted access for maintenance and trouble shooting and well as drive monitoring during crane operation.

The drives shall incorporate advanced diagnostics and fault-finding facilities. All electrical signals necessary for maintenance and troubleshooting shall be easily accessible at a common point in the control panel together with all alarm/trip indications, analogue values such as voltage and current levels for all three phases, and all set points and feedback signals. Operational and fault messages shall be relayed to a display panel in the operator's cabin as well as electrical rooms. The fault/alarm history shall be stored in a non-volatile medium.

All control parameters for crane mounted equipment shall be set up via the software. Because of the harsh working environment at the crane locations, it shall be possible for these parameters to be programmed away from the crane and then easily placed into the drive on site. It shall be possible to easily take a software record of all parameters for later analysis away from the crane.

A dedicated programming unit shall be provided with all necessary cables, attachments, connectors and software to allow remote programming of all aspects of the PLC and other programmable units installed on the crane. The programming operation shall be demonstrated to ESI.

**ii) Medium Duty and Maintenance Cranes**

- Motor drives shall be variable voltage, variable frequency (VVVF) with squirrel cage motors.
- Drive system braking will be electronically controlled via regenerative braking or dissipated through a resistor. Parking and emergency braking will be via suitable drum, caliper disc or band brake.
- All other requirements shall be as for Heavy and Medium Duty Production Cranes above.

**iii) Light Duty Maintenance Cranes**

- Motor drives shall be appropriate to the motor duty.
- Controls shall be appropriate to the crane duty and complexity. Where PLCs are employed, they shall comply with the requirements for Heavy and Medium Duty Production Cranes above.
- Whatever control system is employed, all motion controls shall be fail safe and all safety interlocks such as emergency stops, overspeed devices, overload devices, slack rope devices etc. shall be to the appropriate Safety Integrity Level (SIL) in compliance with IEC 61508.

**3. HOIST DRIVES (MAIN & AUXILIARY)**

**i) Heavy and Medium Duty Production Cranes**

Hoist drives shall have speed control mode with closed loop feedback system through a tacho-generator.

The Contractor shall include the following features as a minimum:

- Individual hoist motor overspeed protection.
- Individual hoist drum (barrel) overspeed protection.
- Hoist motor to hoist motor speed mismatch protection (if two motors are used).
- Hoist motor overcurrent protection.
- Hoist motor overtemperature protection.
- Motor stall protection.
- Protection against unintended reverse operation.



- Hoist overload & slack rope protection via load cells.
- Hoist over winding protection.
- Brake failure status.
- Emergency brake status (if used).
- Emergency brake protection against continuous operation in case of failure of hydraulic system (if used).
- Emergency brake operation in the event of creep through either service brake.

The hoist motion shall include a fail-safe over speed protection device. The system shall have sensors mounted on the rope drum barrel end. The emergency brake system shall be activated if the hoist speed exceeds 15% of full speed.

**ii) Medium (Maintenance) and Light Duty Cranes**

Hoist drives shall have speed control mode with closed loop feedback system through tacho-generator.

The Contractor shall include the following features as a minimum:

- Hoist motor overspeed protection
- Hoist motor overcurrent protection
- Hoist motor over temperature protection
- Motor stall protection
- Hoist overload & slack rope protection via load cells
- Hoist over winding protection
- Brake failure status
- Emergency brake status (if used)

The hoist motion shall include a fail-safe over speed protection device. The system shall have sensors mounted on the rope drum barrel end. The emergency brake system shall be activated if the hoist speed exceeds 15% of full speed.

**iii) Braking distance**

The braking distance for main hoist and auxiliary hoists motions shall not exceed 2.5% of the full speed distance with full load under any circumstances, including power failure or trip due to malfunction of control system.

**4. LONG TRAVEL AND CROSS TRAVEL**

**i) Heavy and Medium Duty Production Cranes**

- Two separate inverter units (where a four-quadrant drive is provided) for long travel drives will be fed via a suitably arranged switch-over mechanism so that

the crane can be operated in emergency mode from one inverter unit supplying two drives on opposite sides of the crane.

- Long travel and cross travel shall have closed loop speed control.
- The speed/torque setting shall be made in such a way that swing movement of the bottom block or other lifting device is reduced to a minimum during slow down/stop.
- The stopping distance shall not exceed, as per ES safety standard, 10% of the full speed with full load.
- Slew protection shall be provided for the long travel.

#### **ii) Medium (Maintenance) and Light Duty Cranes**

- For medium duty cranes, the cross-travel drive shall be either through a suitable soft start or variable speed frequency inverter system depending on the requirements of the application.
- The long travel shall be via a variable frequency inverter drive unit.
- The speed/torque settings of both long and cross travel shall be made in such a way that swing movement of the bottom block or other lifting device is reduced to a minimum during slow down/stop.
- For light duty cranes, the cross traverse and long travel may be of direct online start with conventional contactor control.
- The stopping distance shall not exceed 10% of the full speed distance with full load. The braking distance for cross travel and long travel motions shall not exceed 10% of the full speed distance with full load under any circumstances, including power failure or trip due to malfunction of control system.

### **5. ANTI-COLLISION DEVICES**

In a bay where two or more cranes are operating; an anti-collision system shall be installed on all the cranes. If a new crane is added to a bay where an existing crane or cranes are operating, the Contractor shall install an anti-collision system on both the new and existing cranes.

Radar technology shall be supplied. The distance and relative speed of the cranes shall be measured and the slow down and stop commands applied accordingly. Suitable manual resetting arrangement shall be provided.

### **6. DRIVE JOYSTICK CONTROLLERS**

All cranes provided with an operator's cabin shall be controlled by Joystick controllers mounted on a control desk. A suitable revolving type control seat shall be provided. The number and type of joystick controllers shall depend on the number of movements and other additional features required for the particular crane.

Variable control joysticks shall incorporate notch plates to indicate 25%, 50%, 75% and 100% speed.

## **7. RADIO REMOTE CONTROL**

Where specified, all operations of the crane shall be controlled from floor level through a radio frequency operated remote controller with a receiver and transmitter. In case both radio remote controller and pendant controller are provided, then either radio remote controller or pendant station will be operated at a time. Controller selection switch shall be provided in the control panel.

All switches and controls shall be provided in a single radio remote controller for complete control of the crane. As a minimum, the remote controller shall have push buttons for the following operation:

- Crane "POWER ON"
- Crane "POWER OFF"
- Emergency stop
- Hoist Up-Direction Slow & Fast (as specified)
- Hoist Down- Direction Slow & Fast (as specified)
- Auxiliary Hoist Up-Direction Slow & Fast (as specified)
- Auxiliary Hoist Down- Direction Slow & Fast (as specified)
- Trolley traverse Left movement Slow & Fast (as specified)
- Trolley traverse Right movement Slow & Fast (as specified)
- Bridge travel Forward Slow & Fast (as specified)
- Bridge travel Backward Slow & Fast (as specified)
- Warning siren operation
- Floodlights ON & OFF
- RESET button

In addition to the above, if any auxiliary service hoist is installed on the crane, then push buttons for the following additional operations shall be provided on the controller:

- Service Hoist Up-Direction Slow & Fast (as specified)
- Service Hoist Down-Direction Slow & Fast (as specified)
- Service Hoist Trolley Traverse Left Movement Slow & Fast (as specified)
- Service Hoist Trolley Traverse Right Movement Slow & Fast (as specified)

For remote controlled cranes with variable speed drives, the speeds of hoist/cross travel/long travel shall have two steps, with 15% in the first step and 100% in the second step with an adjustable ramp function.

The radio remote controller shall have adjustable range of up to 30 meters. The allotment and approval of radio frequency by the concerned Government department, if applicable, shall be included in the scope of work of the crane supplier. The controller shall be of rugged design, suitable for industrial use. The antennas of this device shall be mounted within a controlled temperature area, if required.

An emergency stop button shall be provided on the radio remote controller. The emergency stop button will be of twist lock type and shall cause complete immobilisation of all drives. Emergency stop buttons shall also be placed in the electrical panel and on the trolley in accessible positions. Emergency stop push buttons shall not be located in any other position on the crane unless otherwise agreed with ES.

## **8. PENDANT CONTROL**

Where specified, all operations of the crane shall be controlled from floor level either through a pendant controller. In case both radio remote controller and pendant controller are provided, then either radio remote controller or pendant station will be operated at a time. A controller selection switch shall be provided at the control panel.

The pendant controller shall be either of the following possible configurations: -

- a. Fixed on the crane structure
- b. Fixed on the trolley
- c. Movable on the crane structure
- d. Movable with the trolley
- e. Mounted independently of the crane, on a separate festoon cable system

All switches and controls shall be provided in a single pendant control station for complete control of the crane. As a minimum, the pendant controller shall have push buttons for following operation: -

- Crane "POWER ON"
- Crane "POWER OFF"
- Emergency stop
- Hoist Up-Direction Slow & Fast (as specified)
- Hoist Down- Direction Slow & Fast (as specified)
- Auxiliary Hoist Up-Direction Slow & Fast (as specified)
- Auxiliary Hoist Down- Direction Slow & Fast (as specified)
- Trolley traverse Left movement Slow & Fast (as specified)
- Trolley traverse Right movement Slow & Fast (as specified)
- Bridge travel Forward Slow & Fast (as specified)
- Bridge travel Backward Slow & Fast (as specified)
- Warning siren operation
- Flood light ON & OFF
- RESET button

In addition to the above, if any auxiliary service hoist is installed on the crane, then push buttons for the following additional operations shall be provided on the controller: -

- Service Hoist Up-Direction Slow & Fast (as specified)
- Service Hoist Down-Direction Slow & Fast (as specified)
- Service Hoist Trolley Traverse Left Movement Slow & Fast (as specified)
- Service Hoist Trolley Traverse Right Movement Slow & Fast (as specified)

In case of movable pendant controller, it shall be movable through the length of the span through a festoon cable system. The pendant shall be suspended from the moving trolley through a suitable wire/chain.

For pendant controlled cranes with variable speed drives, the speeds of hoist/cross travel/long travel shall have two steps, with 15% in the first step and 100% in the second step with an adjustable ramp function.

The main contactor shall be capable of being operated from the pendant control station.

An emergency stop button shall be provided on the pendant controller. The emergency stop button will be of twist lock type and shall give complete isolation of all drives. Emergency stop buttons shall also be placed on the electrical panel and on the trolley in an accessible position. Emergency stop push buttons shall not be located in any other position on the crane unless otherwise agreed with ES.

## **9. MAINTENANCE INTERCOM**

In order to facilitate crane maintenance, a good quality portable type intercom system shall be hard wired from inside the electrical room to the operator's cabin. Normally, this will be an extension of the crane intercom system required for communication with ground stations (pulpits), if applicable. The intercom system shall conform to Section 11, Part 1, Clause 14.2 of this standard.

### **5.1.65 ANCILLARY EQUIPMENT**

#### **1. ACCESS FOR MAINTENANCE**

Items such as motors, gearboxes, festoon cables, etc. shall be positioned such that they are easily accessible for maintenance and replacement. Cable routes must not restrict component removal and shall not restrict maintenance access. Equipment layout shall be planned with a view to reduce maintenance time and promote equipment availability.

In case of difficult access, appropriate fixed access platforms shall be provided. All access walkways shall incorporate non-slip floorings and maintenance platforms shall have suitable floodlights installed.

#### **2. BOARDING SYSTEM**

All cabin operated cranes shall be incorporated with a boarding system connected to the crane operator's cabin.

The boarding system shall be with a "REQUEST" push button which will notify the crane operator through an indication lamp with alarm in the operator cabin; operator then shall be able to grant permission through a push button located inside the cabin; then the requestor shall be able to get a "green" indication for safe access to the crane. A key operated twist push button shall be provided for additional safety and shall be incorporated with an enable pushbutton inside the cabin. After boarding or exit from the crane the requester shall be able to acknowledge the permission through a pushbutton located near the request pushbutton with green indication lamp, the key from the key

operated push button can be removed, enabling the long travel motion after fixing to the key operated switch inside the cabin. The access system shall be interlocked to disable the long travel motion when the crane operator has granted access. The long travel motion shall be enabled only after the requester has pressed the "acknowledge" push button.

If the boarding system is installed on a crane where it may come in contact with a flame path, then the access system (including push buttons, indicating lamps etc.) shall be provided in a flame-proof enclosure for protection.

### 3. MOTORS

The motors shall comply as a minimum with the requirements of Section 5 of ES Site Conditions and Engineering Standards.

The following duty cycles % ED shall be used as a basis for the individual crane types:

Type of Crane	Long Travel	Cross Travel	Hoist
Workshop cranes	25	25	40
Ladle cranes	60	40	60
Charging Cranes	80	60	80
Bloom/Billet Handling cranes	80	60	80
Rolling mill cranes	40	40	60
Scrap yard cranes	80	60	80
Medium duty maintenance cranes	25	25	40
Light duty maintenance cranes	25	15	25
DRI Plant EOT crane (flame / explosion)	25	25	40
DRI Plant EOT crane (No protection)	40	40	40
Mill Furnace maintenance crane	60	60	60
Roll shop EOT crane	60	60	60
Melt shop – Relining crane	60	60	60

Mould shop – Maintenance crane	60	60	60
Workshop – Maintenance crane	60	60	60
EOT crane (Sea Water inlet channel)	40	40	40
Gantry crane (Workshop duty)	25	25	40
Gantry crane (Slab Handling duty)	80	60	80
Gantry crane (Rolling mill duty)	40	40	60
Gantry crane (Scrap handling duty)	80	60	80
Gantry crane (Medium maintenance duty)	25	25	40
Gantry crane (Light maintenance duty)	25	15	25
Workshop Jib Cranes	15	15	25
Steel Mill Jib Cranes	25	25	40
Rolling Mill Jib Cranes	15	15	25
Workshops Hoists	15		25
Steel Mills Hoists	25		40
Rolling Mills Hoists	15		25

Where motors have variable speed duty, cooling shall be by fan separately supplied from the motor and shall be independent of the motor speed.

For hoists in steel mill areas, the stator and rotor winding shall be designed with insulation class H utilised to class B. For other areas, the stator and rotor winding shall be designed with insulation class F utilised to class B.

All motors in the Steel mill area shall be designed for an ambient temperature of 90°C. For hoists in other areas, all motors shall be designed for an ambient temperature of 70°C.

All motors for the cranes located outdoors shall have IP 56 degree of protection. All crane motors located within a mill building shall have IP55 degree of protection. Motors shall be provided with metal cooling fans inside a metal cowling.



Motors up to 40 kW shall be provided with 3 PTC thermistors for tripping and motors over 40 kW shall have 6 PTC thermistors for alarm and tripping.

As a minimum requirement, all motors in the Steel Plant melt shop area shall be designed for an ambient temperature of 90°C.

As a minimum requirement, all motors in the outdoor duty areas shall be designed for a minimum ambient temperature of 70°C.

As a minimum requirement, all motors of production cranes in all other areas shall be designed for a minimum ambient temperature of 55°C.

For maintenance duty cranes other than steel plant, all motors shall be designed for a minimum ambient of 50°C.

#### **4. MAGNETS AND BATTERIES**

##### **i) Billet Handling Application**

Permanent or electro-magnets shall be used for handling approximately 600°C (max) surface temperature of billets with minimum 60% duty cycle. Magnets shall be arranged in such a way that the variations of load distribution shall be kept to a minimum.

To facilitate handling of short billets, the magnet system shall have selection switches inside the operator's cabin for operating each magnet independently. A suitable indication system shall be installed in the operator's cabin control desk for indication of the status of each magnet. Also, the magnet's electrical parameters (voltage, current, temperature etc.) shall be indicated in the cabin control desk/display panel. The cable reeling system for the magnet shall be of suitable type and make to be approved by ES during detail engineering stage.

##### **ii) Rebar Handling Application**

Permanent or electro-magnets shall be used for handling approximately 400°C (max) temperature rebars with minimum 60% duty cycle. Magnets shall be arranged in such a way that the variations of load distribution shall be kept to a minimum.

To facilitate handling of short lengths, the magnet system shall have selection switches inside the operator's cabin for operating each magnet independently. A suitable indication system shall be installed in the operator's cabin control desk for

indication of the status of each magnet. Also, the magnet's electrical parameters (voltage, current, temperature etc.) shall be indicated in the cabin control desk/display panel. The cable reeling system for the magnet shall be of suitable type and make to be approved by ES during detail engineering stage.

### iii) Slab Handling Application

Permanent or electro-magnets shall be used for handling approximately 400°C (max) temperature of slabs with minimum 60% duty cycle. Magnets shall be arranged in such a way that the variations of load distribution shall be kept to a minimum.

To facilitate handling of short slabs, the magnet system shall have selection switches inside the operator's cabin for operating each magnet independently. A suitable indication system shall be installed in the operator's cabin control desk for indication of the status of each magnet. Also, the magnet's electrical parameters (voltage, current, temperature etc.) shall be indicated in the cabin control desk/display panel. The cable reeling system for the magnet shall be of suitable type and make to be approved by ES during detail engineering stage.

### iv) Rolling Mill General Application

Permanent or electro-magnets shall be used for handling approximately 400°C (max) temperature of scrap materials of rolling mills with minimum 40% duty cycle. Magnets shall be of round shape and attached to the hook of the crane. The cable reeling system for the magnet shall be of suitable type and make to be approved by ES during detail engineering stage.

### v) Scrap Handling Application

Permanent or electro-magnets shall be used for handling approximately 200°C (max) temperature of scrap materials in the scrap yard area with minimum 60% duty cycle. Magnets shall be of round shape and attached to the hook of the crane. The cable reeling system for the magnet shall be of suitable type and make to be approved by ES during detail engineering stage.

### vi) Requirements for Magnet Applications

The magnet "ON" (Energise) control shall be of single push button unit and the "OFF" (de-energise) command shall be with two push buttons controlling a relay to de-energise the magnet with a time delay. A suitable quick de-magnetising system shall be provided with time adjustment from the operator's cabin. If magnet selection system is provided, then it shall be interlocked with OFF changeover. The "ON" /"

OFF”/” JOG” push button shall be attached to the joystick and also parallel push buttons shall be provided on the left control desk with an interlocked selection switch.

#### **vii) Back-up Batteries**

If permanent electro-magnets are used, then back up batteries are not required. For all other types of magnets, suitable battery back-up system, comprising valve regulated Nickel Cadmium cells shall be provided. The backup batteries shall be installed on the crane in an air-conditioned or well-ventilated enclosure with an average ambient temperature of 30°C (max).

The battery backup system shall be of sufficient rating to support the magnets for at least 30 minutes with an ambient of 80° C following a power failure.

#### **viii) Magnet Control System**

The magnet control system shall be located inside the air-conditioned electrical room or switchgear panel. To ensure trouble free operation of the magnet system, the incoming power supply to the magnet switchgear shall be connected directly from the incoming of the main isolator. The voltage and current limit system shall be provided to protect the magnets from unexpected variation in the power supply. A suitable auto-cut off mechanism shall be provided to prevent the magnet remain continuously “ON” for more than 30 minutes. To prevent overheating of magnet, a suitable cold-versus-hot current comparison system shall be adopted, and it shall be interlocked with “ON” command to stop switching ‘ON’ the magnet when temperature reached above the limit. An indication system shall be provided to notify the operator for magnet over temperature.

### **5. LIFTING DEVICES REEVED TO THE CRANE**

#### **i) Spreader Beam (Lifting Beam) With Magnets**

If magnet(s) are being used as lifting devices, then the power/control cable feeding to the magnets shall be through a standard motorised cable reeling drum system or a cage fixed in the spreader beam. The magnet loop cables shall be connected through industrial heavy duty plug and socket system for easy removal and replacement. Individual magnet cables shall be brought to a heavy-duty terminal box mounted on the spreader beam and then connected to the main power cable going to the cable reeling drum or cage. Cable socks shall be used for anchoring the main cable to the spreader beam. Double sheathed fine stranded flexible round cable shall be provided for main as well as distribution cables. The cable

terminations shall be through ring type sockets with bolted connections. Pin type connectors shall not be acceptable.

If a motorised cable reeling drum is used, the drive for the cable reeling drum shall incorporate a magnetic clutch and brake fixed on the motor, or magnetic clutch with ratchet bearing mounted on the motor shaft to avoid overstretching and sagging of the main power feeding cable.

**ii) Motorised Rotary Hook Block**

If the crane is required to be equipped with motorised rotary hook block, the drive shall be with a load limiting clutch mechanism to avoid overloading the motor. The drive motor shall be fitted with brake mechanism to prevent uncontrolled hook rotation. A suitable end stopper or limit mechanism shall be provided to prevent the hook rotating more than 360 degrees in one direction.

The power/control cable feeding the motor shall be through a motorised cable reeling drum system. The loop cable to the rotary mechanism shall be connected through properly sized heavy duty plug and socket system for easy removal/fixing. Cable socks shall be used for anchoring the main cable to the spreader beam. Double sheathed fine stranded flexible round cable shall be provided for main as well as loop cable. The cable terminations shall be through ring type sockets with bolted connections. Pin type connectors shall not be acceptable.

If a motorised cable reeling drum is used, then the drive for the cable reeling drum shall be with magnetic clutch and brake fixed on the motor, or magnetic clutch with ratchet bearing mounted on the motor shaft to avoid overstretching and sagging of the main power feeding cable.

**iii) Motorised Horizontal Plate Lifter**

If the crane is required to be equipped with motorised horizontal plate lifter, then the drives shall be provided with a load limiting clutch mechanism to avoid overloading the motor. The drive motor shall be fitted with brake mechanism to maintain the compression tension. A suitable end stopper or limit mechanism shall be provided to prevent the arms override more than the requirement. The rotary mechanism for the plate lifter also requires a suitable end stopper and limit mechanism to prevent the beam rotation more than 360 degrees in one direction.

A suitable indication system shall be provided in the operator's cabin for indication of the arm positions. The arm tension shall be through motor current feedback and shall be interlocked with the indication (Green signal).

The power/control cable feeding to the motor shall be through a motorised cable reeling drum system or a cage fitted on the spreader beam. The distribution cables to the arm movement mechanism shall be connected through properly sized heavy-duty conduit. Cable socks shall be used for anchoring the main cable to the spreader beam. Double sheathed fine stranded flexible round cable shall be provided for main as well as distribution cables. The cable terminations shall be through ring type sockets with bolt connections. Pin type connectors shall not be acceptable.

If a motorised cable reeling drum is used, then the drive for the cable reeling drum shall be with magnetic clutch and brake fixed on the motor, or magnetic clutch with ratchet bearing mounted on the motor shaft to avoid overstretching and sagging of the main power feeding cable.

## **6. LIFTING DEVICES ATTACHED TO THE CRANE**

### **i) Motorised Vertical Coil Tong**

If the crane is required to be equipped with motorised vertical coil tong, then the drives shall be with a load limiting clutch mechanism to avoid overloading the motor. The drive motor shall be fitted with brake mechanism to maintain the compression tension. A suitable end stopper or limit mechanism shall be provided to prevent the arms overriding.

A suitable indication system shall be provided in the operator's cabin for indication of status of the arms positions. The arm tension shall be through motor current feedback or tension sensors and it shall be interlocked with the indication (yellow signal). A suitable load sensor system shall be fitted with the load carrying arms to give a positive green signal to the operator.

The power/control cable feeding to the motor and controls shall be through a motorised cable reeling drum system. A plug and socket system shall be used for connecting the coil tong to the main feeder cable. Cable socks shall be used for anchoring the main cable to the hook block. Double sheathed fine stranded flexible

round cable shall be provided for main as well as distribution cables. The cable terminations shall be ring type sockets with bolt connections. Pin type connectors shall not be acceptable.

If a motorised cable reeling drum is used, then the drive for the cable reeling drum shall be with magnetic clutch and brake fixed on the motor, or magnetic clutch with ratchet bearing mounted on the motor shaft to avoid overstretching and sagging of the main power feeding cable.

#### **ii) Motorised (Hydraulic) Grab Bucket for Scale Pit Application**

If the crane is required to be equipped with motorised grab bucket, then the bucket shall be a compact unit consisting of hydraulic cylinder-controlled bucket arms. The hydraulic power pack, including motor, valve, tank etc. shall be mounted on the bucket unit. The opening and closing of the bucket shall be controlled by reversing the motor's direction of rotation.

The power cable feeding to the bucket (motor) shall be through a motorised cable reeling drum system. A plug and socket system shall be used for connecting the main feeder cable to the bucket for easy removal/fixing. Cable socks shall be used for anchoring the main cable to the grab bucket unit.

Weatherproof double sheathed fine stranded flexible round cable shall be provided for main as well as distribution cables. The cable terminations shall be through ring type sockets with bolt connections. Pin type connectors shall not be acceptable.

If a motorised cable reeling drum is used, then the drive for the cable reeling drum shall be with magnetic clutch and brake fixed on the motor, or magnetic clutch with ratchet bearing mounted on the motor shaft to avoid overstretching and sagging of the main power feeding cable.

A suitable load sensing/slack rope limit system shall be used as lower limit function.

### **7. POWER COLLECTION AND DISTRIBUTION**

#### **i) POWER SUPPLY FROM BUSBAR CONDUCTORS**

All heavy and most medium duty cranes shall be supplied via open bus bar conductors. Maintenance and light duty cranes shall be supplied from enclosed bus bar conductors. All shall have the following facilities: -

- The crane collector pads shall be connected directly to the main crane isolating switch (circuit breaker) which shall be located adjacent to the access stairway on the crane. From the live side of this main isolator, a second auxiliary isolating switch (circuit breaker) shall be connected for crane lighting, crane air-conditioning systems and power sockets. These services shall be available (for maintenance purposes) while the rest of the crane is isolated. Both isolating switches shall be lockable in the off position with padlocks.
- If the supply to the crane does not include a neutral conductor, a transformer shall be provided to give a three phase and neutral supply or a single phase with neutral, earthed via a test link for crane air conditioning lighting and power outlets.
- The power collection arrangement shall have two spring loaded collector shoes per rail to ensure proper contact for all connections in the power rail system.
- Access to both collector arms shall be via covers that can only be removed using a spanner or screwdriver.
- A local maintenance platform with easy access shall be installed for maintenance of the collector arms.
- Isolating switches and associated cabling for crane maintenance bays ("Hospital bays") shall be provided by the crane supplier. The hospital bays shall be used to electrically isolate any crane requiring maintenance but allow operation of the other cranes on the same runway rail. The crane supplier shall co-ordinate with ES and gather all necessary information regarding this aspect during the design phase.

#### **ii) POWER SUPPLY FROM REELING DRUMS**

- The power supply to the crane shall be through a constant torque drive heavy duty cable reeling drum system to the main crane isolating switch (circuit breaker), which shall be located adjacent to the access stairway on the crane.
- From the live side of the main isolator, a second auxiliary isolator switch (circuit breaker) shall be connected for crane lighting, crane air conditioning (if provided) and power sockets. These services shall be available (for crane maintenance purposes) while the rest of the crane is isolated. Both switches shall be lockable in off position with padlocks.

- If the supply to the crane does not include a neutral conductor, a transformer shall be provided to give a three phase and neutral supply or a single phase with neutral, earthed via a test link for crane air conditioning lighting and power outlets.
- The reel cable shall be round double insulated heavy duty flexible rubber with a minimum of four cores of fine stranded copper conductors sized to suit the total power requirements of the crane. One core of the cable shall be the grounding conductor.
- A safety mechanical/electrical interlock shall be provided between the cable guides, wind /unwind changeover mechanism to prevent cable slack due to a defective drum drive.
- A local maintenance platform with easy access shall be installed for maintenance of the main cable reeling drum unit.

### iii) POWER SUPPLY TO JIB CRANES

#### a. Column and Wall Mounted Jib Cranes

The power supply cable shall be directly connected to a main crane isolating switch (circuit breaker), which shall be located on the column of the jib crane. From the live side of this main isolator a second auxiliary isolator switch (circuit breaker) shall be installed to allow operation of crane lighting and power sockets. These services shall be available (for maintenance purposes) while the rest of the crane is isolated. Both switches shall be lockable in off position with padlocks. The crane supplier shall co-ordinate information regarding this aspect via ES during the design phase.

If the supply to the crane does not include a neutral conductor, a transformer shall be provided to give a single phase with neutral, earthed via a test link for on-crane lighting and power outlets.

Power supply from main isolating switch to the travelling electric hoist shall be made through a suitable slip-ring assembly made from copper alloy.

#### b. Travelling Jib Cranes

Power supplies to travelling jib cranes, whether supplied by busbar conductors or festoon cables shall comply with the principles outline above regarding isolation, earthing and auxiliary supplies.



#### **iv) POWER FEEDING ARRANGEMENTS TO HOISTS**

Power feeding to the hoist unit shall be through festoon cable or enclosed busbar system.

Festoon cable shall be of suitable type (preferably flat form type) to withstand harsh movements, stretching, compression, and temperature over 180°C inside steel plant and 120°C for other areas. The cables shall be wrapped with a heat resistant barrier to protect them from direct heat from the plant wherever applicable. The festoon cable track shall be of I-beam type with horizontal side guide rollers. The clamping materials shall be of hard rubber suitable for high temperature. Control and instrument cables shall be segregated from power cables. The festoon trolley system shall be mounted on a beam supported from the monorail beam. The monorail beam, on which the hoist will be travelling, shall not be used for festoon trolley travel.

The enclosed busbars shall conform to VDE 0470, with minimum IP24 degree of protection. The conductor bars shall be made from copper. The conductor enclosure shall be made from anodized aluminium sections of standard lengths. End caps shall be provided on both ends. Plug-in or bolted type expansion joints shall be used for joining adjacent sections of conductor system. The current collectors shall be provided with spring loaded carbon or composite brushes for uniform contact. The towing arms for current collectors shall be flexible type for automatic alignment. Brackets and hangers as per manufacturer's standard shall be provided.

#### **v) WARNING SIREN**

A warning siren capable of being heard above the ambient noise shall be fitted onto the crane and manually operated from the operator's control.

#### **vi) PLUG-IN CONTROL PENDANT**

Where specified, suitable plug-in type pendant controller shall be provided for maintenance purposes.

### **5.1.6.6 CABLES AND INSTALLATION**

#### **1. CABLES**

Power distribution cables on cranes shall be XLPE insulated. Cable sheaths shall be low smoke zero halogen (LSOH) Panel wiring shall comprise tri-rated fire-resistant cable.

For cranes inside steel plant, the cables shall be of a type suitable for 180°C. For other areas, the cables shall be of a type suitable for 120°C. Cables shall be suitably supported and housed to allow for proper cooling. Cables shall be protected from the effects of flame wherever applicable.

Cables shall be provided with proper gland for entry into all panels and shall be suitably protected when passing through steelwork.

Festoon cables shall be the flat form type. They shall be wrapped with a heat resistant barrier to protect them from direct heat from the plant (for steel plant application); otherwise open cables may be adopted. They shall not be located where they block main walkways but shall be easily accessible for maintenance and replacement. Power and control cables shall be segregated.

The festoon cable track shall be of I-beam type. The festoon cable trolleys shall be made from galvanized steel, having flangeless rollers with horizontal side guide rollers. The clamping materials shall be of hard rubber suitable for high temperature.

## **2. CABLE MARKING**

Cable marking shall be attached to the cable end (e.g. in switch stations, on motors, etc.). The details shall correspond with those on the Contractor's cable schedule. Marking strips shall not be glued to the cable. The cable numbers shall be pressed into copper or aluminium marking strips or be otherwise indelible and resistant to the effects of ageing and heat.

## **3. PROTECTION OF CABLES**

Cables shall be properly secured to cable trays which shall be carefully positioned to avoid all forms of mechanical damage. Attention shall be paid for keeping cable routes away from walkways and stair wells.

Cables shall be fastened to cable trays by means of strong metallic clamps. The screws fastening cable trays shall be of rust-free steel.

All cable ends shall be protected against moisture penetration immediately after cutting. Unused openings at terminal boxes, sockets, distributors etc. shall be sealed off by a blind plug. Compound shall not be used.

Every protective conductor connection shall be clamped to the protective conductor bar in such a way that is individually detachable.

#### **4. JUNCTION BOXES**

Junction boxes shall be positioned for easy access and be protected against direct heat and mechanical damage. There shall be adequate room for reterminating cables.

All junction boxes shall be of galvanised steel construction with hinged doors to IP55 degree of protection. The total number of junction boxes shall be kept to the minimum possible.

##### **5.1.6.7 RADIO COMMUNICATION SYSTEM**

1. The design of the system shall be of the latest available technology and the equipment supplied shall be of the highest quality and of robust construction adequately rated for continuous operation in a steelworks environment. The system shall be of a reputable make.
2. The radios to be installed in the cranes shall be heavy duty industrial type with 25-Watt output power, have at least 16 channels, synthesised programmable type. It shall be supplied with Ultra High Frequency (UHF) mobile transceivers, suitable for 110/220 VAC power supply. Metal heavy duty external antenna, external metal speaker and noise cancelling microphone (IP65 degree of protection) shall be provided. It shall be installed and supplied with foot switch, enabling the operator to use his feet for pressing the switch and using the radio.
3. The radios shall be supplied with suitable enclosure protection level (military, harsh industrial type) against industrial environment (dust, heat, electromagnetic field, acoustic fields, vibration etc.) and weather (high temperature, humidity, rain, etc.).
4. The radios shall be suitable for operating with the existing radio communication systems in ES and shall be also suitable to operate with trunking system.
5. Radio shall have the facility to be programmed with ANI and be capable to be linked to existing telephone call facilities for the radios.
6. The radio shall be suitable to operate in conventional and trunking radio communication systems. The channel spacing of radio shall be minimum 12.5 KHz.

##### **5.1.6.8 INTERCOM SYSTEM**

1. The design of the system shall be to the latest available technology and the equipment supplied shall be of the highest quality and of robust construction

adequately rated for continuous operation in a steelworks environment. The system shall be of a reputable make.

2. The crane communication shall be matching and suitable to be integrated with the existing system in ES
3. The intercom wireless communication system shall be low frequency 440 470MHz (UHF) type with low output power and minimum 12.5 KHz channel separation.

#### **5.1.6.9 Wireless Intercom Station (on the crane)**

1. Crane intercom station shall be of suitable enclosure protection level. It shall have minimum 10 toggle line keys, 440 - 470 MHz, suitable for 110/220 VAC power supply in IP65 housing.
2. Microphone and speaker shall be suitable for operation under harsh industrial environment, dust, heat, humidity etc.
3. HF antenna cable shall be RG58 type, 10m long and shall include TNC plug and TNC coupler.

#### **5.1.6.7.1 Intercom Base station**

1. The base station shall be UHF mobile radio station with 440 - 470 MHz frequency & 1 - 25-Watt output power in IP65 housing. Controller, Interface for Intercom System with 32 lines. Suitable DC/DC converter shall be provided.
2. HF antenna cable shall be RG58 type, 10m long and shall include TNC plug and TNC coupler.

#### **5.1.6.7.2 Intercom Station (Inside Electrical room):**

It shall be weatherproof compact outdoor type intercom station with twin line key for communication with the operator. Microphone, speaker shall be suitably protected against dust, humidity, high ambient temperature etc. The intercom shall be hardwired to the operator's cabin intercom.

#### **5.1.7 SURFACE PREPARATION AND COATING**

Surface preparation and coating shall be according to Section 8 of ES CONDITIONS AND ENGINEERING STANDARDS. Following points shall be adhered to: -

1. All preparation and painting shall be carried out under controlled conditions.
2. Paint systems shall be selected based on the environmental conditions, temperature and application of the crane.
3. All steelwork surfaces shall be prepared for coating by shot blasting to surface preparation equivalent to SA 2<sup>1/2</sup>.
4. The cranes shall be finish painted before dispatch to site.

5. The contractor shall select and propose a three-coat painting system for the cranes suitable for the environment.
6. Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.
7. The finish colour shall be equivalent to RAL 1023 Traffic Yellow.
8. Paintwork damaged during transport and erection shall be repaired at site following a repair procedure recommended by the paint manufacturer.

#### **5.1.8 TOOLING**

A set of suitable maintenance equipment and tool kit shall be provided. These kits shall be sufficient to serve the maintenance requirements of the crane. If specified, a programming unit for PLC, or any other equipment requiring programming, shall be provided.

#### **5.1.9 TESTS AND INSPECTION**

##### **1. SHOP TESTING**

- a. Tests at shop shall be carried out by contractor as per agreed Quality Assurance Plan (QAP). Manufacturer's standard tests can be made if accepted by ES. The QAP shall be submitted in the kick-off meeting. ES shall be notified sufficiently in advance, so that ES representatives may witness all tests, if required.
- b. All material certificates for fabricated, manufactured and bought-out items/systems and other test certificates shall be submitted in original along with supply of the particular crane.

##### **2. TESTING AT SITE AFTER INSTALLATION**

- a. Tests at site shall be carried out by contractor as per approved Quality Assurance Plan (QAP). ES shall be notified sufficiently in advance, so that ES representatives may witness all tests.
- b. Operating Tests: After completion of installation/modification but prior to initial use, the crane shall be tested to ensure compliance with this specification, including the following functions, as applicable: -
  - Hoisting and lowering
  - Cross travel
  - Long travel
  - Limit switches, locking and safety devices
  - Hook approaches
  - Operation of lifting devices/attachments
  - Motor tests
  - Electrical system

- Control system
- Magnet operation
- Magnet battery back-up system
- Anti-collision devices
- Logic controllers
- CCTV camera system
- Air-conditioning systems
- Fire detection & alarm system
- Communication system

Test reports shall be submitted for each test. Adjustments shall be made as required. Tests shall be repeated after adjustments.

- c. The trip setting of hoist devices shall be determined by tests with an empty hook/lifting device travelling at increasing speeds up to the maximum speed. The actuating mechanism of the limit device shall be located so that it will trip the device under all conditions in sufficient time to prevent contact of the hook or load block with any part of the trolley or crane.

### **3. ACCEPTANCE TESTING**

- a. In accordance with the accident prevention regulations, each crane must be tested and inspected by an authorised testing agency prior to initial use before commissioning, as well as after substantial modifications. This third-party testing shall be included in the contract and shall be arranged by the contractor. It is the responsibility of the contractor to make available in good time the crane drawings (including "as-built"), operation and maintenance manuals and specifications to the testing agency.
- b. The acceptance tests shall be carried out only after acceptance of operating test reports by ES.
- c. The testing agency shall be subject to the approval of ES before work commences.
- d. The third-party test certificate shall be submitted in original to ES.
- e. The object of the testing is to determine whether: -
- The accident prevention regulations specified in the contract have been satisfied.
  - The crane complies with the ES safety standards.
  - The crane complies with required hook approaches, speeds, etc.

- The crane functions correctly and safely.
  - The crane is ready for operation.
- f. The principles and procedure for the testing shall be as per DIN 15030. Equivalent international standard may be followed if approved by ES.
- g. A written report shall be furnished by the testing agency, confirming the load rating(s) of the crane. The test reports shall be placed on file, readily available to appointed personnel.
- h. The load rating shall not be more than 80% of the maximum load sustained during the test. Test loads shall not be more than 125% of the rated load, unless otherwise recommended by the crane manufacturer.
- i. The rated load test shall consist of the following operations as minimum requirement:
- - Hoist the test load to a position where it is freely suspended and stop to ensure that the load is supported by the crane and held by the hoist brake(s).
  - Transport the test load by means of the trolley for the full length of the bridge.
  - Transport the test load by means of the bridge for the full length of the runway in one direction with the trolley as close to the extreme right-hand end of the crane as possible and in the other direction with the trolley as close to the extreme left-hand end of the crane as possible.
  - Lower the test load, stop and hold the freely suspended load with the brake(s).
- j. ES will provide the test weights & rope/chain slings beneath the crane for load/overload test purposes, however further handling of the weights and testing of the crane will be the responsibility of the contractor.
- k. Final acceptance shall be subject to compliance report, to be determined after tests & inspection by ES, by results of the requisite tests mentioned above.

#### **5.1.10 DOCUMENTATION**

Complete documentation of the crane installations shall be supplied according to Section 9 of ES SITE CONDITIONS AND ENGINEERING STANDARDS.

All manuals and documentation will be provided in clear written English and all brochures will be provided as manufacturers originals. Photocopies shall not be accepted.

## **5.2 Double Girder Overhead Cranes**

### **5.2.1 GENERAL**

This Section 11.010 outlines the requirements for design, fabrication, supply, delivery, installation, testing, certification, erection and commissioning of Double-girder electric overhead travelling (EOT) cranes and crane runways for use in Emirates Steel (ES).

These Standards refer specifically to the DIN standards for cranes and associated equipment. The definitions of the duties included in these ES standards shall be used to classify the cranes.

Subject to prior agreement with ES equivalent crane standards may be considered. The most up to date versions of the quoted standards shall be applied.

Where standards are no longer current (superseded) the replacement standard shall be applied.

Refer to Section 11-060 Appendix 1 for: -

- Definitions
- Codes and Standards
- Lifting Devices (Attachments)
- Electrical Equipment and Installation
- Air Conditioning Systems
- Communications Systems
- Fire Detection
- Surface Preparation and Coating
- Tests and Inspection
- Documentation

## **5.2.2 CLASSIFICATION**

### **5.2.6.1 GENERAL**

Classification of a particular crane shall be based on the operating conditions of the most severely loaded part of the crane and shall be agreed with ES prior to order placement. For replacement of existing cranes, the classification shall be according to Table-1 below. For new cranes, the classification shall be generally according to DIN 15018 Part 1, which shall be discussed and finalised with ES.

### **5.2.6.2 DRIVES**

#### **a. ROPE DRIVES**



The calculation of rope drives shall be in accordance to DIN 15020 to ensure an adequate degree of safety of operation of the lifting appliance and to achieve an adequate service life for the wire ropes used. The relation of rope diameter to rope sheave diameter respectively rope drum diameter shall be according to the relevant DIN standards.

**TABLE – 1**

Sl	Location	Description	Duty	Hoist Class	Lifting Category	Stress Group
1	Direct Reduction Plant	EOT crane (flame /explosion proof)	Low	1 Bm-2m	H2	B3
2	Direct Reduction Plant	EOT crane (flame / explosion proof)	Low	1 Bm-2m	H1	B2
3	Direct Reduction Plant	EOT crane (No protection)	Low	2m	H2	B3
4	Steel Plant	Hot liquid metal handling crane	High	4m	H4	B6
5	Steel Plant	Additive handling crane	Medium	2m	H2	B3
6	Steel Plant	Relining crane	Medium	2m	H2	B3
7	Steel Plant	Caster Maintenance crane	High	3m	H3	B5
8	Steel Plant	Caster Maintenance crane	Medium	2m	H2	B3
9	Steel Plant	Caster – Cooling bed crane	Medium	3m	H4	B6
10	Steel Plant	Mould shop Maintenance Crane	Low	2m	H2	B3
11	Steel Plant	Refractory – Ladle handling crane	High	3m	H4	B6
12	Steel Plant	Workshop Maintenance Crane	Low	2m	H2	B3
13	Rolling Mill	Billet handling crane	High	4m	H4	B6
14	Rolling Mill	Furnace maintenance crane	Low	1Am	H1	B2
15	Rolling Mill	Mill maintenance crane	Medium	2m	H2	B3
16	Rolling Mill	Cooling bed maintenance crane	Medium	3m	H3	B5
17	Rolling Mill	Roll shop crane	High	3m	H2	B4

18	Rolling Mill	Roll shop crane	Medium	2m	H2	B3
19	Rolling Mill	Roll shop crane	Low	1Am	H2	B3
20	Hot Strip Mill	Slab handling crane	High	3m	H3	B5
21	Hot Strip Mill	Tundish crane	Medium	3m	H2	B4
22	Hot Strip Mill	Furnace maintenance crane	Low	1Am	H1	B2
23	Hot Strip Mill	Mill maintenance crane	Medium	2m	H2	B3
24	Hot Strip Mill	Cooling bed maintenance crew	Medium	3m	H3	B5
25	Hot Strip Mill	Roll shop crane	High	3m	H2	B4
26	Hot Strip Mill	Roll shop crane	Medium	2m	H2	B3
27	Hot Strip Mill	Roll shop crane	Low	1Am	H2	B3
28	Cold Mill / Galvanising Line	EOT crane	High	3m	H2	B4
29	Cold Mill / Galvanising Line	EOT crane	Medium	2m	H2	B3
30	Cold Mill / Galvanising Line	EOT crane	Low	1Am	H1	B2
31	Cold Mill / Galvanising Line	Cantilever crane	Medium	2m	H2	B3
32	Pickling Line	EOT crane	High	3m	H3	B5
33	Pickling Line	EOT crane	Medium	2m	H2	B3
34	Cold Temper Mill	EOT crane	High	3m	H3	B5
35	Hot Strip Mill/MR	EOT crane	Low	2m	H1	B2
36	Rolling Mill	Bar dispatch crane	High	4m	H4	B6
37	Hot/Cold Mill	Coil dispatch crane	High	3m	H3	B5
38	Hot/Cold Mill	Coil dispatch crane	High	2m	H2	B5
39	Scrap Yard	EOT crane	High	4m	H4	B6

40	Utility	EOT crane	Low	2m	H2	B3
41	Utility	EOT crane	Low	1Am	H1	B2
42	Warehouse	EOT crane	Low	1Am	H1	B2
43	Workshops	EOT crane	Medium	2m	H2	B4
44	Workshops	EOT crane	Low	2m	H2	B3

### 5.2.3 MECHANICAL (HOIST)

#### 5.2.6.1 GENERAL

The crane will have one (1) hoist mechanism with / without auxiliary hoist. The mechanical components of the hoist drive(s) shall be rated according to their mode of operation into a drive group in accordance with DIN 15020 in order to achieve the required long service life. All hoist components will be accessible for maintenance.

#### 5.2.6.2 MAIN HOIST DRIVE

The hoist drive shall comprise of the following main components:

- 1 no. squirrel cage motor
- 1 no. Peri flex shaft coupling with brake drums
- 1 no. self-adjusting double shoe brake with electro-hydraulic thruster.
- 1 no. Spur gearbox.
- 1 no. barrel coupling for each drum connection
- Rope drum(s)
- Drum bearings
- Emergency disc/drum brakes (as specified)
- Hoist limit switches (rotary type, located on barrel end shafts)
- Wire ropes
- Bottom block as per DIN 15409 (lockable at 4 points at 90o interval, if required) If required by Operations, hook block can be rotating type.
- Overload and slack rope protection system

#### 5.2.6.3 GENERAL REQUIREMENTS

- i) All drives shall be mounted on base plates and have safe access for maintenance.
- ii) Base mounted drive equipment (motors, gear boxes, brakes etc.) will be mounted on top of single solid shims, which will not be less than 10mm in thickness.
- iii) Details of Main Hoist Drive Components

**a. Motor**

The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. See “Section 7.0 - Electrical Equipment and Installation” of this standard for further details.

**b. Coupling and Drum Brakes**

Peri flex (tyre) shaft couplings with brake drums shall principally be used. The coupling shall include flexible elements rated for high temperature use. Hoist brake (service brake) shall be double shoe drum brake with electro-hydraulic thruster. Brake system shall be designed for 1.6 times the hoist load and they shall be capable of braking the dynamic test load without a damaging snatch effect, and without overheating. The brake shall be suitable for the specified maximum ambient temperature. The thruster brake will be equipped with a manual release facility that will allow the load to be lowered to the ground in the event of a power supply failure. Brake assembly shall be fitted with auto-adjust wear systems. An additional status feedback signal device shall be incorporated in the brake unit to enable proper functioning of the control system.

Electro-hydraulic or electro-magnetic disc brake may be provided for light duty cranes if approved by ES.

**c. Emergency Brake**

The requirement of emergency brake shall be decided by ES, after considering the operational environment of the particular crane. In case of frequent movement of personnel below or near the crane, or if critical equipment is located within the crane operating bay, then emergency brake is a mandatory requirement.

For cranes of 50-ton capacity or more, ES shall decide whether emergency brakes are required and shall specify accordingly.

In the event of detection of over synchronous speed due to service brake failure, and slow speed slippage through the service brakes when the crane is energised,

the control system shall be designed to detect this and shall operate the emergency brakes for holding the suspended load.

The emergency brake shall be so controlled that it is applied automatically, not later than the instant a speed of 1.15 times the normal lowering speed has been reached.

The type and mounting of emergency brake shall be either of the following, and shall be selected only after discussion with ES: -

- i. The emergency brake shall be mounted on the main hoist drum barrel flanges. The brake shall be caliper disc type with wear rings and shall be removable type.
- ii. The emergency drum brakes shall be provided at the gear box input extension shafts. The brakes shall be of same type as the service brake.
- iii. An emergency band brake mounted on the plain end of the hoist rope barrel (drum). The band brake shall operate either by an electro-hydraulic thruster or an electro-magnet.

**d. Spur Gearbox**

Service Factor "f1" For Hoist Gearbox shall be considered as per the following table

Rope reeving group	2m	3m	4m	5m
Service factor "f1"	1.25	1.40	1.60	1.80
Gearbox nominal rating "NG"				

The nominal rating of the gearbox shall be determined by multiplying the actual required hoisting power with the service factor (f1). An additional impact factor shall be considered in the calculation to suit the gearbox application and potential effects of hoist acceleration before hook contact occurs. The resultant factor of safety will be indicated in the offer.

The gearbox shall be rated according to the mode of operation.

The gearbox drain point shall be piped to a location where a drop hose can be installed vertically to floor level. The gearbox shall have a valve at the gearbox casing end of this drain line to enable removal of the box.

In case planetary gearbox is offered, the main hoist mechanism shall have two independent drive systems, in such a way that operation can continue at half speed

if any one of the hoist motors fail. This philosophy shall be suitably reflected in the electrical system.

**e. Wire Rope**

Wire rope diameter shall be calculated to DIN 12385-40, shall be used with an individual wire breaking strength as per the standard. Rope thimbles, if provided, shall conform to DIN 3091. The wire ropes and rope anchors will be suitable for the operating environment. Rope length shall be sufficient to reach ground level.

**f. Rope Drum / Gearbox Connection**

- i. For Heavy and Medium Duty Production Crane Barrel coupling shall be provided for gearboxes conforming to DIN 15053. The barrel coupling shall be fitted with a wear monitoring device.
- ii. Medium and Light Duty Maintenance Crane Barrel coupling shall be provided for gearboxes conforming to DIN 15053. The barrel coupling shall be fitted with a wear monitoring device.

- g. Rope Drum** Rope drum shall be of welded construction with grooves according to DIN 15061. At least 2 dead turns shall be provided on the drum when the rope is at the lowest position as determined by the hoist limit switch.

Material of drum components shall be as follows: -

- Drum shell: St 52-3
- Drum trunnion: St 52-3
- Flange: RSt 37-2
- Trunnion : RSt 37-2

Emergency brake shall be provided to act on the rope drum flanges, as specified.

- h. Drum Bearing** Self-aligning anti-friction roller bearing shall be used for the drum end bearing.

**5.2.6.4 AUXILIARY HOIST DRIVE**

Auxiliary hoist drive will be required to be incorporated into the crane design wherever applicable for operations.

**a. THE AUXILIARY HOIST DRIVE SHALL COMPRISE OF THE FOLLOWING MAIN COMPONENTS**

- 1 no. squirrel cage motor
- 1 no. Peri flex shaft coupling with brake drum
- 1 no. self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435
- 1 no. Spur gearbox according to DIN 15053

- 1 no. barrel coupling for each drum connection
- Rope drum(s)
- Drum bearings
- Emergency disc/drum brakes (as specified)
- Hoist limit switches (rotary type located on barrel end shafts)
- Wire ropes
- Bottom block as per DIN 15409 (lockable at 4 points at 90o interval, if required) If required by Operations, hook block can be rotating type.
- Overload and slack rope protection system (if required)

**b. SPECIAL REQUIREMENTS FOR AUXILIARY HOIST DRIVE**

1. For some of the cranes (e.g. ladle handling cranes), it is required that speeds of main hoist and auxiliary hoist be synchronised. In that case, the following statement shall be explicitly mentioned in the enquiry:

"The ton auxiliary hoist drive speed shall be synchronised with the main hoist drive speed. Electrical system shall be properly designed to achieve this requirement by using a selector switch."

2. For some cranes, it is required that the hooks of main hoist and auxiliary hoist are fixed at a specific distance, to suit a specific operational requirement. In that case, the following statement shall be explicitly mentioned in the enquiry:

"The .... ton auxiliary hoist drive shall be fixed in relation to the main hoist. Independent hoist travel is not required, and the hook centres shall be fixed at \_\_\_mm."

3. For some cranes, it is required that main hoist and auxiliary hoist operate independent of each other to a limited extent. In that case, the following statement shall be explicitly mentioned in the enquiry:

"The .... ton auxiliary hoist shall be capable of operating independently in relation to the main hoist. Independent travel of main & auxiliary hoists is a requirement, and the amount of independent travel shall be mm, after conformation of the working envelope."

4. For some cranes, it is required that main hoist and auxiliary hoist are interlocked to avoid overloading of the auxiliary hoist during tandem operation, the following statement shall be explicitly mentioned in the enquiry:

"The .... ton auxiliary hoist shall be interlocked with main hoist, so that the main hoist lowering motion shall be automatically stopped when the auxiliary hoist overloading is detected.

### **c. DETAILS OF AUXILIARY HOIST DRIVE COMPONENTS**

#### **1. Motor**

The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. See section 7.0 - Electrical Equipment and Installation for further details.

#### **2. Coupling and Drum Brakes**

The coupling shall include flexible elements rated for high temperature use. Hoist brake (service brake) shall be double shoe drum brake with electro-hydraulic thruster. Brake system shall be designed for 1.6 times the hoist load and they shall be capable of braking the dynamic test load without a damaging snatch effect, and without overheating. The brake shall be suitable for the specified maximum ambient temperature. The thruster brake will be equipped with a manual release facility that will allow the load to be lowered to the ground in the event of a power supply failure. Brake assembly shall be fitted with auto-adjust wear systems. An additional status feedback signal device shall be incorporated in the brake unit to enable proper functioning of the control system.

Electro-hydraulic or electro-magnetic disc brake may be provided for light duty cranes if approved by ES.

#### **3. Emergency Brake**

The requirement of emergency brake shall be decided by the operational environment of the particular crane. In case of frequent movement of personnel below or near the crane, or if critical equipment is located within the crane operating bay, then emergency brake is a mandatory requirement.

For cranes of 50-ton capacity or more, ES shall decide whether emergency brakes are required and shall specify accordingly.

In the event of detection of over synchronous speed due to service brake failure, and slow speed slippage through the service brakes when the crane is energised, the control system shall be designed to detect this and operate the emergency brakes for holding the suspended load.



The emergency brake shall be so controlled that it is applied automatically, not later than the instant a speed of 1.15 times the normal lowering speed has been reached.

The type and mounting of emergency brake shall be either of the following, and shall be selected only after discussion with ES: -

- a. The emergency brake shall be mounted on the main hoist drum barrel flanges. The brake shall be caliper disc type with wear rings and shall be removable type.
- b. The emergency drum brakes shall be provided at the gear box input extension shafts. The brakes shall be of same type as the service brake.
- c. An emergency band brake mounted on the plain end of the hoist rope barrel (drum). The band brake shall operate either by an electro-hydraulic thruster or an electro-magnet.

#### 4. Spur Gearbox

Service Factor "f1" For Hoist Gearbox shall be considered as per the following table:

Rope receiving group	2m	3m	4m	5m
Service factor "f1"	1.2	1.40	1.60	1.80

Gearbox nominal rating "NG"

The nominal rating of the gearbox shall be determined by multiplying the actual required hoisting power with the service factor (f1). An additional impact factor shall be considered in the calculation to suit the gearbox application and potential effects of hoist acceleration before hook contact occurs. The resultant factor of safety will be indicated in the offer.

The gearbox shall be rated according to the mode of operation.

The gearbox drain point shall be piped to a location where a drop hose can be installed vertically to floor level. The gearbox shall have a valve at the gearbox casing end of this drain line to enable removal of the box.

In case planetary gearbox is offered, the hoist mechanism shall have two independent drive systems, in such a way that operation can continue at half speed

if any one of the hoist motors fail. This philosophy shall be suitably reflected in the electrical system.

#### **5. Wire Rope**

Wire rope diameter shall be calculated to DIN 15020-1 and DIN EN 12385 shall be used with an individual wire breaking strength as per the standard. Rope thimbles, if provided, shall conform to DIN 3091. The wire ropes and rope anchors will be suitable for the operating environment. Rope length shall be sufficient to reach ground level.

#### **6. Rope Drum / Gearbox Connection**

##### **a. For Heavy and Medium Duty Production Cranes**

Barrel coupling shall be provided for gearboxes conforming to DIN 15053. The barrel coupling shall be fitted with a wear monitoring device.

##### **b. Medium and Light Duty Maintenance Cranes**

Barrel coupling shall be provided for gearboxes conforming to DIN 15053. The barrel coupling shall be fitted with a wear monitoring device.

#### **7. Rope Drum**

Rope drum shall be of welded construction with grooves according to DIN 15061.

At least 2 dead turns shall be provided on the drum when the rope is at the lowest position as determined by the hoist limit switch.

Material of drum components shall be as follows: -

- Drum shell: St 52-3
- Drum trunnion: St 52-3
- Flange: RSt 37-2
- Trunnion: RSt 37-2

Emergency brake shall be provided to act on the rope drum flanges, as specified.

- #### **8. Drum Bearings**
- Self-aligning antifriction roller bearings shall be used for the drum end bearing.

### **5.2.4 MECHANICAL (CROSS TRAVEL (TROLLEY) DRIVE)**

#### **5.2.6.1 GENERAL**

The crane will have cross travel mechanism for main and auxiliary hoist drive. The cross-travel drive shall be either two (2) corner individual wheel drive or central wheel drive type,

depending on the class of duty and operational requirements, as described below. The type of drive shall be subject to acceptance by ES.

The trolley shall have minimum four (4) wheels. At least 50% (half) of all wheel sets shall be driven. It shall be verified that the acceleration power with an unloaded trolley can be transmitted to the wheel without slippage with a friction coefficient ( $\mu$ ) of 0.14 between track wheel and rail.

#### **1. HEAVY AND MEDIUM DUTY PRODUCTION CRANE**

- a. Either two (2) corner individual wheel drive train or central wheel drive train shall be provided.
- b. Individual wheel drive shall have two separate drive trains, each driving one wheel. The driven wheels will be located on diagonally opposite corners of the trolley. The motors of the drive trains shall be controlled by a single inverter drive control. Each drive train will consist of: -
  - 1 squirrel cage motor
  - 1 Peri flex shaft coupling with brake drum -1 self-adjusting double shoe brake with electro-hydraulic thrustor according to DIN 15435
  - 1 spur gearbox according to DIN 15 053
  - 1 heavy duty cardan shaft with connecting flanges.
  - 1 driven wheel according to DIN 15090
  - Hydraulic buffers
- c. Central wheel drive shall have one drive train, driving two wheels. The motor of the drive train shall be controlled by an inverter drive control. The drive train will consist of: -
  - 1 squirrel cage motor
  - 1 Peri flex shaft coupling with brake drum -1 self-adjusting double shoe brake with electro-hydraulic thrustor according to DIN 15435
  - 1 spur gearbox according to DIN 15053
  - 2 heavy duty cardan shafts with connecting flanges.
  - Minimum 2 driven wheels according to DIN 15090
  - Hydraulic buffers

#### **5.2.6.2 MEDIUM (MAINTENANCE) & LIGHT DUTY CRANE**

- a. Either two (2) corner individual wheel drive train or central wheel drive train shall be provided.

- b. Individual wheel drive shall have two separate drive trains, each driving one driven wheel or wheel set. The wheel set, if necessary, will be located on diagonally opposite corners of the crane. The motors of the drive trains shall be controlled by a single inverter drive control. Each drive train will consist of: -
- 1 geared motor with splined hollow output shaft
  - 1 driven wheel or wheel set according to DIN 15090
  - Hydraulic/rubber buffers
- c. The central wheel drive shall have one drive train, driving two wheels. The motor of the drive train shall be controlled by an inverter drive control. The drive train shall consist of: -
- 1 squirrel cage motor
  - 1 shaft coupling with brake drum -1 self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435
  - 1 spur gearbox according to DIN 15053
  - 2 cardan shafts with connecting flanges.
  - Minimum 2 driven wheels according to DIN 15090
  - Hydraulic/rubber buffers

### 5.2.6.3 GENERAL REQUIREMENTS

- Hollow shaft drive systems with spline may be offered for medium duty maintenance cranes and light duty cranes only.
- Suitable access shall be provided on the trolley platform to enable cross travel drive components to be removed via the roof service hoist.
- All drives shall be mounted on base plates and have safe access for maintenance.
- All base mounted equipment (motors, gear boxes, brakes etc.) shall be mounted on top of single solid shims, which shall not be less than 10mm in thickness.

### 5.2.6.4 DETAILS OF CROSS TRAVEL DRIVE COMPONENTS

#### a. MOTOR

The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. See section 7.0 - Electrical Equipment and Installation for further details.

#### b. GEARED MOTOR

The geared motor (STAHL / DEMAG / KONE make) with splined hollow output shaft shall be provided for medium duty maintenance cranes and light duty cranes only. The motor(s) shall be squirrel cage type, suitable for use with the inverter control system

and regenerative braking. The motor shall be provided with integral electro-magnetic disc brake. Brake shall be fitted with auto-adjust wear systems. The brake will be equipped with a manual release facility that will allow the trolley to be moved manually in the event of a total power supply failure. The geared motor shall be suitably mounted on a torque arm. See Section 7.0 - Electrical Equipment and Installation for further details on motor. Hollow splined output shaft is acceptable. Hollow keyed output shaft will not be accepted.

**c. COUPLING AND BRAKE**

Peri flex (tyre) shaft coupling with brake drum shall principally be used. The coupling shall include flexible elements rated for high temperature use. The brake shall be double shoe drum brake with electro-hydraulic thruster, conforming to DIN 15435. Brake assembly shall be fitted with auto-adjust wear systems. The brakes will be equipped with a manual release facility that will allow the trolley to be moved manually in the event of a total power supply failure.

Electro-hydraulic or electro-magnetic disc brake may be provided for light duty cranes if approved by ES.

**d. SPUR GEARBOX**

The gearbox shall be rated according to the mode of operation. **Service Factor "f2" For Travel Motion Gearboxes**

A service factor (f2), generally 1.18 shall be applied, whereby the start-up power is calculated as the total of steady-state power (Nv) and acceleration forces (Na).

The gearbox nominal output is therefore calculated as: **NG = 1.18 x (Nv + Na) (kW)**

In addition, the torque resulting from the yield point of the travel motion gearboxes must not exceed the torque on slippage of the wheels.

For the calculation of the slip torque, a friction coefficient ( $\mu$ ) of 0.25 between track wheel and rail, and the total of the maximum wheel loads of all wheels connected with one gearbox is to be applied.

The value " $\gamma$ " when comparing the torque ( $M_{0.2}$ ) from the yield point of weakest component of the gearbox with the slip torque (MR) must not fall below the value 1.

$$\gamma = \frac{M \leq 0.2}{MR} \geq 1$$

If travel limit switches are provided for cross travel movements to prevent the trolley striking the buffers at full speed, and if the buffers are designed for withstanding trolley impact at 100% of rated speed, then a friction coefficient ( $\mu$ ) of 0.2 may be considered for determining the slip torque.

The gearbox drain point shall be piped to a location where a drop hose can be installed vertically to floor level. The gearbox shall have a valve at the gearbox casing end of this drain line to enable removal of the box.

The orientation of the CT gearbox shall (preferably) be in such a way that the motor and drive connection is not directly above the cardan shaft, thus facilitating maintenance.

For geared motors, the gearbox shall have a splined hollow output shaft. The driven wheel shall be directly mounted on the gearbox output shaft. Gearbox shall have flexible mounting such that the load on wheel is not transferred to the shaft.

**e. CARDAN SHAFT**

Cardan shaft shall be provided for connection between gearbox output shafts and driven wheels. The Cardan shafts shall have connecting flanges.

**f. WHEEL SETS**

**1. Heavy and Medium Duty Production Crane**

The driving and trailing wheel sets shall have a common sub-assembly. The trailing wheels shall be provided with cardan shaft flange couplings, identical to those used in driving wheels, fitted on the shafts. The coupling shall be provided with suitable static (non-rotating) bolted cover.

The wheels shall be flanged according to DIN 15072 with bearings in dismountable diagonal split housings giving unit change facility (wheel, shaft, bearings). Wheel diameter shall conform to DIN 15070. The bearing housings shall be attached to the structure with through bolts. The use of set screws and tapped holes is not acceptable.

The wheel shall be fitted on shaft by interference fit. All wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel

and bearings from the shaft. The oil injection system for wheel shall be provided with either one or two injection bores, depending upon the width of the wheel.

## **2. Medium (Maintenance) & Light Duty Crane**

The driving and trailing wheel sets shall have a common sub-assembly. In case of central motor drive, the trailing wheels shall be provided with a cardan shaft flange coupling, identical to those used in driving wheels, fitted on the shafts. The coupling shall be provided with suitable static (non-rotating) bolted cover.

In case of geared motor drive, the trailing wheels shall be provided with a shaft, identical to those used in driven wheels (except the splined portion).

The wheels shall be flanged according to DIN 15072 with bearings in dismountable diagonal split housings giving unit change facility (wheel, shaft, bearings). Wheel diameter shall conform to DIN 15070. The bearing housings shall be attached to the structure with through bolts. The use of set screws and tapped holes is not acceptable

The wheel shall be fitted on shaft by interference fit. All wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel and bearings from the shaft. The oil injection system for wheel shall be provided with either one or two injection bores, depending upon the width of the wheel.

### **g. BUFFER**

Hydraulic buffers or cylindrical rubber buffers shall be provided on the four corners of the trolley, as specified. The buffers shall be suitable to stop the trolley movement at full rated speed without any damage either to the trolley or the buffers. Suitable end stops shall be provided on the bridge girder. Position of buffers shall match the end stops.

## **5.2.5 MECHANICAL (LONG TRAVEL DRIVE)**

### **5.2.6.1 GENERAL**

The long travel drive shall be either two (2) corner or four (4) corner individual wheel drive, depending on the class of duty and operational requirements, as described below. The type of drive shall be subject to acceptance by ES.

The crane shall have minimum four (4) long travel wheels. At least 50% (half) of all wheel sets shall be driven. It shall be verified that the acceleration power with an unloaded crane can be transmitted to the wheel without slippage with a friction coefficient ( $\mu$ ) of 0.14 between track wheel and rail.

**a. HEAVY AND MEDIUM DUTY PRODUCTION CRANE**

1. Either two (2) corner or four (4) corner individual wheel drive train shall be provided.
2. Individual wheel drive shall have two or four separate drive trains, each driving one driven wheel or wheel set. The wheel set, if necessary, will be located on diagonally opposite corners of the crane. The motors of the drive trains shall be controlled by a single inverter drive control. Each drive train will consist of: -
  - 1 squirrel cage motor
  - 1 Peri flex shaft coupling with brake drum -1 self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435
  - 1 spur gearbox according to DIN 15 053
  - 1 heavy duty cardan shaft with connecting flanges.
  - 1 driven wheel or wheelset according to DIN 15090 (if necessary mounted in an equalising bogie)
  - Hydraulic buffers

**5.2.6.2 MEDIUM (MAINTENANCE) & LIGHT DUTY CRANE**

- a. Either two (2) corner or four (4) corner individual wheel drive train shall be provided. The drive system shall consist of a geared motor with hollow splined output shaft arrangement.
- b. Individual wheel drive shall have two or four separate drive trains, each driving one driven wheel or wheel set. The wheel set, if necessary, will be located on diagonally opposite corners of the crane. The motors of the drive trains shall be controlled by a single inverter drive control. Each drive train will consist of: -
  - 1 no. geared motor with hollow splined output shafts
  - 1 no. driven wheel or wheelset according to DIN 15090 (if necessary mounted in an equalising bogie)
  - 1 no. trailing wheel or wheelset according to DIN 15090 (if necessary mounted in an equalising bogie).
  - Hydraulic buffers

**5.2.6.3 GENERAL REQUIREMENTS**



- a. Hollow shaft drive systems with spline may be provided for medium duty maintenance cranes and light duty cranes only.
- b. All drives shall be mounted on base plates and have safe access for maintenance.
- c. Suitable access platforms, ladders, hand railings etc. shall be provided long travel drive components to be removed via the roof service hoist.
- d. All brakes and motors shall be mounted on top of single solid shims, which shall not be less than 10mm in thickness. Geared motors, however, may be mounted on wheels through torque arms.
- e. Substantial anti-derailing brackets shall be installed on the underside of the wheel bogies to prevent derailment in the event of guide roller failure.
- f. Suitable rail cleaning facilities shall be provided on all four sides of the crane.

#### **5.2.6.4 DETAILS OF LONG TRAVEL DRIVE COMPONENTS**

##### **a. MOTOR**

The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. See section 7.0 – Electrical Equipment and Installation for further details.

##### **b. GEARED MOTOR**

The geared motor (STAHL / DEMAG / KONE make) with splined hollow output shaft shall be provided for medium duty maintenance cranes and light duty cranes only. The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. The motor shall be provided with integral electro-magnetic disc brake. Brake shall be fitted with auto-adjust wear systems. The brake shall be equipped with a manual release facility that will allow the crane to be moved manually in the event of a total power supply failure. The geared motor shall be suitably mounted on a torque arm. See Section 7.0 - Electrical Equipment and Installation for further details on motor. Hollow splined output shaft is acceptable. Hollow keyed output shaft will not be accepted.

##### **c. COUPLING AND DRUM BRAKES**

Peri flex (tyre) shaft coupling with brake drum shall principally be used. The coupling shall include flexible elements rated for high temperature use. The brake shall be double shoe drum brake with electro-hydraulic thruster, conforming to DIN 15435. Brake assembly shall be fitted with auto-adjust wear systems. The brakes shall be equipped with a manual release facility that will allow the trolley to be moved manually in the event of a total power supply failure.

Electro-hydraulic or electro-magnetic disc brake may be provided for light duty cranes if approved by ESI.

**d. SPUR GEARBOX**

The gearbox shall be rated according to the mode of operation. Service Factor "f2" For Travel Motion Gearboxes

A service factor (f2), generally 1.18 shall be applied, whereby the start-up power is calculated as the total of steady-state power (N<sub>v</sub>) and acceleration forces (N<sub>a</sub>).

The gearbox nominal output is therefore calculated as:  $NG = 1.18 \times (N_v + N_a)$  (kW)

In addition, the torque resulting from the yield point of the travel motion gearboxes must not exceed the torque on slippage of the wheels.

For the calculation of the slip torque, a friction coefficient ( $\mu$ ) of 0.25 between track wheel and rail, and the total of the maximum wheel loads of all wheels connected with one gearbox is to be applied.

The value " $\gamma$ " when comparing the torque ( $M_{\theta 0.2}$ ) from the yield point of weakest component of the gearbox with the slip torque (MR) must not fall below the value 1.

$$\gamma = \frac{M_{\theta 0.2}}{MR} \geq 1$$

If travel limit switches are provided for long travel movements to prevent the crane buffers striking the rail stoppers buffers at full speed, and if the buffers are designed for withstanding trolley impact at 85% of rated speed, then a friction coefficient ( $\mu$ ) of 0.2 may be considered for determining the slip torque.

The gearbox drain point shall be piped to a location where a drop hose can be installed vertically to floor level. The gearbox shall have a valve at the gearbox casing end of this drain line to enable removal of the box.

The orientation of the LT gearbox shall (preferably) be in such a way that the motor and drive connection is not directly above the cardan shaft, thus facilitating maintenance.

For geared motors, the gearbox shall have a splined hollow output shaft. The driven wheel shall be directly mounted on the gearbox output shaft. Gearbox shall have flexible mounting such that the load on wheel is not transferred to the shaft.

**e. CARDAN SHAFT**

Cardan shaft shall be provided for connection between gearbox output shafts and driven wheels. The Cardan shafts shall have connecting flanges. Cardan shaft drop hangers shall also be provided (if applicable).

**f. WHEEL SETS**

**1. Heavy and Medium Duty Production Crane**

The driving and trailing wheel sets shall have a common sub-assembly. The trailing wheels shall be provided with cardan shaft flange couplings, identical to those used in driving wheels, fitted on the shafts. The coupling shall be provided with suitable static (non-rotating) bolted cover.

The wheels shall be flangeless according to DIN 15072 with bearings in dismountable diagonal split housings giving unit change facility (wheel, shaft, bearings). Wheel diameter shall conform to DIN 15070. The bearing housings shall be attached to the structure with through bolts. The use of set screws and tapped holes is not acceptable.

The wheel shall be fitted on shaft by interference fit. All wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel and bearings from the shaft. The oil injection system for wheel shall be provided with either one or two injection bores, depending upon the width of the wheel.

**2. Medium (Maintenance) & Light Duty Crane**

The driving and trailing wheel sets shall have a common sub-assembly. The trailing wheels shall be provided with a shaft, identical to those used in driven wheels (except the splined portion).

The wheels shall be flanged according to DIN 15072 with bearings in dismountable diagonal split housings giving unit change facility (wheel, shaft, bearings). Wheel diameter shall conform to DIN 15070. The bearing housings shall be attached to the

structure with through bolts. The use of set screws and tapped holes is not acceptable

The wheel shall be fitted on shaft by interference fit. All wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel and bearings from the shaft. The oil injection system for wheel shall be provided with either one or two injection bores, depending upon the width of the wheel.

**g. SIDE GUIDE ROLLER**

Side guide rollers shall be provided on all Heavy and Medium Duty Production Cranes for transferring crane horizontal forces to the rails, thus ensuring proper alignment of LT wheels on rails.

As no specific DIN Standard exists for horizontal side guide rollers, the surface contact pressure shall be calculated according to DIN 15070. The resultant calculation must prove that the loads on the guide roller wheels are far below the permissible pressure as per the standard.

Horizontal guide rollers shall be eccentrically mounted at one end of the bridge and shall be adjustable at site. The roller shall be provided with two surfaces, an upper and a lower one, so that if one of the surfaces is worn, the second surface can be used by turning the roller.

ES and the contractor shall mutually discuss and decide whether horizontal side guide rollers for guiding on one end of the bridge will be required, depending upon acceleration forces to be transmitted. The location/orientation of any subsequent guide rollers is to be agreed with ES.

**h. HYDRAULIC BUFFER**

Hydraulic buffers shall be provided on the outboard side of all cranes. Position of buffers shall match new or existing rail end stops, as well as new or existing cranes. Extended buffer structure shall be provided, if required.

**5.2.6 MECHANICAL (AUXILIARY SERVICE HOIST)**

**5.2.6.1 AUXILIARY SERVICE HOIST ON CRANE**

Auxiliary service hoist shall be provided on crane, if specified. The hoist shall be of modular compact design, suitable for use in steelworks environment. The hoist shall be either 5 ton or 10-ton capacity and shall have electrically operated hoist drive and travel drive.

The hoists shall be mounted on separate monorail beams on the crane above the top level of the bridge girder. The rope drum of each hoist shall be covered to prevent accumulation of dirt on the drum/ropes. The hook block shall have two fall design.

For steel melt shop cranes, the hooks shall be fitted with suitable latch devices that will allow opening from the furnace floor area when electrodes are handled.

The hoists shall be fitted with overload & slack rope protection.

Maintenance access platforms shall be provided for access to either side of the hoist. This platform will have either a metallic non-slip or alternatively an open mesh flooring to prevent the accumulation of dirt.

The hoist monorail runway beam in the parking area, shall be spliced so that the complete hoist unit can be removed for maintenance or replacement. The hoist will be removed by the roof service hoist, and the auxiliary service hoist will be carried on a section of the monorail beam. To enable rapid removal/replacement of the hoist, all cables to the hoist will be terminated by industrial plugs and sockets.

All other requirements of the hoist shall be as per Section 11-1.3 of this standard.

### **5.2.7 LUBRICATION SYSTEM**

All static grease points of the crane drives shall be grouped together via grease lines. The minimum requirement is for the grease lines to be individually fed via AR 3/8 (DIN 3404) grease nipples, mounted on a common block. The grease nipple type shall be standardised "pull-on" type wherever possible for all equipment on the crane.

All grease lines shall be constructed from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

All oils and lubricants provided shall be as per written agreement by ES during engineering design stage.

Lubrication drawings shall be provided that clearly show the lubrication requirements. These drawings shall be converted to A3 size, they shall be 'plasticised/laminated' and stored in a suitable covered box, either in the driver's cabin or at an agreed location.

## 5.2.8 STEELWORK

### 5.2.8.1 BRIDGE GIRDER AND END CARRIAGE

#### a. GENERAL

Design of bridge girders and end trucks (carriages) shall be determined as per the design capacity of the crane and operational requirements. The bridge girders can be both fully enclosed (non-accessible) type, or they could be of different sizes, one walk-in type and the other a smaller fully enclosed (non-accessible) type, or they could be both wide, walk-in type box girders.

For fully enclosed, non-accessible type bridge girders, all electrical switchgears and air-conditioning panels shall be mounted on top of the girder.

For box girders of two different sizes, the wider girder shall be walk-in type. It shall be insulated and air conditioned since it will house the electrical switchgears.

For larger cranes, both girders shall be walk-in type and consideration shall be given to whether both girders shall be insulated and air conditioned to house electrical switchgears.

Thickness of any structural component used in the bridge girders and end carriages shall not be less than 8 mm.

The deflection of the girders subjected to nominal test load (DIN 15 030) and trolley weight must not exceed 1/1000 of the bridge span. Girders shall also be positively cambered with a minimum amount equal to the dead load deflection plus the deflection caused by the trolley weight including ropes and hook block(s) and 50% of the safe working load of the crane.

Drive systems for the long travel motion shall be base mounted on suitable platforms for light and medium duty cranes. Larger cranes shall have the drive trains preferably mounted inside the box girders.

The box girders shall be rigidly connected at one end by a continuous box-section end carriage.

Generally, halved double T-sections will be welded on top of the bridge girders to carry the trolley rails.

The girders containing electrical equipment shall be suitably insulated and air conditioned to maintain a suitable working temperature for the components.

The electrical room will provide a suitable storage area for maintenance manuals and drawings/documentation.

Design of crane shall consider that the track wheels might need to be arranged in pairs in equalizer trucks to accommodate deviations in the long travel rail level.

Consideration will also be given to alternative arrangements that will ensure proper distribution of the crane loads to the gantry.

To allow for wheel deviation, the difference in individual wheel loading shall not exceed 10%.

It must be observed that the natural frequency in vertical direction shall not fall below the value 3.

The design of the end truck (carriage) shall be determined considering all aspects of the work regime. The requirement for articulated connection (by two (2) coupling pieces) lays with the contractor.

Heat protection (shielding) and insulation shall be provided for cranes operating within areas of high thermal radiation.

**b. MEDIUM AND LIGHT DUTY MAINTENANCE CRANES**

In general, wide box girders shall be provided, with full length walkways along the main girder, platforms for electrical equipment, long travel drive, etc.

Generally, the box girders shall have bolted connection with the end carriages.

Generally, halved double T-sections will be welded on top of the bridge girders to carry the trolley rails.

The deflection of the girders subjected to nominal test load (DIN 15030) and trolley weight must not exceed 1/1000 of the bridge span. Girders shall also be positively cambered with a minimum amount equal to the dead load deflection plus the deflection caused by the trolley weight including ropes and hook block(s) and 50% of the safe working load of the crane.

It must be observed that the natural frequency in vertical direction shall not fall below the value 3.

Heat protection (shielding) and insulation shall be provided for cranes operating within areas of high thermal radiation.

#### **5.2.8.2 TROLLEY FRAME**

The trolley frame shall be made of plates and steel sections in welded construction with welded-on and welded-in transoms, bearing brackets and mounts to accommodate the mechanical and electrical equipment. All openings shall be covered or provided with handrails. The railings shall be fitted in accordance with the VBG 09, Rules for the Prevention of Accidents.

The arrangement of components on the trolley shall be designed to prevent accumulation of tripping hazards. Oil drip trays shall be provided under gearboxes wherever necessary. Cardan shaft drop hangers shall also be provided (if applicable).

The trolley structure shall be designed with due consideration of maintenance requirements. All components and component fixings/fasteners etc. shall be easily accessible from fixed platforms. The design shall also consider the easy and straightforward removal of the heaviest / largest item of equipment.

For all cranes, the trolley design shall ensure that the trolley floor area is sufficient to guarantee that there is no restricted access to any component. Climbing over of components is unacceptable.

#### **5.2.8.3 OPERATOR'S CABIN**

##### **a. HEAVY /MEDIUM /LIGHT DUTY PRODUCTION/MAINTENANCE CRANE**

1. Operator's cabin shall be provided if specified in the enquiry.
2. The operator's cabin must have the following features:



- Roof suspension
  - Closed design
  - Double-walled or equivalent
  - Heat-insulation
  - Safety insulated glass panes
  - Full-vision front and sides and designed in such a way that each window can be easily accessed, allowing for cleaning of the outside of each glass pane.
  - Air conditioning system (with option for back-up system)
  - Double-hinged doors with window and pad locking facilities
  - Access via stairways.
  - Emergency escape route (separate to normal staircase access / walkway)
  - Fire extinguisher
  - Mini refrigerator
  - Copy of VBG9 'operator's instructions for cranes' (printed in both English and Arabic)
3. The operator's cabin will either be fixed or travelling type, depending upon the requirements of the ES. Heat protection (shielding) and insulation shall be provided for the cabin for cranes operating in areas of high thermal radiation and high ambient temperature. Pivot or fulcrum type design for suspension of travelling cabins is not acceptable to ES.

#### **5.2.8.4 SAFETY ASPECTS**

- All points of hazard, for example buffers, hook blocks, spreader beams, steps, narrow passages, supports, etc. on the crane shall be marked and they have to comply/ meet DIN 15026 'Marking of Points of Hazard'.
- All equipment shall be easily accessible for ease of maintenance.
- Ladders arranged at the four corners of the end carriages shall provide access to the platforms. For cabin-controlled cranes, each access position shall incorporate an access acknowledgement boarding system connected to the crane operator's cabin, if specified.
- The access system shall be interlocked with crane operation.
- Crane bridge shall be equipped with necessary railings and safety ladders. All ladder rungs shall be of square bar.
- Suitable access staircases shall be provided, and the safety of personnel shall be of primary consideration during the design of such staircases and platforms.

- Hand railing shall be of tubular section around all access and walkways at a minimum of 1100 mm high. Walkways shall be minimum 800 mm wide with open grating or non-skid plate.
- Nameplate shall be attached to the crane bridge in a clearly visible position, indicating the crane serial number, safe working load and year of manufacture. The name plate shall be written in both English and Arabic.
- All major components shall have suitable lifting lugs or lifting points designed in facilitate erection/maintenance. to
- Protection shall be provided against accidental contact of the hook blocks or any other suspended lifting devices with the DSL lines.
- All fasteners on the crane will be of minimum 8.8 grade and shall have 'Pal type' locking nuts fitted. 'Nyloc' type locking nuts shall not be used.
- Bolted connections shall be of high tensile structural bolting (galvanised or black - 10.9 grade, lightly oiled). All such bolts shall be correctly torqued (tightened).
- Raised areas on the top of the girders and on the trolley, frame will be fitted with suitable ramped covers to reduce the trip hazard.
- Clearances and hook approaches: Hook approaches and clearance envelope must be maintained for operational requirements. For new plants the hook approaches and clearance envelope must reach operational requirements for the new design.

#### **5.2.8.5 CRANE GANTRIES AND CRANE RAILS**

##### **a. GENERAL**

1. For new crane(s) installed in an existing bay with old runways/rails.

The existing crane gantries and rails are old and therefore due to the age of the structure rail alignment according to VDI 3576 will not be achieved. However, the wheel loading of the crane(s) shall be such as not to induce any further detrimental effects to the existing crane gantries, rails and structures. The design of the crane(s) shall consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

2. For new crane(s) installed in an existing bay with good runways/rails.

The existing crane gantries and rails are relatively new and therefore they are good enough to carry the new crane(s).

However, the wheel loading of the proposed crane(s) shall be such as not to induce any detrimental effects to the existing crane gantries, rails and structures.

Structure rail alignment according to VDI 3576 shall be achievable.

The design of the crane(s) shall consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

3. For new crane(s) installed in a brand-new bay

The structure rail alignment according to VDI 3576 shall be achieved and the wheel loading of the proposed crane(s) shall be such as not to induce any detrimental effects to the existing crane gantries, rails and structures.

The design of the crane(s) must consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

**b. CRANE TRACK RAILS**

Dimensions The long travel rails will have rail dimensions as per DIN 536, type A. The rails will be fixed with rail clips. In addition, the rail will be mounted on a resilient pad.

Fixing of Rails

All rails for the long and cross travel motions shall be fixed with clips. Welding of rails to the runway girders and/or EOT bridge girders is not acceptable.

The rails shall be joined by welding using Thermite process.

Track Pads Track pads shall be provided underneath all new rails. The track pads shall be products of competent manufacturers.

**c. Material**

The rails shall have a minimum tensile strength of 690 N/mm<sup>2</sup>. Test certificates shall be submitted. The crane rails for steel plant (melt shop, continuous casting area, cooling bed area, billet/bloom/slab bay area) and rolling mills use shall be made from killed steel as recommended in DIN 536. Rails, clips and resilient pads shall preferably be of GANTRY make.

**d. Interfacing New and Existing Equipment**

Close co-ordination will be required to ensure interfacing of new and existing equipment, e.g. the power collector shoes to the down shop conductor rails, position of LT buffers, rail stoppers, available height between roof & rail etc.

### 5.2.8.6 CRANE INSTALLATION

Installation and commissioning work shall be performed by skilled artisans and labourers under strict supervision and responsibility of experienced engineers. (documentation shall be produced upon request).

In case of erection of a new crane on a bay where another crane(s) is operating, suitable temporary buffer stops shall be used for isolation of the erection area. The temporary buffer stops shall be properly designed. Type of stop (bolted or welded type) shall be decided after discussion with ES. Design, supply, installation and removal of temporary buffer stops shall be included in the contractor's scope of work.

## 5.3 Single Girder Overhead Cranes

### 5.3.1 GENERAL

This part outlines ES's requirements for design, fabrication, supply, delivery, installation, testing, certification, erection and commissioning of Single-girder electric overhead travelling (EOT) cranes and crane runways for use in Emirates Steel (ES).

Refer to Section 11-060 for: -

- Definitions
- Codes and Standards
- Lifting Devices (Attachments)
- Electrical Equipment and Installation
- Air Conditioning Systems
- Surface Preparation and Coating
- Tooling
- Tests and Inspection
- Documentation

### 5.3.2 CLASSIFICATION

#### 5.3.2.1 GENERAL

Classification of a particular crane shall be based on the operating conditions of the most severely loaded part of the crane and shall be agreed with ES prior to order placement. For replacement of existing cranes, the classification shall be according to the Table given below. For new cranes, the classification shall be generally according to DIN 15018 Part 1, which shall be discussed and finalised with ES. For details of technical requirements of various cranes as per location and use, refer to "Crane Requirement Chart" enclosed with this section.

### 5.3.2.2 DRIVES

#### a. ROPE DRIVES

The calculation of rope drives shall be in accordance to DIN 15020 to ensure an adequate degree of safety of operation of the lifting appliance and to achieve an adequate service life for the wire ropes used. The relation of rope diameter to rope sheave diameter respectively rope drum diameter shall be according to the relevant DIN standards.

SI	Location	Description	Duty	Hoist Class	Lifting Category	Stress Group
1	Direct Reduction Plant	EOT crane (flame / explosion proof)	Low	2m-3m	H1	B2
2	Direct Reduction Plant	EOT crane (No protection)	Low	2m	H2	B3
3	Hot Strip Mill	Furnace maintenance crane	Low	1 Am	H1	B2
5	Hot Strip Mill	Roll shop EOT crane	Low	1 Am	H2	B3
6	Steel Plant	Melt shop – Relining crane	Medium	2m	H2	B3
7	Steel Plant	Mould shop – Maintenance crane	Low	2m	H2	B3
8	Steel Plant	Workshop – Maintenance crane	Low	2m	H2	B3
9	Utility	EOT crane (Sea Water inlet channel)	Low	1 Am	H1	B2

### 5.3.3 MECHANICAL

#### 5.3.3.1 GENERAL

The crane shall consist of a monorail type bridge girder, travelling electric hoist with trolley unit, two end trucks (carriages), festoon system, pendant/remote station, control panel(s), etc. including all its associate parts such as power bus bars, etc.

#### 5.3.3.2 HOIST DRIVE

- a. The crane will have one (1) hoist mechanism. The mechanical components of the hoist drive shall be rated according to their mode of operation into a drive group in accordance with DIN 15020 in order to achieve the required long service life. All hoist components will be accessible for maintenance.
- b. A travelling electric hoist with single reeved wire rope and bottom block, conforming to DIN 15409, shall be provided (STAHL or DEMAG make). The hoist shall have both hoist drive and cross travel drive.
- c. The hook shall have a safety latch to prevent accidental release of the load and the hook shall be supported in such a way as to enable it to rotate 360 degrees. For certain

cranes, a lockable hook shall be provided, as specified by ES. The hook and its supports shall be designed in such a way to enable it to lock at every 90-degree interval.

d. Emergency Brake

The requirement of emergency brake shall be decided by the operational environment of the particular crane. In case of frequent movement of personnel below or near the crane, or if critical equipment is located within the crane operating bay, then emergency brake is a mandatory requirement.

In the event of detection of over synchronous speed due to service brake failure, and slow speed slippage through the service brakes when the crane is energised, the control system will detect this and operate the emergency brakes for holding the suspended load.

The emergency brake shall be so controlled that it is applied automatically, not later than the instant a speed of 1.15 times the normal lowering speed has been reached.

The type and mounting of emergency brake shall be either of the following, and shall be selected only after discussion with ES: -

- i) The emergency brake shall be mounted on the main hoist drum barrel flanges. The brake shall be caliper disc type with wear rings and shall be removable type.
- ii) The emergency drum brakes shall be provided at the gear box input extension shafts. The brakes shall be of same type as the service brake.
- iii) An emergency band brake mounted on the plain end of the hoist rope barrel (drum). The band brake shall operate either by an electro-hydraulic thruster or an electro-magnet.

- e. All other technical requirements of the electric hoist shall be as per Section 11, Part 5 (electric hoist) of this standard.

### **5.3.3.3 CROSS TRAVEL DRIVE**

- a. The travelling electric hoist shall be provided with cross travel arrangement with electric geared motor drive. The number of drives shall be indicated by the supplier based on calculations, which shall be subject to approval by ES.
- b. The wheels shall be suitable to run on the lower flange of the girder.

### **5.3.3.4 LONG TRAVEL DRIVE**

- a. The long travel drive arrangement shall comprise of: -

- 2 geared motors with splined output shafts
  - 2 flanged driving wheels
  - 2 flanged idle wheels
  - Hydraulic buffers or Cellular Rubber (of type acceptable to ES)
- b. The number of the driven & idle wheels shall be calculated based on total number of wheels and the acceleration forces to be transmitted. However, each truck (end carriage) shall have at least one driven and one idle wheel.
- c. The driven and idle wheels shall have a common sub-assembly. The idle wheels shall be provided with a splined shaft, identical to those used in driven wheels. Keyed shafts shall not be accepted. Hollow shaft drive systems shall not be incorporated in the design.
- d. All long travel wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel and bearings from the shaft. Dependent upon the width of the wheel, the oil injection system shall be provided with either one or two or multiple injection bores.

#### **5.3.3.5 HYDRAULIC BUFFER**

- a. Hydraulic buffers shall be provided on the outboard side of all cranes. Position of buffers shall match new or existing rail end stops, as well as new or existing cranes. Extended buffer structure shall be provided, if required. All hydraulic buffers shall be of OLEO make.

#### **5.3.3.6 LUBRICATION SYSTEM**

All static grease points of the crane drives shall be grouped together via grease lines. The minimum requirement is for the grease lines to be individually fed via AR 3/8 (DIN 3404) grease nipples, mounted on a common block. The grease nipple type shall be standardised "pull-on" type wherever possible for all equipment on the crane.

All grease lines shall be constructed from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

All oils and lubricants provided shall be as per written agreement by ES during engineering design stage.

Lubrication drawings shall be provided that clearly show the lubrication requirements. These drawings shall be converted to A3 size, they shall be 'plasticised/laminated' and stored in a suitable covered box, either in the driver's cabin or at an agreed location.

#### **5.3.3.7 GENERAL REQUIREMENTS**

- a. **Parking/Maintenance Area:** The Contractor is responsible for ensuring fabrication and installation of an operationally safe parking/maintenance provides easy access and guarantees complete serviceability of the system. the design, area, which
- b. There shall be adequate working access for maintenance provided by means of a working platform, located at the parking area for the crane.
- c. Suitable access staircases shall be provided, and the safety of personnel shall be primary consideration during the design of such staircases and platforms.
- d. **Clearances and hook approaches:** The hook approaches and clearance envelope shall be suitable to the building structure and operational requirements.
- e. **Rope:** Rope length shall be sufficient to reach ground level. Rope guides shall be made of metal. Plastic rope guides are not acceptable.

#### 5.3.4 STEELWORK

##### 5.3.4.1 MATERIAL

- a. The steelwork will consist of structural steels according to DIN EN 10025.
- b. In normal cases, all stress-bearing elements up to a metal thickness of 30 mm shall be fabricated of S355JRG3 or equivalent, whereas S355J2G3 or equivalent will be used for metal thickness above 30 mm.
- c. Rolled sections and weld-in components can also be made of high strength steel, if required.
- d. Non stress-bearing structures can be made from S235JRG2 or equivalent.

##### 5.3.4.2 BRIDGE GIRDERS AND END TRUCKS

- a. Design of bridge girder and end carriages shall be determined as per the design capacity of the crane and operational requirements. In general, I-beam type bridge girder shall be provided.
- b. The girder shall be rigidly supported to both end trucks through end connection plates and high tensile bolts tightened to the required torque.
- c. The deflection of the girders subjected to nominal test load (DIN 15 030) and trolley weight must not exceed 1/1000 of the bridge span. Girders shall also be positively cambered with a minimum amount equal to the dead load deflection plus the deflection caused by the trolley weight including ropes and hook block(s) and 50% of the safe working load of the crane.
- d. It must be observed that the natural frequency in vertical direction must not fall below the value 3.
- e. Heat protection (shielding) and insulation shall be provided for cranes operating within areas of high thermal radiation.



#### 5.3.4.3 SAFETY ASPECTS

- a. All points of hazard, for example buffers, hook blocks, steps, narrow passages, supports, etc. on the crane shall be marked and they have to comply/ meet DIN 15026 'Marking of Points of Hazard'.
- b. Nameplate shall be attached to the crane bridge in a clearly visible position, indicating the crane serial number, safe working load and year of manufacture. The name plate shall be written in both English and Arabic.
- c. All major components shall have suitable lifting lugs or lifting points designed into facilitate erection/maintenance.
- d. Protection shall be provided against accidental contact of the hook blocks or any other suspended lifting devices with the DSL lines.
- e. All fasteners on the crane shall be of minimum 8.8 grade and shall have 'Pal type' locking nuts fitted. 'Nyloc' type locking nuts shall not be used.
- f. Bolted connections shall be of high tensile structural bolting (galvanised or black - 10.9 grade, lightly oiled). All such bolts shall be correctly torqued as per DIN 18800.
- g. All equipment shall be easily accessible for ease of maintenance.
- h. Ladders shall be provided at four corners of the end carriages for access.
- i. Crane maintenance platform shall be equipped with necessary railings and safety ladders. All ladder rungs shall be of square bar. Suitable access staircases shall be provided, and the safety of personnel shall be of primary consideration during the design of such staircases and platforms. Vertical access ladders are not normally acceptable.
- j. Hand railing shall be of tubular section around all access and walkways at a minimum of 1100 mm high. Walkways shall be minimum 800 mm wide with open grating or non-skid plate.

#### 5.3.4.4 CRANE GANTRIES AND CRANE RAILS

##### a. GENERAL

Structure rail alignment according to VDI 3576 shall be achievable.

##### b. CRANE TRACK RAILS

###### 1. Dimensions

The long travel rails shall have rail dimensions to DIN 536-Type A. The rails will be fixed with rail clips. In addition, the rail shall be mounted on a resilient pad.

###### 2. Fixing of Rails

All rails for the long travel motions shall be fixed with clips. Welding of rails to the runway beams is not acceptable. The rails shall be joined by welding using Thermit process.

### 3. Track Pads

Track pads shall be provided underneath all new rails. The track pads shall be products of competent manufacturers.

### 4. Material

The rails shall have a minimum tensile strength of 690 N/mm<sup>2</sup>. Test certificates shall be submitted.

The crane rails for steel plant (melt shop, continuous casting area, cooling bed area, billet bay area), rolling mill and hot strip mill use shall be made from killed steel as recommended in DIN 536.

Rails, clips and resilient pads shall preferably be of GANTRY make.

### 5. Interfacing New and Existing Equipment

Close co-ordination will be required to ensure interfacing of new and existing equipment, e.g. the power collector shoes to the down shop conductor rails, position of LT buffers, rail stoppers, available height between roof & rail etc.

#### 5.3.4.5 CRANE INSTALLATION

Installation and commissioning work shall be performed by skilled artisans and laborers under strict supervision and responsibility of experienced engineers. Documentation shall be produced upon request.

## 5.4 Gantry Cranes

### 5.4.1 GENERAL

This part outlines ES's requirements for design, fabrication, supply delivery, installation, testing certification, erection and commissioning of Double Girder Gantry (Goliath) or Semi-Gantry (Semi-Goliath) cranes and crane runways for use in Emirates Steel (ES).

**Gantry Crane:** The crane shall be of top running double-girder gantry type with all motions electrically operated. The crane shall mainly consist of bridge girders, fixed and articulated/hinged legs, hoist drive, cross travel drive and trolley unit, two end carriages, long travel drive, trolley festoon system, pendant festoon system with pendant station,

control panel, cable reeling drum etc. The crane may be required to be operated from an open pulpit or operator's cabin.

**Semi-Gantry Crane:** The crane shall be of top running double-girder semi-gantry type with all motions electrically operated. The crane shall mainly consist of bridge girders, fixed or articulated legs, hoist drive, cross travel drive and trolley unit, two end carriages, long travel drive, trolley festoon system, pendant festoon system with pendant station, control panel, cable reeling drum etc. The crane may be required to be operated from an open pulpit.

Refer to Section 11-060 for: -

- Definitions
- Codes and Standards
- Lifting Devices (Attachments)
- Electrical Equipment and Installation
- Air Conditioning Systems
- Communications Systems
- Fire Detection
- Surface Preparation and Coating
- Tooling
- Tests and Inspection
- Documentation

## 5.4.2 CLASSIFICATION

### 5.4.2.1 GENERAL

Classification of a particular crane shall be based on the operating conditions of the most severely loaded part of the crane and shall be agreed with ES prior to order placement. For replacement of existing cranes, the classification shall be according to the Table given below. For new cranes, the classification shall be generally according to DIN 15018 Part 1, which shall be discussed and finalised with ES. For details of technical requirements of various cranes as per location and use, refer to "Crane Requirement Chart" enclosed with this section.

### 5.4.2.2 ROPE DRIVES

The calculation of rope drives shall be in accordance to DIN 15020 to ensure an adequate degree of safety of operation of the lifting appliance and to achieve an adequate service life

for the wire ropes used. The relation of rope diameter to rope sheave diameter respectively rope drum diameter shall be according to the relevant DIN standards.

SI	Location	Description	Duty	Hoist Class	Lifting Category	Stress Group
1	Scrap	Gantry Crane	High	4m	H4	B6
2	Scale Pit	Gantry Crane	Medium	3m	H2	B4
3	Rolling	Gantry Crane	High	4m	H3	B5
4	Rolling	Gantry Crane	Low	1:00	H2	B3
5	Rolling	Semi-Gantry Crane	Low	1:00	H2	B3
6	Rolling	Semi-Gantry Crane	Medium	1:00	H2	B3

### 5.4.3 MECHANICAL (HOIST DRIVE)

#### 5.4.3.1 GENERAL

The crane will have one (1) hoist mechanism with / without auxiliary hoist. The hoist shall be electrically operated, single reeved wire rope type, with a hook block having a single hook with safety latch. The hook shall be able to rotate 360 degree. Alternatively, the hook block shall have forged eye bar for grab connections.

The mechanical components of the hoist drive(s) shall be rated according to their mode of operation into a drive group in accordance with DIN 15020 in order to achieve the required long service life. All hoist components shall be accessible for maintenance.

The hoist drive shall comprise of the following main components:

- 1 no. squirrel cage motor
- 1 no. Peri flex shaft coupling with brake drums
- 
- 1 no. self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435
- 1 no. Spur gearbox according to DIN 15053
- 1 no. barrel coupling for each drum connection
- 1 no. rope drum
- Drum bearings
- Emergency disc/shoe brakes operating on barrel flanges/gear box shaft (if required)  
Type SIME
- Hoist limit switches (rotary type barrel end shafts)

- Wire ropes
- Bottom block as per DIN 15409 (lockable at 4 points at 90° interval, if required) Overload and slack rope protection system

#### **5.4.3.2 DETAILS OF MAIN HOIST DRIVE COMPONENTS**

##### **a. MOTOR**

The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. See section 7.0 - Electrical Equipment and Installation for further details.

##### **b. COUPLING AND DRUM BRAKES**

Peri flex (tyre) shaft couplings with brake drums shall principally be used. The coupling shall include flexible elements rated for high temperature use. Hoist brake shall be double shoe drum brake with electro-hydraulic thrustor. Brake system shall be designed for 1.6 times the hoist load and they shall be capable of breaking the dynamic test load without a damaging snatch effect, and without overheating. The brake shall be suitable for the specified maximum ambient temperature. The thrustor brake will be equipped with a manual release facility that will allow the load to be lowered to the ground in the event of a power supply failure. Brake assembly shall be fitted with auto-adjust wear systems. An additional status feedback signal device shall be incorporated in the brake unit to enable proper functioning of the control system.

Electro-hydraulic or electro-magnetic disc brake may be provided for light duty cranes if approved by ES.

##### **c. EMERGENCY BRAKE**

The requirement of emergency brake shall be decided by the operational environment of the particular crane. In case of frequent movement of personnel below or near the crane, or if critical equipment is located within the crane operating bay, then emergency brake is a mandatory requirement.

For cranes of 50-ton capacity or more, ES shall decide whether emergency brakes are required and shall specify accordingly.

In the event of detection of over synchronous speed due to service brake failure, and slow speed slippage through the service brakes when the crane is energised, the

control system shall be designed to detect this and operate the emergency brake(s) for holding the suspended load.

The emergency brake(s) shall be so controlled that it is applied automatically, not later than the instant a speed of 1.15 times the normal lowering speed has been reached.

The type and mounting of emergency brake shall be either of the following, and shall be selected only after discussion with ES: -

- The emergency brake shall be mounted on the main hoist drum barrel flanges. The brake shall be caliper disc type with wear rings and shall be removable type.
- The emergency drum brakes shall be provided at the gear box input extension shafts. The brakes shall be of same type as the service brake.
- An emergency band brake mounted on the plain end of the hoist rope barrel (drum). The band brake shall be operated either by an electro-hydraulic thruster or an electro-magnet.

**d. SPUR GEARBOX**

Service Factor "f1" For Hoist Gearbox shall be considered as per the following table: -

Rope reeving group	2m	3m	4m	5m
Service factor "f1"	1.25	1.40	1.60	1.80
Gearbox nominal rating "NG"				

The nominal rating of the gearbox shall be determined by multiplying the actual required hoisting power with the service factor (f1). An additional impact factor shall be considered in the calculation to suit the gearbox application and potential effects of hoist acceleration before hook contact occurs. The resultant factor of safety will be indicated in the offer.

The gearbox shall be rated according to the mode of operation.

The gearbox drain point shall be piped to a location where a drop hose can be installed vertically to floor level. The gearbox shall have a valve at the gearbox casing end of this drain line to enable removal of the box.

In case planetary gearbox is offered, the main hoist mechanism shall have two independent drive systems, in such a way that operation can continue at half speed if any one of the hoist motors fail. This philosophy shall be suitably reflected in the electrical system.

**e. WIRE ROPE**

Wire rope diameter shall be calculated to DIN 3064 shall be used with an individual wire breaking strength as per the standard. Rope thimbles, if provided, shall conform to DIN 3091. The wire ropes and rope anchors shall be suitable for the operating environment. Rope length shall be sufficient to reach ground level.

**f. ROPE DRUM / GEARBOX CONNECTION**

• **For Heavy and Medium Duty Crane**

Barrel coupling shall be provided for gearboxes conforming to DIN 15053. The barrel coupling shall be fitted with a wear monitoring device.

• **Light Duty Crane**

Barrel coupling shall be provided for gearboxes conforming to DIN 15053. The barrel coupling shall be fitted with a wear monitoring device.

**g. ROPE DRUM**

Rope drum shall be of welded construction with grooves according to DIN 15061.

At least 2 dead turns shall be provided on the drum when the rope is at the lowest position as determined by the hoist limit switch.

Material of drum components shall be as follows: -

- Drum shell: St 52-3
- Drum trunnion: St 52-3
- Flange: RSt 37-2
- Trunnion: RSt 37-2

Emergency brake shall be provided to act on the rope drum flanges, as specified.

**h. DRUM BEARING**

Self-aligning antifriction roller bearing (SKF) shall be used for the drum end bearing.

**5.4.3.3 AUXILIARY HOIST DRIVE**

Auxiliary hoist drive will be required to be incorporated into the crane design wherever applicable for operations.

a. The auxiliary hoist drive shall comprise of the following main components: -

- 1 no. squirrel cage motor
- 1no. Peri flex shaft coupling with brake drum
- 1 no. self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435
- 1 no. Spur gearbox according to DIN 15053
- 1 no. barrel coupling for each drum connection
- 1 no. rope drum
- Drum bearings
- Emergency disc brakes operating on barrel flanges (if required) Type SIME
- Hoist limit switches (rotary type barrel end shafts)
- Wire ropes
- Bottom block DIN 15409 (lockable at 4 points at 90° interval, if required) If required by Operations, hook block can be rotating type.
- Overload and slack rope protection system (if required)

b. **Special Requirements for Auxiliary Hoist Drive**

- For some of the cranes, it is required that speeds of main hoist and auxiliary hoist be synchronised. In that case, the following statement shall be explicitly mentioned in the enquiry

"The ton auxiliary hoist drive speed shall be synchronised with the main hoist drive speed. Electrical system shall be properly designed to achieve this requirement by using a selector switch."

- For some cranes, it is required that the hooks of main hoist and auxiliary hoist are fixed at a specific distance, to suit a specific operational requirement. In that case, the following statement shall be explicitly mentioned in the enquiry.

"The .... ton auxiliary hoist drive shall be fixed in relation to the main hoist. Independent hoist travel is not required, and the hook centres shall be fixed mm."



- For some cranes, it is required that main hoist and auxiliary hoist operate independent of each other to a limited extent. In that case, the following statement shall be explicitly mentioned in the enquiry

"The .... ton auxiliary hoist shall be capable of operating independently in relation to the main hoist. Independent travel of main & auxiliary hoists is a requirement, and the amount of independent travel shall be mm, after conformation of the working envelope."

- For some cranes, it is required that main hoist and auxiliary hoist are interlocked to avoid overloading of the auxiliary hoist during tandem operation, the following statement shall be explicitly mentioned in the enquiry:

"The .... ton auxiliary hoist shall be interlocked with main hoist, so that the main hoist lowering motion shall be automatically stopped when the auxiliary hoist overloading is detected.

#### **5.4.4 MECHANICAL (CROSS TRAVEL (TROLLEY) DRIVE)**

The crane will have cross travel mechanism for main and auxiliary hoist drive. The trolley shall be top running type with two (2) driving and two (2) trailing wheels which will run on the trolley rails clamped/welded to the top of the girders. The cross-travel drive shall be either two (2) corner individual wheel drive or central wheel drive type, depending on the class of duty and operational requirements, as described below. The type of drive shall be subject to acceptance by ES.

The trolley shall have minimum four (4) wheels. At least 50% (half) of all wheel sets shall be driven. It shall be verified that the acceleration power with an unloaded trolley can be transmitted to the wheel without slippage with a friction coefficient ( $\mu$ ) of 0.14 between track wheel and rail.

##### **5.4.4.1 HEAVY AND MEDIUM DUTY CRANE**

- a. Either two (2) corner individual wheel drive train or central wheel drive train shall be provided.
- b. Individual wheel drive shall have two separate drive trains, each driving one wheel. The driven wheels will be located on diagonally opposite corners of the trolley. The motors

of the drive trains shall be controlled by a single inverter drive control. Each drive train shall consist of: -

- 1 squirrel cage motor
- 1 Peri flex shaft coupling with brake drum -1 self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435.
- 1 spur gearbox according to DIN 15 053
- 1 heavy duty cardan shaft with connecting flanges.
- 1 driven wheel according to DIN 15090
- Hydraulic buffers

Geared motor with integral brake may be provided if approved by ESI.

c. Central wheel drive shall have one drive train, driving two wheels. The motor of the drive train shall be controlled by an inverter drive control. The drive train shall consist of:

-

- 1 squirrel cage motor
- 1 Peri flex shaft coupling with brake drum -1 self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435.
- 1 spur gearbox according to DIN 15053
- 2 heavy duty cardan shafts with connecting flanges.
- Minimum 2 driven wheels
- Hydraulic buffers

#### **5.4.4.2 LIGHT DUTY CRANE**

a. A central wheel drive shall be provided. The central wheel drive shall have one drive train, driving two wheels. The motor of the drive train shall be controlled by an inverter drive control.

b. The drive train shall consist of: -

- 1 squirrel cage motor
- 1 Peri flex shaft coupling with brake drum -1 self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435.
- 1 spur gearbox according to DIN 15053
- 2 cardan shafts with connecting flanges.
- Minimum 2 driven wheels
- Hydraulic buffers

#### 5.4.4.3 GENERAL REQUIREMENTS

- Hollow shaft drive systems with spline may be offered for medium duty maintenance cranes and light duty cranes only.
- Suitable access shall be provided on the trolley platform to enable cross travel drive components to be removed via the roof service hoist.
- All drives shall be mounted on base plates and have safe access for maintenance.
- All base mounted equipment (motors, gear boxes, brakes etc.) shall be mounted on top of single solid shims, which shall not be less than 10mm in thickness.

#### 5.4.4.4 DETAILS OF CROSS TRAVEL DRIVE COMPONENTS

##### a. Motor

The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. See section 7.0 - Electrical Equipment and Installation for further details.

##### b. Geared motor

The geared motor with splined hollow output shaft shall be provided for medium duty maintenance cranes and light duty cranes only. The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. The motor shall be provided with integral electro-magnetic disc brake. Brake shall be fitted with auto-adjust wear systems. The brake shall be equipped with a manual release facility that will allow the trolley to be moved manually in the event of a total power supply failure. The geared motor shall be suitably mounted on a torque arm. See Section 7.0 - Electrical Equipment and Installation for further details on motor. Hollow splined output shaft is acceptable. Hollow keyed output shaft shall not be accepted.

##### c. Coupling and Drum Brakes

The coupling shall include flexible elements rated for high temperature use. The brake shall be double shoe drum brake with electro-hydraulic thruster, conforming to DIN 15435. Brake assembly shall be fitted with auto-adjust wear systems. The brakes shall be equipped with a manual release facility that shall allow the trolley to be moved manually in the event of a total power supply failure.

Electro-hydraulic or electro-magnetic disc brake may be provided for light duty cranes if approved by ES.

##### d. Spur Gearbox

The gearbox shall be rated according to the mode of operation. Service Factor "f2" For Travel Motion Gearboxes

A service factor (f2), generally 1.18 shall be applied, whereby the start-up power is calculated as the total of steady-state power (N<sub>v</sub>) and acceleration forces (N<sub>a</sub>).

The gearbox nominal output is therefore calculated as: NG = 1.18 x (N<sub>v</sub> + N<sub>a</sub>) (kW)

In addition, the torque resulting from the yield point of the travel motion gearboxes must not exceed the torque on slippage of the wheels.

For the calculation of the slip torque, a friction coefficient (μ) of 0.25 between track wheel and rail, and the total of the maximum wheel loads of all wheels connected with one gearbox is to be applied.

The value "γ" when comparing the torque (M<sub>e0.2</sub>) from the yield point of weakest component of the gearbox with the slip torque (MR) must not fall below the value 1.

$$\gamma = \frac{M_{e0.2}}{MR} \geq 1$$

If travel limit switches are provided for cross travel movements to prevent the trolley striking the buffers at full speed, and if the buffers are designed for withstanding trolley impact at 100% of rated speed, then a friction coefficient (μ) of 0.2 may be considered for determining the slip torque.

The gearbox output shaft shall be splined, matching with the splined bore of the Cardan shafts or driven wheels.

The gearbox drain point shall be piped to a location where a drop hose can be installed vertically to floor level. The gearbox will have a valve at the gearbox casing end of this drain line to enable removal of the gearbox without removing the piping.

The orientation of the CT gearbox shall (preferably) be in such a way that the motor and drive connection is not directly above the cardan shaft, thus facilitating maintenance.

For geared motors, the gearbox shall have a splined hollow output shaft. The driven wheel shall be directly mounted on the gearbox output shaft. Gearbox shall have flexible mounting such that the load on wheel is not transferred to the shaft.

**e. Cardan shaft**

For central wheel drive, cardan shafts shall be provided for connection between gearbox output shafts and driven wheels. The Cardan shafts shall have connecting flanges.

**f. Wheelsets**

**1. Heavy and Medium Duty Crane**

The driving and trailing wheel sets shall have a common sub-assembly. The trailing wheels shall be provided with cardan shaft flange couplings, identical to those used in driving wheels, fitted on the shafts. The coupling shall be provided with suitable static (non-rotating) bolted cover.

The wheels shall be flanged according to DIN 15072/15093 with bearings in dismountable diagonal split housings giving unit change facility (wheel, shaft, bearings). Wheel diameter shall conform to DIN 15070. The bearing housings shall be attached to the structure with through bolts. The use of set screws and tapped holes is not acceptable.

The wheel shall be fitted on shaft by interference fit. All wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel and bearings from the shaft. The oil injection system for wheel shall be provided with either one or two injection bores, depending upon the width of the wheel.

**2. Medium and Light Duty Crane**

The driving and trailing wheel sets shall have a common sub-assembly.

In case of central motor drive, the trailing wheels shall be provided with a cardan shaft flange coupling, identical to those used in driving wheels, fitted on the shafts. The coupling shall be provided with suitable static (non-rotating) bolted cover.

In case of geared motor drive, the trailing wheels shall be provided with a shaft, identical to those used in driven wheels (except the splined portion).

The wheels shall be flanged according to DIN 15072/15093 with bearings in dismountable diagonal split housings giving unit change facility (wheel, shaft, bearings). Wheel diameter shall conform to DIN 15070. The bearing housings shall be attached to the structure with through bolts. The use of set screws and tapped holes is not acceptable

The wheel shall be fitted on shaft by interference fit. All wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel and bearings from the shaft. The oil injection system for wheel shall be provided with either one or two injection bores, depending upon the width of the wheel.

**g. Buffer**

Hydraulic buffers or cylindrical rubber buffers shall be provided on the four corners of the trolley, as specified. The buffers shall be suitable to stop the trolley movement at full rated speed without any damage either to the trolley or the buffers. Suitable end stops shall be provided on the bridge girder. Position of buffers shall match the end stops.

**5.4.5 MECHANICAL (LONG TRAVEL DRIVE)**

**5.4.5.1 LONG TRAVEL DRIVE**

Each end carriage shall be provided with long travel drive. The long travel drive shall be electrically driven and shall be either two (2) corner or four (4) corner individual wheel drive, depending on the class of duty and operational requirements, as described below. The type of drive shall be subject to acceptance by ES.

The crane shall have minimum four (4) long travel wheels, i.e. each end carriage shall have at least one driving wheel and one trailing wheel. At least 50% (half) of all wheel sets shall be driven. It shall be verified that the acceleration power with an unloaded crane can be transmitted to the wheel without slippage with a friction coefficient ( $\mu$ ) of 0.14 between track wheel and rail.

**a. HEAVY AND MEDIUM DUTY CRANE**

1. Either two (2) corner or four (4) corner individual wheel drive train shall be provided.
2. Individual wheel drive shall have two or four separate drive trains, each driving one driven wheel or wheel set. The driven wheel set, if necessary, will be located on diagonally opposite corners of the crane. The motors of the drive trains shall be controlled by a single inverter drive control. Each drive train will consist of: -
  - 1 no. squirrel cage motor
  - 1 no. shaft coupling with brake drum

- 1 no. self-adjusting double shoe brake with electro-hydraulic thruster according to DIN 15435
  - 1 no. gearbox
  - Hydraulic buffers
3. For indoor cranes, geared motors with integral brake and splined output shaft arrangement may be provided if approved by ESI. In this case, each drive train shall comprise of: -
- 1 no. geared motor with splined output shaft
  - 1 no. driving wheel or wheel set according to DIN 15090 (if necessary mounted in an equalising bogie)
  - 1 no. trailing wheel or wheel set according to DIN 15090 (if necessary mounted in an equalising bogie)
  - Hydraulic buffers

#### **5.4.5.2 MEDIUM (MAINTENANCE) AND LIGHT DUTY CRANE**

- a. Either two (2) corner or four (4) corner individual wheel drive train shall be provided. The drive system shall consist of a geared motor with hollow splined output shaft arrangement.
- b. Individual wheel drive shall have two or four separate drive trains, each driving one driven wheel or wheel set. The wheel set, if necessary, will be located on diagonally opposite corners of the crane. The motors of the drive trains shall be controlled by a single inverter drive control. Each drive train will consist of: -
- 1 no. geared motor with hollow splined output shaft
  - 1 no. driven wheel or wheelset according to DIN 15090 (if necessary mounted in an equalising bogie)
  - 1 no. trailing wheel or wheelset according to DIN 15090 (if necessary mounted in an equalising bogie)
  - Hydraulic buffers

#### **5.4.5.3 GENERAL REQUIREMENTS**

1. Hollow shaft drive systems with spline may be provided for medium duty maintenance cranes and light duty cranes only.
2. All drives shall be mounted on base plates and have safe access for maintenance.
3. Suitable access platforms, ladders, hand railings etc. shall be provided for long travel drive components to be removed via the roof service hoist.

4. All brakes and motors shall be mounted on top of single solid shims, which shall not be less than 10mm in thickness. Geared motors, however, may be mounted on wheels through torque arms.
5. Substantial anti-derailing brackets shall be installed on the underside of the wheel bogies to prevent derailment in the event of guide roller failure.
6. Suitable rail cleaning facilities shall be provided on all four sides of the crane.

#### **5.4.5.4 DETAILS OF LONG TRAVEL DRIVE COMPONENTS**

##### **1. Motor**

The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. See section 7.0 - Electrical Equipment and Installation for further details.

##### **2. Geared motor**

The geared motor with splined hollow output shaft shall be provided for medium duty maintenance cranes and light duty cranes only. The motor(s) shall be squirrel cage type, suitable for use with the inverter control system and regenerative braking. The motor shall be provided with integral electro-magnetic disc brake. Brake shall be fitted with auto-adjust wear systems. The brake shall be equipped with a manual release facility that shall allow the crane to be moved manually in the event of a total power supply failure. The geared motor shall be suitably mounted on a torque arm. See Section 7.0 - Electrical Equipment and Installation for further details on motor.

Hollow splined output shaft is acceptable. Hollow keyed output shaft will not be accepted.

##### **3. Coupling and Drum Brakes**

The coupling shall include flexible elements rated for high temperature use. The brake shall be double shoe drum brake with electro-hydraulic thruster, conforming to DIN 15435. Brake assembly shall be fitted with auto-adjust wear systems. The brakes shall be equipped with a manual release facility that shall allow the crane to be moved manually in the event of a total power supply failure.

Electro-hydraulic or electro-magnetic disc brake may be provided for light duty cranes if approved by ES.



#### 4. Gearbox

To prevent long travel movement due to wind force, all Gantry and Semi-Gantry cranes operating outdoor shall be provided with self-locking (worm & wheel type) gearboxes. This requirement is mandatory.

For the calculation of the slip torque, a friction coefficient ( $\mu$ ) of 0.25 between track wheel and rail, and the total of the maximum wheel loads of all wheels connected with one gearbox is to be applied.

The gearbox shall be rated according to the mode of operation. Gantry and Semi-Gantry cranes operating indoor may be provided with spur or spur-helical or bevel-helical gear boxes as required by ES.

The gearbox shall be rated according to the mode of operation. **Service Factor "f2" For Travel Motion Gearboxes (Spur/helical)**

A service factor ( $f_2$ ), generally 1.18 shall be applied, whereby the start-up power is calculated as the total of steady-state power ( $N_v$ ) and acceleration forces ( $N_a$ ).

The gearbox nominal output is therefore calculated as:  $NG = 1.18 \times (N_v + N_a)$  (kW)

In addition, the torque resulting from the yield point of the travel motion gearboxes must not exceed the torque on slippage of the wheels.

For the calculation of the slip torque, a friction coefficient ( $\mu$ ) of 0.25 between track wheel and rail, and the total of the maximum wheel loads of all wheels connected with one gearbox is to be applied.

The value " $\gamma$ " when comparing the torque ( $M_{\theta 0.2}$ ) from the yield point of weakest component of the gearbox with the slip torque ( $MR$ ) must not fall below the value 1.

$$\gamma = \frac{M_{\theta 0.2}}{MR} \geq 1$$

If travel limit switches are provided for long travel movements to prevent the crane buffers striking the rail stoppers buffers at full speed, and if the buffers are designed for withstanding trolley impact at 85% of rated speed, then a friction coefficient ( $\mu$ ) of 0.2 may be considered for determining the slip torque.

The gearbox drain point shall be piped to a location where a drop hose can be installed vertically to floor level. The gearbox shall have a valve at the gearbox casing end of this drain line to enable removal of the gearbox.

The orientation of the LT gearbox shall (preferably) be in such a way that the motor and drive connection is not directly above the cardan shaft, thus facilitating maintenance. For geared motors, the gearbox shall have a hollow splined output shaft. The driven wheel shall be directly mounted on the gearbox output shaft. Gearbox shall have flexible mounting such that the load on wheel is not transferred to the shaft.

## **5. Wheelsets**

For Gantry cranes, a flanged wheel bogie shall be provided at each corner of the crane. The travelling wheels shall be provided with split cage bearings, mounted on the end carriages.

For Semi-Gantry cranes, all wheels shall be flangeless type, with guide rollers on the top end carriage.

The driving and trailing wheel sets shall have a common sub-assembly. The trailing wheels shall be provided with shafts identical to those used in driven wheels.

The wheels shall be double flanged/flangeless according to DIN 15072/15093 with bearings in dismountable diagonal split housings giving unit change facility (wheel, shaft, bearings). Wheel diameter shall conform to DIN 15070. The bearing housings shall be attached to the structure with through bolts. The use of set screws and tapped holes is not acceptable.

The wheel shall be fitted on shaft by interference fit. All wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel and bearings from the shaft. The oil injection system for wheel shall be provided with either one or two injection bores, depending upon the width of the wheel.

## **6. Side Guide Roller**

Side guide rollers shall be provided, as required, for transferring crane horizontal forces to the rails, thus ensuring proper alignment of LT wheels on rails.

Since specific DIN Standard does not exist for horizontal side guide rollers, the surface contact pressure shall be calculated according to DIN 15070. The resultant calculation must prove that the loads on the guide roller wheels are far below the permissible pressure as per the standard for the roller material.

Horizontal guide rollers shall be eccentrically mounted at one end carriage and shall be adjustable at site. The roller shall be provided with two surfaces, an upper and a lower one, so that if one of the surfaces is worn, the second surface can be used by turning the roller.

ES and the contractor shall mutually discuss and decide whether or not horizontal side guide rollers for guiding on one end of the bridge will be required, depending upon acceleration forces to be transmitted. The location/orientation of any subsequent guide rollers is to be agreed with ES.

#### **7. Parking Brake**

Parking (storm) brakes shall be provided on both sides of the crane. The parking brake shall be electrically/hydraulically/manually operated, as required by ES.

#### **8. Hydraulic Buffer**

Hydraulic buffers shall be provided on the outboard side of end carriages of all cranes. Position of buffers shall match new or existing rail end stops, as well as new or existing cranes operating on the same rail. Extended buffer structure shall be provided, if required. Suitable end stoppers shall be provided, as required.

#### **5.4.6 LUBRICATION SYSTEM**

All static grease points of the crane drives shall be grouped together via grease lines. The minimum requirement is for the grease lines to be individually fed via grease nipples, mounted on a common block. The grease nipple type shall be standardised "pull-on" type wherever possible for all equipment on the crane.

All grease lines shall be constructed from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

All oils and lubricants provided shall be as per written agreement by ES during engineering design stage.

Lubrication drawings shall be provided that clearly show the lubrication requirements. These drawings shall be converted to A3 size, they shall be 'plasticised/laminated' and stored in a suitable covered box, either in the driver's cabin or at an agreed location.

## **5.4.7 STEELWORK**

### **5.4.7.1 BRIDGE GIRDERS AND END CARRIAGES**

#### **a. GENERAL**

Design of bridge girders and end trucks (carriages) shall be determined as per the design capacity of the crane and operational requirements. The bridge girders shall be of closed box design. The box girders shall be made of plates, pre-welded, and reinforced with transverse bulkheads and longitudinal web stiffeners. All electrical switchgears and air-conditioning panels shall be mounted on top of the girder.

For Gantry cranes, the girders shall be rigidly connected to the fixed/hinged legs. The fixed legs shall be rigidly connected to the end carriage through end connection plates and high tensile bolts. The hinged legs shall be connected to the other end carriage by means of hinged pins through end connection plates and high tensile bolts.

For Semi-Gantry cranes, one end of both girders shall be rigidly connected to the fixed legs. The fixed legs shall, in turn, be rigidly connected to one end carriage, running at floor level. The other end of the girders shall be rigidly connected to the end carriage at the elevated runway beam level. All connections shall be made through end connection plates and high tensile bolts.

All load bearing structural bolted connections shall be through high tensile fasteners conforming to DIN EN 14399-4 (galvanized or black, grade 10.9, lightly oiled). All structural fasteners shall be tightened with torque as per DIN 18800.

Thickness of any structural component used in the bridge girders and end carriages shall not be less than 8 mm.

The deflection of the girders subjected to nominal test load (DIN 15030) and trolley weight shall not exceed 1/1000 of the bridge span. Girders shall be positively cambered with a minimum amount equal to the dead load deflection plus the deflection caused by the trolley weight including ropes, hook block(s), other attachments and 50% of the safe working load of the crane.

Generally, halved double T-sections will be welded on top of the bridge girders to carry the trolley rails.

Design of crane will consider that the track wheels might need to be arranged in pairs in equalizer trucks to accommodate deviations in the long travel rail level.

Consideration will also be given to alternative arrangements that shall ensure proper distribution of the crane loads to the gantry.

To allow for wheel deviation, the difference in individual wheel loading shall not exceed 10%.

It must be observed that the natural frequency in vertical direction shall not fall below the value 3.

The design of the end truck (carriage) shall be determined considering all aspects of the work regime. The requirement for articulated connection (by two (2) coupling pieces) lies with the contractor.

Heat protection (shielding) and insulation shall be provided for cranes operating within areas of high thermal radiation.

**b. TROLLEY FRAME**

The trolley frame will be made of plates and steel sections in welded construction with welded-on and welded-in transoms, bearing brackets and mounts to accommodate the mechanical and electrical equipment. All openings shall be covered or provided with handrails. The railings shall be fitted in accordance with the VBG 09, Rules for the Prevention of Accidents.

The arrangement of components on the trolley shall be designed to prevent accumulation of tripping hazards. Oil drip trays shall be provided under gearboxes wherever necessary. Cardan shaft drop hangers shall also be provided (if applicable).

The trolley structure shall be designed with due consideration of maintenance requirements. The hoist and cross travel drive shall be suitably covered for weather protection. All components and component fixings/fasteners etc. MUST be easily

accessible from fixed platforms. The design **MUST** also consider the easy and straightforward removal of the heaviest / largest item of equipment.

For all cranes, the trolley design shall ensure that the trolley floor area is sufficient to guarantee that there is no restricted access to any component. Climbing over of components is unacceptable.

**c. OPERATOR'S CABIN**

1. Operator's cabin shall be provided if specified in the enquiry.
2. The operator's cabin shall have the following features:
  - Roof suspension or floor mounting.
  - Closed design.
  - Double-walled or equivalent.
  - Heat-insulation.
  - Safety insulated glass panes.
  - Full-vision front and sides and designed in such a way that each window can be easily accessed, allowing for cleaning of the outside of each glass pane.
  - Air conditioning system (with option for back-up system), if specified.
  - Double-hinged doors with window and pad locking facilities.
  - Access via stairways.
  - Emergency escape route (separate to normal staircase access / walkway)
  - Fire extinguisher.
  - Copy of VBG9 "operator's instructions for cranes" (printed in both English and Arabic).
3. The operator's cabin will either be fixed or travelling type, depending upon the requirements of the ESI. Heat protection (shielding) and insulation shall be provided for the cabin for cranes operating in outdoor areas, as well in areas of high thermal radiation and high ambient temperature. Pivot or fulcrum type design for suspension of travelling cabins is not acceptable to ESI.

**d. SAFETY ASPECTS**

1. All points of hazard, for example buffers, hook blocks, spreader beams, steps, narrow passages, supports, etc. on the crane shall be marked and they have to comply/ meet DIN 15026 'Marking of Points of Hazard'.
2. Heavy Duty Cranes: The crane shall be accessible at two (2) corners. The bridge girders shall generally be accessible by means of stairs fixed to the two (2) portal

- legs. Vertical ladders are not generally acceptable unless necessary due to space constraints.
3. Medium and Light Duty Cranes: The crane should be accessible at one (1) corner. The bridge girders shall generally be accessible by means of a staircase fixed to the one (1) portal leg. Vertical ladders are not generally acceptable unless necessary due to space constraints.
  4. All equipment shall be easily accessible for ease of maintenance. A non-slip walkway platform shall be provided for maintenance purposes. A maintenance platform shall be provided for hoist and cross travel drive components. Suitable access staircases shall be provided, and the safety of personnel shall be of primary consideration during the design of such staircases and platforms. Crane bridge shall have with necessary hand railings and safety ladders. All ladder rungs shall be of square bar. Hand railing shall be of tubular section around all access and walkways at a minimum of 1100mm high. Walkways shall be minimum 800 mm wide with open grating or non-skid plate.
  5. For cabin-controlled cranes, each access position shall incorporate an access acknowledgement boarding system connected to the crane operator's cabin (if required by ES). The access system will interlock with crane operation.
  6. The long travel drive shall be suitably covered for weather protection.
  7. Nameplate shall be attached to the crane bridge in a clearly visible position, indicating the crane serial number, safe working load and year of manufacture. The name plate shall be written in both English and Arabic.
  8. All major components shall have suitable lifting lugs or lifting points designed in to facilitate erection/maintenance.
  9. Protection shall be provided against accidental contact of the hook blocks or any other suspended lifting devices with the DSL lines (if provided).
  10. All fasteners on the crane shall be of minimum 8.8 grade and will have 'Pal type' locking nuts fitted. 'Nyloc' type locking nuts shall not be used.
  11. Raised areas on the top of the girders, end carriages, trolley frame, walkways etc. shall be provided with suitable ramped covers to reduce the trip hazard.
  12. Hook approaches and clearance envelope shall be maintained for operational requirements. For new plants the hook approaches and clearance envelope shall reach operational requirements.

## 5.4.7.2 CRANE GANTRIES AND CRANE RAILS

### a. GENERAL

#### 1. For new crane(s) installed in an existing bay with old runways/rails

The existing crane gantries and rails are old and therefore due to the age of the structure rail alignment according to VDI 3576 will not be achieved. However, the wheel loading of the crane(s) shall be such as not to induce any further detrimental effects to the existing crane gantries, rails and structures.

The design of the crane(s) must consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

#### 2. For new crane(s) installed in an existing bay with good runways/rails

The existing crane gantries and rails are relatively new and therefore they are good enough to carry the new crane(s). However, the wheel loading of the proposed crane(s) shall be such as not to induce any detrimental effects to the existing crane gantries, rails and structures.

Structure rail alignment according to VDI 3576 shall be achievable.

The design of the crane(s) must consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

#### 3. For new crane(s) installed in a brand-new bay

The structure rail alignment according to VDI 3576 shall be achieved and the wheel loading of the proposed crane(s) shall be such as not to induce any detrimental effects to the existing crane gantries, rails and structures.

The design of the crane(s) must consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

### b. CRANE TRACK RAILS

#### 1. Dimensions

The long travel rails will have rail dimensions to DIN 536. The rails will be fixed with rail clips. In addition, the rail shall be mounted on a resilient pad.

#### 2. Fixing of Rails

All rails for the long and cross travel motions shall be fixed with clips. Welding of rails to the shop girders and/or EOT bridge girders is not acceptable.



The rails shall be joined by welding using Thermite process.

### **3. Track Pads**

Track pads shall be provided underneath all new rails. The track pads shall be products of competent manufacturers.

### **4. Material**

The rails shall have a minimum tensile strength of 690 N/mm<sup>2</sup>. Test certificates shall be submitted.

The crane rails for steel plant (melt shop, continuous casting area, cooling bed area, billet bay area), rolling mill and hot strip mill use shall be made from killed steel as recommended in DIN 536.

Rails, clips and resilient pads shall preferably be of GANTRY make.

### **5. Interfacing New and Existing Equipment**

Close co-ordination will be required to ensure interfacing of new and existing equipment, e.g. the power collector shoes to the down shop conductor rails, layout of cable reeling, layout of festoon system, layout of pendant control festoon system, position of LT buffers, rail stoppers, available height between roof & rail etc.

#### **5.4.7.3 CRANE INSTALLATION**

Installation and commissioning work shall be performed by skilled artisans and labourers under strict supervision and responsibility of experienced engineers. (documentation shall be produced upon request).

### **5.5 Jib Cranes**

#### **5.5.1 GENERAL**

This part outlines ES's requirements for design, fabrication, supply, delivery, installation, testing, certification, erection and commissioning of Column (Pillar) or Wall mounted Jib Cranes for use in Emirates Steel (ES).

Refer to Section 11-060 for

- Definitions
- Codes and Standards
- Electrical Equipment and Installation
- Surface Preparation and Coating
- Tooling

- Tests and Inspection
- Documentation

## 5.5.2 JIB CRANE – CLASSIFICATION

### 5.5.2.1 GENERAL

Classification of a particular crane shall be based on the operating conditions of the most severely loaded part of the crane and shall be agreed with ES prior to order placement. For replacement of existing cranes, the classification shall be according to the Table given below. For new cranes, the classification shall be generally according to DIN 15018 Part 1, which shall be discussed and finalised with ES. For details of technical requirements of various cranes as per location and use, refer to "Crane Requirement Chart" enclosed with this section.

### 5.5.2.2 DRIVES

#### a. ROPE DRIVES

The calculation of rope drives shall be in accordance to DIN 15020 to ensure an adequate degree of safety of operation of the lifting appliance and to achieve an adequate service life for the wire ropes used. The relation of rope diameter to rope sheave diameter respectively rope drum diameter shall be according to the relevant DIN standards.

Sl	Location	Description	Duty	Hoist Class	Lifting Category	Stress Group
1	Cold Rolling Mill	Pillar Jib Crane	Medium	2 m	H2	B3
2	Cold Rolling Mill	Pillar Jib Crane	Low	1 Am	H1	B2
3	Direct Reduction Plant	Pillar / Wall Jib Crane (explosion proof)	Medium	2 m	H2	B3
4	Direct Reduction Plant	Pillar / Wall Jib Crane (Explosion proof)	Low	1 Am	H1	B2
5	Pickling Line	Pillar Jib Crane	Medium	1 Am	H1	B2
6	Pickling Line	Pillar Jib Crane	Low	1 Am	H1	B2
7	Rolling/ Hot Strip Mill	Pillar Jib Crane	Medium	2 m	H2	B3
8	Rolling / Hot Strip Mill	Pillar Jib Crane	Low	1 Am	H1	B2
9	Rolling / Hot Strip Mill (Roll Shops)	Pillar Jib Crane	Medium	2 m	H2	B3
10	Rolling / Hot Strip Mill (Roll Shops)	Pillar Jib Crane	Low	1 Am	H1	B2
11	Steel Plant – Melt Shop	Pillar Jib Crane	Medium	2 m	H2	B3
12	Steel Plant – Caster	Pillar Jib Crane	Medium	2 m	H2	B3
13	Workshops	Pillar Jib Crane	Low	1 Am	H1	B2

### 5.5.3 JIB CRANE – MECHANICAL

#### 5.5.3.1 GENERAL

##### a. PILLAR / COLUMN MOUNTED JIB CRANE

The jib crane shall mainly consist of a cantilever arm (jib) structure with hoist and trolley unit, slewing mechanism and associated parts such as power supply cables, festoon system, pendant/remote station, control panel etc. All motions shall be electrically operated.

The cantilevered jib arm shall be mounted to a pillar (column), which shall be fixed to a foundation or support structure. In general, the jib arm shall be able to slew 0 - 360 degree.

##### b. WALL MOUNTED JIB CRANE

The jib crane shall mainly consist of a cantilever arm (jib) structure with hoist and trolley unit, slewing mechanism and associated parts such as power supply cables, festoon system, pendant/remote station, control panel etc. All motions shall be electrically operated.

The cantilevered jib arm shall be suitably fitted to a wall/structure. In general, the jib arm shall be able to slew 0 - 180 degree.

##### c. TRAVELLING JIB CRANE

The jib crane shall mainly consist of a cantilever arm (jib) structure with hoist & trolley unit, long travel drive, slewing mechanism and associated parts such as power supply cables, festoon system, pendant/remote station, control panel etc.

The cantilevered jib arm shall be mounted on a vertical column (pillar) which shall be provided with three end trucks (carriages) – top horizontal, bottom vertical and bottom horizontal.

#### 5.5.3.2 HOIST DRIVE

a. The crane will have one (1) hoist mechanism. The mechanical components of the hoist drive shall be rated according to their mode of operation into a drive group in accordance with DIN 15020 in order to achieve the required long service life. All hoist components shall be accessible for maintenance.

b. A travelling electric hoist with single reeved wire rope and bottom block, conforming to DIN 15409. The hoist shall have both hoist drive and trolley travel drive. All other

technical requirements of the electric hoist shall be as per Section 11, Part 5 (electric hoist) of this standard.

- c. The lifting hook shall conform to DIN 15400/15401/15402, depending on the hook type. All hooks shall be made from forged steel. The hook shall be either free swiveling type, or lockable at 90° interval, depending upon the operational requirements. Safety latch shall be provided on the hook. The hook shall be suspended from the crosshead by means of thrust and radial anti-friction bearings. Bearing life shall be minimum 10,000 hours. Warning Stripes shall be painted as per DIN 15026 'Marking of Points of Hazard'.
- d. If chain operated electric hoist is provided, then a chain collection box shall be provided on the hoist.

#### **5.5.3.3 TROLLEY TRAVEL DRIVE**

- a. The electric hoist shall be provided with travel arrangement with electric geared motor drive. The travel arrangement shall have minimum two (2) driving and two (2) driven wheels. The number of drives shall be indicated by the supplier based on calculations, which shall be subject to approval by ES. All other technical requirements of the travel drive shall be as per Section 11, Part 5 (electric hoist) of this standard.
- b. The wheels shall be suitable to run on the lower flange of the jib arm.

#### **5.5.3.4 LONG TRAVEL DRIVE**

- a. Long travel drive shall be provided for Travelling Jib Crane.
- b. The long travel drive arrangement shall comprise of: -
  - 2 geared motors with splined output shafts
  - 2 flanged driving wheels (minimum)
  - 2 flanged idle wheels (minimum)
  - Hydraulic buffers (OLEO make) or Cellular Rubber (of type acceptable to ESI)
- c. The number of the driven & idle wheels shall be calculated based on total number of wheels and the acceleration forces to be transmitted. However, each truck (end carriage) shall have at least one driven and one idle wheel.
- d. The driven and idle wheels shall have a common sub-assembly. The idle wheels shall be provided with a splined shaft, identical to those used in driven wheels.
- e. Hollow shaft drive systems with splined shaft connection shall be provided. Keyed or shrink disc type connections shall not be accepted.
- f. The geared motor shall be provided with suitable electro-magnetic disc brake.

- g.** All long travel wheels shall have an oil injection system incorporated into the design to facilitate easy removal of the wheel and bearings from the shaft. Dependent upon the width of the wheel, the oil injection system shall be provided with either one or two or multiple injection bores.

#### **5.5.3.5 SLEWING MECHANISM**

##### **a. GENERAL**

1. The crane shall be provided with motorised slewing mechanism for jib rotation. The slewing mechanism can be either gear pinion type, or roller type.
2. Slewing mechanism is not required for travelling jib cranes.

##### **b. GEAR PINION TYPE SLEWING MECHANISM**

1. The gear-pinion type slewing mechanism shall comprise of: -
  - 1 no. geared motor with pinion mounted on the output shaft
  - 1 no. bull gear mounted on the column (pillar) structure.
  - Top bearing assembly.
2. The geared motor shall be suitably mounted on the jib structure.
3. Hollow shaft drive systems shall not be incorporated in the design.
4. The geared motor shall be provided with suitable electro-magnetic disc brake. The geared motor output shaft shall preferably be of splined design for mounting the pinion.
5. The pinion & bull gear shall be made from suitable quality forged steel. The gear teeth shall be of involute shape and shall be formed by hobbing and grinding. The gear teeth of both the pinion and bull gear shall be suitably hardened.
6. The bull gear shall be fixed to the column structure by high tensile structural bolting (galvanised or black - 10.9 grade, lightly oiled). All such bolts shall be correctly torqued as per DIN 18800. The bolt holes shall be machine drilled and reamed.
7. Suitable arrangement shall be provided for gear teeth lubrication during slewing operation.
8. The jib structure shall be mounted on the column through a suitable top bearing. The bearing arrangement shall be able to transmit all types of load combinations (including dynamic loads) generated in the jib to the column structure during operation. Bearing life shall be minimum 10,000 hours. Suitable lubrication arrangement shall be provided for the bearing arrangement.
9. Suitable oil injection system shall be provided, if required by ES, for easy removal of any component of the slewing mechanism.

### **c. ROLLER TYPE SLEWING MECHANISM**

1. The roller type slewing mechanism shall comprise of: --1 no. geared motor with a set of drive roller mounted on the output shaft
  - 1 set of guide roller mounted on the jib structure.
  - Top bearing arrangement.
2. The geared motor shall be suitably mounted on the jib structure.
3. Hollow shaft drive systems shall not be incorporated in the design.
4. The geared motor shall be provided with suitable electro-magnetic disc brake. The geared motor output shaft shall preferably be of splined design for mounting the pinion.
5. The drive rollers and guide rollers shall be bearing mounted. Roller surfaces shall be properly hardened for long life. Bearing life shall be minimum 10,000 hours. Suitable lubrication arrangement shall be provided for the bearing arrangement.

#### **5.5.3.6 BUFFER**

- a. Rubber stops/buffers shall be provided for travel motion.
- b. If limited rotation is required for slewing mechanism, suitable stops/buffers shall be provided.
- c. Hydraulic buffers shall be provided on the outboard sides of travelling jib cranes. Position of buffers shall match new or existing rail end stops, as well as new or existing cranes. Extended buffer structure shall be provided, if required. All hydraulic buffers shall be of OLEO make.

#### **5.5.3.7 LUBRICATION SYSTEM**

All static grease points of the crane drives shall be grouped together via grease lines. The minimum requirement is for the grease lines to be individually fed via grease nipples, mounted on a common block. The grease nipple type shall be standardised "pull-on" type wherever possible for all equipment on the crane.

All grease lines shall be constructed from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

All oils and lubricants provided shall be engineering design stage. as per written agreement by ES during

Lubrication drawings shall be provided that clearly show the lubrication requirements. These drawings shall be converted to A3 size, they shall be 'plasticised/laminated' and stored in a suitable covered box, either in the driver's cabin or at an agreed location.

### 5.5.3.8 GENERAL REQUIREMENTS

1. Parking/Maintenance Area (for travelling jib crane): The Contractor is responsible for ensuring the design, fabrication and installation of an operationally safe parking/maintenance area, which provides easy access and guarantees complete serviceability of the system. There shall be adequate working access for maintenance provided by means of a working platform, located at the parking area for the crane.
2. Suitable access staircases shall be provided, wherever required, and safety of personnel shall be primary consideration during the design of such staircases and platforms. Platform lighting shall be provided if required by ES.
3. Clearances and hook approaches: The hook approaches and clearance envelope shall be suitable to the building structure and operational requirements.
4. Rope: Rope length shall be sufficient to reach ground level. Rope guides shall be made of metal. Plastic rope guides are not acceptable.

### 5.5.4 JIB CRANE – STEELWORK

#### 5.5.4.1 MATERIAL

The steelwork shall consist of structural steels according to DIN EN 10025.

#### 5.5.4.2 PILLAR/COLUMN MOUNTED JIB CRANE

1. Design of jib, column, tie rods and other structural components shall be determined as per the design capacity of the crane and operational requirements. In general, I-beam type jib arm and circular column shall be provided.
2. The jib shall be suitably supported on the column on one end through top bearing arrangement. The column, jib, support arrangement and all structural components shall be designed to transmit all types of load combinations, including minimum dynamic load of 25% of the rated load, as well as bending, buckling etc., generated in the crane during operation.
3. The deflection of the jib arm subjected to nominal test load (DIN 15 030) and hoist weight must not exceed 1/450 of the maximum jib radius.
4. For roller type slewing mechanism, suitable annular roller support rings, accurately machined, shall be fixed to the column at required locations. The support rings shall be designed for long life. The support rings shall be accurately aligned with the column structure.
5. In general, the crane column shall be fixed/anchored to a concrete foundation on the ground. Size of footing shall conform to DIN 15019, Part 1, Crane Type 2 (Rotating

Tower Cranes). Allowable floor loading shall be as per DIN 1054. Load diagram and foundation assignment drawings shall be supplied by the crane supplier.

6. Suitable anchor bolts shall be supplied by the crane manufacturer, if specified.
7. For column jib cranes mounted on steel structures, acceptance regarding weight, reinforcement and stress calculations shall be gained after consultation with ES.
8. The column shall be truly vertical after installation to ensure that the jib does not move due to gravity regardless of its position.
9. Adequate working access and platforms for maintenance shall be provided. Suitable access staircases shall be provided. Safety of personnel shall be primary consideration during the design of such staircases and platforms. Hand railing shall be of tubular section and all ladder rungs are to be square bar. Platform lighting shall be provided if required by ES.
10. Heat protection (shielding) and insulation shall be provided for areas of high thermal radiation. cranes operating within

#### **5.5.4.3 WALL MOUNTED JIB CRANE**

1. Design of jib and other structural components shall be determined as per the design capacity of the crane and operational requirements. In general, I-beam type jib arm shall be provided.
2. The jib shall be suitably supported on pivoted bracket(s) on one end. The bracket shall be rigidly fixed to the wall/structure. The jib, support arrangement and all structural components shall be designed to transmit all types of load combinations, including minimum dynamic load of 25% of the rated load, as well as bending, buckling etc., generated during operation.
3. In general, the crane column shall be fixed/anchored to a concrete foundation on the ground. Size of footing shall conform to DIN 15019, Part 1, Crane Type 2 (Rotating Tower Cranes). Allowable floor loading shall be as per DIN 1054. Load diagram and foundation assignment drawings shall be supplied by the crane supplier.
4. Suitable wall fixing bolts shall be supplied by the crane manufacturer, if specified.
5. For jib cranes mounted on steel structures, acceptance regarding weight, reinforcement and stress calculations shall be gained after consultation with ES.
6. In case the crane is fixed to a steel structure, all bolted connections for fixing to the structure shall be of high tensile structural bolting (galvanised or black - 10.9 grade, lightly oiled). All such bolts shall be correctly torqued as per DIN 18800.



7. The pivot arrangement shall be truly vertical after installation to ensure that the jib does not move due to gravity regardless of its position.
8. The deflection of the jib arm subjected to nominal test load (DIN 15 030) and hoist weight must not exceed 1/450 of the maximum jib radius.
9. Adequate working access and platforms for maintenance shall be provided. Suitable access staircases shall be provided. Safety of personnel shall be primary consideration during the design of such staircases and platforms. Hand railing shall be of tubular section and all ladder rungs are to be square bar. Platform lighting shall be provided if required by ES.
10. Heat protection (shielding) and insulation shall be provided for areas of high thermal radiation. cranes operating within

#### **5.5.4.4 TRAVELLING JIB CRANE**

1. Design of jib, end trucks (carriages), bracings and other structural components shall be determined as per the design capacity of the crane and operational requirements. In general, I-beam type jib arm shall be provided.
2. The jib shall be rigidly supported to the end trucks through end connection plates and high tensile structural bolting conforming to DIN 6914 (galvanised or black - 10.9 grade, lightly oiled). All such bolts shall be correctly torqued as per DIN 18800 part VI.
3. The jib, end carriages, support arrangement and all structural components shall be designed to transmit all types of load combinations, including minimum dynamic load of 25% of the rated load, as well as bending, buckling etc., generated during operation.
4. Drive systems for the long travel motion shall be base mounted on suitable platforms.
5. The deflection of the jib arm subjected to nominal test load (DIN 15030) and hoist weight must not exceed 1/450 of the maximum jib radius.
6. Consideration will be given to arrangements that will ensure proper distribution of the crane loads to the end carriages and rails.
7. To allow for wheel deviation, the difference in individual wheel loading shall not exceed 10%.
8. It must be observed that the natural frequency in vertical direction shall not fall below the value 3.
9. For jib cranes mounted on steel structures, acceptance regarding weight, reinforcement and stress calculations shall be gained after consultation with ESI. Load diagram and foundation assignment drawings shall be supplied by the crane supplier.
10. The pivot arrangement shall be truly vertical after installation to ensure that the jib does not move due to gravity regardless of its position.

11. Adequate working access and platforms for maintenance shall be provided. Suitable access staircases shall be provided. Safety of personnel shall be primary consideration during the design of such staircases and platforms. Hand railing shall be of tubular section and all ladder rungs are to be square bar. Platform lighting shall be provided if required by ES.
12. Heat protection (shielding) and insulation shall be provided for areas of high thermal radiation. cranes operating within

#### **5.5.4.5 SAFETY ASPECTS**

1. All points of hazard, for example buffers, hook blocks, steps, narrow passages, supports, etc. on the crane shall be marked and they have to comply/ meet DIN 15026 'Marking of Points of Hazard'.
2. Name plate shall be attached to the jib in a clearly visible position, indicating the crane serial number, safe working load and year of manufacture. The name plate shall be written in both English and Arabic.
3. All major components shall have suitable lifting lugs or lifting points designed in facilitate erection/maintenance.
4. For travelling jib cranes, protection shall be provided against accidental contact of the hook blocks or any other suspended lifting devices with the DSL lines.
5. All fasteners on the crane shall be of minimum 8.8 grade and will have 'Pal type' locking nuts fitted. 'Nyloc' type locking nuts shall not be used.
6. Bolted connections shall be of high tensile structural bolting conforming to DIN 6914 (galvanised or black - 10.9 grade, lightly oiled). All such bolts shall be correctly torqued as per DIN 18800.
7. All equipment shall be easily accessible for ease of maintenance.
8. Ladders shall be suitably provided for crane access.
9. For travelling jib cranes, crane maintenance platform shall be provided. The platform shall be equipped with necessary railings and safety ladders. All ladder rungs shall be of square bar. Suitable access staircases shall be provided, and the safety of personnel shall be of primary consideration during the design of such staircases and platforms. Vertical access ladders are not normally acceptable. Platform lighting shall be provided if required by ES.
10. Hand railing shall be of tubular section around all access and walkways at a minimum of 1100mm high. Walkways shall be minimum 800 mm wide with open grating or non-skid plate.

#### 5.5.4.6 CRANE GANTRY AND CRANE RAIL (For Travelling Jib Crane)

##### 1. GENERAL

- a. For new crane(s) installed in an existing bay with old runways/rails the existing crane gantries and rails are old and therefore due to the age of the structure rail alignment according to VDI 3576 will not be achieved.

However, the wheel loading of the crane(s) shall be such as not to induce any further detrimental effects to the existing crane gantries, rails and structures.

The design of the crane(s) must consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

- b. For new crane(s) installed in an existing bay with good runways/rails. The existing crane gantries and rails are relatively new and therefore they are good enough to carry the new crane(s).

However, the wheel loading of the proposed crane(s) shall be such as not to induce any detrimental effects to the existing crane gantries, rails and structures.

Structure rail alignment according to VDI 3576 shall be achievable.

The design of the crane(s) must consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

- c. **For new crane(s) installed in a brand-new bay**

The structure rail alignment according to VDI 3576 shall be achieved and the wheel loading of the proposed crane(s) shall be such as not to induce any detrimental effects to the existing crane gantries, rails and structures.

The design of the crane(s) must consider this fact. The contractor shall inform in the offer the working rail tolerance that the crane(s) can accommodate.

##### 2. CRANE TRACK RAIL

###### a. Dimensions

The long travel rails will have rail dimensions to DIN 536-Type A. The rails shall be fixed with rail clips. In addition, the rail shall be mounted on a resilient pad.

###### b. Fixing of Rails

All rails for the long travel motions shall be fixed with clips. Welding of rails to the runway beams is not acceptable.

The rails shall be joined by welding using Thermite process.

**c. Track Pads**

Track pads shall be provided underneath all new rails. The track pads shall be products of competent manufacturers.

**d. Material**

The rails shall have a minimum tensile strength of 690 N/mm<sup>2</sup>. Test certificates shall be submitted.

The crane rails for steel plant (melt shop, continuous casting area, cooling bed area, billet bay area), rolling mill and hot strip mill use shall be made from killed steel as recommended in DIN 536.

Rails, clips and resilient pads shall preferably be of GANTRY make.

**e. Interfacing New and Existing Equipment**

Close coordination will be required to ensure interfacing of new and existing equipment, e.g. the power collector shoes to the down shop conductor rails, position of LT buffers, rail stoppers, available height between roof & rail etc.

**5.5.4.7 CRANE INSTALLATION**

Installation and commissioning work shall be performed by skilled artisans and labourers under strict supervision and responsibility of experienced engineers. (Documentation shall be produced upon request).

**5.6 Electric Hoists**

**5.6.1 GENERAL**

This part outlines ES's requirements for design, manufacturing, supply, delivery, installation, testing, certification, erection and commissioning of Electrically Operated Rope/Chain Hoist for use in Emirates Steel (ES). Pneumatically operated hoists, balancers, manually lever operated hoists etc. are outside the scope of this standard.

Refer to Section 11-060 for: -

- Definitions
- Codes and Standards
- Electrical Equipment and Installation

- Surface Preparation and Coating
- Tooling
- Tests and Inspection
- Documentation

### 5.6.2 CLASSIFICATION

Classification of a particular hoist shall be based on the operating conditions of the most severely loaded part of the hoist and shall be agreed with ES prior to order placement. For replacement of existing hoists, the classification shall be according to the Table given below. For new hoists, the classification shall be generally according to DIN 15018 Part 1, which shall be discussed and finalised with ES. For details of technical requirements of various hoists as per location and use, refer to "Crane Requirement Chart" enclosed with this section.

#### 5.6.2.1 DRIVES

The calculation of hoist and trolley drive mechanisms shall be in accordance to DIN 15020, or equivalent international standard, to ensure an adequate degree of safety of operation of the lifting appliance and to achieve an adequate service life for the wire ropes used. The relation of rope diameter to rope sheave diameter respectively rope drum diameter shall be according to the relevant DIN or equivalent standards.

SI	Location	Description	Duty	Hoist Class	Lifting Category	Stress Group
1	Cold Rolling Mill	Roof service hoist	Low	1 Am	H2	B1
2	Direct Reduction Plant	Electric monorail hoist (flame explosion proof)	/Low	1 Bm	H2	B1
3	Direct Reduction Plant	Electric monorail hoist	Medium	2 m	H2	B1
4	Direct Reduction Plant	Electric monorail hoist	Low	1	AmH2	B1
5	Direct Reduction	Pneumatic hoist	Low	2m –	H1-H2	B1-B2

	Plant	(flame proof / explosion proof)		1Bm		
6	Hot Strip Mill/Cold Rolling Mill – Dispatch	Roof service hoist	Low	1 Am		B1
7	Rolling Mill – Dispatch	Roof service hoist	Low	1 Am 1		B1
8	Rolling Mill / Hot Strip Mill	Roof service hoist	Low	Am		B1
9	Scale Pit	Electric monorail hoist	Low	1 Am 1		B1
10	Scrap Yard	Roof service hoist	Low	Am 1 Am <sup>H2</sup>		B1
11	Steel Plant – Melt Shop	Roof service hoist	Low	1 Am 1	H2 H2	B1
12	Steel Plant – Caster	Roof service hoist	Low	Am 1 Am	H2 H2	B1
13	Steel Plant – Refractory	Roof service hoist	Low	1 Am 1	H2	B1
14	Steel Plant – Bag House	Electric monorail hoist	Low	Am	H2 H2	B2
15	Utilities	Electric monorail hoist	Low		H2 H2	B1
16	Workshops	Electric monorail hoist	Low		H2	B1

### 5.6.3 ELECTRIC HOIST – GENERAL REQUIREMENTS

#### 5.6.3.1 TRAVELLING ELECTRIC ROPE HOIST

The hoist shall be of low height, under slung, modular design, compact construction type. The hoist shall be of weather-proof construction.

The hoist shall mainly consist of an electrically driven rope drum with rope, an electrically operated trolley unit, and all its associate parts such as hook block, festoon system or enclosed conductor system, pendant/remote station, control panel, monorail beam etc. All motions shall be electrically operated.

The hoist unit and trolley unit shall be assembled as one unit, with permanent connections. Hook mounted hoist unit shall not be accepted.

The hoist shall be suitable for travelling on the bottom flange of an I-beam type monorail.

#### 5.6.3.2 TRAVELLING ELECTRIC CHAIN HOIST

The hoist shall be of low height, under slung, modular design, compact construction type. The hoist shall be of weather-proof construction.

The hoist shall mainly consist of an electrically driven chain drum, chain collection box, an electrically operated trolley unit, and all its associate parts such as hook block, festoon system or enclosed conductor system, pendant/remote station, control panel, monorail beam etc. All motions shall be electrically operated.

The hoist unit and trolley unit shall be assembled as one unit, with permanent connections. Hook mounted hoist unit shall not be accepted.

The hoist shall be suitable for travelling on the bottom flange of an I-beam type monorail.

#### **5.6.3.3 ROOF SERVICE HOIST FOR CRANE MAINTENANCE**

Roof service hoist shall be used for crane repair/maintenance purpose. These hoists shall preferably be travelling electric rope hoist. The hoist shall be of weather-proof construction. The working environment of particular hoist shall be taken into consideration to determine any additional requirements of the hoist (e.g. flame and/or explosion proof type). The hoist shall be mounted in such a way that all removable items from the crane(s) can be easily removed/replaced. The height of the monorail beam shall be determined by the maximum height required for removal of any item on the crane(s), plus an additional 400mm gap between top of hook block and bottom of hoist over winding limit switch.

The hoist shall be suitable for travelling on the bottom flange of an I-beam type monorail.

The location of the hoist will be decided suitably, depending on the crane maintenance bay location. Hook approaches and clearance envelope shall be suitable to the building structure and the crane(s) operating below.

#### **5.6.3.4 HOISTS FOR DIRECT REDUCTION PLANT**

The Direct Reduction Plant generates a lot of fine dust containing iron bearing materials, which are flammable in moderately high temperature and in presence of spark. Moreover, these dusts make solid cakes in presence of moisture. The Direct Reduction Plant also emits flammable gases, which may catch fire under certain conditions.

These hoists shall preferably be rope hoist. The hoist shall be of weather-proof construction. All equipment and components used for hoists used in Direct Reduction Plant shall be flame-proof and/or explosion-proof as per the specified hazard category (this is a mandatory requirement). All mechanical & electrical components shall be suitably designed

to prevent dust build-up, and shall be properly enclosed for protection against fume, gas, thermal radiation, flame etc.

#### **5.6.3.5 HOIST FOR UTILITY SERVICES**

1. Electric hoists used for utility services come in contact with various types of water (Sea water, process water, industrial wastewater, sanitary wastewater etc.) and other fluids. Each hoist shall be carefully selected for the particular application.
2. These hoists shall be of weather-proof construction.
3. In general, hoists operating in sea water application shall be made from corrosion resistant materials.
4. Hook block of all hoists shall be suitable for underwater service. The hook blocks shall be lubricated with water resistant grease of suitable quality (Renolite CA-FG 50 or equivalent)
5. Suitable maintenance platform with lighting shall be provided for each hoist, wherever required.
6. It will be the contractor's responsibility to ensure the suitability of the hoist for work in the high temperature and dusty steelworks environment.

#### **5.6.4 ELECTRIC HOIST – MECHANICAL COMPONENTS**

##### **5.6.4.1 GENERAL**

1. All mechanical components shall be provided with sufficient safety factor. Load limiting devices shall be provided such that the load does not exceed 35% of ultimate strength of load bearing parts.
2. Hollow shaft design for gearbox or geared motor shall not be accepted.
3. Cast iron shall not be used for any component, including hook ballast weight.
4. All antifriction bearings shall be life lubricated sealed type.

##### **5.6.4.2 HOIST DRIVE**

1. The hoist drive shall be of electrically operated type, with single reeved wire rope and hook block.
2. The mechanical components of the hoist drive shall be rated according to their mode of operation into a drive group in accordance with DIN 15020 in order to achieve the required long service life.
  - a. The hoist drive shall comprise of the following main components. The description is general in nature. The hoist shall be as per manufacturer's standard, and shall be customized to suit the particular requirement or application:
    - 1 no. squirrel cage motor, or geared motor, with integral brake



- 1 no. gearbox (alternatively, geared motor)
- 1 no. rope drum integrally mounted on the gear box output
- Wire ropes or chains
- Hoist over winding limit switches
- Hook block (bottom block)
- Overload protection system

## **b. Details of Hoist Drive Components**

### **1. Motor**

The motor shall be squirrel cage type. The motor shall be suitable for use with the inverter control system and regenerative braking, if specified. See section 7.0 -Electrical Equipment and Installation for further details of motor.

### **2. Brake**

Electro-magnetic disc brake, integrally mounted within the motor, shall be provided. Brake system shall be designed for 1.6 times the hoist load and they shall be capable of braking the dynamic test load without a damaging snatch effect, and without overheating. The brake shall be suitable for the specified maximum ambient temperature. The brake will be equipped with a manual release facility that will allow the load to be lowered to the ground in the event of a power supply failure. Brake shall be fitted with auto-adjust wear systems.

### **3. Gearbox**

The gearbox shall be spur or spur-helical type. Planetary gearbox may also be provided.

The gearbox shall be selected as per the drive classification of DIN standard and shall be rated according to the mode of operation, with sufficient safety factor.

Gears shall be machine cut, made from heat treated alloy steel, designed as per relevant DIN standard.

The gearbox casing shall preferably be fabricated type. Cast iron casing will not be accepted.

#### **4. Wire Rope**

Wire rope diameter shall be calculated as per DIN 3064 shall be used with an individual wire breaking strength as per the standard. Rope thimbles, if provided, shall conform to DIN 3091. The wire ropes and rope anchors shall be suitable for the operating environment.

Rope length shall be sufficient to reach ground level. Wire rope shall be properly lubricated.

Rope guides shall be made from metal. Plastic rope guides will not be accepted.

#### **5. Chain**

Welded link chain as per DIN standard made from suitable alloy steel shall be provided.

Chain size shall be calculated with suitable safety factor as load classification. Chain length shall be sufficient to reach ground level.

For chain operated electric hoist, a chain collection box shall be provided on the hoist.

#### **6. Rope Drum**

Rope drum shall be integrally mounted on the gearbox output shaft. Rope drum shall be of welded construction with grooves according to DIN 15061. At least 2 dead turns shall be provided on the drum when the rope is at the lowest position as determined by the hoist limit switch.

Preferred material of drum components shall be as follows: -

- Drum shell: St 52-3
- Drum trunnion: St 52-3
- Flange: RSt 37-2

#### **7. Drum Bearing**

Self-aligning antifriction roller bearing shall be used for the drum end bearing. The bearings life shall be at least 10,000 hours.

#### **8. Hook Block**

The hook block shall mainly consist of a set of rope sheaves and a lifting hook. The hook block shall conform to DIN 15409. Ballast weight shall be provided if required. The ballast weight shall be bolted type.

The sheaves shall be designed as per DIN 15422. The rope sheaves shall be preferably be made from cast steel. Rope groove profile shall conform to DIN 15061. The rope sheaves shall be mounted on suitable life-lubricated sealed ant-friction bearings. Bearing life shall be minimum 10,000 hours.

The rope sheave guard design shall be such that the distance will cover over half of the centre distance of the rope sheaves to prevent accidental rope removal.

The lifting hook shall conform to relevant DIN standard, depending on the hook type. The hook shall be made from drop forged steel, and suitably heat treated. The hook shall be either free swiveling type, or lockable at 90° interval, depending upon the operational requirements. Safety latch shall be provided on the hook. The hook shall be suspended from the crosshead by means of thrust and radial anti-friction bearings. Bearing life shall be minimum 10,000 hours.

For chain operated hoists, the chain end shall be directly connected to the hook block. Other constructional requirements of the hook block and hook shall be as detailed above.

All safety regulations for Load Suspension Devices according to DIN 15003, DIN 15428 and VGB 9a shall be observed.

All rotating parts shall be mounted on bearings. All bearings shall be life-lubricated sealed ant-friction type. In case other types of bearings are used, suitable lubrication system shall be provided.

The hook block shall be painted with RAL 1023 (Traffic Yellow) colour.

Safe working load (SWL) written in English language shall be clearly marked in large print, in a prominent position on a minimum of two sides of the hook block.

Warning Stripes shall be painted at the extreme ends of hook block as per DIN 15026 'Marking of Points of Hazard'

### 5.6.4.3 TROLLEY TRAVEL DRIVE

#### 1. TROLLEY TYPE

##### a. Standard Trolley

The trolley shall be electrically driven, under slung type, with two (2) driving and two (2) driven wheels which shall travel on the lower flange of a straight monorail beam.

##### b. Articulated Trolley

Articulated trolley shall be provided where trolley shall need to travel along a curved path or round tight bends. The trolley shall be electrically driven, under slung type, with two (2) driving and two (2) driven wheels. Lateral guide rollers shall be provided to ensure minimal wear on the monorail beam.

2. The trolley shall have minimum four (4) wheels. At least 50% (half) of all wheel sets shall be driven. It shall be verified that the acceleration power with an unloaded trolley can be transmitted to the wheel without slippage.

3. The trolley travel drive shall comprise of the following main components. The description is general in nature. The trolley shall be as per manufacturer's standard, and shall be customized to suit the particular requirement or application:

- 1 no. squirrel cage geared motor with integral brake
- 2 nos. driven wheels
- 2 nos. idle wheels
- Side guide rollers (for articulated trolley)
- Buffers
- Travel limit switches

#### 4. Details of Trolley Drive Components

##### a. Motor

The motor shall be squirrel cage type. The motor shall be suitable for use with the inverter control system and regenerative braking, if specified. See section 7.0 -Electrical Equipment and Installation for further details of motor.

##### b. Brake

Electro-magnetic disc brake, integrally mounted within the motor, shall be provided. Brake system shall be designed for 1.6 times the hoist load and they shall be

capable of braking the dynamic test load without a damaging snatch effect, and without overheating. The brake shall be suitable for the specified maximum ambient temperature. The brake will be equipped with a manual release facility that will allow the load to be lowered to the ground in the event of a power supply failure. Brake shall be fitted with auto-adjust wear systems.

**c. Gearbox**

The gearbox shall be spur or spur-helical type. Planetary gearbox may also be provided.

The gearbox shall be selected as per the drive classification of DIN standard and shall be rated according to the mode of operation, with sufficient safety factor. Gears shall be machine cut, made from heat treated alloy steel, designed as per relevant DIN standard.

Splined gearbox output shaft shall be preferred. Hollow shaft drive systems shall not be incorporated into the design.

The gearbox casing shall preferably be accepted. fabricated type. Cast iron casing will not be

**d. Wheel**

The wheels shall be suitable to run on the lower flange of the jib arm.

The driving and trailing wheels shall be interchangeable as far as possible.

The wheels shall be flanged type, to suit the profile of the monorail beam. The wheels shall be mounted on bearings in suitable housings giving unit change facility (wheel, shaft, bearings).

The wheels shall be made from forged steel and suitably heat treated.

The wheel bearing housings shall be attached to the trolley structure with through bolts. The use of set screws and tapped holes is not acceptable

#### **e. Side Guide Roller**

Side guide rollers shall be provided on all articulated trolleys for transferring horizontal forces to the monorail beam flange, thus ensuring proper alignment of wheels.

The side guide rollers shall be suitably mounted on the trolley and shall be adjustable at site.

The rollers shall be made from forged steel, and heat treated for long life. The rollers shall be mounted on life lubricated sealed anti friction bearings. Bearing life shall be minimum 10,000 hours.

#### **5.6.4.4 BUFFER**

Rubber buffers shall be provided on the hoist for trolley travel motion.

Suitable end stops, matching with the buffer dimensions and locations, shall be provided at both ends of the monorail beam.

#### **5.6.4.5 LUBRICATION SYSTEM**

Wherever pivoting actions are taking place and/or for all moving parts, an adequate lubrication system shall be provided.

All static grease points of the hoist drives shall be grouped together via grease lines. The minimum requirement is for the grease lines to be individually fed via grease nipples, mounted on a common block. The grease nipple type shall be standardised "pull-on" type wherever possible for all equipment on the crane.

All grease lines shall be constructed from suitable stainless-steel pipe and piped to areas where safe access can be ensured.

All oils and lubricants provided shall be as per written agreement by ES during engineering design stage.

Lubrication drawings shall be provided that clearly show the lubrication requirements.

These drawings shall be converted to A3 size, they shall be 'plasticised/laminated' and stored in a suitable covered box, either in the driver's cabin or at an agreed location.

#### **5.6.4.6 GENERAL REQUIREMENTS**

1. Parking/Maintenance Area: The Contractor will be responsible for ensuring the design, fabrication and installation of an operationally safe parking/maintenance area, which shall provide easy access, and for guarantee of complete serviceability of the system. There shall be adequate working access for maintenance provided by means of a working platform, located at the parking area.
2. A weatherproof parking/maintenance outdoor. enclosure shall be provided for hoists located
3. Suitable access staircases shall be provided, wherever required, and safety of personnel shall be primary consideration during the design of such staircases and platforms.
4. Clearances and hook approaches: The hook approaches and clearance envelope shall be suitable to the building structure and operational requirements.
5. Heat protection (shielding) and insulation shall be provided for hoists operating within areas of high thermal radiation.

#### **5.6.5 ELECTRIC HOIST – STEELWORK**

##### **5.6.5.1 MATERIAL**

The steelwork will consist of structural steels according to DIN EN 10025.

##### **5.6.5.2 MONORAIL BEAM**

Design of monorail beam and other structural components shall be determined as per the design capacity of the hoist and operational requirements. In general, I-beam type monorail beam shall be provided.

The monorail beam and other support structure components shall be designed to transmit all types of load combinations, including impact load, generated in the hoist unit during operation.

The deflection of the monorail beam subjected to nominal test load and hoist weight must not exceed 1/1000 of the support span.

The monorail beam shall be mounted to the building structure by means of bolted connection. Suitable pedestals may be used for inclined roofs.

The bolted connections shall be made by high strength friction grip (HSFG) bolts (black - grade 10.9, lightly oiled), they shall be correctly torqued as per DIN 18800. Care must be taken to ensure that the tapered washers are correctly installed.

In case of replacement of hoist on an existing monorail beam, the contractor shall be responsible for ensuring that the existing monorail, maintenance platform, access staircase etc. are suitable for the new hoist.

#### **5.6.5.3 MAINTENANCE PLATFORM**

For adequate working access for maintenance, a working platform shall be provided at the parking area for the hoists. Suitable access staircases shall be provided, and the safety of personnel shall be of primary consideration during the design of such staircases and platforms.

Vertical access ladders shall, in general, not be accepted. During detailed engineering, in case staircases for access to new maintenance platforms cannot be provided for maintaining minimum safety clearances to cranes or other existing equipment, then ladders with safety cages, or other alternatives, shall be considered.

Hand railing shall be of tubular/rectangular section and all ladder rungs shall be made from square bar.

The contractor shall be responsible for ensuring the design, fabrication and installation of an operationally safe parking/maintenance area, which provides easy access and guarantees complete serviceability of the system.

For hoist relocation work, the existing platforms, ladders etc. shall be re-used as far as possible.

#### **5.6.5.4 SAFETY ASPECTS**

1. All points of hazard, for example buffers, hook blocks, steps, narrow passages, supports etc. upon the hoist system and platforms shall be marked and they have to comply with DIN 15026 'Marking of Points of Hazard'.
2. Name plates showing hoist manufacturer, SWL, serial number and year of manufacturing shall be fitted to the hoist such that it is clearly legible. Two name plates, one in English & another in Arabic language, shall be provided on each side of the hoist. Hoist capacity shall be indicated on the hook block also.



3. All major components shall have suitable lifting lugs or lifting points designed in facilitate erection/maintenance.
4. All fasteners on the hoist shall be of minimum 8.8 grade and shall have 'Pal type' locking nuts fitted. 'Nyloc' type locking nuts shall not be used.
5. All equipment shall be easily accessible for ease of maintenance.
6. Hand railing shall be of tubular/square section around all access and walkways at a minimum of 1100 mm high. Walkways shall be minimum 800 mm wide with open grating or non-skid plate.

#### 5.6.5.5 INSTALLATION

Installation and commissioning work shall be performed by skilled labour under strict supervision and responsibility of experienced engineers. (Documentation shall be produced by the contractor upon request).

### 6. SUPPORTING DOCUMENTS

NA

### 7. REVISION HISTORY

Issue No.	Date	Page/s	Cause of Revision
0	17.11.2019	All	First Issue