GENERAL TECHNICAL SPECIFICATION
FOR
SUPPLY, FABRICATION, ERECTION
SHEETING & PAINTING OF
STEEL STRUCTURES
(GS – 04)
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## AMENDMENT SHEET

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GENERAL DESCRIPTION OF WORK

SECTION : 1

1.1 The general specifications for structural works furnished herein are intended as guidelines for execution of the works satisfying the Owner’s requirements as also complying with all technical norms in totality. This specification is to cover the design, preparation of design drawings and fabrication drawings, supply of all labour as well as materials and construction of all structural work on a turnkey basis for the Project / Works as described in the general conditions of contract.

1.2 Description of various items of work under this specification and nature of work in detail are given hereinafter. The complete work under this scope is referred to as STRUCTURAL WORKS. The detailed scope of works covered under Structural works is given in Section -2.

1.3 The work to be performed under this specification consists of design, engineering , supply, fabrication, erection and cladding, as well as providing all labour, materials, consumables, equipment, temporary works, temporary labour and staff colony, constructional plant, fuel supply, transportation and all incidental items not shown or specified but reasonably implied or necessary for the completion and proper functioning of the plant, all in strict accordance with the specifications, including revisions and amendments thereto as may be required during the execution of the work.

1.4 Supply of all materials including structural steel, roof cladding & side-cladding sheets, fasteners, paints, consumables like gas, electrodes etc. and all other materials as deemed necessary for proper completion of the work, are included in the scope of the Contractor.

1.5 The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the Owner/Consultant.
For all buildings and structures, necessary layout and details are to be
developed by the Contractor keeping in view the statutory & functional
requirements of the plant and facilities and providing enough space and
access for operation, use and maintenance. Certain minimum
requirements are indicated in this specification for guidance purpose
only. However, the Contractor’s offer shall cover the complete
requirements as per the best prevailing practices and to the complete
satisfaction of the Owner.

1.6 Contractor shall inspect the site, examine and obtain all information
required and satisfy himself regarding matters and things such as access
to site, communications, transport, right of way, the type and number of
equipment and facilities required for the work, availability of local labour,
materials and their rates, local working conditions, weather, tidal / flood
levels, subsoil conditions, natural drainage, etc. Ignorance of the site
conditions shall not be accepted by the Owner as basis for any claim for
compensation or extension of time. The submission of a bid by the
Contractor will be construed as evidence that such an examination was
made and any later claims / disputes in regard to price quoted shall not
be entertained or considered by the Owner on account of ignorance of
prevailing site conditions.

1.7. Contractor shall comply with all the applicable statutory rules pertaining
to Factory act, Fire safety rule of Loss prevention association, Water act
for Pollution control, Explosives act etc. Provisions of Safety, health and
welfare according to Factories act shall also be complied with. Statutory
clearances and norms of State Pollution Control Board shall be followed.
Statutory body /Act requirements shall be fulfilled by the Contractor and
in case any modifications /additions to the building /Structures are to be
made as per the above, shall be carried out by the Contractor at no extra
cost to the Owner.

SECTION - 2   SCOPE OF WORK
2.0. The scope of work shall cover, but shall not be exclusively limited to, the following:

- collection of all site related data & conducting site investigations,
- design, preparation of all design drawings, fabrication drawings,
- obtaining Owner’s/Consultant’s approval on general arrangements and design of structures
- dismantling, retrieval, sorting and storing of any existing structures as directed by the owner, if dismantling is a part of the total work
- supply of all materials viz, raw steel, sheeting for roof and side cladding, and paints
- supply of fasteners like bolts, nuts, washers etc
- supply of consumables like electrodes for welding, gases for gas cutting etc
- supply of plant & machinery, tools tackles, instruments for fabrication and erection
- providing facilities for testing of materials and conducting NDT
- providing facilities for transport and handling
- deploying requisite skilled and unskilled manpower
- making arrangements for all services like approach to site, electricity, water etc
- fabrication of structures, their transport and proper storing at site
- erection of structures, claddings, gutters, down pipes etc
- application of paints at shop after fabrication and at site after erection
- providing all reasonable facilities for inspection by Owner/Consultant
- conducting NDT as stipulated by the Owner and making test results available to Owner / Consultant for evaluation
- compliance with primary acceptance tests / inspection, liquidation of defects; compliance with final acceptance tests / inspection, liquidation of defects;

- carrying out field-engineering decisions as desired by the Owner

- preparation of “As Built” drawings for all the structures and hand over to the Owner the completed structural work to the Owner’s full satisfaction.

- supply of all loading data for RCC foundation, layout drawing, HD bolt insert details and all other necessary information for requirement of Foundation/ RCC work, where future expansion is envisaged, the successful contractor shall furnish load data separately for present and future construction.

- any other work deemed incidental for the completion of the overall work but not included in the above detailed scope.

SECTION – 3  DESIGN OF BUILDING STRUCTURES

3.0 General

This specification shall apply to steel work in building and general structural steel work. For technological structures, additional stipulations shall be considered as per technical requirements.

3.1 Design considerations

3.1.0 General

3.1.01 Structures shall be designed such that they are economical and safe and meet the functional and service requirement of the technological process for which
they are designed. The architectural planning of the building shall be based on technological requirements.

3.1.02 The structures shall be designed conforming to the relevant safety regulations, Factory Acts, Electricity Rules and stipulations of Statutory bodies as applicable to the project.

3.1.03 Natural ventilation shall be provided ensuring that it does not permit rain water entry into the building. Scope of natural lighting shall be used to the maximum possible extent.

3.1.04 Mild steel gutters and down-pipes with gutter outlets having grating cover shall be provided to carry rain water from roofs of buildings to the drainage system at ground level. All gutters shall be designed as walkable with 600 mm sole width.

3.1.05 Adequate facilities in the form of monorails, hoists, platforms etc. shall be provided to facilitate repair and maintenance of overhead cranes, equipment, etc. Access to these platforms shall be provided by stairs / ladders from the nearest accessible floor or platform.

3.1.06 Access to all floors, gangways and landings shall be by staircases. Access to platforms and landing of secondary importance or where such access is used only rarely, shall be by vertical ladders with safety hoops.

3.1.07 Roofs with access shall be provided with safety handrails along the periphery of the roof.

3.1.08 Edges of floors, gangways, stairs and landings shall be provided with safety hand railings.

3.1.09 At gable ends of buildings, platforms shall be provided connecting the walkways at crane gantry level.

3.1.10 Floors, gangways and landings shall be covered as follows:

   a) Gangways and landings shall have chequered plate with a minimum thickness of 6mm o/p suitably stiffened to meet design load requirements.

   b) Floors and operating platforms other than the above shall have chequered plate flooring or hot dip galvanised open gratings, or RCC slab resting on steel structural framework, to suit the technological requirements.
3.1.11 Protective metal heat shields shall be provided for steel structures exposed to continuous heat radiation of temperature exceeding 150 °C and also where hot metal splashing on structures is likely to occur.

3.1.12 All buildings and their foundations shall be designed so that it shall be possible to extend them in the longitudinal direction at a later date without further strengthening of gable structures. Provision for transverse extension, if any, shall also be made at the initial stage.

3.1.13 Sheeting on sides and gables shall generally terminate 3.0 m above ground floor level unless required to be otherwise. Sides below this level shall be generally screened by brick walls allowing sufficient air inlet to achieve natural ventilation, unless otherwise required from technological / ventilation requirements.

3.1.14 Connection by permanent bolts to structural elements subject to vibration shall be provided with lock nuts.

3.1.15 For Analysis/design of steel structural frame work STAAD PRO soft ware shall be used. CD of input files shall be submitted to purchaser/consultant along with the hard copy of the document.

3.2 Elements of Structures

3.2.01 Columns

a) At the location of passage/opening through columns web shall be suitably strengthened by vierendeel panel or modified lattice system.

b) Shear force at the column base shall be resisted either by shear keys shop-welded to the underside of column base plates or by welding base plate to inserts provided in foundation.

c) The level of underside of column base shall be so chosen such that the complete anchor table lies below the finished floor level, thus keeping the shop floor free from projections of anchor tables.
3.2.02 Crane Girders

a) Crane girders shall generally be of simply supported design, unless continuous crane girders are specifically required.

b) Top flange plate shall be welded to web plate with full penetration butt weld with fully automatic submerged arc welding. Bottom flange plate shall be welded to web plate by continuous fillet welds with automatic/semi-automatic welding.

c) All intermediate stiffeners shall be fitted against top flange and welded to it by fillet welds/partial penetration butt welds. These stiffeners shall terminate short of bottom flange with at least 25 mm gap. The stiffeners shall be fillet welded to web plate and corners shall be cut suitably to clear thermally affected area of web to top flange connection.

d) End bearing stiffener plates of crane girder shall be capable of transmitting the maximum reactions to the columns. The bearing surface of the bearing plate shall be planed/machined to ensure full contact.

e) Tension flange of crane girders shall be stabilised by horizontal latticed bracings, where required in order to limit the slenderness ratio of the flange to 150.

f) Generally for girders having span 12m and above, vertical auxiliary girder and horizontal girder at crane girder bottom flange level shall be provided.

g) All crane girders shall be checked for fatigue as per IS: 1024 (latest).

h) i) At crane girder level, walkway shall be provided on both sides. Walkway at column location shall have minimum clear width of 500mm. Approach by staircase to this level shall be near the maintenance bay.

j) All crane girders and their supporting structures shall be designed for loading from loaded crane in worst position of crab and crane to create most unfavorable loading condition of the girders. For increase of load due to impact and crane load combination including lateral surge shall be taken as per provision of IS 875 (Part – 2) -1987.

k) Suitable approach to be provided for tightening of bolts of Crane Rail. Approach for Crane Rail fixing shall be properly planned for all types of sections of Crane Girders.

3.2.03 Surge Girder walkways and auxiliary beams.
a) Continuous maintenance walkways with safety hand-railing shall be provided along each column row adjacent to each crane gantry girder. These walkways shall be of non-slip plate construction connected to crane girder top flange by continuous fillet welds. Staircase at every 120m shall be provided from floor for access to this walkways so that stairs are available within 60m from any location.

b) Connections between surge girder and the main columns shall be designed to resist load due to lateral braking of crane trolley.

c) On the periphery of the building, full length handrails shall be provided along the edge of the maintenance walkway at crane girder level.

d) Handrail and its clearance from crane end carriage shall conform to provisions of relevant safety regulations.

3.2.04 Crane Stops

a) Crane stops shall be provided at the ends of each crane girder system, or as required to limit the movement of crane as per technological requirements.

b) Crane stops shall be bolted to crane gantry girder.

c) Only tested rail materials shall be used. Manufacturer’s test certificate, including chemical analysis shall be supplied.

d) Rails shall be free from twists, pitting, laminations and any other internal and external defects. The rail shall be straight and the deviation from the straightness shall not exceed + 1.5mm. If necessary the rail shall be cold straightened.

e) Unless otherwise specified, the crane rail joint shall be butt-jointed (either by Thermit or fusion welding) or by fishplates.

f) For Butt-welding the contractor shall take prior approval of the Purchaser regarding method of edge preparation, welding procedure and sequence of welding to be done. Edge preparation shall be done by oxyacetylene flame and shall be neatly finished by chipping and grinding.

g) All position low hydrogen electrodes conforming to IS 814-1991 shall be used for welding. The rail end shall be preheated to 250 deg. C before welding. The electrode shall be preheated as per manufacture’s instructions. The welded joint shall be allowed to cool slowly. It is recommended that the initial and intermediate layers of deposit may be by using ferron V, Superchord or equivalent. Top 3mm layer shall be deposited with Duroid 2A or equivalent, to obtain good wearing surface.
h) The joints shall be free from kinks, twists etc, and shall be grinded properly after welding to ensure smooth running of the crane.

i) Method of securing the crane rail to the crane gantry, alignment and expansion joints, if any, shall be subject to Purchaser’s approval. The crane rail clips shall be preferably forged or pressed from steel plates.

3.2.05 Roof Structures

a) The main supporting element for roof shall be roof trusses provided at uniform spacing to suit shop layout. Roof shall be provided with adequately sized roof monitor for natural ventilation, wherever required.

b) Roof shall have suitable slope to meet technological as well as rainwater drainage requirements. Hand railings at eaves level and gable ends of the roof of the building shall be provided.

c) System of bracings shall be provided in the roof top chord and bottom chord levels along with longitudinal ties to ensure stability and rigidity of the roof structures. Vertical bracings between trusses shall also be provided wherever required.

d) Galvanised wind tie (45x6 mm flat) shall be provided at the free edge of roof sheeting.

e) Suitable arrangement of anchors shall be provided at the ridge of roof sheeting for holding lanyards of safety belts.

3.2.06 Roof lighting walkways

a) Full length roof lighting walkways, generally 600 mm wide, shall be provided in each bay as required to match the number of rows of roof lights provided in the shop as per technological requirement.

b) These walkways shall span between roof truss members and will be decked with chequered plate floor. Walkways shall be provided with handrails on both sides.
3.2.07 Roof drainage system

a) Roof drainage system shall be designed for maximum precipitation for 5 minutes based on local meteorological data. A factor of safety of 1.3 shall be kept in the design.

b) All valley and eaves gutters shall be of pressed plate construction with a minimum sole width of 600 mm so as to function as walkways.

c) Eaves gutter shall be provided for eaves height ranging between 10 m to 25 m above apron/ground level.

d) The gutters shall be laid to slope towards down-pipes with welded outlets and having grills fitted flush with gutter sole. Slope of gutters and collector pipes shall not be flatter than the following limits:

   i) Longitudinal slope of gutter 1 : 500
   ii) Longitudinal slope of collector pipe 1 : 300

e) Poking holes with cover shall be provided in the down-pipes at suitable intervals as well as at accessible levels, to clean the down-pipes.

f) Collector pipes shall be provided with covered manholes at 6 m intervals.

g) Eaves gutter shall be provided with safety handrails.

h) When rain water falls from higher to lower roof, double layer of sheets shall be provided for the portion of roof sheeting on which rain water falls, provided the drop of roof is in the range of 3 m to 6 m. In case the drop is more than 6 m, independent gutter shall be provided.

i) Down pipes shall be spaced preferably at 24 m centres. The down-pipes shall be connected to the gutter with suitably designed hoppers with gratings at sole level of gutter, made of 8 mm dia rounds at 50 mm centers.

j) Joints of gutter and collector pipes shall be by welding in order to be leak-proof.
3.2.08 Wall Structures

a) Wall runners with necessary sag rod arrangements shall be provided to support wall and gable sheeting, including internal partition wall, wherever required.

b) Hanging wall posts shall generally terminate at 3.5 m above ground floor level unless required to be otherwise (Refer Clause 3.1.13).

c) Gables of buildings shall have wall post spaced at intervals to suit bay width.

d) Walls shall be provided with louvres and translucent sheeting at appropriate levels, to provide natural ventilation and lighting.

3.2.09 Floor Frameworks

a) Floor beams supporting vibrating equipment shall be designed to avoid resonant frequencies. (Refer clause 3.3.01 (c))

b) Beams along-with framework, shall be provided with both horizontal and vertical bracing (wherever permissible) to achieve overall rigidity.

3.2.10 Vertical bracings

a) Vertical bracings shall be provided on all column rows for each expansion block.

b) Vertical bracings shall extend from ground level to roof level and shall be designed to transmit longitudinal forces i.e wind forces, crane tractive forces, seismic forces etc. to the foundation.

c) Below crane girder level, for two-legged columns, the bracings shall be of twin system in the plane of each column leg, suitably tied or laced together.

3.2.11 Access staircase, walkways, platforms and ladders.
a) Wherever possible, access shall be provided by means of stairs.

b) All walkways and stairs leading to working platforms shall have minimum 1000 mm width of walkways/flight of stair.

c) All other walkways and stairs leading to areas for maintenance purpose, or due to restriction of space, shall have a minimum width of 800 mm of walkway/flight of stair, unless required otherwise.

d) Staircases shall be generally designed with slope of approximate 37.5° with the horizontal. (in no case the slope shall exceed 40 ° with the horizontal). Intermediate landings shall be provided wherever required such that vertical rise of each flight does not exceed 3000 mm. Risers in one flight shall be equally spaced.

e) Walkway floors and stair treads shall be designed with chequered plate ( or non-slip type plates). Ribbed floor/treads may be provided wherever the possibility of accumulation of dust exists, taking care that such provisions do not crate a nuisance to the operating personnel on the shop floor.

f) Rise of treads in staircases shall not exceed 200 mm.

g) A minimum headroom of 2200 mm shall be provided over operating platforms, visitor's galleries, or other areas with possibility of public gathering. In all other platforms, walkways and stairs, a minimum headroom of 2000 mm shall be provided. Only in special cases, local headroom of 1800 mm may be allowed (i.e at intersection with structural members etc.).

h) Cat ladders shall be provided for access, wherever provision of staircase is impractical due to limitations of space, or the access is required very infrequently.

i) Wherever the height of cat ladder exceeds 4.0 m, safety cage shall be provided. Intermediate landing shall be provided to cat ladders such that vertical height of single rise does not exceed 8.0 m.

j) Cat ladders shall be designed with following provisions :

   i) Width of rung = 500 mm
   ii) Minimum rise of rung = 250 mm
      Maximum rise of rung = 300 mm

   iii) Minimum clearance from rung of ladder to back of cage (in case of caged ladders) = 700 mm
iv) Minimum clearance from the centre of cage all round = 350 mm

v) Slope of cat-ladders:

I. For normal cat-ladders, slope shall be within the range of 75°-90° with the horizontal.

II. For ship-type ladders (i.e. cat-ladders with short side handrails) the slope shall be within the range of 65°-75° with the horizontal.

k) All walkways, platforms and stairs shall be provided with safety handrails. All handrails shall be constructed with steel tubes/angles for posts, top and middle rail and plates/sheets for toe plates. In case of stairs, the toe guards need not be provided.

l) The vertical height of hand-railings on walkways and stairs shall be minimum 1000 mm above floor level.

m) Hand-railing along edge of roof and gutters shall have a minimum height of 600 mm over top edge of gutters/sheets. In such hand-railings toe guards need not be provided. (only top handrail and mid-rail shall be provided).

n) Access to roof of the building shall be provided by means of staircases at midway length of the building. Pair of staircases shall be provided with one at the near end and the other at far end length of building. Approach to monitor roof/high bay roof from the roof of the bay approachable by staircases at midway length of the building shall be by means of staircase (if height of roof > 3m) or cat-ladder. Approach shall be provided on the roof of the building along the cross-section of the building.

3.3 Design

3.3.01 Design of structures

a) Design of steel structures shall be done in accordance with IS:800-1984 or any equivalent international code of practice that may be applicable.

b) Structures subjected to fluctuating/reversal of stress (eg. Crane girders) shall be designed in accordance with IS:1024-1979.

c) Resonance in structures: Structures supporting vibratory/reciprocating equipments shall be designed so as to obviate occurrence of resonance. The ratio of applied frequency to natural frequency shall not lie within the range 0.7
3.3.02 Description of design loads

Loads considered in design shall allow fully for all aspects of:

i) Dead weight of structures, wall, floors, equipment, wiring, machinery, pipe-work, cabling and any item of a permanent nature.

ii) Superimposed loads for roofs and floors plus any temporary machinery not allowed within the general superimposed loads.

iii) Crane loading.

iv) Temperature loads from process requirements because of the position of the structure relative to the heat source or from support of mains, pipes etc. subject to heat.

v) Maximum range of temperature variation for climatic conditions = ± 45°C

vi) Dust load.

vii) Dynamic loads from screens and other such reciprocating machinery.

viii) Maintenance hoists on Runway beams.

ix) Wind Loads

x) Seismic loads

xi) From future extensions.

xii) Any special erection requirements.

xiii) Erection loads on floor and structures

3.3.03 Loading codes
a) All live loads shall be considered in accordance with IS:875(Part-2)-1987. (Also refer clause 3.3.04)

b) Wind loads shall be in accordance with IS:875(Part-3)-1987 and any other consideration specific to the site.

c) Seismic loads shall be in accordance with IS:1893-2002.

d) Crane loading to be considered in design shall be as follows:

I. As per relevant clause of IS:800-1983.

II. IS:875(Part-2)-1987 for conditions not covered in IS:800-1983. unless more severe loads have to be considered for technological/operational conditions.

e) Crane stopper shall be designed in accordance with clause 6.1.4 of IS:875 (Part-5)-1987.

f) In absence of any suitable provision for design loads, any other recognised code of practice may be followed subject to prior approval of the Owner.

3.3.04 Additional Design Loads

Besides technological loads, all platforms, walkways, stairs etc. shall be designed for the following live loads:

i) Walkways and Platforms : 2 KN/m²

ii) Visitor's galleries : 4 KN/m²

iii) Maintenance platforms : 4 KN/m² including crane level walkway.

iv) Staircase and treads : 4 KN/m²

v) Monorail walkways : 4 KN/m²

vi) Handrails (Horizontal) : 0.75 KN/m run

vii) Ladder at middle of rung : 0.9 KN

viii) Dust loads (for buildings and structures located in dusty zone) : 0.5 KN/m²

ix) All structures supporting : Overloading vibrating equipment by 25 % on (motors, fans etc.) Static load unless specified otherwise of Equipment.
3.3.05 Combination of loads

Various design loads considered shall be combined in accordance with clause 8.0 of IS:875(Part-5)-1987 to give the most severe loading condition for design of structures.

3.3.06 Stress Enhancements

Permissible limits of stress may be increased wherever permissible, in accordance with IS:800-1983.

3.3.07 Limiting deflection

a) The deflection shall be limited in various elements of structures in accordance with IS:800-1984 (clause 3.13).

b) In addition, the following limitations in deflection shall be observed in design:

**Vertical Deflection**

i) Monorail track beams, main floor beams, equipment supporting beams & beams supporting brick walls: Span / 400

ii) Main roof trusses, roof girders: Span / 400
   main floor beams in operating platforms

iii) Secondary floor beams: Span / 325

**Horizontal Deflection**

i) Crane girders due to surge force: Span / 2000
   (from one crane only).

ii) Main columns at crane rail level: H / 2500
   in transverse direction due to action of crane surge (for surge force consider one crane for single bay and one crane each on adjacent aisles for multi-bay buildings)

iii) Open gantry for condition as in: H/4000 (ii) above.
Where \( H \) = Height of Column from bottom of base plate to crane rail level.

c) All deflections shall be calculated without dynamic factor.

### 3.3.08 Camber

Wherever excessive deformation is likely to cause operational problem or is aesthetically not agreeable, camber shall be provided to neutralise the effect of deformation due to dead load plus 50% of imposed loads.

### 3.3.09 Expansion joints

a) Longitudinal and transverse expansion joints shall be provided in buildings and structures in accordance with IS:800-1984 (clause 3.14).

b) Expansion joints shall be formed by providing double rows of columns, with overhanging gantry girders, secondary roof and wall framing being detailed to allow the maximum calculated movement for the specified temperature variation.

### 3.3.10 Miscellaneous design requirements

a) The minimum thickness of structural steel elements shall be in accordance with IS:800-1984 (clause 3.8). Minimum size angle shall be ISA50x50x6.

b) The diameter of structural bolts shall not be less than 16 mm except for those securing roof and wall sheets, windows, doors and stitching of thin coverings. For bolted joints, at least two bolts per joint shall be provided.

c) The size of fillet welds shall not be less than 5 mm.

d) Main structural elements shall be welded continuously. Intermittent welding shall be used only on secondary members which are not exposed to weather or other corrosive influence.

e) Field connection and splices shall be made as follows:

i) by welding
ii) by permanent bolts (for secondary members such as purlins, wall runners etc.)

iii) by High Strength Friction Grip bolts (HSFG)

3.4 DESIGN OF CONVEYOR GALLERIES AND JUNCTION HOUSES

3.4.0 Design Considerations

3.4.01 The general parameters for conveyor galleries shall conform to the provision of IPSS:2-03-001-81 (Interplant Standards : Steel Industry - Design parameters for galleries and tunnels for belt conveyors in steel plant), and provisions of IS : 11592-1985 unless specified otherwise in Technical Specifications. The structures shall be designed so as to meet functional requirements and shall provide space for operation, maintenance and removal of machinery and give the workers good and safe environment.

3.4.02 Gallery floors shall be of pre-cast R.C.C slabs / Chequered plates (as required) supported on steel beams.

3.4.03 Steps shall be provided (rise not exceeding 130 mm) along the walkways if the gallery slope exceeds 12°. In case the slope of gallery is between 6° to 12°, suitable ribs shall be provided on floor (without any sharp edges) at 250 to 300 mm intervals.

3.4.04 Provisions shall be made for emergency exit from galleries to ground level and also for cross-over above conveyor at 100 m intervals (maximum). The width of cross over shall not be less than 600 mm.

3.4.05 Roof and side walls of conveyor galleries shall be covered with GCS/Aluminium sheets. With a provision of gap of 300 mm below roof and 150 mm from top of floor level on the side wall for ventilation.

3.4.06 Adequate provision for natural light inside conveyor gallery shall be made through side walls by providing translucent sheets (FRP sheets as per IS: 12866-1989). Every sixth sheet on side wall shall be FRP sheet and shall be staggered on opposite wall.
3.4.07 Roof slopes of conveyor galleries shall be 1:5 (1 vertical, 5 Horizontal).

3.4.08 The level of underside of the base plate of gallery supporting trestles shall be 300 mm above the average ground level of the surrounding area.

3.4.09 Protective hand railing shall be provided along gallery walkways, open platform, stairways, landings, edges of walkways when the gallery is not enclosed, and around erection openings, if any, to ensure safety of operating personnel.

3.4.10 Conveyor galleries longer than 150 m shall be provided with expansion joints with twin trestles/supports. Each expansion block shall have fixed support/rigid trestle with adequate arrangement (provision of top chord and bottom chord bracing to gallery girder etc.) for transferring the transverse and longitudinal forces to the foundation.

3.4.11 Gallery girders near junction house shall be preferably supported on trestle located as close to the junction house as possible, with part of gallery girder between junction house and trestle cantilevered from the trestle. Supporting gallery girders on junction house shall be generally avoided.

3.4.12 The underside of the belt conveyor shall be fully covered with 3 mm sheet in case of conveyor is located within the boundaries of the plant. Wherever such covering is not provided (as in case of the mines area or cross country), the covering must be provided where the gallery crosses roads, railway lines or areas of public gatherings.

3.4.13 Conveyor gallery over hot metal track:

When underside of gallery is at less than 12m height from track level, heat shield shall be provided below gallery as well as on sides for a width of track 8 m (i.e. 4 m on either side of center line of the track).

3.4.14 When conveyor gallery crosses above or below H.T cables, a minimum clear distance of 1.0 m between the structural elements/cladding and HT cables shall be maintained.

3.4.15 When the conveyor bridge passes over plant roads, clearance between the road surface and the lowest points of the bridges shall not be less than 4.5 m or the height needed for the passage of the largest individual components of the plant equipment, whichever is the larger.

3.4.16 The junction house shall be designed to suit the technological requirements. Number of floors, height of building etc. shall be decided accordingly.
3.4.17 In general the junction house shall be designed as framed structures on shorter span side and vertically braced on longer side to achieve stability.

3.4.18 Floor of junction houses shall be of RCC slab supported on steel beams, unless required otherwise from technological consideration. The RCC slab will be connected to steel beams through suitable lugs.

3.4.19 Roof and side covering of junction houses shall be with GCS/Aluminium sheets / troughed colour coated sheets as specified. Roof slope shall be 1 : 5 (1 Vertical : 5 Horizontal).

3.4.20 Suitable access staircase and safety hand railing shall be provided to all floors of junction houses.

3.4.21 When hydro-washing of floor of junction house is envisaged, the floor beam supporting RCC slab shall be laid to a suitable slope to achieve the same, wherever the same is not practicable to achieve through screed concrete. (Minimum slope of floor shall be 1.5%).

3.4.22 Wall sheeting shall generally start from the lowest working floor and extend up to roof level with louvres at each floor level to ensure adequate natural ventilation.

3.4.23 Monorails for maintenance hoists shall be provided for maintenance and repair of various equipments located on the floors.

Components of structures

3.4.24 Gallery Trusses and Roof

a) Gallery truss shall be of latticed type construction and shall support roof (for covered galleries) as well as floor deck supporting conveyor system.

b) The trusses shall be adequately braced at top and bottom chord level to transfer the horizontal wind forces to end portals.

3.4.25 Stringer Beam

These beams shall be suitably spaced to support the conveyor stringer post and shall deliver load to gallery trusses. Walkways on either side of the conveyor shall also be supported on these stringer beams.
3.4.26 Supporting Trestles

Intermediate trestles shall be two legged and shall deliver loads from gallery trusses to the foundations. In addition, four legged trestles shall be provided which will act as fixed support to transmit all longitudinal forces between expansion block, in addition to other forces.

3.4.27 Junction Houses

a) Floors - Floor beam layout shall be arranged to suit equipment layout as well as equipment anchoring system.

b) Columns - In addition to loads from floor and roof, columns shall be designed to transmit horizontal load due to belt tension/snapping of belts to the foundation.

3.4.28 Belt Tensioning Device

Suitable structures shall be provided to accommodate belt-tensioning device which may be located either under the conveyor gallery or in the junction house itself.

3.4.29 Wall Structures

a) Wall runners with necessary sag rods shall be provided to support wall sheeting in conveyor galleries and junction houses.

b) Wall sheeting and louvres - refer clause 3.2.08

3.4.30 Access stairs, walkways, platforms, ladders, hand railing etc. - These shall be provided in accordance with clause 3.2.11 of this specification.

3.5 Design of Structures.

3.5.0 a) Design of steel structures shall be done in accordance with IS:800-1984.

b) In absence of specified dynamic factor to be considered for the load from the belt conveyor, a dynamic factor of not less than 1.3 shall be considered for the design of floor beams and gallery girders.
c) Gallery trusses and stringers as well as floor beams of junction house shall be checked for obviating occurrence of resonance and shall be designed in accordance with clause 3.3.01(c).

d) For wind load consideration the following may be considered:
   - Basic wind speed \((v_b)\) at 10 M ht \(= 39\) m/s.
   - Risk co-efficient \((K1)\) \(= 1.0\)
   - Terrain ht and structure size factor \((K2)\) shall be calculated with category 2.
   - Topography co-efficient \((K3)\) \(= 1.0\)

e) Seismic load – structure shall be designed as per IS 1893 (Part 1) 2002. site is located in zone II.

3.5.1 Description of loads and loading codes

3.5.01 Unless specified otherwise hereinafter, all the live loads shall be considered in accordance with IS:875 (Part-2)-1987.

3.5.02 Wind loads shall be considered in accordance with IS:875 (Part-3)-1987.

3.5.03 Seismic loads shall be considered in accordance with IS:1893-1984.

3.5.04 Live loads from conveyor on the gallery floor shall be as per conveyor suppliers load data.

3.5.05 While designing the fixed support/rigid trestles in an expansion block of conveyor gallery the following loads (in addition to wind load) shall be considered.

   a) Forces due to difference in frictional resistance of top and return idle rollers of conveyor.

   b) Forces due to inertia of rollers at the time of starting of conveyor belt.

   c) Break down load caused by snapping of belt (in case of multiple conveyors, snapping of one belt at a time) shall be considered.

   d) Special loads if any

3.5.06 Gallery girders and floor shall be designed for the following live loads, inclusive of spillage loads on floors.

   a) Walkway/Supporting beams for floor - 4.0 KN/m²

   b) Under the conveyor belt - 0.75 KN/m²
c) Gallery girder, for floor load of - 3.0 KN/m²

3.5.07 Dust load on roof of junction house and conveyor galleries shall be considered as follows:

a) For building and structures located at a distance of 300 m from the dust producing units - 0.5 KN/m²
b) At a distance of 300 m to 800 m from the dust producing unit - 0.25 KN/m²

3.5.08 As per technological requirements, provision of supporting the following, and load arising thereof shall be considered in the design of conveyor gallery.

a) Ventilation duct.

b) Electrical cables/cable racks.

c) Fire Fighting equipment.

3.5.09 Junction house floors shall be designed for the following loads:

a) Live load on floor - 4.0 KN/m²
b) Tension from conveyor belt
c) Load due to equipment located on floor.
d) Load due to jamming of chutes.
e) Erection loads anywhere on the floor.

3.5.10 Combination of loads

The various loads specified shall be combined in accordance with clause 8.0 of IS:875 (Part-5)-1987 to give the most severe loading condition for design of structures.
3.5.11 Stress enhancements

Permissible limits of stress may be increased, wherever permissible, in accordance with IS:800-1984.

3.5.12 Limiting deflection

a) The deflection shall be limited in various elements of structures in accordance with clause 3.13 IS:800-1984.

b) In addition following limitation in deflection shall be observed in design:

i) Gallery Trusses - Span / 400

ii) Top of End portal of gallery truss - H / 325 where H = Height of portal above beams

iii) Traverse deflection of top of supporting Trestle - H/1000 where H = Height of trestle above foundation.

3.6 PIPELINE SUPPORTING STRUCTURE

3.6.0 Design considerations

3.6.01 Bridges shall be provided to support pipelines of smaller diameters for which maximum permissible span is less than the distance between supporting trestles.

3.6.02 Trestles which are designed to transmit longitudinal loads (along the length of pipeline) to the foundation, shall be four legged construction. Other trestles which transmit only the vertical load to the foundation shall be two-legged construction.
3.6.03 Access stair and platforms shall be provided for maintenance of equipment installed in the pipeline (eg. valves etc.). Maintenance walkways with hand-railing shall also be provided along the pipeline, wherever required. Provision of access stairs, walkways platforms, hand-railing etc. shall conform to clause 3.2.11 of this specification.

3.7 Design of Structures

3.7.0 Design of steel structures shall be done in accordance with IS:800-1984.

3.7.01 Unless otherwise specified hereinafter, all live loads shall be considered in accordance with IS:875 (Part-2) 1987.

3.7.02 Wind load shall be considered in accordance with IS:875 (Part-3)-1987.

3.7.03 Seismic loads shall be considered in accordance with IS:1893-2002.

3.7.04 In addition, pipeline, bridge and supporting trestle shall be designed for the following loads:

   a) Weight of liquid or condensate, as is appropriate for pipeline.

   b) Weight of valves, compensators, fittings etc. in addition of self-weight of pipe.

   c) Load due to thermal expansion of pipeline

3.7.05 Maintenance platforms shall be designed for a service load of 4 kN/sq.m

3.7.06 Combination of loads

The various loads specified shall be combined in accordance with clause 8.0 of IS:875 (Part-5)-1987 to give the most severe loading condition for design of structures.

3.7.07 Stress enhancements

Permissible limits of stress may be increased, wherever permissible, in accordance with IS:800-1984.

3.7.08 Limiting deflection
3.8

**STEEL CHIMNEY**

3.8.0 **General**

This specification shall apply to design of self supporting steel chimneys.

3.8.1 **Design Consideration**

a) Lining shall be provided in chimney shell as per technological requirements. In the case of lined chimneys, checking for stress and resonance due to wind shall be done for both the conditions i.e lined and unlined.

b) Annular platforms with minimum clear width of 1200mm shall be provided at locations of environment monitoring equipment, in addition to the stipulations of IS:6533 (Part-2)-1989. Landing/resting platforms to ladders shall be provided at intervals not exceeding 10.00 M where annular platforms are provided at intervals of height greater than 10.00 M.

c) Approach to platforms shall be with ladders with safety cages. (Refer Clause 3.2.11(j) of this specification.

d) Chimneys shall be provided with adequate number of Painter's trolleys for inspection and maintenance unless categorically agreed to otherwise with Owner. In case where Painter's trolley is not provided, suitable alternative facility shall be provided for inspection and maintenance.

e) Chimneys shall be fitted with helical strakes of three rail system, and shall be strong enough to withstand the additional wind load from the strakes.

3.8.2 **Design**

a) Steel chimneys shall be designed in accordance with IS:6533(Part-2)-1989.
b) Elements like platforms, hand-rails, ladders, anchor bolts etc. shall be designed in accordance with IS:800-1984.

c) For wind and seismic refer clause 3.3.01 (d) and (e).

### 3.8.3 Limiting Deflection

The maximum deflection at the top due to the action of wind, without considering the dynamic factor shall not be greater than $h/200$, where $h$ is the unsupported height of the chimney.

### 3.9 STANDARISATION AND UNIFORMITY

#### 3.9.0 General

Every endeavour shall be made to achieve standardisation and uniformity amongst the steel structures of different units of the plant.

#### 3.9.1 The following items shall be kept in view in design of structures:

a) Uniform layout module shall be adopted to the extent possible consistent with economy. It is suggested to adopt a basic module of 3 m for building width and 6 m for column spacing along building length.

b) Uniform slopes of roofs matching with existing buildings unless specifically required otherwise for any particular unit.

c) Provision of expansion joints by using twin columns.

d) Uniform adoption of clearance between structures and moving parts of equipment.

e) Provision of adequate natural ventilation by using louvres (canopy like structures) at appropriate location and roof monitors/natural ventilation systems at roof.
4.0 FABRICATION OF STEEL STRUCTURES

4.1 Drawings

4.1.1 The Contractor shall prepare design drawings indicating general arrangement, members, sections and details of important joints, fabrication drawings, erection drawings, bill of materials, drawing office despatch lists / shipping documents, schedule of bolts and nuts and as built drawings. All drawing work shall be in metric system and all writing work shall be in English. Drawings shall be prepared using Autocad software.

4.1.2 The fabrication drawings shall show full length layout with all connecting members and connections marked thereon. The fabrication drawings shall include all the necessary blown-up details required for the correct fabrication of the structures to meet the design requirements. These drawings shall be made in conformity with the best modern practices and with due regard to speed and economy in fabrication and erection. Each erection piece shall be clearly identified by an erection mark in these drawings.

4.1.3 The preparation / detailing of fabrication drawing shall be complete in all respects. In the case of bolted connections, the bolt dia., the hole dia.,
the actual location of holes and the coordinating scheme with connecting/ matching elements shall be clearly indicated. As far as possible, uniformity in the bolt dia shall be maintained. Where HSFG bolts are used, method of surface preparation shall be indicated. In case of welded constructions, the size and length of welds along the relevant weld lines should be distinctly marked. The length specified shall be the effective length excluding end crates. For all butt welds, details of appropriate edge preparation shall be indicated.

4.1.4 Detailing of structural steel members subjected to dynamic loading shall be so as to keep the stress concentration to a minimum. Cross welding shall be avoided as far as practicable.

4.1.5 For bolted connections subjected to dynamic loading, lock nuts or spring washers shall be used in addition to plain washers.

4.1.6 Erection drawings shall consist of line diagrams showing every detailed member in position with the respective erection mark. Erection marks shall appear on the left end of the members as detailed. All steel members shall be erected with marks in the same relative position as shown in plan or elevation. All loose members shall either be given part marks or wired on to the main erection mark for despatch.

4.1.7 The erection clearances for cleat-connected ends of members connecting steel to steel shall preferably not be greater than 10 mm. at each end. The erection clearance at ends of beams shall not be more than 20mm. at each end but where for particular reasons greater clearance is necessary, suitably designed seats shall be provided.

4.1.8 The fabrication drawings shall be prepared in such a manner that structures are despatched with maximum transportable lengths and work involved at site is minimum. Steelwork shall be shop-fitted and shop-assembled as far as practicable.

4.1.9 All edge preparations for welding shall conform to IS:9595.

4.1.10 The contractor shall ensure correctness & completeness of fabrication drawings.

4.2 **Material of Construction**
4.2.1 All steel and other materials used for steelwork and in association with steelwork shall conform to appropriate Indian standards. Only tested materials shall be used unless written authority is obtained for the use of untested materials for certain secondary structural members.

Unless otherwise specified in the drawings

a) All rolled sections and plates up to & including 20 mm thickness shall conform to Grade "A" as per IS : 2062.

b) Plates of thickness above 20 mm and Plated structures subjected to dynamic loading shall conform to Grade "B" as per IS: 2062.

c) For High Tensile steel requirements, material conforming to IS:8500 or SAIL- MA (HYA or HYB) shall be used.

4.2.2 Steel sheets shall conform to IS : 1079.

4.2.3 Steel tubes for structural purpose shall conform to IS : 1161 (of Grade Yst 240)

4.2.4 Corrugated Galvanised Sheets shall conform to IS:277 with appropriate Zinc coating for the selected thickness of sheet on roof and sides.

4.2.5 Aluminium industrial toughed sheets conforming to IS : 1254 shall be used as follows:

   i) In roof - 0.91mm thick
   ii) In side walls - 0.71mm thick

4.2.6 Translucent sheets shall be fibreglass reinforced polyester sheets of matching profile as per IS:12866.

4.2.7 Colour coated sheets shall be as per appropriate standard. All roof, monitor roof galvanised / zinc aluminium colour coated sheets of total coated thickness (TCT) of 0.65 mm with base metal yield strength of 240 MPa or alternately sheets having TCT of 0.5mm with base metal yield strength of 550 MPa.

   All side sheets, monitor sides colour coated sheets of total thickness (TCT) of 0.6 mm with base metal yield strength of 240 MPa or alternately sheets having TCT of 0.5mm with base metal yield strength of 550 MPa.

   Ridging/ Flushing : colour coated sheets TCT of 0.8 mm with base metal yield strength of 240 MPa or alternately sheets having TCT of 0.5 mm with base metal yield strength of 550 MPa. For all above, minimum zinc deposition shall be 150 gms per sq.m.
4.2.8 Gutters shall be of copper bearing steel conforming to Grade "A" as per IS :2062

4.2.9 Crane Rails shall conform to IS : 3443.

4.2.10 All black bolts, nuts and locknuts shall conform to IS : 1363 and IS : 1364 (for precision and semi precision hexagonal bolts) of property class 6.4 unless otherwise specified. Washers shall conform to IS : 6610

4.2.11 All tapered washer shall be as per IS:5372 for channels, and IS:5374 for Joists. Spring washers shall conform to IS:3063.

4.2.12 All HSFG bolts shall conform to IS : 3757. Assembly of joints using HSFG bolts shall conform to IS : 4000. Nuts and washers for HSFG bolts shall be as per IS:6623 & IS:6649 respectively.

4.2.13 Covered electrodes for arc welding shall conform to IS: 814. Coding of electrodes shall be as follows:

a) ER421 ‘C’ X for mild steel of Grade 'A' and Grade 'B' as per IS : 2062
b) EB 542 ‘C’ H3X for Mild steel of Grade 'B' as per IS 2062 for dynamically loaded structures (arising out of crane, vibratory screen, equipments etc.) ‘C’ is the value of the current as recommended by the electrode manufacturer.

4.2.14 Certified mill test reports of materials used in the work shall be made available for inspection by the Owner / Consultant upon request.

4.2.15 All materials shall be straight and if necessary before being worked shall be straightened and / or flattened by pressure including de-coiling of plates unless required to be of curvilinear form and shall be free from twists.

4.2.16 The MS / GI gratings shall be electro-forged and shall be of approved brand and manufacturer unless otherwise agreed to by the Owner. The type of grating selected shall be based on the loading in the area in which the grating is provided and shall be subject to approval of Owner.

4.3 Material preparation
4.3.1 Cut edges shall be finished smooth by grinding or machining wherever necessary. Sufficient allowance (3 mm to 5 mm) should be kept in the items in case machining is necessary.

4.3.2 Cutting may be effected by gas cutting, shearing, cropping or sawing. In gas cutting of high tensile steel, special care is to be taken to leave sufficient metal to be removed by machining so that all metal that has been hardened by flame is removed.

4.3.3 Sufficient shrinkage allowance (@ 1mm/M) shall be kept wherever heavy welding is involved.

4.3.4 Straightening and bending shall be done in cold condition as far as practicable.

4.3.5 If required, straightening and bending may be done by application of heat between 900°C and 1100°C. Cooling down of the heated item shall be done slowly.

4.4 Drilling and punching of holes

4.4.1 Drilling and punching of holes for bolts shall be done as per clause no.11.4.4 of IS:800:1984, unless otherwise specified by the Owner.

4.4.2 Drifting of holes for bolts during assembly shall not cause enlargement of holes beyond permissible limit or damage the metal.

4.4.3 Holes for bolted connection should match well to permit easy entry of bolts. Gross mismatch of holes shall be avoided.

4.4.4 Permissible deviation in holes for mild steel bolts of normal accuracy and high strength bolts are given in the ANNEXURE-A.

4.5 Assembly for fabrication
4.5.1 Fabrication of all structural steelwork shall be in accordance with IS:800-1984 and in conformity with various clauses of this specification, unless otherwise specified in the drawings.

4.5.2 Fabrication of structures shall preferably be taken up as per the sequence of erection.

4.5.3 All erection units shall bear erection mark no. and reference drg no. at a prominent location on the structures for easy identification at site.

4.5.4 Fabricated structures shall conform to tolerance as specified in this standard and in IS:7215-1974. In case of contradiction, tolerances specified in this standard shall prevail.

4.5.5 All the components of structures shall be free from twist, bend, damage etc.

4.5.6 Assembly of structures shall be carried out by using suitable jigs and fixtures in order to obviate distortion during welding.

4.5.7 Cutting of items specially for truss, bracing, bunker, hopper, galleries surge girder, portal etc, shall be done only after checking of sizes as per Layout.

4.5.8 Surface, wherever machining is specified, shall be either planed or milled or ground to ensure maximum contact.

4.5.9 If end-milling or machining is planned after the assembly is over, sufficient allowance (5 mm to 15 mm) shall be kept in the items where milling/machining is to be done.

4.5.10 If pre-bending of the plate is required to avoid welding distortion, it shall be done in cold condition.

4.5.11 Sufficient trial assembly of fabricated components (despatch elements) shall be carried out in the fabrication works to control the accuracy of workmanship.

4.5.12 Where necessary, washers shall be tapered or otherwise suitably shaped to give the heads of nuts and bolts satisfactory bearing.

4.5.13 The threaded portion of each bolt shall project through the nut at least by one thread.
4.5.14 Tolerance of assembled components of structures are given in TABLE -

4.5.15 Permissible deviations from designed (true) geometrical form of the despatch elements shall be in accordance with IS:7215-1974.

4.6 **Method of Construction**

4.6.1 The method of construction shall be either by welding or by bolting limiting the site work to the minimum possible.

4.6.2 Bolt diameter shall not be less than 16mm. except for bolts securing roof and wall sheeting, windows, doors and stitching of thin coverings. For bolted joints, min. two bolts shall be used.

4.6.3 The size of fillet welds shall not be less than 5mm for load-bearing joints.

4.6.4 Main structural elements shall be welded continuously. Intermittent welds shall be used only on secondary members, which are not exposed to weather or other corrosive influence.

4.6.5 Connections and splices shall be made by welding, or by bolting with appropriate property class. Black bolts shall be used in connections and attachments of secondary members such as purlins, wall girts, etc. Bolts shall be prevented from loosening by means of lock nuts, single coil spring washers or similar devices.

4.6.6 Method of splicing shall be similar to the method of construction adopted for structures. All splices shall be full-strength splice unless exception is specified.

4.6.7 Roof and wall sheets shall be fixed to purlins and wall girts by stainless steel top speed screws/galvanized J- hook bolts, each complete with neoprene and stainless steel /galvanized washers. The connections shall ensure water-tightness into the buildings. The spacing of these screws/bolts shall be sufficient to prevent uplift of sheets by suction. The roof and wall sheets shall be stitched together at their edges by using studs, rivets or screws. The end and side overlaps of sheeting shall be sufficient to prevent ingress of rainwater. End lap shall not be less than 75mm and side lap shall not be less than one and half corrugation for
4.7 Structural steel connection

4.7.1 The Contractor shall be responsible for the design and the detailing of all connections. The design of connections shall provide for adequate strength for the transfer of force in the structural elements indicated on the design drawings. For purposes of detailing of connections, the allowable stresses in material, bolts and welds shall be as per IS:800 and IS:816 or as specified in the design drawings.

4.7.2 For all full strength butt welding of plates and sections thicker than or equal to 10 mm, edge preparation shall be done and got approved by the Owner / Consultant.

4.7.3 Two numbers of washers shall be used for all bolted connections, one washer bearing against the head and other bearing against the nut.

4.7.4 The magnitude of forces shown on design drawings shall be used at face values with no reductions for connections.

4.7.5 If extra joints are to be provided in column, crane girder etc, prior approval on the same shall be obtained from the Owner / Consultant. However, as general guidance, the following is suggested:
   - Splice joint on column and crane girder shall be of full strength butt weld, and, wherever possible, shall be located at the section of minimum or substantially lesser stress.
   - Splice joints of web and flange should be sufficiently staggered in position.

4.7.6 All penetration for piping, conduit, cable trays, etc., through grating or plate flooring shall be cut and suitably banded in the field, except when such penetrations are dimensioned in the drawings in which case they shall be shop cut and banded.
4.8 **Fabrication**

4.8.1 Fabrication of all structural steelwork shall be in accordance with IS:800 or their equivalent foreign national standard of the country of origin of supply unless otherwise specified, and in conformity with various clauses of the Technical Specification.

4.8.2 Wherever practicable and wherever perfect matching of parts is required at site, members shall be shop assembled before despatch to minimise site work. Parts not completely assembled in the shop shall be secured, to the extent possible, to prevent damage during despatch.

4.8.3 All pieces shall be properly identified and bundled for transportation to work site. Care shall be exercised in the delivery, handling and storage of material to ensure that material is not damaged in any manner. Materials shall be kept free of dirt, grease and foreign matter and shall be protected from corrosion. All materials shall be stored properly on skids above the ground which shall be kept clean and properly drained. Girders and beams shall be placed upright and stored. Long members such as columns and chord members shall be supported on skids spaced near enough to prevent damage due to deflection.

4.8.4 Bolts shall be furnished according to bolt lists showing the location of their use and additional bolts shall be supplied to cover wastage.

4.8.5 All fabricated pieces shall bear erection mark numbers painted/punched according to appropriate erection and shop drawings at a prominent location on the structure for easy identification.

4.8.6 All workmanship shall be in accordance with the best practice in modern structural shops. Greatest accuracy shall be achieved in the manufacture of every part of the work and all identical parts shall be strictly interchangeable.

4.8.7 Shearing or flame cutting may be used at the Contractor's option provided that a mechanically controlled cutting torch is used for flame cutting and that the resulting edges are clean and straight.

4.8.8 Unless clean square and true to shape all flame cut edges shall be planed/cleaned by chipping or grinding. Where machine flame cutting is permitted for high tensile steel, special care shall be taken to leave sufficient margin and all flame hardened material shall be removed by machining/edge grinding.
4.8.9 Wherever shearing is used for cutting to size, sheared members shall be free from distortions at sheared edge.

4.8.10 The ends of all girder stiffeners shall be in contact with the compression flange and shall be planed or ground to fit tightly against flange plates unless otherwise stated on the drawings. Care shall be taken to ensure full bearing of the stiffeners at the supports by machining the contact surfaces of both bearing stiffeners and bearing plates. The ends shall not be drawn or caulked.

4.8.11 Column splices and butt joints of struts and compression members depending on contact for stress transmission shall be accurately machined and close butted over the whole section with a clearance not exceeding 0.1 mm locally at any place.

4.8.12 In column cap and bases, the ends of shafts, should be accurately machined so that the parts connected butt over the entire surface of contact. Care should be taken so that these connecting members are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0 mm. On secondary members, where sufficient gussets and welds are provided to transmit the entire loading, the column ends may not be machined subject to the approval of the Owner / Consultant.

4.8.13 Holes for permanent black bolts shall not be more than 1.5 mm larger than the nominal diameter of the black bolts unless specified otherwise. All holes for turned and fitted bolts shall be sub punched or drilled and reamed at site under assembly of connected parts to a tolerance of +0.3 mm unless specified otherwise. Holes in purlins, side-sheeting runners, packing plates and lacing bars may be punched full size. Holes in light framing with the exception of joint holes, may be punched full size. All punching and sub-punching shall be clean and accurate and all drilling free from burrs. In block/batch drilling, parts shall be separated after drilling and the burrs removed. No hole shall be made by gas cutting process.

4.8.14 The component parts shall be so assembled that they are neither twisted nor otherwise damaged and specified cambers, if any, shall be provided. No drifting of hole shall be permitted except to draw the parts together. Drifts used shall not be larger than the nominal diameter of the bolt. Drifting done during assembling shall not distort the metal or enlarge the holes. Sufficient trial assembly shall be carried out in the fabrication works to prove the accuracy of workmanship of the and the number of such trials required shall be at inspector's discretion.
4.8.15 Where necessary, washers shall be tapered or otherwise suitably shaped to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut by at least one thread.

4.8.16 In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a washer of sufficient thickness, under the nut so as to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. Column bases and caps, shall be in one solid piece, and except when cut from plates with true surfaces, shall be accurately machined over the bearing surfaces, and shall be in effective contact over the whole area of the machine end of the stanchion.

4.8.17 Each piece shall be distinctly marked before delivery, in accordance with an approved marking diagram and shall bear such other marks as well to facilitate erection. For easy identification at site a small distinguishing mark for each building shall be painted at each end of every member before despatch from fabrication shop. The fabricated steel work shall be despatched in sequence as per agreed programme and for such portion as may be found convenient for erection or as ordered by the Owner / Consultant.

4.8.18 The Contractor shall provide suitable packing wherever necessary to guard against damage during handling and transportation to site. All fabricated parts shall be adequately braced to prevent damage during transit.

4.8.19 The tolerances for fabrication of steel structures shall generally conform to IS:7215 and to suit the technological requirements as specified by the equipment supplier.

4.8.20 Any fabrication work which is considered not to be in keeping with the Technical Specification forming the Contract, or in absence of Technical Specification with recognized good practice, shall be rectified /replaced /corrected at the Contractor's expense as directed by the Owner / Consultant. Site fabrication work shall also conform to all specifications, stipulations, terms and conditions applicable for shop-welded structures as mentioned above.

4.8.21 Fabrication of steel structures shall not be allowed inside the plant premises.

4.9 Wastage & Accountability
4.9.1 For the purpose of accounting of materials where the same is supplied by the Owner, free or on cost recoverable basis, the following wastage including rolling margin, invisible wastage and cut pieces of less than one metre length and plates with lesser dimension less than 300 mm shall be allowed.

a) Structural Steel :
   i) Sections - 5% on the quantity by weight computed, based on Fabrication drgs.
   ii) Plates - 7.5% on the quantity by weight computed, based on Fabrication drawings.

b) Other materials : 5% on the quantity by weight computed, based on manufacturing drawings.

For all cut pieces (plates & sections) invisible wastage (cutting and burning losses) of maximum 0.5% will be admissible.

4.9.2 Owner reserves the right to take back such sections or quantity of steel issued in excess of quantity as per fabrication drawings plus permissible wastage where raw steel is issued free of cost by Owner. The contractor shall return to the Owner all such steel supplied in good and acceptable condition. In case of failure of the Contractor to return such surplus steel on demand by the Owner, Owner reserves the right to recover the cost of such steel at a penal rate of twice the SAIL- Stockyard rate of that particular section of steel as on the date of accountability.

4.9.3 If the Contractor fails to return scrap / wastage generated as per the percentage mentioned at 4.9.1. recovery on account of such scrap / wastage shall be made by the owner at prevailing rate of steel+20 pc per tonne.

The charging of penal rate shall be without prejudice to any other remedies or action, available to the Owner, against the Contractor.

4.10 Despatch Instructions

4.10.1 Each despatchable structure shall bear mark no. along with reference drawing number at two prominent locations (e.g. on flange and bottom of base plate of a column).

4.10.2 "As built" drawing shall be prepared after fabrication is completed to indicate additions / alterations made during the process of fabrication.
4.10.3 Control assembly of important structures shall be done in the shop floor before despatch to avoid mismatching. For all such important structures, match marking shall be given at the control assembly stage in the shop floor and such match markings shall be made clearly visible while assembling the structures at site.

4.10.4 Centre lines of column flanges and both sides of web shall be punched, preferably at top and bottom to facilitate alignment after erection.

5. **ERECTION OF STEEL STRUCTURES**

5.1 **Scope**

The scope of work under erection includes in addition to provision of erection and transport equipments, tools and tackles, consumables, materials, labour and supervision, the following:

a) Storing and stacking at site of erection of all fabricated structural components/units/assemblies till the time of erection.

b) Transportation at site of structures.

c) Receiving at site of structures including site handling/movement, unloading, storing and stacking at site of erection of technological structures such as bunkers and the related structures.

d) All minor rectification/modification such as:

   i) Removal of bends, kinks, twists, etc. for parts damaged during transportation and handling;
   
   ii) Cutting chipping, filing, grinding, etc., if required, for preparation and finishing of site connections;
iii) Reaming for use of next higher size bolt for holes which do not register or which are damaged.
iv) Welding of connections in place of bolting for which holes are either not drilled at all or wrongly drilled during fabrication.

e) Other rectification work such as
   i) Re-fabrication of parts, damaged beyond repair during transportation and handling or incorrectly fabricated.
   ii) Fabrication of parts omitted during fabrication by oversight or subsequently found necessary.
   iii) Plug-welding and re-drilling of holes which do not register and which cannot be reamed for use of next higher size bolt.
   iv) Drilling of holes which are either not drilled at all or are drilled at incorrect position during fabrication.

f) Fabrication of minor items/missing items or such important items as directed by the Owner Consultant.

g) Assembly at site of steel structural components wherever required including temporary supports and staging.

h) Making arrangements for and providing all facilities for conducting ultrasonic X-ray or gamma ray tests on welds; getting the tests conducted by reputed testing laboratories, making available test films/ graphs, reports and interpretation.

i) Rectifying at site, damaged portions of shop primer by cleaning and touch-up paint.

j) Erection of structures including making connections by bolts/high strength friction grip bolts / welding.

k) Alignment of all structures true to line, level plumb and dimensions within specified limits of tolerances as per IS :12843 “Tolerance for Erection of Steel Structures”.

l) Application of second coat of primer paint and two coats of finishing paint at site after erection.

m) Grouting of all column bases after proper alignment of columns and only after obtaining clearance from Owner / Consultant.

n) Supply of labour in sufficient numbers, where necessary, as directed by the Owner / Consultant.

o) Conducting preliminary acceptance and final acceptance tests.
p) Preparation of as built drawings, preparing of sketches/drawings to suit field engineering decisions, availability of material, convenience of fabrication, transportation and erection and changes during fabrication and erection.

All such works are subject to approval by the Owner / Consultant.

5.2 Erection Drawings

5.2.1 The erection drawings prepared by the Contractor and any approved arrangement drawings, specifications or instructions accompanying them shall be followed in erection of structures and miscellaneous connected items throughout the project.

5.3 Storing and Handling

5.5.1 The fabricated materials on receipt at site shall be carefully unloaded, examined for defects, checked, stored out for each building and stacked securely on skids above level ground which shall be kept clean and properly drained. Girders and beams shall be placed upright and stored. Long members, such as columns and chord members, shall be supported on skids spaced near enough to prevent damage from deflection.

5.5.2 The fabricated materials shall be verified with respect to markings on the marking plan or shipping list which shall be supplied by the Contractor.

5.5.3 Any material found damaged or defective shall be stacked separately and the damaged or defective portions shall be painted in distinct colour for identification. Such materials shall be dealt with as ordered by the Owner / Consultant.

5.5.4 The handling and storing of the component parts of a structure shall involve the use of methods and appliances not likely to produce injury by twisting, bending or otherwise deforming the structures. No member slightly bent or twisted shall be put in place until the defects are corrected. Members seriously damaged in handling shall be rejected.

5.4 Defects in material & fabrication
5.4.1 All materials shall be straight unless required to be of curvilinear form and shall be free from twist. All cold straightening shall be done by pressure only.

5.4.2 During assembly and during erection of the units to position, the Contractor shall compare the structures with the drawings to ensure that there are no fabrication omissions or errors. Should any omission or defect be found the same shall be brought to the notice of the Owner / Consultant who will issue necessary instructions for the rectification.

5.5 Setting out

5.5.1 The Contractor shall prepare geodetic survey scheme of all embedded parts and holding down bolts and submit the same to Owner / Consultant. The Contractor shall inform the Owner / Consultant about any discrepancy with approved design drawings well in advance of erection and if necessary shall make necessary adjustments at site or during fabrication of structures.

5.5.2 The Contractor shall assume, full responsibility for the free and correct setting out of all steel work and erection correctly in accordance with position, alignment, dimensions and levels shown on the approved drawings and plumbing vertical members. Particular care shall be taken to ensure free expansion and contraction wherever provided. Notwithstanding any assistance rendered to the Contractor by the Owner / Consultant, if at any time during the progress of the work, any error should appear or arise therein, on being required to do so, the Contractor at his own cost shall remove and amend the work to the satisfaction of the Owner / Consultant.

5.6 Assembly and Erection

5.6.1 Before starting erection, the Contractor shall submit to the Owner / Consultant for his approval the method he proposes to follow and the number of types of equipments and temporary, works he proposes to use for the erection.

5.6.2 The approval of drawings by the Owner / Consultant will not relieve the Contractor from the basic approach to design as regards the loads which the erection equipment and temporary work shall be called upon to carry and support. Adequate allowance and provision shall be made for lateral forces and wind loads.
5.6.3 If in the opinion of the Owner / Consultant, the tools, tackles plant and equipment instruments, apparatus, etc. arranged by the Contractor are not sufficient or are inadequate for the fulfilment of the contractual obligations of the Contractor within the stipulated period, the Owner / Consultant will have the right to order the Contractor and the Contractor shall comply with the order to bring/arrange such additional tools, tackles, plant and equipment instruments, apparatus, etc. to the site and employ the same to complete the work in time. All charges in connection thereof shall be borne by the Contractor.

5.6.4 Proper consideration shall be given to the following items during erection.

i) Frame of building to be true and plumb.
ii) Temporary guying and bracing shall be used to align the framing during erection, if required.
iii) Temporary bracing may be required to sustain forces due to erection loads and equipments. Erected parts of the structures shall be made stable during all stages of erection. The stability of structures subjected to the action of wind, dead weight and erection forces shall be attained by observing specified sequence of erection of vertical and horizontal structural members and by installing permanent and temporary bracings.
iv) Erection members shall be held securely in place by bolts to take care of dead load, wind load and erection load.
v) Free expansion and contraction wherever provided
vi) No final bolting or welding of joints shall be done until the structure has been properly aligned and consent obtained from Owner / Consultant.
vii) Erection tools and machinery shall be of suitable capacity for handling the materials furnished and must be in safe operating conditions at all times to avoid danger to materials and personnel.
viii) In positioning beams, columns or other steel members the use of steel slegdes shall not be permitted.
ix) The Contractor shall report all failures of the fabricated Steel to fit together properly to the Owner / Consultant and shall obtain approval prior to taking corrective measures.
   ii) Steel members shall not be allowed to fall or be subject to shock or impact due to other members being swung into position or for any other cause.
   iii) All exposed bolt holes not required shall be plugged

5.6.5 Erection shall be carried out according to the best modern practices and as laid down in the IS : 800-1984 and other relevant standards referred
to therein and according to this erection Specification together with approved erection drawings and Technical Specification.

5.6.6 The Contractor shall design, manufacture, erect and provide false work; staging, temporary supports, etc. required for safe and accurate erection of structural steelwork and shall be fully responsible for the adequacy of the same.

5.6.7 The Contractor shall, if so required by the Owner Consultant, get his drawings, erection schemes and designs for such false work, staging, etc. approved by the Owner / Consultant, but such approval by the Owner / Consultant shall not relieve the Contractor of any of his responsibilities for the safety of such works. As far as possible, assemblies of structures shall be made on the ground itself.

5.6.8 The Contractor shall provide adequate supervision at all stages of the work and examine each portion of the work for accuracy before commencing the erection of the next structural member. The Contractor shall also provide facilities such as adequate temporary access ladders, tools and tackles, instruments, etc. satisfactory to Owner Consultant for his inspection at any stage during erection.

5.6.9 Instrumental checking for correctness of initial setting out of structures, and adjustment of alignment shall be carried out in sequence at different stages as determined by design as against checking and adjustment of alignment in one stage after completion of entire erection. The final levelling and alignment shall be carried out immediately after completion of each section of a building or when called for by the Owner / Consultant.

5.6.10 All structural members shall be erected with erection marks in the same relative position as shown in the appropriate erection and shop drawings.

5.7 **Field connections**

5.7.1 The holes of erection joints required to be machine bolted shall be filled with temporary bolts and plugs after mounting the structures. The number of bolts and plugs shall be determined by design but it shall not be less than 50% of the total number of holes. In joints where the number of holes is equal to 5 or less, not less than 3 holes shall be filled. The number of plugs shall be about 20% of the holes filled.
5.7.2 The number of washers on permanent bolts shall not be more than two (and not less than one) for nut and one for the bolt head. Wooden rams or mallet shall be used in forcing members into position, in order to protect the metal from injury and shocks. Chipping of edges of plates shall be done without breaking parent metal. Chipped edges shall be finished with a file and all short corner and hammered rough faces shall be rounded off. Chipping with the use of sledge hammer shall only be permitted in exceptional cases and shall be done without resulting in fractured edges.

5.7.3 Where bolting is specified on the drawings, the bolts shall be tightened to the specified limit. The threaded portion of each bolt shall project through the nut by at least one thread. Tapered washers shall be provided for all heads and nuts having bearing on bevelled surfaces. Use of special bolts, such as high strength friction grip bolts, shall be according to the relevant Indian or other recognized standards and shall be subject to the prior approval of the Owner / Consultant before use.

5.7.4 Spring washers or lock nuts shall be provided as specified in the design/shop drawings. All machine fitted bolts shall be perfectly tight and the ends shall be checked to prevent nuts from becoming loose. No unfilled holes shall be left in any part of the structures. All field assembly and welding shall be executed in accordance with the requirements for shop fabrication. Where the steel has been delivered painted, the paint shall be removed before field welding, for a distance of at least 50mm on either side of the joints.

5.7.5 Erection bolts shall be retained in position permanently even after site welding

5.8 Assembly by high strength friction grip bolts

5.8.1 The mating surfaces shall be absolutely free from grease, lubricant, dust, rust, etc. and shall be thoroughly cleaned before assembly. The preparation of the mating surfaces shall be done as specified in the design drawings.

5.8.2 Nuts shall be tightened up to the specified torque with the help of torque wrench or by half turn method with the help of pneumatic wrench lever. Torque value has to be specified in design / fabrication drawings itself. The direction of tightening of the nuts shall be from the middle towards the periphery of the joint. The bolt head, nuts and edges of the mating surfaces shall be sealed with a coat of paint to obviate entry of
moisture. As far as possible, the diameter of bolts and nature of mating surface preparation shall be kept uniform to have specified unique torque.

5.9 **Bedding and grouting**

5.9.1 Base plates shall be set to elevations shown in the drawings, supported and aligned using steel wedges and shims or any other approved method. The supply of wedges, shims and any other material for alignment shall be the responsibility of the Contractor as part of his work. Plates shall be levelled, properly positioned and the anchor bolts properly tightened. The bedding/grouting shall not be carried out until a sufficient number of columns have been properly aligned, levelled and plumbed, and sufficient girders, beams, trusses and bracings are in position to the satisfaction of the Owner / Consultant.

5.9.2 Grouting shall be done before casting of elevated RCC floors, if any, and before equipments contributing to the loading on columns are placed in position. No moving equipment shall be tested and no trial run of any equipment conducted, before grouting has been done and cured to the satisfaction of the Owner / Consultant.

5.9.3 Grouting shall be minimum M25 grade or one grade higher than the grade of base concrete with 10 mm and below graded coarse aggregate. Ready-mix, non-shrink, free-flow grout from recognised manufacturer as approved by the Owner / Consultant shall be used with pressure grouting technique to ensure proper filling-up of all void spaces underneath the base plate. Manufacturer’s recommendations / instructions shall be followed for proper application of grout material.

5.9.4 The Contractor shall inform the Owner / Consultant when the base plates are ready for grouting for their verification. The Contractor shall be responsible for final vertical and horizontal alignment of all the base plates.

5.10 **Painting after erection**

The painting shall be as per painting specifications and instructions given in TS and, in GS for painting works.

5.11 **ACCEPTANCE OF WORK**
5.11.1 Acceptance of erected steel structures shall be either after completion of erection of the whole building or in blocks.

Intermediate acceptance certificates will be given in the following cases

i) Any steelwork or part thereof, embedded in concrete.
ii) Steel structures which are to be covered in the process of carrying out further work.

5.11.2 The following documents shall be prepared and produced by the Contractor at the time of acceptance of erected steel structures:

i) Documents showing approved deviations made during execution of erection work.
ii) Documents showing acceptance of embedded structural steelwork.
iii) Certificates / documents on control checking and test of materials (if any) and welds.
iv) Data and results of Geodetic measurements while checking the erection of structures.
v) Copies of "As Built Drawings" showing thereon all additions and alterations.

6.0 WELDING SPECIFICATIONS

6.1 General

6.1.1 The welding and welded work shall conform to IS:816 and other relevant codes unless otherwise specified. Electrodes shall conform to IS:814 and shall be approved by the Owner / consultant.

6.1.2 Welding shall be done by Electrical Arc Process. Automatic welding shall be employed for important structures as specified in the drawings. Generally, submerged arc, Automatic & Semi-automatic welding shall be
employed. Only where it is not practicable, Manual Arc welding may be
resorted to. In case of Manual Arc Welding, recommendations of
electrode manufacturer are to be strictly followed.

6.1.3 Welding shall not be done under such weather conditions which might
adversely affect the efficiency of the welding and where necessary,
effective protection and other safeguards shall be provided.

6.1.4 Only qualified welders suitable for the job shall be employed. The Owner
/ Consultant at his discretion can order periodic tests in accordance with
IS:817 of the welders and / or of the welds produced by them at no extra
cost. Welding shall be done using requisite jigs and fixtures to avoid
distortions or damage to members during / after welding. Welds on
exposed work shall be finished uniformly smooth to present a neat
appearance.

6.1.5 The layouts and sequence of operations shall be arranged so as to
eliminate distortion and shrinkage stress to the satisfaction of the
Inspector. Welding work shall be under constant supervision of
competent welding supervisor and shall be done in a properly organized
manner with the approved quality welding sets and with automatic
welding machines. Detailed welding procedure shall be submitted to
the Owner / Consultant and approval of the same shall be obtained
before fabrication is commenced.

6.2 **Welding Procedure**

6.2.1 Welding procedure to be prepared by the Contractor shall include the
following :

i) Type and size of electrodes.
ii) Current and arc voltage. (for automatic welding)
iii) Length of run per electrode, or (for automatic welding) speed of
travel.
iv) Number and arrangement of runs in multi-run welds.
v) Position of welding.
vi) Preparation and set-up of parts.
vii) Welding sequence.
viii) Pre or, post-heating.
ix) Specification and thickness of steel
x) Welding process ( manual arc / submerged arc welding )
xii) Thickness of components meeting at a joint
xii) Pre and post heating requirement
xiii) Weather condition – restrictions thereof
xiv) Use of jigs and fixtures
xv) Type of non-destructive testing to be carried out
xvi) Inspection procedure to be followed
xvii) Sequence and process to be followed in different multiple-pass butt welding for different plate thicknesses.

The welding procedure shall be subject to Owner’s / Consultant’s approval.

6.2.2 The welding procedure shall be arranged to suit the details of the joints as indicated in the drawings and the positions in which the welding is to be carried out. The welds shall meet the requirements of quality specified.

6.2.3 All electrodes for use in the work to which the specification relates shall be kept under dry conditions. Electrodes which are damaged by moisture shall not be used unless it is certified by the manufacturer that when it is properly dried there shall be no detrimental effect. Any electrode which has part of its flux coating broken away or is otherwise damaged shall be discarded.

6.2.4 Low hydrogen electrodes and flux for submerged arc welding shall be dried at 250-300 deg. C for one hour in drying oven before use.

6.2.3 At site, the electrodes shall be kept in proper coves while using them for welding

6.2.4 All metal arc welding shall be as per IS : 9595

6.2.5 Submerged arc welding of mild steel and low alloy steel shall be as per IS : 4353

6.2.6 For multi-run weld deposit the succeeding run shall be done only after the preceding run is cleaned of all slag and flux deposits.

6.2.7 The Contractor shall prepare the edges with an automatically controlled flame cutting torch followed by grinding correctly to the shape, size and dimensions of the groove, prescribed in the design and shop drawings. In case of U-groove joint, the edges shall be prepared with an automatic flame cutting torch in two passes following a bevel cut with a gouging pass, or by machining.

6.2.8 The welding surfaces shall be smooth, uniform and free from fins, tears, notches or any other defect, which may adversely affect welding.
Welding surfaces or the surrounding surfaces within 50 mm of weld shall be free from loose scale, slag, rust, grease, paint, moisture or any other foreign material. Pre-bending of plates for three plate welded sections shall be done where found necessary.

6.2.9 Manipulators may be used where necessary and shall be designed to facilitate welding and to ensure that all welds are easily accessible to the operators. Where full strength butt welds are specified run-on and run-off pieces shall be used. The welding shall be such that the face of weld deposit shall at all places be proud of the surfaces of the parent metal by 1 to 1.5 mm. Where a flush surface is required, the surplus weld metal shall be ground and dressed off.

6.2.10 After completing each run of weld, all slag shall be thoroughly removed, and the surface cleaned before starting the next run of weld. The weld metal, as deposited (including tack welds if to be incorporated) shall be free from cracks, slag, inclusions, gross porosity, cavities and other deposition faults. The weld metal shall be properly fused with the parent metal without serious undercutting or overlapping at the toes of the weld. The surfaces of the weld shall have a uniform and consistent contour and uniform appearance.

6.2.11 All weld runs found defective shall be cut by using either chipping hammer, gouging torch, or suitable grinding wheel in such a manner that adjacent material is not injured in any way. Peeling of the welds involving deformation of the weld surface either during de-slagging or thereafter shall not be allowed.

6.2.12 Arc-strikes on parent surfaces of structures shall be strictly avoided.

6.3 Control in Welding

6.3.1 The extent of quality control in respect of welds for structural elements for both statically and dynamically loaded structures shall be as follows and shall be conducted by the contractor at his own cost:-

a) Visual Examination - All welds shall be 100% visually inspected to check the following:

i) Presence of undercuts
ii) Visually identifiable surface cracks in both welds and base metals.

iii) Unfilled craters

iv) Improper weld profile and size

v) Excessive reinforcement in weld

vi) Surface porosity

Before inspection, the surface of weld metal shall be cleaned of all slag, spatter beads, scales etc. by using wire brush or chisel.

b) **Dye Penetration Test (DPT)** - This shall be carried out for all important fillet welds and groove welds for both statically and dynamically loaded structures to check the following

i) Surface cracks

ii) Surface porosities

Dye Penetration Test shall be carried out in accordance with American National Standard ASTME 166.

c) **Ultrasonic- testing:** Ultrasonic test shall be conducted for all groove welds and heat affected zone in dynamically loaded structures and for other important load bearing butt welds in statically loaded structures as desired by Owner, to detect the following

i) Cracks

ii) Lack of fusion

iii) Slag inclusions

iv) Gas porosity

Ultrasonic testing shall be carried out in accordance with American National Standard ANSI/AWS DI.1-96. Before ultrasonic test is carried out, any surface irregularity like undercuts, sharp ridges etc. shall be rectified. Material surface to be used for scanning by probes must allow free movement of probes. For this purpose, surface shall be prepared to make it suitable for carrying out ultrasonic examination.

d) **Radiographic Testing** (X-ray and & Gamma-Ray Examination)

This test shall be limited to 2% of length of welds for welds made by manual or semi- automatic welding and 1% of length of weld if made by automatic welding machines. The location and extent of
weld to be tested by this method will be decided by Owner to detect the following defects:

i) gas porosity
ii) slag inclusions
iii) lack of penetration
iv) lack of fusion
v) cracks

Radiographic testing shall be conducted in accordance with American National Standard ANSI/AWS D1.1-96. Any surface irregularity like undercuts, craters pits etc. shall be removed before conducting radiographic test. The length of weld to be tested shall not be more than 0.75 x focal distance. The width of the radiographic film shall be width of the welded joint plus 20 mm on either side of the weld.

6.3.2 The Contractor shall provide testing equipment for conducting non-destructive tests for confirming the integrity of welding wherever necessary as directed by the Owner / consultant.

6.4 **Acceptable Limits of Defects of Weld**

Limits of Acceptability of welding defects shall be as follows:

a) Visual inspection & Dye Penetration Test

The limits of acceptability of defects detected during visual inspection and Dye Penetration Test shall be in accordance with American National Standard ANSI/AWS D1.1-96.

b) Ultrasonic Testing - The limits of acceptability of defects detected during ultrasonic testing shall be in accordance with American National Standard ANSI/AWS D1.1-96.

c) Radiographic testing - The limits of acceptability of defects detected during Radiographic testing shall be in accordance with American National Standard ANSI/AWS D1.1-96

General guidelines for permissible deviations in welding have been given in Section 11.0 of this document.
6.5 **Rectification of Defects in Welds**

In case of detection of defects in welds, the rectification of the same shall be done as follows

i) All craters in the weld and breaks in the weld run shall be thoroughly filled with weld.

ii) Undercuts, beyond acceptable limits, shall be repaired with dressing so as to provide smooth transition of weld to parent metal.

iii) Welds with cracks and also welds with incomplete penetration, porosity, slag inclusion etc. exceeding permissible limits shall be rectified by removing the length of weld at the location of such defects plus 10 mm from both ends of defective weld, and shall be re-welded. Defective weld shall be removed by chipping hammer gouging torch or grinding wheel. Care shall be taken not to damage the adjacent material.

7.0 **PAINTING OF BUILDING STEEL STRUCTURES**

All steel structural work shall be painted as follows unless otherwise stated in the drawing / Technical Specification. Relevant section of the GS shall be referred for further guidelines on painting.

7.1 **Surface Preparation**

The steel surface which is to be painted shall be cleaned of dirt and grease, and the heavier layers of rust shall be removed by chipping prior to actual surface preparation to a specified grade.

Following are the type and standards of surface preparation to be followed based on the requirement of a particular painting system or as specified in the design drawings.

**Manual / Power tool cleaning** Manual/Power tool cleaning shall be done as per Grade St-2 or St-3 of Swedish Standard institution SIS 05 5900 or cl. 7.2.1.1 & 7.2.1.2 of IS : 1477 (Part - I).
Grade St-2: Thorough scraping and wire brushing, machine brushing, grinding, etc. This grade of preparation shall remove loose mill scale, rust and foreign matter. Finally the surface is to be cleaned with a vacuum cleaner or with clean compressed air or clean brush. After preparation, the surface should have a faint metallic sheen. The appearance shall correspond to the prints designated St-2.

Grade St-3: Very thorough scraping and wire brushing, machine brushing, grinding etc. The surface preparation is same as for St-2 but to be done much more thoroughly. After preparing the surface, it should have a pronounced metallic sheen and correspond to the prints designated St-3.

BLAST CLEANING – Blast cleaning shall be done by shot blasting as per Grade SA-2 or SA-2 1/2 as specified in the drawings.

If no grade of surface preparation is specified, St-2 grade of preparation as per Swedish Standard shall be followed.

7.2 Paints and painting

Guidelines stipulated here shall be considered along with those specified in GS separately for painting.

7.2.1 Manufacture of paints, mixing of paints, etc - shall be generally according to the relevant IS codes of practice and as per guidelines in the General Specification in the relevant chapter.

7.2.2 In the event of conflict between this General Specification for painting and the paint manufacturer's specification, this conflict shall be immediately brought to the notice of the Owner / Consultant. Generally in cases of such conflicts, manufacturer's Specification/recommendation shall prevail.

7.2.3 Generally compatibility between primer intermediate and finishing paint shall be certified by the paint manufacturer supplying the paints. Before the Contractor buys the paint in bulk, it is recommended to obtain sample of paint and establish “Control Areas of Painting”. On Control Area, surface preparation and painting shall be carried out in the presence of the manufacturer of paint.

7.2.4 Control areas shall serve as specimen of painted surfaces, for observing and recording quality and performance of paint.
7.2.5 In case of any doubts, the Contractor shall send samples of paint to recognized testing laboratories to establish quality of paint with respect to:
   i) Viscosity
   ii) Adhesion/bond of paint to steel surfaces
   iii) Adhesion/simulated salt spray test
   iv) Chemical analysis/percentage of solid by weight
   v) Normal wear resistance as encountered during handling and erection
   vi) Resistance against exposure to acid fumes, and such other tests as considered necessary by the Owner / Consultant.

Whole system of paint shall be obtained from the same manufacturer.

7.2.6 Guarantee period on paints and painting shall commence from the date of completion of finishing coat of paint on entire structures. The guarantee period shall be indicated depending on the type of surface preparation and system of painting. To fulfil this obligations, the Contractor may obtain from the painting manufacturer, guarantee for the performance of paint/painted surfaces.

7.2.7 The painting material as delivered to the Contractor/Applier, must be in the manufacturer's original containers bearing thereon manufacturer's name, brand and description. Paint/painting material in the containers without labels or with illegible labels shall be rejected, removed from the area and shall not be used. Thinners wherever used shall be those recommended by the paint manufacturer and shall be obtained in the containers with manufacturer's name and brand name of the thinner legibly printed, failing which the thinner is liable to be rejected and shall not be used.

7.2.8 Wherever shop primer painting is scratched, abraded or damaged, the surface shall be thoroughly cleaned using emery paper and power driven wire brush wherever warranted or as directed by the Owner / Consultant, and touched up with corresponding primer. Touching up paint shall be matched and blended to conspicuous marks. If more than 50% of the painting surface of an item requires repair, the entire item shall be mechanically cleaned and new primer coats followed by finishing coats shall be applied as per painting Specification.

7.2.9 All field welded areas on shop painted items shall be mechanically cleaned including the weld area proper, adjacent areas contaminated by
weld splatter or fumes & areas where existing primer / intermediate / finish paint is burnt.
Subsequently, new primer and finishing coats of paint shall be applied as per painting Specification.

7.2.10 Application of paint shall be by spraying or brushing as per IS : 486 and IS . 487 and in uniform layers of 50% overlapping strokes by skilled painters. Painting shall not be done when the temperature is less than 5 degree C or more than 45 degree C and relative humidity is more than 85%; unless manufacturer's recommendations permit. Also painting shall not be done in foggy weather. During application, paint agitation must be provided where such agitation is recommended by the manufacturer.

7.2.11 Paint shall be applied at painting manufacturer's recommended rates. The number of coats shall be such that minimum dry film thickness specified is achieved. The dry film thickness (DFT) of painted surfaces shall be checked with ELCOMETER or measuring gauges to ensure specified DFT.

7.2.12 The inside surfaces of gutter which come in contact with rain water shall be provided with 2 finishing coats of water resistant, bitumastic paint of minimum DFT 75 microns, in addition to the primer coats of red oxide zinc phosphate in phenolic alkyde medium or 2 primer coats of epoxy based red oxide zinc chromate/epoxy based zinc phosphate of minimum DFT 25 microns per coat, as given in Specification and drawings. Other structures shall be painted as per painting system mentioned.

7.2.13 All structures shall receive one coat of primer paint at shop after fabrication before despatch after surface preparation has been done as per requirements. Unless otherwise specified all structures after erection shall be given one coat of primer and two coats of finishing paint of approved colour and quality. The under coat shall have different tint to distinguish the same from the finishing coat. Edges, corners, crevices, depressions, joints and welds shall receive special attention to ensure that they receive painting coats of required thickness.

7.2.14 Machine-finished surface shall be coated with white lead and tallow before shipment or before being put out into the open air. Part of steel structures to be embedded in concrete, shall be given a protective coat of Portland cement slurry immediately after fabrication after this part is thoroughly cleaned from grease, rust, mill scales etc. No paint shall be applied on such parts.
7.2.15 Zinc-rich primer paints, which have been exposed several months before finishing coat is applied, shall be washed down thoroughly to remove soluble zinc salt deposits. In similar circumstances, the surface of paint based on epoxy resin should be abraded or lightly blast cleaned to ensure adhesion of next coat.

7.2.16 Paints selection shall be based on Preferred make list of BSP. Type of paint (heat resistant/high corrosion resistant) required to be applied for a structure shall be approved by BSP and prior permission shall be taken before application of paint.

8.0 GENERAL REQUIREMENTS

8.1 Programme

The Contractor shall prepare a programme showing the date of supply of steel to his work, and the fabrication and erection of each section of the structure or structures. The erection dates shall be the dates for completion of all the follow-up work in addition to main erection keeping overall completion of project in view. The programme shall include quantum of different activities of work planned month wise to complete the work.

8.2 Drawings

8.2.1 The Contractor shall prepare steel structural arrangement drawings and design drawings along with analysis and design calculation of major elements and take their approval by Owner / Consultant within the time schedule as per contract. Necessary number of prints of drawings and documents; as per contract shall be submitted for approval. The Contractor shall prepare the fabrication drawings and bill of materials shall form part of the fabrication drawings which will be included in the body of the drawing or prepared separately.
8.2.2 Even if the drawings are Approved / Commented by the Owner / Consultant, the Contractor shall not be relieved of the responsibilities for the accuracy of the detailed dimensions shown in the drawings and the safety of all structural connections.

8.2.3 Notes on specifications shown on design drawings shall considered as superseding or overriding the specifications with which they conflict. On all drawings, dimensions shown in figures shall be acted on. Erection drawings in requisite number of sets shall be submitted to the Owner / Consultant showing thereon all authorized additions and alterations in the process of erection. These drawings shall show the "As-Built Installations".

8.2.4 Supply and distribution of fabrication drawings, and other documents like bolt list etc. for the contractors own use or for the use of his subcontractors shall be the responsibility of the Contractor.

8.2.5 The Contractor shall assume full responsibility for the correct setting out of all steel works and erecting correctly in accordance with alignment and levels shown on the approved drawings and plumbing of vertical members. Notwithstanding any assistance rendered to the Contractor by the Owner / Consultant, if at any time during the progress of the work, any error should appear or arise therein, on being required to do so, the Contractor at his own cost shall remove and amend the work to the satisfaction of the Owner/Consultant.

8.2.6 The Contractor shall provide his own measuring instruments for setting out, levelling and aligning work at his own expense.

8.3 **Co-ordination with other Contractors**

The structures shall have to be erected suitably detailed with erection of equipment or construction of civil works. The Contractor shall ensure spirit of co-operation with other contractors and strict adherence to the schedule so that erection schedules of the other parties are not affected.

8.4 **Staging**

Any staging necessary for the pre assembly work of structures shall be provided by the Contractor.
8.5 **Rules and regulations of safety, electricity boards, factory etc.**

The Contractor shall at all times comply with such rules and regulations as stipulated in relevant factory acts, electricity rules, safety regulations, etc.

8.6 **Deviations**

Should the contractor wish to deviate from any specifications or approved drawings and/or technical specifications, he shall obtain the Owner/Consultant’s written authority before proceeding with the deviations.

9. **INSPECTION OF STRUCTURES**

The Owner / Owner’s Inspector shall have free access at all times to those parts of Contractor’s or his Sub-Contractor’s works which are concerned with the fabrication of steel works and shall be afforded all reasonable facilities at all stages of preparation, fabrication and trial assemblies for satisfying himself that the fabrication is being undertaken in accordance with the provisions of relevant specification.

9.2 All gauges and templates, tools, apparatus, labour and assistance for checking shall be supplied by the contractor free of charge. The Owner / Inspector may at his discretion, check the test results obtained at the Contractor’s works, by independent test at the Government Test House or elsewhere, and should the material so tested be found to be unsatisfactory, the cost of such test shall be borne by the Contractor.

9.3 Contractor shall make all necessary arrangements for stage inspection by Owner/Inspector during the fabrication at shop and incorporate all on-the-spot instructions / changes conveyed in writing to the Contractor.
9.4 Material improperly detailed or wrongly fabricated shall be reported to the Owner/Inspector and shall be made good as directed. Minor misfits which can be remedied by moderate use of drift pins, and moderate amount of reaming and slight chipping may be corrected in that manner, if in the opinion of the Owner / Inspector the strength or appearance of the structure shall not be adversely affected. In the event the Owner / Inspector directs otherwise, the items shall be rejected and a completely new piece shall be fabricated. The cost of correcting errors shall be to the account of the Contractor.

9.5 The Owner / Owner's Inspector shall have the power:

a) To declare, before any structure is submitted for inspection, that the same is not in accordance with the contract, owing to the adoption of any unsatisfactory method of fabrication and the same will be rejected.

b) To reject any structure as not being in accordance with specifications & drawings.

c) To insist that no structure or parts of the structure once rejected is resubmitted for inspection/test, except in cases where the Owner / Inspector authorised representative considers the defects as rectifiable.

9.5.1 If, on rejection of structure by the Owner/Inspector the Contractor fails to make satisfactory progress within the stipulated period, the Owner / Inspector shall be at liberty to cancel the contract and fabricate or authorise the fabrication of the structures at any other place he chooses, at the risk and cost of the Contractor, without prejudice to any action being taken in addition to terms of General Conditions of Contract.

9.5.2 The Owner / Inspector's decision regarding rejection shall be final and binding on the Contractor.

9.5.3 The specifications prescribe various tests at specified intervals for ascertaining the quality of the work done. If the tests prove unsatisfactory, Owner/Inspector shall have liberty to order the Contractor to re-do the work, done in that period and/ or to order such alterations and strengthening that may be necessary at the cost of the Contractor and the contractor shall be bound to carryout such orders failing which the rectification/redoing shall be done by the Owner through other agencies and the cost recovered from the Contractor.
9.5.4 Notwithstanding any inspection at the workshop the Owner/Inspector shall have the liberty to reject, without being liable for compensation any fabricated members or materials brought to site that do not conform to specifications / drawings.

9.5.5 All rejected materials shall be removed from the site of fabrication by the Contractor at his own cost and within the time stipulated by the Owner/Inspector.

10.0 QUALITY SYSTEM AND THIRD PARTY INSPECTION.

10.1 GENERAL

Inspection shall be carried out at the works of the Contractor during fabrication and on final product to ensure conformity of the same with the acceptable criteria of technical specifications, approved fabrication drawings and indicated standards.

10.1.1 This specification is in addition to the provisions laid down in Owner's General Condition of Contract (GCC) and special instructions to Contractor, if any.

10.2 QUALITY SYSTEM REQUIREMENTS.

The Contractor must recognise the importance of quality and follow the defined quality programme in all manufacturing and quality control activities of the product. The Contractor shall define and implement the tasks and controls that shall provide needed assurance in case manufacturing of product is sub-contracted either partly or fully and / or for the procured components of the product. All bought-out components, if any, shall be procured from approved list of vendors issued by the Project Authority.

Owner reserves the right to verify the quality programme and entire product characteristics to assure the intended and specified quality of the product.

10.3 QUALITY ASSURANCE PLAN (QAP)
10.3.1 The Contractor shall furnish the Quality Assurance Plan (QAP) for the respective structural unit / component after finalisation of billing schedule for Owner's approval at least two months prior to start of manufacturing.

10.3.2 The Contractor shall indicate the procurement source and furnish to Owner during discussions on QAP, copies of Owner Order, Sub-Owner Order, and data sheets as backup reference materials for scrutiny & finalisation of QAP.

10.3.3 QAP shall be prepared & furnished by the Contractor in the prescribed format (enclosed as Annexure- B) for structural components, in four sets.

10.3.4 Inspection and test requirements shall be decided with due consideration of factors like safety, duty cycle, operating conditions, equipment life, environmental conditions, place of installation and statutory regulations, as applicable, for a particular component. Any, additional type or special test or routine tests if found necessary to establish the intended quality, shall be incorporated in the QAP on mutual agreement without any commercial implication.

10.3.5 Detailed QAP shall be prepared by the Contractor based on the general plan given by Owner and shall be approved by Owner to avoid any complication later.

10.3.6 QAP shall clearly indicate the followings through use of codes in the appropriate columns:

a) Range of inspection & tests to be done by the Contractor during fabrication of structures from raw materials to finishing stage.

b) Suggestive check / hold points for Owner’s inspection and witnessing of tests during the fabrication and final product inspection.

c) Details of test certificates, internal inspection reports and calibration certificates to be furnished by the Contractor to Owner.

d) Inspection documents to be furnished by the Contractor to Owner for reference during inspection.

10.3.7 Sampling method for lot inspection of similar bulk items, if any, shall be indicated under column 16 of QAP with linkage to applicable standard.

10.3.8 While submitting the QAP, the Contractor shall indicate the acceptance criteria under column 15 of QAP form regarding check parameters of each
component. Acceptance criteria shall have reference of documents viz. Owner Order, Sub-Owner Order, T.S., Approved fabrication drawings. Wherever the acceptance criterion is not available in above documents, the same shall be specified with traceability to national / international specifications.

10.4 INDICATIVE SURVEILLANCE BY OWNER.

10.4.1 Surveillance level of Owner may vary from component to component as per product characteristics.

Indicative extent of inspection for buildings and structures is furnished below for guidance of Contractors in developing QAP.

<table>
<thead>
<tr>
<th>Categories of Equipment</th>
<th>Extent of Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Manufactured items</td>
<td>Material &amp; manufacturer's test certificate to be submitted by giving inspection call for the main equipment in the final stage.</td>
</tr>
<tr>
<td>(Structural fabricated and welded)</td>
<td></td>
</tr>
</tbody>
</table>

Scrutiny of welding procedure and welder’s qualification record shall be carried out if required as per governing code.

Following checks / tests shall be carried out in the final stage:
- Visual inspection
- Alignment and fitment checking
- Dimensional checking
- Weld inspection - visual and NDT as per design requirements. Radiographs are to be shown and reports to be submitted to Owner for review during inspection, if applicable.

10.5 CALIBRATION OF MEASURING EQUIPMENT.

10.5.1 All the measuring equipment used for inspection & testing shall be calibrated and appropriate accuracy class of measuring equipment shall be used. Calibration standards used for calibration of measuring
equipment shall be traceable to national standards of National Physical Laboratory (NPL), New Delhi with unbroken chains of comparison.

10.5.2 Calibration Certificate of All Measuring Equipments.

Valid calibration certificates for all measuring equipments used during inspection and testing with traceability to national standards of NPL / NPL accredited laboratories shall be furnished along with inspection call prior to undertaking inspection by Owner.

Calibration certificates shall also indicate reference number of calibration standards calibrated by NPL / NPL accredited laboratories and copies of such calibration certificates of calibration standards shall also be furnished when asked for.

10.6 TEST CERTIFICATES AND DOCUMENTS.

10.6.1 For each of the items being fabricated, the following test certificates and documents, as applicable, in requisite copies including original shall be submitted to Inspection Agency. All test certificates must be endorsed by the Contractor with linkage to project, purchase order and acceptance criteria.

i) Raw materials identification & physical and chemical test certificates for all materials used in fabrication of the component (except IS 2062-1992).

ii) WPS, PQR & WPQ Documents as per applicable code.

iii) Details of stage-wise inspection & rectification records for fabricated items and machined articles.

iv) Control dimension chart with records of alignment, trueness of shape, etc.

v) Details of heat-treatment and stress relieving charts as per specification.

vi) Non-Destructive Test reports as per respective code.

vii) Hardness test certificate.

viii) Performance Test Certificates for all characteristics.
ix) Geometric accuracy and repeatability test reports of machine tools.

x) Surface preparation and painting certificates.

xi) Certificates from competent authority for the items coming under statutory regulations.

10.6.2 The Inspection Agency shall have the right to be present and witness all tests being carried out by the Contractor at their own laboratory or approved laboratories. Also, the Inspection Agency shall reserve the right to call for confirmatory test on samples, at his discretion.

10.7 MANUFACTURING AND INSPECTION SCHEDULE

The Contractor shall submit the schedule for fabrication and inspection indicating components/ assembly / sub-assembly, date of approval of drawings / data sheets, address of Fabricator with contact person and scheduled date of inspection. Such reports shall be submitted to Owner with a copy to Inspection Coordinating Office once in a month. These monthly reports shall state the planning for next three months. Submission of first report must commence one month prior to commencement of fabrication activities of the component.

10.8 INTERNAL INSPECTION BY CONTRACTOR

10.8.1 The Contractor in accordance with approved drawings, T.S., Owner Order, and approved QAP shall carry out inspection and tests. The Contractor shall maintain records of each inspection and test carried out and signed documents shall be submitted to Owner for verification.

10.8.2 The Contractor shall carry out their internal inspection & obtain clearance from statutory bodies e.g. IBR, CCE, TAC, Weights & Measures, safety, IE rules etc. as and where applicable, prior to offering any component for Owner's inspection in accordance with approved QAP.

10.8.3 The Contractor shall ensure use of appropriate calibrated measuring equipment during their internal inspection, as well as, make available the same during Owner's inspection and tests. Also, they shall make necessary arrangement for access and use of Owner owned measuring equipment during inspection.

10.8.4 The Contractor shall identify all the inspected component / raw materials & shall maintain the record of status of inspection viz. inspected & found acceptable, require rectification / rework, rejected etc.
10.8.5 The Contractor shall establish and maintain procedures to ensure that product that does not conform to specified requirements, is prevented from inadvertent use or installation. The description of non-conformity that has been accepted subsequently by Owner by concession and/or of repairs shall be recorded.

Repaired and reworked product shall be offered for re-inspection to Owner along with records of corrective action taken.

10.8.6 The Contractor shall not despatch any equipment till receipt of despatch clearance from Owner.

10.9 METHOD OF UNDERTAKING INSPECTION & TESTING BY OWNER.

10.9.1 Agency Responsible:-

Inspection / Waiver of component shall be undertaken by various MECON Offices depending upon the location of manufacturers.

10.9.2 Method of Issuing Inspection Call to MECON:

(i) Inspection call shall be given only on readiness of the assembly/sub-assembly and approval of all relevant drawings and QAP. In case assembly/sub-assembly offered for inspection are found not ready, all the cost of visit of Owner's personnel shall have to be borne by the Contractor. Also, if the assembly/sub-assembly after inspection found not acceptable, require rework and involve Owner's re-inspection, all the cost of such re-inspections shall also be borne by the Contractor.

(ii) Inspection call shall be floated to Owner with ten days clear margin, enclosing all documents like test Certificates, Internal Inspection Reports, Purchase Order, Sub-Purchase Order, T.S., Approved QAP, approved GA drawings/data sheets and fabrication drawings with a copy of call letter to Inspection Co-ordinating Office. Inspection calls without above documents shall be ignored.

(iii) The supplier shall offer substantial quantities for economical inspection consistent with the size of order.

10.10 OBLIGATIONS OF CONTRACTOR.
10.10.1 The Contractor shall provide all facilities and ensure full and free access of the Inspection Engineer of Owner to the Contractor’s or their Sub-Contractor’s premises at any time during contract period, to facilitate him to carry out inspection & testing of the product during or after manufacture of the same.

10.10.2 The Contractor shall delegate a Representative / Co-ordinate to deal with Owner / Consultant on all inspection matters. Also, Contractor’s Representative shall be present during all inspection at Sub-Contractor’s works.

10.10.3 The Contractor shall comply with instructions of the Inspection Engineer fully and with promptitude.

10.10.4 The Contractor / Sub-Contractor shall provide all instruments, tools, necessary testing & other inspection facilities to Inspection Engineer free of cost for carrying out inspection.

10.10.5 The cost of testing welds by ultrasonic, radiographic and dye penetration tests etc. in the fabrication workshop shall be borne by the Contractor.

10.10.6 The Contractor shall ensure that the assembly / component of the plant and equipment required to be inspected, are not dismantled or despatched before inspection.

10.10.7 The Contractor shall not offer equipment for inspection in painted condition unless otherwise agreed in writing by Owner / Consultant.

10.10.8 The Contractor shall ensure that the equipment and materials once rejected by the Inspection Engineer are not re-used in the manufacture of the plant and equipment. Where parts rejected by the Inspection Engineer have been rectified, as per agreed procedures laid down in advance, such parts shall be segregated for separate inspection and approval, before being used in the work.

10.11 STAMPING AND ISSUE OF INSPECTION DOCUMENTS.

Inspection Memo: -

For stage inspection & for rejected items / items which do not conform to Technical Specification in one or more quality characteristics requiring rectification / rework, Inspection Memo shall be issued in
standard form indicating therein the details of observation & remarks. Fabricator shall indicate all the non-conformities with respect to specification of the product in the Inspection Memo for further control.

Inspection Certificate: -

On satisfactory completion of final inspection & testing by Owner / Third Party Inspector, all accepted plant & equipment shall be stamped suitably and the Inspection Engineer for the accepted items shall issue Inspection Certificate in standard form.

Inspection Waiver Certificate: -

For the waiver category of items identified in the approved QAP, Owner shall issue Inspection Waiver Certificate after scrutiny of Contractor's Internal Inspection Report, Test Certificates and other Documents as identified in QAP.

10.12. GENERAL CLAUSES

10.12.1 Inspection & tests carried out by Owner / Third Party Inspector shall not absolve the responsibility of the Contractor to provide acceptable product nor shall it preclude subsequent rejection.

10.12.2 Owner / Third Party Inspector reserves the right to inspect any product at any stage of manufacturing without prior notice to Contractor beyond pre-identified stages & hold points of approved QAP.

11. PERMISSIBLE DEVIATION IN ASSEMBLY OF WELDED JOINTS

A) SQUARE BUTT-JOINT

a) Gap between the ends of plates : + 1.0 mm
b) Stepping of one plate over the other : + 1.0 mm

B) SINGLE VEE-GROOVE JOINT

a) Bevel angle : + 5 deg
b) Gap between two plates          : + 1.0 mm
c) Stepping of one plate over the other : + 2.0 mm
d) Root thickness               : + 1.0 mm

C) LAP JOINT

a) Over lap                     : + 5.0 mm
b) Gap between the surfaces     : + 1.0 mm

D) TEE FILLET JOINT

a) Gap between the edge of the web and the surface of the flange : + 2.0 mm

E) DOUBLE VEE-GROOVE JOINT

a) Stepping of plate over one another : + 2.0 mm
b) Deviation in value of root thickness : + 1.0 mm
c) Deviation in bevel angle            : + 1.0 mm
d) Deviation in value of gap        : + 1.0 mm

12. PERMISSIBLE DEVIATIONS IN FABRICATION & ERECTION

TABLE – 1

DUST CATCHER SHELL

<table>
<thead>
<tr>
<th>Description</th>
<th>Tolerance in mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Ellipticity (max. difference between diameters) of the cylindrical and conical portions.

0.005 of the theoretical diameter of the cylinder and conical portion.

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>DEVIATION IN mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ellipticity (max. difference in diameters) of a course.</td>
<td>+ 0.002 of the theoretical diameter of the course.</td>
</tr>
<tr>
<td>Stepping of the edges of plates in the vertical and circular weld joint.</td>
<td>0.1 of shell thickness but not more than 3 mm.</td>
</tr>
<tr>
<td>Local warping of shell along the generatrix and periphery as measured by gauge over the length of 1500 mm.</td>
<td>Not more than 15 mm.</td>
</tr>
</tbody>
</table>
Caving in or bulging of joints measured by gauge over a length of 200 mm.

Note: H - height measured from the base of the point of alignment.

### TABLE – 3

**COVERAGE OF NDT FOR WELDS**

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>NORMS FOR CONTROLLING AS A % OF TOTAL LENGTH OF WELDING (NOT LESS THAN) FOR</th>
<th>PLACES TO BE SUBJECT TO RADIOGRAPHIC TESTING COMPULSORILY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ULTRASONIC TESTING</td>
<td>MANUAL &amp; SEMI-AUTOMATIC</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AUTOMATIC</td>
</tr>
<tr>
<td>BF Shell</td>
<td>100</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Portions of the welded joint found defective by ultrasonic testing</td>
</tr>
<tr>
<td>Stoves, hot blast main &amp; bustle main</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Portions of the welded joint found defective by ultrasonic testing and crossing of welded joint</td>
</tr>
</tbody>
</table>
### Dust catcher, Junction & places of variable cross sections by the following norms without ultrasonic testing with ultrasonic testing

<table>
<thead>
<tr>
<th>Description</th>
<th>Tolerance</th>
<th>Value</th>
<th>Crossing of welded joint</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>1</td>
<td>0.5</td>
<td>Portions of the welded joints found defective by</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ultrasonic welding</td>
</tr>
</tbody>
</table>

### Portions of gas pipelines from BF to DC & DC to GCP

<table>
<thead>
<tr>
<th>Description</th>
<th>Tolerance</th>
<th>Value</th>
<th>Portions of the welded joints found defective by</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>ultrasonic testing</td>
</tr>
</tbody>
</table>

#### TABLE – 4

**ERECTION TOLERANCES**
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>TOLERANCE (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>COLUMNS</strong></td>
<td></td>
</tr>
<tr>
<td>Deviation of column axes at foundation top level with respect to true axes</td>
<td>± 5</td>
</tr>
<tr>
<td>In longitudinal direction</td>
<td>± 5</td>
</tr>
<tr>
<td>In lateral direction</td>
<td></td>
</tr>
<tr>
<td>Deviation in the level bearing surface of columns at foundation top level</td>
<td>± 5</td>
</tr>
<tr>
<td>with respect to true level.</td>
<td></td>
</tr>
<tr>
<td>Out-of-plumbness (verticality of column axis from true vertical axis, as measured at column top)</td>
<td></td>
</tr>
<tr>
<td>For columns without any special requirements</td>
<td>± H/1000 or ±25 mm whichever is less.</td>
</tr>
<tr>
<td>Up to and including 30 M height</td>
<td></td>
</tr>
<tr>
<td>Over 30 M height</td>
<td>± H/1200 or ±35 mm max.</td>
</tr>
<tr>
<td>For columns with special requirement like cranes or such similar requirements.</td>
<td></td>
</tr>
<tr>
<td>Upt o and including 30 M height</td>
<td></td>
</tr>
<tr>
<td>Over 30 M height</td>
<td>± H/1000 or ±20 mm whichever is less.</td>
</tr>
<tr>
<td>Deviations in straightness in longitudinal and transverse plans of columns at any point along the height.</td>
<td>± H/1000 or ±10 mm whichever is less.</td>
</tr>
<tr>
<td>DESCRIPTION</td>
<td>TOLERANCES (mm)</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------</td>
</tr>
<tr>
<td><strong>TRUSSES</strong></td>
<td></td>
</tr>
</tbody>
</table>

| Difference in the erected position adjacent pairs of columns along with cross width of building prior to connecting trusses/beams with respect to true distance. | ± 5 |
| Deviation in any bearing or seating level with respect to true level. | ± 5 |
| Deviation in difference in bearing levels of a member on adjacent pair of columns both across and along the building. | ± 5 |

**Note:**

Tolerance specified under 3(a) & 3(b) should be read in conjunction with 4 & 5. 'H' above is the column height in mm. contnd..
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>TOLERANCES (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRANE GIRDERS &amp; RAILS</td>
<td></td>
</tr>
<tr>
<td>Shift in the centre line of crane rail with respect to centre line of web of crane girder.</td>
<td>± ( web thickness + 2 )/2</td>
</tr>
<tr>
<td>Shift in plan of alignment of crane rail with respect to true axis of crane rail at any point.</td>
<td>± 5</td>
</tr>
<tr>
<td>Deviations in crane track gauge with respect to true crane gauge. For track gauge up to and including 15 M. For track gauge more than 15 M.</td>
<td>± 5 ( 5 + 0.25 ( S-15 ) ) subject to a max. of 10 mm, where S in...</td>
</tr>
</tbody>
</table>

Lateral shift in location of truss from its true vertical position. | ± 10 mm |
Lateral shift in location of purlins from its true positions. | ± 5 |
Deviation in difference of bearing levels of trusses or beam from the true difference. | L/1200 or ± 20 mm whichever is less ( L = span ) |

contnd..
<table>
<thead>
<tr>
<th>Description</th>
<th>Limitation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deviations in crane rail level at any point from true level.</td>
<td>± 10</td>
</tr>
<tr>
<td>Difference in levels between crane track rails (across the bay) at:</td>
<td>± 15</td>
</tr>
<tr>
<td>Support of crane girder</td>
<td>± 20</td>
</tr>
<tr>
<td>Mid span of crane girders</td>
<td></td>
</tr>
<tr>
<td>Relative shift of crane rail surfaces at a joint in plan and elevations.</td>
<td>2 mm subject to grinding of surfaces for smooth transitions.</td>
</tr>
<tr>
<td>Relative shift in location of crane stops (end buggers) along the crane track gauge.</td>
<td>1/1000 of track gauge S in mm subject to max. of 20 mm</td>
</tr>
<tr>
<td>CHIMNEYS &amp; TOWERS</td>
<td></td>
</tr>
<tr>
<td>Out of plumbness (vertically from the true vertical axis).</td>
<td>1/1000 of the height of chimney or tower in mm.</td>
</tr>
<tr>
<td>BUNKERS</td>
<td></td>
</tr>
<tr>
<td>Deviation in length of bunker from the true length.</td>
<td>± 1/1000 of length in mm</td>
</tr>
<tr>
<td>Deviation in width of bunker from the true width.</td>
<td>± 1/1000 of width in mm</td>
</tr>
<tr>
<td>Deviation in height of bunker from the true height.</td>
<td>± 1/1000 of height in mm</td>
</tr>
<tr>
<td>Component</td>
<td>Specification</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>BF SHELL</strong></td>
<td></td>
</tr>
<tr>
<td>Ellipticity</td>
<td>The maximum difference in diameter in diameter of courses.</td>
</tr>
<tr>
<td></td>
<td>0.002 of the theoretical diameter of the courses.</td>
</tr>
<tr>
<td><strong>STOVE SHELL</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The dome centre shift with respect to the bottom centre.</td>
</tr>
<tr>
<td></td>
<td>± 20</td>
</tr>
<tr>
<td>Ellipticity</td>
<td>0.002 of the nominal diameter</td>
</tr>
<tr>
<td><strong>TOP STRUCTURES</strong></td>
<td></td>
</tr>
<tr>
<td>Shift of frame centre from</td>
<td></td>
</tr>
<tr>
<td>the designed position.</td>
<td>± 20 mm</td>
</tr>
<tr>
<td>Non horizontality of girders</td>
<td>3 mm per 1 m of girder length.</td>
</tr>
<tr>
<td><strong>DOWN COMERS</strong></td>
<td></td>
</tr>
<tr>
<td>Erection and sag of down</td>
<td></td>
</tr>
<tr>
<td>comers</td>
<td>0.0015 L but not more than 80 mm. (L is the length of pipeline)</td>
</tr>
<tr>
<td><strong>GAS PIPELINE SUPPORTS</strong></td>
<td></td>
</tr>
<tr>
<td>Section</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Deviations of support axes from the vertical plane.</td>
<td>0.002 ( h ), but not more than 20 mm, ( h ) is the height of the support.</td>
</tr>
<tr>
<td>GAS &amp; AIR</td>
<td>Distortion of flange /surfaces (except for the furnace top one ) with respect to the branch pipe/ pipe socket axis.</td>
</tr>
<tr>
<td>DUST CATCHER</td>
<td>Ellipticity</td>
</tr>
<tr>
<td>BUSTLE PIPE</td>
<td>The deviations of the bottom level ( of the shell ) of the ring pipe ( measured along the axis of air tuyere ) from the designed one.</td>
</tr>
<tr>
<td></td>
<td>Ellipticity</td>
</tr>
</tbody>
</table>
Note:

The tolerances given at Sections 11 and 12 above, are meant as general guidelines, mainly for technological structures, and for those not covered in IS Codes. Tolerances for fabrication and erection, in general, shall be as per stipulations of IS : 7215-1974, and IS : 12843 -1989. In case of a conflict between the guidelines given in IS Codes and this Specification, those specified herein shall prevail.

ANNEXURE-A

Permissible deviations in pitch and gauge of holes for bolts of normal accuracy (high strength bolts included)

<table>
<thead>
<tr>
<th>Description</th>
<th>Hole diameter (mm)</th>
<th>Permissible deviations in spacing (mm)</th>
<th>Permissible deviations in each group of holes</th>
</tr>
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<tr>
<td></td>
<td></td>
<td>Carbon Steel</td>
<td>Low Alloyed Steel</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>a) Deviation in the hole diameter</td>
<td>Upto 17.0</td>
<td>+1</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Above 17.0</td>
<td>+1.5</td>
<td>5</td>
</tr>
<tr>
<td>b) Ovality (difference between the biggest and the smallest diameter)</td>
<td>Upto 17.0; Above 17.0;</td>
<td>+1</td>
<td>+1.5</td>
</tr>
</tbody>
</table>
| c) Curves, exceeding 1mm and | | | | Not permissible
cracks on the hole edges

d) (i) Non-coincidence of holes in separate details of the assembled unit, up to 1mm

(ii) Above 1 mm up to 1.5 mm

(e) Slope of axis

<table>
<thead>
<tr>
<th>Details</th>
<th>Limits</th>
<th>Limits</th>
</tr>
</thead>
<tbody>
<tr>
<td>cracks on the hole edges</td>
<td>Upto 50%</td>
<td>Upto 50%</td>
</tr>
<tr>
<td>(i) Non-coincidence of holes in separate details of the assembled unit, up to 1 mm</td>
<td>Upto 10%</td>
<td>Upto 10%</td>
</tr>
<tr>
<td>(ii) Above 1 mm up to 1.5 mm</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>e) Slope of axis</td>
<td>Upto 30%</td>
<td>No</td>
</tr>
<tr>
<td>of the thickness of unit</td>
<td>No Limits</td>
<td>No Limits</td>
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INSPECTION

(CHAPTER-05)
GENERAL SPECIFICATION
FOR
QUALITY SYSTEM, INSPECTION &
TEST OF PLANT / EQUIPMENT AT
MANUFACTURER’S PREMISES
(GS – 05)
## CONTENTS

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</table>

**ENCLOSURES:**

- i) Form No. 11.20.(DQM)F-09 Rev-0 - QAP for Structural & Mechanical Equipment
- ii) Form No. 11.20.(DQM)F-10 Rev-0 - QAP for Electrical Equipment
- iii) Form No. 11.20.(DQM)F-11 Rev-0 - QAP for Refractory Materials
- iv) Form No. 11.20.(DQM)F-5/2 Rev-0 - Inspection Call Proforma
- v) LIST OF MECON OFFICES and Contact Address Details
1.0 GENERAL

1.1 Inspection & testing of plant & equipment shall be carried out by Consultant/ Purchaser at the works of successful tenderer during manufacturing and/or on final product to ensure conformity of the same with the acceptable criteria of technical specifications, approved drawings, manufacturing drawings and applicable national / international standards.

2.0 QUALITY SYSTEM REQUIREMENTS

The successful tenderer must recognise the importance of quality and follow defined quality programme in all stages of manufacturing and quality control activities of the product. Contractor must define and implement the tasks and controls that will provide needed assurance, in case manufacturing of product is sub-contracted either partly or fully and/or for the procured components of the product. All bought-out equipment or component shall be procured from vendors which are duly approved by the project authority.

Consultant/ Purchaser reserve the right to verify the quality programme of tenderer & its vendors/sub- vendors to assure the effectiveness of the programme to meet the intended and specified quality of the product.

3.0 QUALITY ASSURANCE PLAN (QAP)

3.1 The successful tenderer shall furnish Quality Assurance Plan (QAP) for respective equipment after completion of detailed engineering and finalisation of billing schedule / equipment identification number for Consultant's approval at least one month prior to start of manufacturing.

3.2 QAP shall be prepared & furnished by Contractor in Form No. 11.20(DQM) F-09,10,11 (specimen copy enclosed) / detailed manufacturing QAP for structural & mechanical equipment, electrical equipment and refractory materials respectively, QAPs must be submitted in four (4) sets duly signed and stamped by tenderer for MECON approval.

3.3 The successful tenderer shall indicate procurement source and furnish to Consultant, during the submission of QAP, copies of P.O., Sub-P.O., T.S., approved GA drawings/data sheets & detailed manufacturing drawings, as backup reference materials for scrutiny & final approval by Consultant. The submission & subsequent approval of QAPs shall be ensured to be restricted to one round only.

3.4 Inspection and test requirements shall be decided with due consideration of factors like safety, duty cycle, operating conditions, equipment life, environmental conditions, place of installation and statutory regulations, as applicable, for a particular equipment. Any, additional type or special tests or routine tests if found necessary to establish the intended quality after detailed engineering then the same shall have to be incorporated in the QAP without any commercial implication.

3.5 Detailed QAP shall be prepared by the successful tenderer in consultation with their Sub-contractors / Manufacturers to avoid any complicacy later.
4.0 **CALIBRATION OF MEASURING EQUIPMENT**

4.1 All the measuring equipment used for inspection & testing shall be calibrated and appropriate accuracy class of measuring equipment shall be used. Calibration standards used for calibration of measuring equipment shall be traceable to national standards of National Physical Laboratory (NPL), New Delhi with unbroken chains of comparison.

4.2 Valid calibration certificate for all measuring equipment used during inspection and testing at manufacturer's works, with traceability to national standards of NPL/ NABL accredited laboratories shall be furnished prior to undertaking inspection by Consultant/ Purchaser.

Calibration certificate shall also indicate reference no. of calibration standards calibrated by NPL/NABL accredited laboratories and copies of such calibration certificates of calibration standards shall be included in the compiled dossiers of inspection/test results.

5.0 **TEST CERTIFICATES AND DOCUMENTS**

5.1 For each of the items being manufactured as per approved QAP, following test certificates and documents, as applicable for each of the equipment, in requisite copies including original, duly endorsed by the Manufacturer/successful tenderer with appropriate linkage to project, purchase order and acceptance criteria etc shall be submitted to Consultant/ Purchaser.


ii) WPS, PQR & WPQ documents as per applicable code.

iii) Details of stagewise inspection & rectification records for fabricated items, castings, forgings and machined articles.

iv) Control dimension chart with records of alignment, squareness etc.

v) Manufacturer's material and performance/relevant test certificates for all bought-out items.

vi) Details of heat-treatment and stress relieving charts as per specification.

vii) Non-Destructive Test reports as per respective code.

viii) Static/dynamic balancing certificate for rotating components/machines.

ix) Hardness test certificate.

x) Pressure/Leakage Test Certificates.

xi) Performance Test Certificates for all characteristics.

xii) Routine / type / calibration /acceptance / special test (Type Tests etc) certificates for electrical items.
xiii) Surface preparation and painting certificates.

xiv) Certificates from competent authority for the items coming under statutory regulations.

5.2 Where physical and chemical test certificates of material are not available, the successful tenderer/Sub-contractor shall arrange to have specimens and test samples of the materials, tested in his own laboratory at his cost and submit the copies of test results in requisite numbers to Consultant/Purchaser for review. Number of test samples against each heat/cast/lot or batch of materials, as applicable shall be as per relevant Indian or International Standards.

5.3 Where facilities for testing do not exist in the successful tenderer/Sub-contractor's laboratories or in case of any dispute, samples and test pieces shall be drawn by the successful tenderer/Sub-contractor in presence of Consultant/ Purchaser and sealed sample shall be sent to any Govt. approved /NABL accredited laboratory for necessary tests at former's own cost.

5.4 The Consultant/ Purchaser shall have the right to be present and witness all tests being carried out by the successful tenderer/Sub- contractor at their own laboratory or approved laboratories. Also, the Inspection Agency shall reserve the right to call for confirmatory test on samples, at his discretion.

6.0 INTERNAL INSPECTION BY SUCCESSFUL TENDERER/MANUFACTURER

6.1 Inspection and tests shall be carried out by Contractor/ Manufacturer in accordance with approved drawings, T.S., P.O., and approved QAP. They shall maintain records of each inspection and test carried out and signed documents shall be submitted to Purchaser/Consultant for verification.

6.2 The successful tenderer shall carry out their internal inspection & obtain clearance from statutory bodies e.g. IBR, CCE, TAC, Weights & Measures, safety, IE rules etc. prior to offering any equipment for Purchaser/Consultant's inspection in accordance with approved QAP.

6.3 The successful tenderer/ Manufacturers shall identify all the inspected equipment/component/raw materials & shall maintain the record of status of inspection viz. inspected & found acceptable, require rectification/rework, rejected etc.

6.4 The successful tenderer shall establish and maintain procedures to ensure that the product that does not conform to specified requirements, is prevented from inadvertent use or installation. The description of non-conformity that has been accepted subsequently by Consultant/ Purchaser by concession and/or of repairs, shall be recorded.

Repaired and reworked product shall be offered for re- inspection to Consultant/ Purchaser alongwith records of corrective action taken.

7.0 MANUFACTURING AND INSPECTION SCHEDULE

All contractors shall submit the schedule for manufacturing and inspection indicating equipment / components, sub-assembly/ assembly. Date of approval of drawings / data sheets. Address of manufacturer with contact person and scheduled date of inspection. Such reports shall be submitted to respective Consultant Inspecting Offices with a copy
to Inspection Co-ordinating Office once in a month. These monthly reports shall state the planning for next three months. Submission of first reports must commence one month prior to commencement of manufacturing activities of the product.

8.0 METHOD OF UNDERTAKING INSPECTION & TESTING BY CONSULTANT/PURCHASER

8.1 Inspection call shall be given only on readiness of the equipment/assembly/sub-assembly & after approval of all relevant drawings and QAP. In case, equipment/assembly/sub-assembly offered for inspection are found not ready, all the cost of visit of Consultant's engineer shall have to be borne by the successful tenderer.

If the equipment/assembly/sub-assembly after inspection found not acceptable, require rework and involve Consultant's re-inspection, all the cost of such re-inspections shall also have to be borne by the successful tenderer.

8.2 Inspection call shall be floated to Consultant, in the enclosed Form No.11.20(DQM)F-05/2.REV-0 duly filled in, with ten days clear margin, enclosing all documents like test Certificates, Internal Inspection Reports, P.O., Sub-P.O., T.S., Approved QAP, approved GA drawings/data sheets and manufacturing drawings. Inspection calls without above documents shall be treated as invalid and shall be ignored. The hard copy of such documents must also accompany a CD (comprising computer readable files) containing the identical documents.

8.3 The successful tenderer shall offer substantial quantities for economical inspection consistent with the size of order.

8.4 On receipt of the Inspection call, pertaining to particular package/equipment/item, QA & Inspection group of Consultant, Ranchi (Overall co-ordinating office for Inspection activities) shall organize inspection visit or will issue Inspection assignment to other Consultant's office (based on nearness to the vendor's manufacturing works/relevant job expertise). For further inspection pertaining to the same package/equipment/item, successful tenderer may forward the subsequent inspection calls to the respective Consultant's offices (as identified per initial assignment), with a copy to QA & Inspection Section, Ranchi.

9.0 OBLIGATIONS OF SUCCESSFUL TENDERER

9.1 The successful tenderer shall provide all facilities and ensure full and free access of the Inspection Engineer of Purchaser/Consultant to their own or their Sub-Contractor's premises at any time, during contract period, to facilitate him to carry out inspection & testing of the product during or after manufacture of the same.

9.2 The successful tenderer shall delegate a Representative/Co-ordinator to deal with Consultant/Purchaser on all inspection matters. Representative of successful tenderer shall be present during all inspection at Sub-Contractor's works.

9.3 The successful tenderer shall comply with instructions of Consultant/Purchaser fully and with promptitude.

9.4 The successful tenderer/Sub-Contractor shall provide all instruments, tools, necessary testing & other inspection facilities to Consultant/Purchaser free of cost for carrying out inspection.

9.5 The cost of testing welds by ultrasonic, radiographic and dye penetration tests etc. in the fabrication workshop shall be borne by the successful tenderer. These tests need to be
witnessed by ASNT/ISNT Level-II qualified NDT personals

9.6 The successful tenderer shall ensure that the equipment/assembly/ component of the plant and equipment required to be inspected, are not dismantled or dispatched before inspection.

9.7 The successful tenderer shall not offer equipment for inspection in painted condition unless otherwise agreed in writing by Consultant/ Purchaser.

9.8 The successful tenderer shall ensure that the equipment and materials once rejected by the Consultant/Purchaser, are not re-used in the manufacture of the plant and equipment. Where parts rejected during inspection have been rectified as per agreed procedures laid down in advance, such parts shall be segregated for separate inspection and approval, before being used in the work.

10.0 STAMPING AND ISSUE OF INSPECTION DOCUMENTS

10.1 Inspection Memo: For rejected items/items, which do not conform to Technical Specification in one or more quality characteristics requiring rectification / rework, Inspection Memo shall be issued indicating therein the details of observation & remarks. All the non-conformities with respect to specification of the product shall be indicated in the Inspection Memo for further quality control by successful tenderer.

10.2 Inspection Certificate: On satisfactory completion of final inspection & testing, all accepted plant & equipment shall be stamped suitably and Inspection Certificate shall be issued by the Consultant for the accepted items.

11.0 GENERAL CLAUSE

11.1 Inspection & tests carried out by Consultant/Purchaser shall not absolve the responsibility of the successful tenderer/ Manufacturer to provide acceptable product as per the terms of contract nor shall it preclude subsequent rejection.

11.2 Purchaser/ Consultant reserve the right to inspect any product at any stage of manufacturing beyond pre-identified stages & hold points of approved QAP.
## INSTRUCTIONS FOR FILLING UP:

1. QAP shall be submitted for each of the equipment separately with break-up of assembly/sub-assembly/part/component or for group of equipment having same specification.

2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for the plant and equipment.

3. Separate identification number with quantity for equipment shall be indicated wherever equipment having same specification belonging to different facilities are grouped together.

4. Weight in tonnes (T) must be indicated under column 5 for each item. Estimated weights may be indicated whenever actual weights are not available.

## ABBREVIATIONS USED:

- CONTR: CONTRACTOR
- MFG: MANUFACTURER

## CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS:

<table>
<thead>
<tr>
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<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Visual (Welding etc.)</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Dimensional</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Fitment &amp; Alignment</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Physical Test (Sample)</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Chemical Test (Sample)</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>Ultrasonic Test</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>Magnetic Particle Test (MPT)</td>
</tr>
<tr>
<td>8</td>
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<td>Radiography test</td>
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<td>9</td>
<td>Dye Penetration Test</td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td>Metallurgical Exam.</td>
</tr>
<tr>
<td>11</td>
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<td>Welder's Qualification &amp; Weld Procedure Test</td>
</tr>
<tr>
<td>12</td>
<td>12</td>
<td>Approval of Test and Repair Procedure</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>Heat Treatment</td>
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<td>Pressure Test</td>
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<td>Leakage test</td>
</tr>
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<td>Balancing</td>
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<td>17</td>
<td>Vibration test</td>
</tr>
<tr>
<td>18</td>
<td>18</td>
<td>Amplitude test</td>
</tr>
</tbody>
</table>

## DOCUMENTS:

- D1. Approved GA drawings
- D2. Information and other reference
- D3. Relevant catalogues
- D4. Bill of Material Item no./Identification
- D5. Matchmark details
- D6. Line/Layout diagram
- D7. Approved erection procedures
- D8. Unpriced sub P.O. with specification and amendments
- D10. Ordering Specification

## EQUIPMENT DETAILS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description (with equipment heading, place of use and brief specification)</th>
<th>Identification No.</th>
<th>Quantity</th>
<th>Manufacturer's Name and Address</th>
<th>Expected Schedule of Final Inspn</th>
<th>Raw Material and Inprocess Tests</th>
<th>Final Inspection / Test Inspn</th>
<th>Test Certificates &amp; documents to be submitted to MECON</th>
<th>Acceptance Criteria Standards/BIS/ASME/Norms and Documents</th>
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</thead>
<tbody>
<tr>
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## QUALITY ASSURANCE PLAN

For CONTRACTOR/SUB-CONTRACTOR

(Stamp & Signature)
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<th>Raw Material and Inprocess stage Inspection</th>
<th>Final Inspection / Test by MECON</th>
<th>Test Certificates &amp; documents to be submitted to MECON</th>
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<th>REMARKS/</th>
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<td>D2</td>
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<td>Catalogues / Approved data sheet</td>
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<td>Enclosure protection Test.</td>
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<td>Noise &amp; Vibration.</td>
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**ABBREVIATIONS USED:**
- CONTR: CONTRACTOR
- MFG: MANUFACTURER

**EQUIPMENT DETAILS**

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**FOR MECON (Stamp & Signature)**

**PROJECT**
- ORDER NO. & DATE
- SUB-CONTRACTOR
- ORDER NO. & DATE

**QUALITY ASSURANCE PLAN**
- FOR ELECTRICAL EQUIPMENT
- CODES FOR EXTENT OF INSPECTION, TESTS, TEST CERTIFICATES & DOCUMENTS:
- DOCUMENTS:
  - D1. Approved GA drawings
  - D2. Approved single line / schematic diagram
  - D3. Catalogues / Approved data sheet
  - D5. Unpriced P.O. copy.
  - D6. Calibration Certificate of all measuring instrument and gauges

**INSTRUCTIONS FOR FILLING UP:**
1. GAP shall be submitted for each of the equipment separately with break-up of assembly/sub-assembly/part/component or for group of equipment having same specification.
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For CONTRACTOR / SUB - CONTRACTOR

for MECON (Stamp & Signature)

(Q.A.P NO. TO BE ALLOTTED BY MECON)
## QUALITY ASSURANCE PLAN FOR REFRATORY MATERIALS

### INSTRUCTIONS FOR FILLING UP:

1. **QAP** shall be submitted for each of the equipment separately with break up of assembly, sub-assembly, and part/component or for group of equipment having same specification.

2. Use numerical codes as indicated for extent of inspection & tests and submission of test certificates & documents. Additional codes & description for extent of inspection & tests may be added as applicable for plant and equipment.

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### ABBREVIATIONS USED:

- **CONTR**: CONTRACTOR
- **MFR**: MANUFACTURER
- **MECON**: MECON

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<th>Acceptance Criteria</th>
<th>REMARKS/ SAMPLING PLAN</th>
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QAP NO. TO BE ALLOCATED BY MECON

For CONTRACTOR / SUB-CONTRACTOR

(Stamp & Signature)

For MECON (Stamp & Signature)

(Stamp & Signature)

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<td>Place of Inspection with address, Fax &amp; Ph. No.</td>
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**A = Approved, AAN = Approved as Noted, INF = Information Category**

## List of documents & Test Certificates enclosed in four (4) sets.

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<td><strong>BANGALORE</strong></td>
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<td>D.G.M. Inspection Section MECON Ltd., 89, South End Road, Basavanagudi, Bangalore-560 004 (Karnataka)</td>
<td>Karnataka, A.P. &amp; Kerala</td>
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<td>Gram : MECONIND</td>
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GENERAL SPECIFICATION
FOR
MATERIAL HANDLING AND HOISTING
(GS – 06)
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01 CONVEYOR SYSTEM & RELATED EQUIPMENT

01.00 Scope

1. The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, transit insurance, delivery FOR Purchaser’s site, unloading, handling and storage at site, insurance during storage, erection supervision, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics and standard accessories the following components for all the conveyors indicated in the enclosed drawings.

   i) Motors
   ii) Gear boxes
   iii) Couplings
   iv) Pulleys with bearing blocks – head, trail, snub bend and take-up
   v) Idlers – carrying, return, impact, self-aligning and transition
   vi) Idler frames
   vii) Belt cleaning devices
   viii) Hold back devices
   ix) Electro-magnetic brakes
   x) Pull-cord switches with cord
   xi) Belt sway switches
   xii) Zero-speed switches
   xiii) Take up pulley frame with take up guides
   xiv) Bend pulley frame
   xv) Head pulley frame
   xvi) Tail pulley frame
   xvii) Drive base frame
   xviii) Guards – tail pulley, bend pulley, coupling
   xix) Discharge hood up to 500 mm below the discharge pulley platform
   xx) Skirt Boards
   xxi) Belt Weigh Scale – wherever required

2. The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

3. The scope of supply and services of the Tenderer shall include the following:
   a) Mechanical
      – Each equipment shall be complete in all respect including, its drive units, cables, safety switches, structural, mechanical and other standard accessories.
      – Provision of necessary fixtures, supporting angles and brackets required for mounting and supporting the equipment.
   b) Electrical
      – LT AC motors and brakes with rectifier panels as required for the equipment.
      – Switches as necessary for interlocking and control and safe operation of equipment.
      – Complete flexible cable festoon arrangement with protective chain, cable guide & rollers, junction boxes etc. required for shuttle conveyors / carriages including power & control flexible cables and their termination up to junction boxes. Junction boxes for power and control supply shall be separate and shall be supplied by the Tenderer.
Any other mounted electrics that may be required for satisfactory operation and maintenance of equipment supplied by Tenderer.

01.01 Design Basis & Hierarchy of Specifications

The equipment shall be designed as per design criteria given below:

Hierarchy of Specifications

a) Technical Specification
b) General Technical Specification (GTS)
c) Inter Plant Standard for Steel Industries (IPSS)
d) Indian Standard (IS).
e) Indian Electricity Rules & statutory requirements of Central Govt. and State Govt.

Equipment complying with other recognised Standards such as IEC, BS, VDE, and IEEE will also be considered if it ensures performance equivalent to or superior to Indian Standards.

The components and materials used and the equipment supplied shall conform to high standards of design, engineering and workmanship and shall be suitable for efficient operation and reliable service in steel plant conditions.

Design Basis

- Utilisation of cross sectional area - 80 % of theoretical cross sectional area indicated in IS 11592-2000 (for computation of belt speed)
- Design capacity of belt conveyors- 20% more than rated capacity to be considered while calculating motor power
- Troughing angle - 35o
- Friction factor (for kW calculation) of belt conveyors- 0.03
- Belting
  a) Top cover thickness - 6 mm (Min)
  b) Bottom cover thickness - 3mm (Min)
  c) Running tension < 80% of allowable belt tension
  d) Starting tension > 150% of allowable belt tension
  e
- Idlers -152.4 mm Outer Diameter with 5.0 mm shell thickness
- Flat return Idlers – 152.4 mm Outer Diameter.
- Carrying idler spacing -1000 mm. Spacing in the convex curve position of conveyor shall be limited to half the normal spacing of carrying idlers
- Return idler spacing - 3000 mm spacing
- Training Idler spacing
  a) Carrying side - 15 m
  b) Return side - 30 m
- Impact idler spacing - 500 mm or less - (min. 6 Nos.)
- Deck plate - 3.15 mm thick wherever specified
- Drive pulley – 12 mm thk. vulcanized natural rubber lagging, minimum durometer hardness of 55o shore A scale. Pulley Shell thickness 16 mm minimum
- Tail/ Bend/take-up pulley – 10 mm thk vulcanized natural rubber lagging, minimum durometer hardness of 45o shore A scale, and shell thickness 12 mm minimum.
- Pulley face width - As per IS 8531-1986, Reaffirmed in 1993.
- Pillow blocks
  a) Material - cast iron / cast steel
  b) Bearing - Self aligning spherical roller bearing
  c) Life - 40,000 working hrs min
  d) Construction - Horizontal split type (one end fixed and the other end expn. type)
- Reducer
  a) Service rating of 1.5 times the calculated shaft kW and thermal capacity of gear box shall be better or equal to that of motor
  b) Material - fabricated or cast steel
  c) kW rating shall be not less than 1.25 times the motor kW. Higher value of `a’ or `c’ will be considered
  d) No worm gear except for traveling gate
- Brakes
  D.C. electromagnetic brakes on conveyors wherever required
  - To prevent roll back
  - Where stopping time regulation is required.
- Roller type hold back device - To be provided on all inclined conveyors to prevent roll back.
  Rating minimum 1.5 times the maximum calculated torque.
- Take up
  Screw take up - up to 40 m (with protected thread)
  Automatic take up travels as per I.S.
- High speed coupling - gear coupling/ resilient coupling less than 30 kW
- Fluid coupling for 30 kW & more
  (Pin bush coupling - Not Applicable)
- Low speed coupling - gear or resilient.
01.02 Belt Conveyor system

1. General

All equipment shall be designed, manufactured, supplied, erected, tested and commissioned in accordance with relevant Indian Standards, IPSS and International Standard where applicable in addition to the requirement mentioned herein.

The Supplier shall make his own calculation in respect of belt speed, motor kilowatt, belt tension etc. of belt conveyors to ensure satisfactory performance of the conveyor components and system as a whole. The drive motor selected shall not be of lesser kW than what is indicated and the belting chosen shall not be of inferior quality than what is specified. The starting torque of drive motor and the high speed coupling shall be so chosen as to allow soft start condition.

Adequate no. of locating pins and match marking shall be provided for easy assembly and dismantling.

Standardisation of components and assemblies shall be carried out to the maximum possible extent to ensure interchangeability.

All equipment shall be designed such that all components are easily accessible for inspection, repair and maintenance.

2. Conveyor Belting

Belting shall be designed for heavy duty condition and shall be suitable for 24 effective working hours operations per day and 365 working days per year. It shall be suitable for installation over conveyor system having 35° troughing angle and shall be suitable for operation at an ambient temperature of 50°C. It shall have sufficient resistant against exposure to open sunlight so that its qualities do not deteriorate while working in open sun. It also may have to work in rain and / or in conditions where relative humidity goes upto 100%.

The fabric for belting shall be of Nylon/Nylon heavy duty type. The belting shall be pre-stretched, straight ply, skin coated with open ends. It shall have sufficient strength to give required tension at 10 safety factor and 80% tension utilistion. All belts shall be joined by vulcanized splicing.
The belt shall have sufficient lateral flexibility so that it suits the troughing angle requirements even when it is empty. The belt shall have sufficient longitudinal flexibility so that it can easily flex around different pulleys of the conveyor system. The belt shall have sufficient impact resistance to withstand impact at the loading points. The rubber cover used in the top and bottom cover of the belting generally shall be of M-24 grade. For material above 50 deg C cover shall be of HR grade and material above 100 degC & red hot FR grade belt shall be provided. The edge shall be of cut edge construction.

On the carrying surface, at interval of maximum 12 meters, the belting shall be marked as follows:

a) Manufacturer’s name and trade mark, if any.
b) Fabric designation as NN
c) Belt designation i.e. KN/m
d) Code of rubber cover i.e. M-24.
e) Last two digits of year of manufacturing.

Belt roll shall be packed in wooden drums. This packing should enable easy unreeling of the belting. On the body of the wooden drum the direction of belt and location of end of the belting should be indicated so that belting can be properly placed while unreeling.

The design, construction, testing and performance of the belting shall comply with all applicable codes and as per IS, IPSS and International Standards.

Before dispatch, the finished material shall be subject to inspection by the Purchaser/MECON. The inspection shall be carried out in the presence of Purchaser/MECON, in terms of up to date engineering practice and relevant IPSS, IS and International Standards in this respect, for which all facilities shall be provided by the Contractor at his cost. This shall interalia, include the following:

a) Full thickness belt test
   i) Breaking load, Kg/sq. cm for wrap and weft.
   ii) Elongation under reference load (%).
   iii) Elongation at break (%).

b) Rubber cover test (Top/Bottom)
   i) Tensile strength of cover , Kg/sq. cm
   ii) Elongation at break (%)
   iii) Adhesion between ply to ply and between covers and ply.
   iv) Abrasion loss of rubber cover

c) Physical dimension check
d) Flexibility Test

All relevant type test certificates shall have to be produced during inspection and along with supply for necessary verification and approval.

3. **Conveyor Pulleys**
All pulleys shall be of welded steel construction, stress relieved before boring and machining and statically balanced. Solid end discs shall be designed and provided to give maximum strength. Pulleys shall be designed as per relevant Indian Standard and IPSS where applicable. Pulleys shall be connected to the shaft preferably through keyless friction grip connections for HT motors and key connection for LT motors unless otherwise agreed.

Shell thickness of the pulley shall be suitable for taking bending loads on the pulley. This shall not be less than 16mm for drive pulley and 12 mm for tail and other pulleys.

Drive pulleys shall be covered with minimum 12mm thick diamond rubber lagging. Tail, bend and take-up pulleys shall be covered with minimum 10 mm thick diamond rubber lagging. The depth and width of the grooves in the lagging shall be 6 mm spaced at 30mm interval. The eccentricity of pulley shell shall not be more then + 0.5% of the diameter prior to lagging.

Drive pulleys shall be machined at steel faces prior to lagging. Shore hardness of rubber for drive pulleys shall be not less than 55 deg A and for other pulleys shall be not less than 45 deg A. All pulleys shall be statically balanced to minimize the vibration during running.

Rolled steel may be used for pulley shafts of diameter up to 140 mm. Forged steel shall be used for shafts above 140 mm diameter. The deflection slope of pulley shaft at bearings shall be restricted to 1/2000 under rated load condition. Combined stress value shall be restricted to 500kg/sq.cm. Shaft diameter shall be selected based on the maximum value. The shaft diameter shall be as per IPSS.

Pulley shafts shall be supported on self-aligning double row spherical roller bearings with adequate sealing and external lubrication arrangement in plummer blocks. One bearing for each shaft shall be fixed to prevent any movement of the shaft assembly and the other bearing shall be floating to have free axial movement. All lubricating nipples shall be readily accessible without removing the guards. All plummer blocks shall also have four mounting bolts.

Welding on the pulley shaft shall be tested radio graphically or by ultrasonic method. Pulley shafts shall be ultrasonically tested. Checking of out of roundness and static balancing tests shall be carried out before dispatch of the pulleys.

4. **Idlers**

Three roll inline troughing idlers of equal length shall be used throughout. The angle of inclination of side rollers to horizontal shall be 35o. Troughing as well as return idlers shall be of reputed make and manufactured out of heavy duty seamless tube/ ERW tubes as per IS:9296-1983. Spindle - Class 4 , IS :1875-1992. Frame - Rolled section.Troughing Idlers - in line equal rolls.Idlers shall be of “drop-in-slot” type. Minimum diameter of idlers shall be as follows:

Carrying Idlers – 114.3 mm Outer Diameter for 500 mm and 650 mm belt and 139.7 mm for higher width belt with 4.5 mm shell thickness. Transition idler at 10o and 20 o troughing at both head and tail end.

The eccentricity (diametrical run out) of troughing and return idlers shall not exceed + 0.8 mm. Minimum shell thickness of idler tube shall be 5.0 mm. All idlers shall be fitted with either heavy duty deep groove ball bearings or seize resistant ball bearings. The bearings shall be held positively on the shafts. Multi-labyrinth seals shall be used for retention of grease. All bearings shall be greased and sealed for life against ingress of dust, water and escape of grease. All bearings shall be rated for minimum 40,000 working hours. Bearing - Taper roller bearing/ deep groove.Bearing housing of idler shall be made of pressed steel of CRCA sheet press fitted and preferably be welded with idler tube.
Self-aligning troughing and return idlers with vertical guide rollers shall be of above specified construction. All self-aligning idlers shall be provided with grease lubricated anti-friction bearings at pivot points. All grease fittings shall be of the button head type or equivalent and shall be accessible from the walkway side of the conveyor by piping. The grease tubing shall be made of aluminium. The grease fittings shall have adequate protection against dust collection.

Impact cushioned idlers shall be of above specified construction. The rings or disc for impact idler shall be made of rubber. The minimum number of impact idlers at each loading point shall be six. The first impact idler shall be placed approx. 150 mm behind the loading point. Conveyor with multiple loading points shall also be provided with impact idlers at each loading point.

Transition idlers of above specified construction shall be used adjacent to head and tail drums to permit proper support of loaded belt near the head and tail pulleys without excessive stress and stretch of the belt edges. The transition idlers shall be installed in steps of 10°, 20° toughing angles. Horizontal carrying idlers for supporting flat loaded belts shall also be of above specified construction. Return idlers for wet or sticky material shall be of rubber disc type of two roller trough design. Flat return idlers only shall be used under the "V" scrapers and in high tension areas. One number disc type self cleaning idler shall be provided near discharge pulley.

Training idlers shall not be used close to belt-weighing scales.

Idler shaft shall be made of class -4, IS-1875 or EN-8, BS-970 or bright bar of equivalent grade suitable for the duty requirement. Idler frame shall be made of rolled/ formed steel with provision for securely bolting to the stringers of the conveyor frame. All fixing bolts shall have spring washers.

Clearance, gap etc. for the carrying and return idlers shall conform to the relevant IS/IPSS Standard to extent possible. The fixing arrangement of carrying and return idlers shall be such as to permit adjustment of idler sets for the purpose of belt training. Allowance for such adjustment shall be provided on both sides of the conveyor and the play shall not be less than 10 mm on either side.

All idler rollers shall be painted with 2 coats of red oxide primer and 2 coats of enamel finish paint.

Following tests shall be carried at random on the assembled idler roller in the presence of Purchaser / MECON:

a) Friction factor test
b) Idler running test at high speed.
c) Test for dust proof
d) Test for water proof
e) Quality test.
f) Alignment and co-axiality test.

5. **Belt Cleaners**

a) External belt cleaners

External belt cleaners shall be provided at the discharge pulley of the conveyors. The cleaner shall have sprung metallic blades (in segments) with tungsten carbide tips.
Polyurethane deflector skirts shall be provided below the tips to prevent materials build up on the unit. The cleaners shall be mounted on an elastomount system to facilitate automatic blade adjustment on wear. The inclination of the blades should be such as to effect efficient scraping of the belt. The spring action of the individual metallic blades should ensure constant contact with belt during operation and suitable sprung deflection of contact with uneven surface of the belt. The blades shall be in segments for ease of replacement and mounting on the head pulley frame. The material scraped should fall inside the discharge chute directly.

b) Internal scraper

`V` shaped internal scraper shall be provided on the upper side of the return belt near the tail end, fitted with wear resistant non-metallic scraper blade to remove spilled materials on the belt. The blade shall be adjustable after the wear.

6. Gear Boxes

Conveyors shall be driven through totally enclosed oil-cooled reduction gearing having anti-friction bearings with oil seals at shaft projection. These shall be suitable for continuous operation at full load and shall be suitable for shock loads. Wherever required, oil temperature rise over ambient shall be restricted by 50°C (Max.). Worm gear or chain drive shall not be used. The reducers shall be selected with a service rating of minimum 1.5 times of motor kW or 1.8 times the calculated kW whichever is higher. The transmission efficiency of the gearing shall not be less than 0.98 per stage. The material of gears, profile and geometry shall ensure high power/weight ratio with low volume. Gears and pinions shall preferably be solid forged. Where forging is not possible, forged steel gear rims shall be fitted on steel centers to withstand shock loads. All reducers shall have permanent magnet plugs. All gear box shall be of fabricated steel or cast steel casing construction. No cast iron casings shall be used.

7. Couplings

Flexible couplings shall be used between motor and gear-box and geared couplings shall be used between gear-box and drive pulley. The hub and sleeves of the geared coupling shall be of forged C-40 steel and bolts shall be of alloy steel. The hub teeth shall be of triple vary crown design. Traction type fluid coupling shall be used between motor and gear-box for drives of 30 kW to 100 kW, Delayfil Chamber type fluid coupling for LT motor above 100kW and Scoop controlled fluid coupling(Air cooled type) for HT motor to be used. All coupling bolts shall be replaceable without shifting of drive components.

8. Hold Back and Brakes with panel

All inclined conveyors shall be provided with suitable roller type hold back devices (other than brakes) to prevent belt from running back in case of conveyor stoppage due to power failure or otherwise. Holdback rating shall be minimum 1.5 times the maximum calculated torque.

D.C. Electro-magnetic brake shall be provided on all conveyors after calculating the coasting time. Brake shall have min 1.5 times the max. calculated torque rating. Brakes shall be mounted on brake drum coupling at input shaft end of gear box. Rectifier panel complete with conators, timer, fuses, rectifier, resistors etc. shall be provided with each brake.

9. Take Up
All conveyors up to 40 meters in length shall have screw take-ups having protected threads. Take-up travel shall be minimum 500mm. The screw of the screw take-up shall be of square thread type and stainless steel construction with brass nut.

Automatic counterweight gravity take up shall be provided for conveyors above 40 meters in length. Horizontal gravity take up/VGTU shall be provided wherever feasible. Take-up travel shall be as per IS:4774 (part-I) and it shall be complete with pulley carriage suitable for guide structure made of pipe. Suitable hoisting arrangement shall be provided to handle cwt. Weight/Gravity take up pulley. Metallic counter weight shall be used.

10. **Discharge Hood**

Hood shall be made of 6mm thick mild steel plate for portion above the pulley frame. For portion of hood below the pulley frame and up to 500 mm below the floor, the thickness of plate shall be 10mm. 10 mm thick liner plate shall be provided in this portion of hood in the material impact zone. The hood shall be in segments bolted to each other for ease of maintenance. The hood shall cover discharge opening for the chute as well as pulley. Rubber curtain and guard shall be provided at the entry of belt in the discharge hood. Easily adjustable baffle plates shall be provided in the hood to control trajectory of materials, if necessary.

Hinged inspection door shall also be provided in the hood. The door shall preferably be located within a height of 1200 mm from the floor. Adequate opening shall be provided in the hood for withdrawal and adjustment of belt scrapers.

11. **Guards**

Guards on the conveyor shall comply with the relevant IS/IPSS Standard. The guards shall be of expanded metal conforming to IS: 412 (current)

Safety guards shall be provided for all couplings, brakes etc. of the conveyor drive and screwed on the above base frame.

12. **Chutes**

All transfer points shall be provided with non choking chutes made of minimum 10 mm thick mild steel plates and shall be constructed in small segments for easy dismantling.

Hinged type sealed inspection doors shall be provided at suitable height and location. The size of the door shall allow replacement of liners without any dismantling.

Snub pulley near discharge end shall be covered with spillage chutes.

Chutes shall be designed such that impact of the material on the conveyor is minimum. They shall be designed to ensure continuous flow of material to the centre of the belt with minimum spillage, noise and dust emission.

Minimum valley angle of the chute shall be 55 deg. to the horizontal. Minimum angle of slope of chute plate shall be 60 deg. The valley angle and slope angle shall be suitably increased for handling wet or sticky material.

Adjustable stone box shall be provided at discharge end of chute for arresting the free fall of material and to form a natural bed of material for protecting the parent plate. Chutes shall be
oriented as far as possible so as to ensure discharge of material in the direction of travel of receiving belt.

Liner shall be as follows:

Bunkers- For lumps of more than 80 mm size, Reinforced Rubber liner of 40 mm thickness (minimum) in secondary impact zone, 60mm thick reinforced rubber liner in Primary impact zone & 10 mm thick SAIL hard/ LA60/wearesist in rest of the portion upto 1 m height . For storage bunkers of fine/ sized material (lump size less than 20mm) cast basalt or 6mm thick SS-410 /SS-316 may be used at inclined area. For lump size between 20mm to 80mm 40 thk rubber liner shall be used.

Chute- Rubber liner of 40 mm thickness (minimum in secondary impact zone and 60 mm in primary impact zone for lumps of 40mm and above of coal and ore,For coke lumps 40mm and less,20 m.m thick PU liner/ SS-409 M (8 mm thick) shall be used.

For ore lumps 40mm and less stainless steel liner (SS-304/SS-409)6m thick shall be used.

13. Conveyor Frames

Conveyor frames shall be made of joists and/or channels suitably stiffened and braced. The spacing of supports shall not exceed 3000 mm. Frames shall be connected to floor beams/civil foundation of junction house by bolting.

14. Deck Plates

Deck plates of minimum 3.15 mm thickness shall be provided throughout the length of shuttle conveyor to avoid spillage of materials from the carrying side of belt on to the return side. For other conveyors, loading zones (at least 15m), within /junction /houses and at road/ rail crossings etc. shall have deck plates.

15. Skirt Boards

Skirt boards of minimum 5000 mm length shall be provided at the loading points of all conveyors, however wherever dust-suppression system with water spraying arrangement is provided – the length & height of the skirt shall be suitably designed. Wherever the loading points are nearer to each other, the skirt board shall be made continuous between them. Minimum length of skirt boards from the beginning of loading area in the chute shall be 2500 mm in the direction of belt travel. Skirt shall be totally covered where dust extraction system is envisaged or when handling dry fine materials (-10 mm). The thickness of skirt plate shall be minimum 10 mm. The top cover plate where provided shall be minimum 3 mm thick. Skirt plates shall be provided with suitable (minimum 10 mm thick) replaceable liners.

The arrangement for fixing rubber curtain and PU board (Min 15 thk) shall be used for side sealing so as to ensure quick adjustment. The thickness of rubber curtains shall be minimum 10 mm. PU block shall be in segments and the design shall ensure automatic adjustment of block for proper sealing. Shore hardness of skirt rubber shall be min. 550 A.

16. Drive Base Frame

The drive unit consisting of motor, gear-box, coupling and brakes along with protective guards shall have a common base frame and shall be fabricated form heavy structural sections and plates. Suitable bracings should be provided wherever necessary on the drive unit base frame and structure to make it rigid. Proper arrangements shall be provided with
17. Reversible Shuttle Conveyors

Refer TS drawing showing the general arrangement of reversible shuttle conveyors. Shuttle conveyors shall have independent drive for travel motion through electric motor and bevel helical gearbox. Stringer frame for the conveyor shall be in segments independently supported on wheels and connected together through hinged pins. Screw take-up arrangements for the belt conveyors shall be positioned at one of the hinged joints to avoid shifting of discharge pulley location in the discharge hood.

Double flanged parallel tread wheels shall run on flat bottomed rails of minimum 60 lb/yd and shall have min hardness of 350 BHN. Cleaners shall be provided to sweep the rail from spilled material. Anti-friction bearings shall be used throughout. The travel drive shall be so designed that no part of equipment shall project below rail level.

The belt conveyor shall be driven through motor and bevel-helical gear box. All other stipulation for conveyor component as detailed above shall be applicable for the shuttle conveyor.

The minimum clear distance between two adjacent shuttle/ reversible shuttle conveyors shall be 1000mm at any given position of the same.

Power supply shall be given through flexible trailing cable system.

Position indicators shall be provided as per requirement of control logic.

18. Belt Feeders

Belt Feeder shall be rugged construction having heavy duty flat belt, life sealed idlers. Inlet opening to the feeder shall be equipped with a manually adjustable vertical slide gate to adjust the depth of material in the feeder. The load area shall be skirted on three sides. The width of belt shall be so chosen that material shall not rub with the side skirt. The feeder below hopper / bunker shall be driven with a variable speed drive and rest with normal drive. The speed of feeder below hopper / bunker shall be provided with facility to put on or withdrawal of endless vulcanized belts from side. Belt scraper shall be provided to clean carrying as well as return side of the belt.

19. Pull Cord Switches

Pull cord switches shall be provided for emergency stoppage of conveyor. The first switch shall be about 4000 mm away from the driving drum and subsequently at not more than 30 m interval. The pull wires shall run along the entire length of each conveyor on both sides. Where mobile trippers are used on conveyors, the pull wires shall run along the hand-railings on conveyor walkways. All pull cord switches shall have individual local indication lamps to indicate when operated.

20. Belt Sway Switches
Belt sway switches shall be provided on each conveyor for protection against excessive sway of the belt. A pair of switch shall be installed near the head end and a pair near the tail end and a pair of switch shall be installed at 100 m interval thereafter. A pair of these switches shall also be provided before the belt weighing scales.

21. Belt Slip Switches

Belt slip switches shall be provided for each conveyor to stop the drive in case of excessive slippage of belt or over speeding. Provision shall be made such that preceding conveyor does not start unless the running conveyor picks up 80% of the rated speed.

22. Chute Jamming Detectors

Chute jamming detectors shall be provided on each chute. The detectors shall be so located or protected that they do not come in contact with regular flow of material. The detector shall, also, be protected against deposit of fine particles causing false alarm or stoppage of the conveyors. The position of each detector shall be decided based on the braking time of the delivery conveyor at rated capacity and the holding capacity of the chute.

23. Motors

Totally enclosed fan cooled squirrel cage motors shall generally be used for all the above mentioned equipment unless it is necessary to use slip ring or D.C. motors for speed control. Where power requirement is more than 180 KW, HT motors shall be considered. All LT motors from 30 KW and above shall be suitable for continuous duty (S3) category and all motors below 30 KW shall be suitable for intermittent duty (S4) category.

01.03 Erection Norms

Erection of all equipment shall be carried out as per manufacturer's recommendation.

Manufacturer's standards and recommendations for tolerances in assembly and erection shall be submitted to the Purchaser before actual erection of equipment.

Unless specified otherwise by equipment manufacturers, equipment shall be installed within the tolerances indicated below:

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Supporting structures for drive pulleys, tensioning drum, intermediate frame, electric motor, gearbox &amp; idler supporting structure.</td>
<td>In height 3.0 mm In horizontal plane - 1/1000 of length in mm</td>
</tr>
<tr>
<td>b</td>
<td>Driving pulley</td>
<td>1/1000 of length of pulley in vertical plane.</td>
</tr>
<tr>
<td>c</td>
<td>Axis of conveyor &amp; center line of drum.</td>
<td>10 mm in horizontal plane</td>
</tr>
<tr>
<td>d</td>
<td>Tension pulley</td>
<td>± 2 mm in vertical plane ± 2 mm in horizontal plane</td>
</tr>
<tr>
<td>e</td>
<td>Idler arrangement</td>
<td>± 2 mm in vertical plane ± 2.5 mm in horizontal plane</td>
</tr>
<tr>
<td>f</td>
<td>Rail mounted equipment like trippers, shuttle conveyor etc. in longitudinal direction of the same rail</td>
<td>2 mm /m of rail 5 mm/ 25 m of rail 15 mm Max.</td>
</tr>
</tbody>
</table>
### General Technical Specification

| g) | Rail gauge | : | + 5 mm |
| h) | Difference in rail level with respect to one another base | : | ± 1% of rail gauge for rigid +2% of rail gauge for flexible base |
| i) | Difference in height of connecting rails at joints | : | less than 0.3 mm |
| j) | Horizontal gap between rails at joints | : | less than 0.3 mm |
| k) | Location of end stopper (in plan) with respect to one another | : | ± 1% of gauge but max 20 mm |
| l) | Deviation of rail in plan with respect to true line | : | ± 10 mm but shall not exceed ± 1 mm in 2m length |
| m) | Tilt of rail in horizontal | : | ± 8% of rail head plane width |
| n) | Deviation in conveyor centre line | : | 2 mm for 1 m length , 5 mm for 2 m length but 15 mm max for total length |
| p) | Absolute bearing vibration velocity r.m.s. for rotating machines (to be measured by vibration measurement instrument) | |
|   | i) Up to 15 kw | : | Less than 0.7 mm/sec |
|   | ii) Up to 300 kw | : | Less than 1.1 mm/sec |

### Performance Tests & Guarantee Parameters

I. After the equipment are completely erected at Purchaser’s site, each item/equipment will be thoroughly inspected for correctness and completeness of the installation and they shall be subjected to final tests as to performance and guarantee to be carried out in the presence of Contractor and the Purchaser / MECON to demonstrate that the performance of the equipment conforms to relevant standards and specifications and meet the requirements as given in this specification. The tests/ checks to be conducted shall be generally as under:

II. For each equipment, the load test shall be conducted in stages. The equipment shall be run for 8 to 10 hours continuously (cumulatively) at no load, 25%, 50%, 75%, 100% of the rated capacities or at rate mutually agreed upon between Contractor and Purchaser / MECON. The intervening period shall be available for making adjustments and arrangements by the Contractor as may be required.

III. All the specified speeds of the equipment shall be measured under full load conditions.

IV. Proper operation of all positional limit switches for shuttle conveyor and all safety switches for cable reeling drums, limit and safety switches/ alarm for conveyors like pull cord switch, zero speed switch, belt sway switch etc. shall be demonstrated by the Contractor in the presence of Purchaser / MECON.

V. During operations of the equipment at no load and at full load, performance of all the drives shall be checked in respect of current drawn by the motors, temperature rise, vibrations, gear box noise and its heating, bearing heating etc. consumption of power and various consumptions like lubricants etc. shall also be measured and compared with the respective rated values.

VI. Any other observations/ tests felt necessary for judging the performance of the machines and mutually agreed between Contractor and Purchaser shall be carried out.
VII. If during the test runs, there is an interruption exceeding 2 hours due to any cause other than power failure or shortage of input materials for which the Purchaser is responsible, the test run shall be discontinued and fresh date shall be decided mutually by both the parties.

VIII. The equipment shall be considered to have performed satisfactorily when
   i) Rated capacity of equipment is demonstrated with all its drives and accessories functioning properly over a minimum period of eight (8) hours.
   ii) It runs successfully for a continuous period of 15 days at the rated capacity.
   iv) Successful reversing of reversible shuttle conveyors (if any) on load.

01.05 Drawings / Document / Information to be furnished by Tenderer

The number of copies of drawings/data and other documents shall be as per General Technical Specification (GTS).

1 List of drawings/data to be submitted along with tender
   a) General arrangement drawing of conveyors/shuttle conveyors etc. showing overall dimension, profile, idler spacing, take-up arrangement, motor kW, drive arrangement etc. along with chutes, scraper, skirt boards, switches, wheel load, wheel spacing, wheel diameters, travel drive, power supply arrangement for travel drive etc.
   b) General Arrangement of conveyor-equipment showing overall dimensions and weight as well as GA of motor with its component list.
   c) Supplier’s name for conveyor components (like idlers, pulleys, motors, and gearbox) catalogues for these items shall be furnished.
   d) List of commissioning spares proposed by the Tenderer.
   e) List of recommended spares for two years maintenance of plant and equipment along with itemised price.
   f) Duly filled up questionnaire given below.
   g) List of imported components in the equipment, if any.

2 List of drawings to be submitted for approval (by successful Tenderer)

Following design data, calculations and drawings shall be submitted by the Successful Tenderer to the Purchaser / MECON in stages for approval.
   - All the drawings/data listed in clause above, giving all the details, loads/power requirement etc.
   - Calculation of motor kW, gear box, coupling and pulley selection of shuttle conveyor.
   - Technical parameters of shuttle conveyor in a tabulated form.
   - In addition to the above, the Purchaser/Consultant reserve the right to insist on submission of calculations/drawings/data for any mechanical, structural or electrical equipment/component as required.

3 Drawing/data/calculation for reference (by successful Tenderer)
- Load data and foundation pedestal plan for head end, tail end, drive base frame etc., specially where the Junction House/ building is provided by another supplier/ purchaser.

- Wheel load diagram for shuttle conveyors.

- Any other load data/information required by Purchaser / MECON for design of building/ structures.

- All drawings and documents approved by Purchaser/MECON as per GTS.

- Procedure for testing and commissioning. This shall also be furnished in soft copy.

- Spare part list and drawings

- Catalogues/literatures

- Operation and maintenance manual.

- Final test certificates

- As built drawings

- Ordering specifications for operating consumables/ supplies

01.06 Questionnaire (To be filled by by Tenderer)

The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

• General

  01 Name and address of the Tenderer :

  02 Previous experience of the Tenderer :

  03 List of similar equipment supplied :

  04 Whether the Tenderer has any technical collaboration with any other company/ organisation for his equipment.

  05 If answer to question .04 is yes, furnish the following details.

    a) Name and address of the collaborator

    b) Nature of the collaboration in detail

    c) Previous experience of the collaborator

  06 List of drgs./ literatures enclosed with the offer.

• Questionnaire for conveyors

  i) Conveyor no. :

  ii) Carrying capacity (t/h) :
iii) Centre to centre horizontal: distance (m) :

iv) Belt width (mm) :

v) Belt speed (m/s) :

vi) Total weight of conveyor (kg) :

vii) Pulley details:

Followings to be indicated for head, bend, snub, tail, take-up pulleys separately:

a) Make :

b) Pulley diameter (mm) :

c) Face width (mm) :

d) Shell thickness (mm) :

e) Bearing
   - Make :
   - Expected life (hrs) :

f) Weight (kg) :

viii) Idlers:

The following to be indicated for carrying, cushion, return, SAC, SAR and transition idlers:

a) Type (in-line / off set) :

b) Diameter (mm) :

c) Shell thickness (mm) :

d) Tube specification :
   (ERW / Seamless)

e) Max. roll eccentricity (mm) :

f) Troughing angle :

g) Bearing
   - Make :
   - Expected life (hrs) :

h) Weight (kg) :

ix) Motors:

a) KW rating :

b) RPM :

c) Type :

e) Bearing
   Make :
   Expected life (hrs) :

x) Gear Boxes for belt drive and carriage travel:

a) Make :

b) Type :

c) Reduction ratio :

d) Torque rating (kg-m) :

e) Overall efficiency :

f) Wt. of Gear box (kg) :

xi) Couplings:

a) Make and type of high speed couplings :

b) Make and type of low speed couplings :
c) Weight (kg) : 

xii) Take-up type :

xiii) Belt cleaners – type :
 – Weight (kg) :

xiv) Pull chord switches
 (no. of pairs ) :

xv) Belt sway switches (no. of pairs ) :

xvi) Zero Speed Switches :

xvii) Brakes
 a) No. and location :
 b) Brake drum diameter (mm) :
 c) Torque rating (kg-m) :
02  CRUSHERS

02.00  SCOPE OF WORK

1. The scope of work of the Tenderer shall consist of design, engineering, manufacture, inspection, assembly shop testing, painting at manufacturer's shop as well as at site after erection, packing, loading and transportation, supply at site, erection, testing and commissioning of the following crushers & vibration isolation system (if required).

   The crusher shall be complete with individual drive, lubrication/ greasing arrangement and the control, wiring, panels, local control box.

2. Complete erection and commissioning of crusher and vibration isolation system including prestressing of vibration isolation elements, placing of elements in position, checking clearances in the shuttering of the RCC top deck, releasing of prestress in spring elements and making final adjustments and alignments after machine installation etc. including all grouting as required.

3. All fixing bolts& nuts including foundation bolts, brackets, supporting structures shall be included in the scope of supply of Tenderer.

4. All civil works, grouting of foundation bolts chipping, making holes or pockets, if any required for fixing crushers base plate, inserts etc and finishing work after chipping shall be in the scope of the Tenderer.

5. Spares for two years trouble free operation of each equipment. Lists of such spares along with item wise prices shall be furnished.

6. Required quantity of initial fill of oil, grease, lubricants, hydraulic fluid etc. and other consumable which are necessary for cleaning / flushing including erecting, testing and commissioning the crushers.

7. Necessary tools and tackles for each crusher required for maintenance, testing or inspection of the crusher or any of the installations on it List of such spares shall be furnished along with the quotation.

8. All miscellaneous items and spares required for commissioning of the crushers. The list of such spares shall be furnished along with the quotation.

9. Supply of insurance spares along with their list for each equipment.

10. All electrics/ electrical equipment as indicated under relevant clauses.

11. Statutory approval wherever required shall be taken by the Supplier for the equipment being supplied by them from relevant state/ central authorities.

12. The equipment supply shall be complete in all respect including its structural, mechanical and electrical components and standard accessories such as Roll Grinding attachment for Roll Crusher, Vibration isolation system of spring with damping pad for swing hammer reversible impactor/ Ring Granulator etc.

13. All items essential for the desired operation of the equipment, whether specifically mentioned in this specification or not, shall be included in the scope of work the Tenderer.
02.01 TECHNICAL SPECIFICATION

02.02.01 Roll Crusher

- The Roll Crushers shall be of robust construction and suitable for ease of maintenance. The housing shall be of welded construction with individually driven counter rotary crushing roll arrangement housed in a M.S. fabricated body. The frame shall be equipped with renewable, abrasion resistant liner plates of adequate thickness.

- Automatic gap adjustment of roll shells shall be provided.

- Roll shell shall be of replaceable type and made of chrome molly alloy steel.

- Automatic roll grinding system shall be provided for turning each crusher top & bottom rolls.

- The shaft shall be supported on antifriction bearings.

- Direct drive through fluid coupling and gear box shall be provided for driving the rolls.

- Centralised grease lubrication system shall be provided.

- Product analysis curve shall be provided justifying the selection of proper crusher.

- The crushers shall be designed so as to eliminate vibration when machine is running. The crusher shall be mounted on vibration isolation system.

02.02.02 Swing Hammer Reversible Impactor

- The swing hammer reversible impactors shall be of robust construction and suitable for ease of maintenance. The housing shall be of welded construction. The frame shall be equipped with renewable, abrasion resistant liner plates of adequate thickness. The hammers of the impactor shall be fitted to the disc mounted on the rotor shaft and inner surface of impactor shall be provided with replaceable breaker plates. Life of hammer shall be min. four lakh tonnes of material crushed. The crusher shall be provided with arrangement for setting the required product size by suitable means.

- The crushers shall be designed so as to eliminate vibration when machine is running. The crusher shall be mounted on vibration isolation system.

- Suitable wear resistant lining of operating life minimum 2 years shall be provided in the housing.

- Material for the beater heads & grinding gibs shall be annealed chrome molly steel.

- Power transmission to the crusher shall be complete with V-belt drive, which includes motor, sheaves, drive sheaves, fluid coupling, belts and guards, motor base, pedestal bearings, hydraulics & other necessary items. The hammer shall be reversible.
• All bearings shall be provided with adequate dust seals & the bearing shall preferably be of special roller type. Protection hood shall be provided for coupling.

• All the parts shall be easily accessible for maintenance and repair. Inspection door shall be provided wherever needed. The drive unit shall ensure smooth starting & running. Extra insulations shall be used to limit the noise level.

02.02.03 Rod Mill

• Rod mills shall be provided for secondary crushing/ grinding. The rod mills shall be of robust construction with provision of feeding the material from end. It shall be of welded construction complete with drive arrangement through motor, fluid coupling, gear box, brake and open girth gear. The shell shall be made of mild steel lined with suitable replaceable liners with sub-lining so that noise level does not exceed 85 db. The shell shall be provided with manhole & openings for the end peripheral discharge.

The Tenderer shall guarantee that the noise level will be limited to 85 db at a distance of 1.5 metre from the machine.

• The rod mills shall be of rugged design. The wearing out parts of the crusher shall be easily replaceable. The crusher shall preferably be designed such that it is protected against damage due to entry of foreign material. Alternatively, additional system shall be provided to prevent the entry of such foreign material into the rod mill.

The design of rod mill shall be such that wear of crushing components can be easily compensated and the same will not affect or upset either the product sizing or its capacity. The Tenderer shall ensure the availability of replaceable wear parts. The rod mill shall be provided with the inching device with separate drive.

• Automatic centralized lubrication system shall be provided for main supporting bearing and automatic spray for gear drive unit, ring gear, metering grease pump for the trunion bearings with labyrinth, seals & pinion shaft bearings. Necessary piping with couplings and connections are also included in the scope of work. Necessary instruments, valve etc. mounted on a panel shall be provided.

• 360 degree sectionalized guard of steel plate for ring gear and pinion shall be provided with inspection door and felt seals on both sides of the ring gear. The guards shall also be equipped with clean out and drain openings.

02.02.04 Ring Granulator

• The crusher shall have a frame adequately designed for the service intended with large quick opening inspection doors, fitted with dust tight seals. The frame shall be equipped with renewable, abrasion resistant liner plates of adequate thickness.

• The cage shall be supported on top by a heavy hinged shaft and it shall be provided with means for adjustment to control output size and also to compensate for wear and tear of screen plates and crushing rings. The breaker plates and screen plates provided shall be of abrasion-resistant renewable type manganese steel conforming to IS: 276:1992 grade-III. The opening of the screen plate shall be so designed as to allow free flow of crushed material even with the maximum percentage of moisture specified. The crusher cage shall be adjustable with hydraulic cylinders.

• The rotor assembly shall consist of forged and heat treated alloy steel shaft and abrasion
resistant manganese steel, suspension disc which shall be keyed to the shaft. Suspension bar support adequately designed rings. The crusher rings shall be made of work hardening type manganese steel conforming to IS-276 grade-III, 1992.

- The crusher shall be provided with a tramp iron trap (deflector plate and access door), to prevent uncrushable material from being brought back into the crushing cycle.

- The crusher bearings shall be spherical roller type with provision for grease or oil lubrication. In case of oil lubrication, supply of oil pump along with pipes, temperature & pressure gauges & control panel to be included in the scope.

- The drive unit shall be complete with motor, fluid coupling and all other accessories.

- Crusher casing shall be provided with hinged inspection doors of minimum 300 x 200 mm on top. There shall be arrangement to lift the top half of crusher for inspection/maintenance.

- The crushers shall be designed so as to eliminate vibration when machine is running. The crusher shall be mounted on vibration isolation system

02.02 Drawings / Document / Information to be furnished.

1. List of drawings/data to be submitted along with tender
   a. Tender shall be accompanied by general arrangement drawings for crushers, auxiliaries & vibration isolation system showing to scale the elevation, side view and plan along with information such as clearances, arrangement and disposition of all drives and other equipment installed on the crusher. Crusher weight, wt. of heaviest single piece, motor kw, drive arrangement, control system write up and important technical features of the crusher offered and the load data of individual crushers, auxiliaries & vibration isolation.

   b. Tender shall be accompanied with details of spring & damping pad arrangement with all literature/catalogues.

   c. List of commissioning spares proposed by the Tenderer.

   d. List of operational spares recommended for two year normal operation, insurance spares and list of tools and tackles to be supplied with the equipment.

   e. Duly filled up questionnaire given below.

   f. List of imported component in the equipment.

   g. Data sheet for noise protection.

2. List of drawings to be submitted for approval
   a) Drawings listed hereinafter shall be submitted to the Purchaser/his consultant in stages for approval, starting within one month of issue of letter of intent and prior to the commencement of fabrication.

   The load data/drawing must be submitted within one month of issue of letter of intent.
b) General arrangement drgs drawn to the scale and containing all information’s as described elsewhere along with civil load data for individual equipment.

d) Assembly drawings of individual drives

e) Technical characteristics of crushers in a tabulated form, characteristic curves.

f) In addition to the above, the Purchaser/ consultant reserves the right to insist on the submission of calculation and/or drawings for any mechanical, structural and electrical components as required.

g) Submission of detailed design calculations, analysis (static and dynamic) and drawings for Purchasers acceptance and approval. All documents and drawings shall be supplied in copies and two reproducible. All calculation shall be submitted in sets.

3. **Drawings / data / calculations for reference**

01. Civil load data drgs for Crushers
02. Hydraulic circuit drgs for Crushers and for each system, lubrication arrangement etc.
03. Parts list, bill of materials and material specification.
04. Major sub assembly drgs of drives.
05. G.A of grinding attachment for roll crushers.
06. G.A of greasing systems for crushers.
07. Hydraulic circuit for door opening for swing hammer reversible impactor
08. Oil lubrication system for Rod mills.
09. Grease spraying system for Rod mills.
11. P & I diagram for Rod Mills, swing hammer reversible impactor and roll crushers.
12. a) Furnishing methodology of providing shuttering for the deck structure and its removal, installation of springs and dampers isolation system.
   b) Furnishing installation and maintenance manual indicating all erection sequences and details of maintenance of equipments, procedure etc. necessary for installation, maintenance of vibration isolation system and the detail specification of various spares required for 5 years operation of the plant.
   c) Furnishing bill of materials of various elements such as springs, visco dampers with their rating, stiffness etc.
   d) Furnishing detailed specification of the vibration isolation system and various items indicated in the supply and standard national or international code to which they conform to.

13. Drawings of all wearing out parts.


4. **Contract drawings and documents to be furnished along with the supply:**

   i/ Erection drawings, erection specification & erection instructions
   ii/ Instruction for storage and reconservation including those for electrical, instrumentation and communication items
   iii/ Performance data
   iv/ Test charts and inspection certificates in bound volume
   v/ Operation & maintenance manuals
   vi/ Safety manuals
   vii/ List of spares for 2 year’s normal operation/maintenance
viii/ Manufacturing drawings and bill of materials for all spares and wearing parts (excluding those for proprietary items)
ix/ Ordering specs. including catalogues and details for all spares (including proprietary items) along with spare lists.
x/ Ordering specifications for operating consumables/supplies
xi/ All as built drawings, in bound volumes incorporating approved changes if any made during erection and commissioning, shall be supplied progressively within two months of commissioning of the (all drawings are to be furnished even if there is no change) equipment.
xii/ Classified list of drawings in A4 size.

02.03 Questionnaire to be filled by Tenderer.

The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

01. Name and address of the Tenderer : 
02. Previous experience of the Tenderer : 
03. List of similar equipment supplied along with user’s certificate : 
04. Is it the Tenderer's intention, if awarded the contract, to comply fully in all respects with Purchaser's specifications covering the work? If not, he shall state specific exception in details.
05. Location / Nos. off 
06. Designation 
07. Capacity through. 
08. Material (input & product) details. 
09. Drive details & rating (kW, rpm etc.) 
10. Material of construction for various parts 
11. Liner material used, type, thickness, fixing arrangement. 
12. Product size adjustment methodology 
13. Control details 
14. Gross weight of equipment (t) and weight of individuals parts 
15. Weight of heaviest part 
16. Foundation load data 
17. Duty
18. Special features if any
19. Any other information as the tenderer thinks necessary for installation
20. Details of vibration isolation system
03  SCREENS

03.01  SCOPE OF WORK

1. The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser's site, unloading, handling and storage at site, insurance during storage, erection, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics and standard accessories of screens.

The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

2. The scope of supply and services of the Tenderer shall include the following:

   a) Mechanical

      – Each equipment shall be complete in all respect including, its drive units, cables, safety switches, hoods, sealing materials, structural, mechanical and other standard accessories.

      – Provision of necessary fixtures, supporting angles and brackets required for mounting and supporting the equipment & drive with floor / bins.

   b) All Electricals and controls

3. All fixing bolts and nuts including foundation bolts shall be included in the scope of supply of Tenderer.

4. Statutory approval wherever required shall be taken by the Tenderer for the equipment being supplied by them from relevant state/central authorities.

5. Tenderer shall furnish necessary technical supervisory personnel to supervise the erection; testing, commissioning & PG test. The assembly of the equipment shall be made in such a way that while handling/erection of the equipment at site no problem is encountered. Erection mark of such assembly shall clearly be marked to facilitate the erection of the equipment.

6. The Tenderer shall submit detailed proposals setting forth his terms, conditions and fees for rendering the following services.

7. Training of Purchaser's personnel in all branches connected with the operation and maintenance of the equipment.

8. The scope of work shall stand supplemented by such details as are given in this specification, tender drawing, and instruction to the Tenderer, General Conditions of Contract (GCC), or any other part of the document.
03.02 TECHNICAL SPECIFICATION

1. General

All equipment shall be designed, manufactured, supplied, erected, tested and commissioned in accordance with relevant Indian Standards and International Standard where applicable in addition to the requirement mentioned herein.

The Supplier shall make his own calculation in respect of motor kilowatt to ensure satisfactory performance of the equipment.

Adequate no. of locating pins and match marking shall be provided for easy assembly and dismantling of the equipment.

Standardisation of components and assemblies shall be carried out to the maximum possible extent to ensure interchangeability.

All equipment shall be designed such that all components are easily accessible for inspection, repair and maintenance.

2. Equipment Specification (Mechanical)

a) The screen shall be of continuous duty type, robust construction and shall be fabricated from steel plates and structural of adequate strength and of balanced design. All welded parts will be stress relieved and all holes will be drilled and not punched. Sharp edge on screen body will be avoided. The screen body will be adequately reinforced at supporting points where vibrating mechanism is connected to the screen body. It will be provided with suitable back plate at feed end to prevent spillage of material. The screen body will be supported on adequate number of springs to give adequate rigidity to the equipment as well as transmission of dynamic force to the supporting structure will be minimum, to the extent possible. The springs will have fixed spring-constant throughout its operating range. It shall be floor mounted inclined at 8 degree (max.) with horizontal and installed as per design requirement.

b) Screening surfaces shall be adequate to render 95% efficiency of screening.

c) The tenderer shall offer the linear motion screen with the direct force exciter (DFE) until and unless the requirement changes due to specific technical reasons. The motion to DFE shall be imparted through cardon shaft. Other type of screens shall be specifically mentioned in the data sheet.

d) The screen shall have in-built design feature to overcome the additional load likely to occur when the screen passes through the resonance zone. Such momentary additional loads shall not be transferred to the supporting building structures.

e) Wherever applicable the screen shall be provided with heavy duty, self-aligning, spherical double row roller bearings in such a manner as would reduce maintenance and refitting time. The load distribution due to eccentricity shall be such so as to minimise shaft deflection and prevent misalignment of bearing races. The bearings shall be protected from dust effectively by dust tight seals and provided with pressure type lubrication.

f) The screen deck shall be totally covered.

g) The screen shall be provided with non-clogging screen cloths/plates. Screen cloth/plates
support will be suitably planned / devised so that the distance between the supports is uniform and proper chamber is obtained. The clamping arrangement shall be suitable to hold the cloth/ plate at proper tension and also allow easy changing.

Screen will be having secondary induced vibration of screen cloth/ plate to minimise the choking. The selection of bed area will be done in such a way that the bed depth is limited to reduce the choking.

h) The vibrating springs of the screen shall be high quality chrome vanadium steel.

i) In order to prevent deterioration of the materials being screened, relatively high speed, low amplitude vibration of the screen shall be preferred.

j) The drive shall be such that no unwanted vibration forces are transmitted to the stationary structure. The screen shall be designed for smooth starting and stopping without excessive bouncing.

03.03 DOCUMENTATION

1 List of drawings /data to be submitted along with tender

The Tenderer shall submit adequate sets of following technical drawings & technical data/ information with tender for vibrating screens without which the tender shall be considered as incomplete & may not be considered for acceptance.

a) General description of design consideration and all the assumption made by the supplier.

b) Specification of individual equipment indicating capacity (rated and designed), dimension, drive ratings, safety factors, drive details, duty rating, weight of individual equipment, weight of heaviest part, etc.

c) Make and model of equipment/parts/components.

d) Specification of materials of construction of major parts/ components along with standards and chemical composition.

e) Catalogues/leaflets for all equipment including bought-out items. Details of bought-out items with makes shall be given separately.

f) G.A. drgs for the equipment/ system including sections and details giving relevant information, binding dimension, loads for designing civil/structural works etc.

g) Standard/ special accessories being considered for supply along with the equipment.

h) Requirement of tools and tackles for erection and maintenance.

i) Requirement of utilities and services.

j) Deviation from tender document.

k) Duly filled in questionnaire

2 List of drawing/documents to be furnished by the Successful Tenderer
The following drawing/document shall be submitted by the Successful Tenderer within one month of placement of order:

a. General arrangement drawing of equipment showing full details of screens, feeders, chutes, hoods etc in plan and section along with design calculations.

b. Calculation sustaining the screen / feeder size selection and motor power calculation

c. Foundation outline drawing with load data, pocket sizes and location, foundation bolts and inserts details as required.

d. Fixture details, load data and special erection instruction with allowable tolerances as required.

e. Specification of oils and lubricants and other consumables and their quantity and frequency of change.

f. Motor list including kW rating

g. Technical data sheet

3 List of drawings/ documents to be furnished along with equipment by the Successful Tenderer.

a. Sets of all Approved GA drawings and motor data sheets, complete assembly and sub assembly drawings of the equipment together with one copy of good quality polyester reproducible.

b. Drawing of all equipment/ component received from sub supplier together with one copy of reproducible.

c. Engineering and design calculations

d. Test and warranty certificate for each item of equipment

e. Detailed erection schedule and manuals, assembly/ erection drawings, erection sequence, special precautions to be followed during assembly/ erection (these shall be despatched three months prior to FOT /FOR delivery)

f. Test reports and inspection reports

g. Instruction manuals for testing and commissioning

h. Operation, maintenance and safety manuals

i. Requirement of special tools and tackles, if any, for subsequent maintenance

3. Detail drawing and specifications of all wearing out parts and parts subject to breakage during normal operating conditions.

4. List of spare parts with drawings, sketches, specifications and manufacturer’s catalogue (two sets and one reproducible and/or two sets of catalogues)

03.04 QUESTIONNAIRE
The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

21. Name and address of the Tenderer :

22. Previous experience of the Tenderer :

23. List of similar equipment supplied along with user’s certificate :

24. Type of screen :

25. Location / Nos. off :

26. Capacity through

27. Drive details & rating (kW, rpm etc.)

28. Deck size( mm x mm), Panel size & inclination

29. Material of construction of deck plate & other parts

30. Liner material used, type, thickness, fixing arrangement.

31. Screen cloth/ plate specification and type of perforation

32. Control details

33. Gross weight of equipment (t) and weight of individuals parts

34. Weight of heaviest part

35. Foundation load data for screens & feeders for design of building

36. Duty

37. Special features if any

38. Any other information as the tenderer thinks necessary for installation

39. Guarantee efficiency of the screen

40. Details of spring, i.e. material composition, wire dia, free length etc.

41. Whether anti- vibration pads have been provided below spring base plate

42. a) Stroke and amplitude of vibration
   b) Limits of adjustment of amplitude & stroke

43. Gear Boxes
   a) Make :
   b) Type :
   c) Reduction ratio :
   d) Torque rating (kg-m) :
44. Couplings
   a) Make and type of high speed couplings :
   b) Make and type of low speed couplings :
   c) Weight (kg) :

26. Bearing
   Make :
   Expected life (hrs) :
04  VIBRO FEEDERS

04.01  SCOPE OF WORK

1. The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser's site, unloading, handling and storage at site, insurance during storage, erection supervision, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics and standard accessories of Vibratory feeders as covered under this specification.

The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

2. The scope of supply and services of the Tenderer shall include the following:

   - Mechanical

   - Each equipment shall be complete in all respect including, its drive units, cables, safety switches, structural, mechanical and other standard accessories.

   - Provision of necessary fixtures, supporting angles and brackets required for mounting and supporting the equipment and feed chute.

   - Electricals and controls

3. All fixing bolts and nuts including foundation bolts shall be included in the scope of supply of Tenderer.

4. Two years maintenance spares.

5. Commissioning spares as required during testing and commissioning of the equipment.

6. Insurance spares.

7. Required quantity of initial fill of oil, grease, lubricants, hydraulic fluid etc. and other consumables which are necessary for cleaning/flushing including erection, testing and commissioning the equipment shall be in the scope of supply of the Tenderer.

8. Necessary tools and tackles for each equipment required for maintenance, testing or inspection of the equipment.

9. Statutory approval wherever required shall be taken by the Tenderer for the equipment being supplied by them from relevant state/central authorities.

10. The scope of work shall stand supplemented by such details as are given in this specification, tender drawing, and instruction to the Tenderer, General Conditions of Contract (GCC), or any other part of the document.
04.02 TECHNICAL SPECIFICATION

1. General

All equipment shall be designed, manufactured, supplied, erected, tested and commissioned in accordance with relevant Indian Standards and International Standard where applicable in addition to the requirement mentioned herein.

The Supplier shall make his own calculation in respect of motor kilowatt to ensure satisfactory performance of the equipment.

Standardisation of components and assemblies shall be carried out to the maximum possible extent to ensure interchangeability.

All equipment shall be designed such that all components are easily accessible for inspection, repair and maintenance.

2. Equipment Specification (Mechanical)

a. Vibratory feeders shall be of generally electro-mechanical type (any other type shall be indicated in data sheet for respective equipment). The vibrating units of the feeders shall be of unbalanced motor type. The vibrating feeders and their mounting arrangement shall be properly designed to suit the scheme shown in the TS drawing. It shall be ensured that no vibration is transmitted to the supporting/ surrounding structures. The troughs of the feeders shall be of tray type construction and shall be made out of minimum 6 mm thick MS plate (IS: 2062-1992). 10 mm thick liner (SAIL Hard) shall be provided inside the trough along its length and cross section. The trough liner shall be provided with adequate side guard to avoid spillage. The trough shall be covered with dust tight hoods with provision of cut out and flange for dust extraction. The equipment will be provided with enclosed dust proof vibrators (un-balanced masses).

b. All the feeders shall be of suspended type unless otherwise mentioned in data sheets. Each vibrating feeder shall be supplied complete with supporting structures, feed chutes, manually operated feed control gates, hood cover, electrics, plates and fixing nuts and bolts, suspension rods, ropes, turn buckets etc.

c. The successful Tenderer shall ensure that minimum amount of assembly will be required for erection and commissioning of equipment at site. Site welding etc. shall be avoided as far as possible

d. The feeders shall be of robust construction and of balanced design.

e. SAIL hard liner of 10 mm thick shall be provided in feed chute

f. All bolts except those with nyloc nuts shall be provided with lock nuts and spring washers.

g. No cast iron parts shall be used (except for pillow block)

h. Equipment shall be designed such that all components are easily accessible for inspection, repair and maintenance
04.03 DOCUMENTATION

a) List of drawings/data to be submitted along with tender

b) General arrangement drawing with bill of material of equipment showing overall dimension, motor kW, drive arrangement etc. along with load data, weight etc.

c) Supplier's name for components (like motors, coupling, gearbox etc.) catalogues for these items shall be furnished.

d) List of commissioning spares proposed by the Tenderer.

e) List of recommended spares for two years maintenance of plant and equipment along with itemised price.

f) List of tools and tackles to be supplied with the plant and equipment.

g) Duly filled up questionnaire.

h) The Tenderer has to furnish one copy of the specification drawing duly signed by him as a token of acceptance along with the list of deviation from tender documents.

04.04 QUESTIONNAIRE

The Tenderer shall furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

01. Name and address of the Tenderer : 
02. Previous experience of the Tenderer : 
03. List of similar equipment supplied along with user’s certificate :
04. Is it the Tenderer's intention, if awarded The contract, to comply fully in all respects with Purchaser’s specifications covering the work? If not, he shall state specific exception in details.
05. Location / Nos. off :
06. Type of feeder & Designation :
07. Capacity through :
08. Material of construction of different parts :
09. Total weight and weight of individuals parts :
10. Type of liner and thickness :
11. Motors 
   a) KW rating :

______________________________
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Material Handling and Hoisting
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12. Gear Boxes

a) Make
b) Type
c) Reduction ratio
d) Torque rating (kg-m)
e) Overall efficiency
f) Wt. of Gear box (kg)

13. Couplings

a) Make and type of high speed couplings
b) Make and type of low speed couplings
c) Weight (kg)
05  VIBRATORY GRIZZLY FEEDERS

05.01  Scope

9. The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser’s site, unloading, handling and storage at site, insurance during storage, erection, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics and standard accessories of screens

The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

10. The scope of supply and services of the Tenderer shall include the following:
   a) Mechanical
      - Each equipment shall be complete in all respect including, its drive units, cables, safety switches, hoods, sealing materials, structural, mechanical and other standard accessories.
      - Provision of necessary fixtures, supporting angles and brackets required for mounting and supporting the equipment & drive with floor / bins.
   b) All Electricals and controls

05.02  Technical Specification

1. Code & Standards

The design, manufacture, inspection and testing of Vibrating Grizzly Feeder shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Vibrating Grizzly Feeder shall conform to the latest edition of standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility.

2. Technical requirement

1. The vibrating grizzly feeder shall be of mechanical type.

2. The grizzly feeder shall be capable to segregate the desired size of material. The width of vibrating grizzly feeder shall match to feed the material uniformly over the entire length of subsequent equipment.

3. The screening area excluding solid deck area shall be minimum 0.75 m$^2$ per 100 tonnes/hr of incoming feed. Inclination of the grizzly pan shall be so selected so as to ensuing proper flow ability of material on the deck without any hindrance.

4. The equipment shall be designed in such a manner that choking does not occur during operation, particularly during rainy season when the coal gets sticky.
3. Constructional Features

1. The deck of vibrating grizzly feeder shall have continuous solid deck section in the impact zone under direct coal fall and remaining deck shall be fitted with perforated deck assembly.

2. The solid deck section shall be provided with replaceable SAIL HARD or equivalent liner plate of adequate thickness.

3. The perforated deck shall be wear resistant and shall be rigidly fixed with main frame along the length of grizzly deck.

4. The Vibrating Grizzly feeders shall be mounted on the floor with the help of helical springs made of alloy steel. No rubber / synthetic material for the support shall be provided.

5. Suitable sealing arrangement shall be provided between the vibrating structure and chute work to avoid dust nuisance in the surrounding area. Proper arrangement to avoid dust ingress into lubricant of eccentric shafts shall be provided. Necessary arrangements shall be provided for maintaining the complete vibratory assembly.

6. In case V-belt drive to avoid loosening of sheave mounted on eccentric shaft, suitable arrangement like taper bush or dobicon coupling shall be provided. Marker plate to indicate stroke length and stroke angle shall be provided.

05.03 Drawing & documents to be submitted by the successful bidder

1. List of drawings /data to be submitted along with tender

The Tenderer shall submit adequate sets of following technical drawings & technical data/information with tender for vibrating screens without which the tender shall be considered as incomplete & may not be considered for acceptance.

a) General description of design consideration and all the assumption made by the supplier.

b) Specification of individual equipment indicating capacity (rated and designed), dimension, drive ratings, safety factors, drive details, duty rating, weight of individual equipment, weight of heaviest part, etc.

c) Make and model of equipment/parts/components.

d) Specification of materials of construction of major parts/components along with standards and chemical composition.

e) Catalogues/leaflets for all equipment including bought-out items. Details of bought-out items with makes shall be given separately.

f) G.A. drgs for the equipment/system including sections and details giving relevant information, binding dimension, loads for designing civil/structural works etc.

g) Standard/special accessories being considered for supply along with the equipment.

h) Requirement of tools and tackles for erection and maintenance.
i) Requirement of utilities and services.

j) Deviation from tender document.

k) Duly filled in questionnaire

2 List of drawing/documents to be furnished by the Successful Tenderer

The following drawing/document shall be submitted by the Successful Tenderer within one month of placement of order:

a. General arrangement drawing of equipment showing full details of screens, feeders, chutes, hoods etc in plan and section along with design calculations.

b. Calculation sustaining the screen / feeder size selection and motor power calculation.

c. Foundation outline drawing with load data, pocket sizes and location, foundation bolts and inserts details as required.

d. Fixture details, load data and special erection instruction with allowable tolerances as required.

e. Specification of oils and lubricants and other consumables and their quantity and frequency of change.

f. Motor list including kW rating

g. Technical data sheet

3 List of drawings/documents to be furnished along with equipment by the Successful Tenderer.

a. Sets of all Approved GA drawings and motor data sheets, complete assembly and sub assembly drawings of the equipment together with one copy of good quality polyester reproducible.

b. Drawing of all equipment/ component received from sub supplier together with one copy of reproducible.

c. Engineering and design calculations.

d. Test and warranty certificate for each item of equipment

e. Test reports and inspection reports

f. Instruction manuals for testing and commissioning

g. Operation, maintenance and safety manuals

h. Requirement of special tools and tackles, if any, for subsequent maintenance

5. Detail drawing and specifications of all wearing out parts and parts subject to breakage during normal operating conditions.
6. List of spare parts with drawings, sketches, specifications and manufacturer's catalogue (two sets and one reproducible and/or two sets of catalogues)

05.04 QUESTIONNAIRE

The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

01. Name and address of the Tenderer:

02. Previous experience of the Tenderer:

03. List of similar equipment supplied along with user's certificate:

04. Is it the Tenderer's intention, if awarded the contract, to comply fully in all respects with Purchaser's specifications covering the work? If not, he shall state specific exception in details.

05. Location / Nos. off

06. Designation

07. Capacity through

08. Drive details & rating (kW, rpm etc.)

09. Deck size (mm x mm), Panel size & inclination

10. Material of construction of deck plate & other parts

11. Liner material used, type, thickness, fixing arrangement.

12. Screen cloth/plate specification and type of perforation

13. Control details

14. Gross weight of equipment (t) and weight of individuals parts

15. Weight of heaviest part

16. Foundation load data for screens & feeders for design of building

17. Duty

18. Special features if any

19. Any other information as the tenderer thinks necessary for installation

20. Guarantee efficiency of the screen

21. Details of spring, i.e. material composition, wire dia, free length etc.
22. Whether anti-vibration pads have been provided below spring base plate

23. a) Stroke and amplitude of vibration
   b) Limits of adjustment of amplitude & stroke

24. Gear Boxes
   a) Make :
   b) Type :
   c) Reduction ratio :
   d) Torque rating (kg-m) :
   e) Overall efficiency :
   f) Wt. of Gear box (kg) :

25. Couplings
   a) Make and type of high speed couplings :
   b) Make and type of low speed couplings :
   c) Weight (kg) :

26. Bearing
   Make :
   Expected life (hrs) :
06 GATES

06.01 SCOPE OF WORK

1. The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser’s site, unloading, handling and storage at site of the equipment.

The scope of the Tenderer shall also be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

2. The scope of supply and services of the Tenderer shall include the following:

3. All fixing bolts and nuts shall be included in the scope of supply of Tenderer.

4. Two years spares for each type of gates.

5. Commissioning spares as required during testing and commissioning of the conveyor system.

6. The scope of work shall stand supplemented by such details as are given in this specification, tender drawing, and instruction to the Tenderer, General Conditions of Contract (GCC) or any other part of the document.

06.02 TECHNICAL SPECIFICATION

1. Only the broad specifications covering the technical requirements for the equipment to be supplied are indicated. It is not the intent of this specification to specify complete details of the equipment including design and manufacture. The Successful Tenderer shall carry out detailed design, engineering and manufacture in a manner that shall ensure smooth and trouble free performance of the equipment as a whole.

2. The Tenderer shall ensure that minimum amount of assembly is necessary for erection and commissioning of equipment at site. Site welding shall be avoided as far as possible.

3. All components shall be designed and tested in accordance with latest Indian Standards unless stated otherwise & agreed to.

4. All components shall be manufactured with material of approved quality & best of workmanship. The equipment shall be shop assembled for checking operation and accuracy of parts.

5. All working parts of the equipment shall be suitably located for convenient operation, inspection, lubrication, repairs & easy replacement.

6. Rod gates shall be fitted between the bunker & equipment below like feeder/screens etc. to control the feed rate and to isolate the equipment from the bunker during maintenance. The gate shall be normally in partial/full open position and shall be controlled manually. The gates shall be fabricated from rolled steel. All rods shall be of diameter that ensures no bending. The spacing between rods shall be decided based on size of material stored in hopper/bin & direct material load. The tapered ends of the rod shall rest on square bars placed beyond zone of discharge. A tray shall be provided on the hopper for storing the rods.
7. **Sector gates** shall be fitted below bins/bunkers and shall be manually operated to regulate the discharge of material from the bins/bunkers. Sector gates shall be constructed out of materials having good resistance against impact and sliding wear rolled plates St 58 HT (IS: 961 – 1975) after hardening and tempering to HRC 25-30, shall be used. The material of pin shall be C-40 (IS: 1570 – 1979). The sector gears used shall be made of cast steel grade 23-24 (IS: 1030 – 1989) or EN-8 or equivalent and the teeth shall match perfectly to render noiseless and smooth service in operation. Wear resistant liner plate of suitable material shall be provided. Liner shall be provided on the gate main body and bottom portion. Antifriction ball and roller bearings shall be used throughout.

- All bolts except those with nyloc nuts shall be provided with grip lock nuts or washers. Stud or body bolts shall not be used as fasteners for mechanical items.
- Manual lubrication nipples shall be provided for all the bearings.

8. The **motor operated flap gates** shall be provided in transfer chutes as specified and shall be complete with electrically operated actuators. The gates shall be of robust construction and suitable for trouble free operation.

- The flap gates shall be used to divert the flow of material received from feeding conveyor to the receiving conveyors. The gates shall be operated by an electromechanical linear actuator. The actuators will be mounted on the chute body/or on a working/maintenance platform. The exact mode of support will be intimated to the successful Tenderer.
- The gate shall be fabricated out of 10 mm thick MS plates with wear resistant, replaceable liners. The liners will be bolted by counter sunk bolts. The thickness of the liners shall be adequate so as to give minimum 3 years operating life.
- The gate shall be capable of changing the direction of material on remote mode of control even when the material is being discharged from the feeding conveyor pulley.
- The equipment shall be capable of being operated for at least 15 switchings per hour at rated load and thrust and shall be suitable for 10 Nos. consecutive switchings at rated load and thrust. The equipment shall be shop tested to prove the requirement.
- The motor rating for the actuator shall be so selected as to provide sufficient thrust (min. 2500 kg) for operation of the flap gates against the moving weight of material and/or flap gate.
- The flap gate travel shall be in the range of 60° to 70°. Limit switches shall be provided to indicate extreme positions. Lever arm shall be provided between actuator and flap gate shaft for obtaining required thrust. Each gate shall be provided with a shaft, a hand lever and self aligning type antifriction bearings with adequate sealing for dust proofing.
- The actuators shall be capable of preventing any over travel. Suitable travel dependent limit switches controlling the travel; of the flap gates on either direction shall provided. These shall be placed internal to the drive unit and shall be completely dust-proof. The limit switches shall be capable of adjustments to vary to total length of travel of the gates.
- Suitable thrust dependent limit switches shall be provided. This shall trip off the actuator motor in case of excessive thrust due to jamming the gates during its travel in either direction.
• Provision for alternative manual operation shall also be made using declutchable hand wheel. The diameter of hand wheel shall be selected considering a 25 kg (max.) force to be applied by a single operator.

• Suitable stiffening arrangement shall be provided between the two faces of the gate plate. At the end of the travel the total length of edge of flap gate shall rest on a suitable projected surface from chute to prevent leakage of material through the available clearance between chute and flap gate.

• Maximum feasible counterweights shall be provided for better utilisation of system. However for calculation of thrust required, the benefit of counterweight shall not be taken into consideration.

• Suitable self aligned double row ball bearings of approved make in dust tight housing shall carry the gate shaft

• For standardisation purposes, only one standard type of actuator (of 2500 kg thrust load) of flap gates shall be provided. Flap gate actuator as a whole and individual component wise shall be completely interchangeable for all locations.

• The material of shaft shall be EN-8 or equivalent material. The diameter of the shaft shall be suitable for motor stalled conditions and associated twisting.

• The deflector plates fixed to the actuators through linkages shall be used to divert the flow of materials onto the chutes below. Details of the deflector plates will be furnished to the successful Tenderer.

9. **Rack & Pinion Gates** shall be of two types, i.e. motorised actuator operated or manually operated. All clauses below under “Motorised Rack & Pinion Gate” shall be applicable for manually operated Rack & Pinion Gates also, except that the mode of operation shall be manually and hence actuators, drives etc. are only for the motorised type.

10. **Motorised Rack & Pinion Gates**

• The gate shall be fitted in the transfer chutes between the bunkers / hoppers and feeders to control the feed rate to the feeder. During maintenance of equipment lying below the hopper / bunker, the gate shall be utilised for restraining fall of material from the hopper / bunker.

• The gate shall be normally in partial / full open position. Actuator shall be provided for opening & closing of the gate. In case of by-passing the actuator, the gates opening shall be controlled by the hand chains (manually).

• The actuator operated rack & pinion gates shall be suitable for closing and opening the gate with hopper / bunker full.

• All components shall be designed and tested in accordance with latest IS Specification unless stated otherwise and agreed to. In such case where Indian Standards are not available reputed International standards shall be followed.

• Rack and Pinion Gates shall be fabricated from rolled steel plates and section. It shall be complete in all respects including gates plate, frame work, operating chains, sprockets, gear rack and pinion, rollers etc. The gates plate shall have wear resistant liners and shall slide over rollers mounted on anti-friction bearings. The flap shall be properly stiffened to avoid distortion of flap. The flap shall be made of minimum 12 mm thick plates and lined. Material of construction for various elements shall be:-
Gate plate | Gate plates to be made from 20 thk ms plates conforming to IS : 2062 and to be suitably lined with sail hard plates of 16mm thk.
---|---
Pin | C-45 / EN-8
Liner | Material SAIL HARD 16 thk. On Gate plate & 10 thk. On side walls.
Rack | EN-8 / C-45 Hardness-225 BHN (min)
Pinion | EN-8 / C-45 Hardness-250 BHN (min)
Roller | EN-8 on Ball bearing.

- The pull required to operate the gate manually (on actuator bypass) shall not exceed 25 kg when operating under a loaded bunker / hopper.
- All bolts except those with nyloc nuts shall be provided with grip lock nut or grip washers. Stud or body bolts shall not be used as fasteners for mechanical items.
- Gear boxes used shall be of approved make.

### 06.03 DOCUMENTATION

1. **List of drawings /data to be submitted along with tender**
   a. General arrangement drawing of each type of gates showing overall dimension, profile, material of construction, weight etc.
   b. List of commissioning spares proposed by the Tenderer.
   c. List of spares for two years operation.
   d. Duly filled up questionnaire.

2. **List of drawings to be submitted for approval by successful tenderer**

   Drawings listed hereinafter shall be submitted to the Purchaser/ MECON for approval, starting within one month of issue of letter of intent and prior to the commencement of fabrication.
   
   a) General arrangement drawing of each type of gates showing overall dimension, profile, material of construction, weight, bill of materials etc.
   
   b) In addition to the above, the Purchaser/ Consultant reserve the right to insist on submission of calculations/ for component selection.

3. **Drawing/data/calculation for reference to be submitted by successful tenderer**

   - Procedure for testing and commissioning.
   - Instruction for storage /erection, testing & commissioning.
   - Catalogues/literatures
   - Operation and maintenance manual.
   - Final test certificates

### 06.04 QUESTIONNAIRE
The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

01 Name and address of the Tenderer  :

02 Previous experience of the Tenderer  :

03 List of similar equipment supplied  :

05 List of drgs./ literatures enclosed with the offer.  :

06 List of gates with details  :
07  MOTORISED DIVERTER GATE

07.01  Scope

The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser’s site, unloading, handling and storage at site, insurance during storage, erection supervision, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics and standard accessories of Motorised Diverter Gates as covered under this specification.

The equipment shall be designed as per design criteria given below:

I.  Hierarchy of Specifications
   a)  Technical Specification
   b)  General Technical Specification (GTS)
   c)  IPSS & IS
   c)  Indian Electricity Rules & statutory requirements of Central Govt. and State Govt.

Equipment complying with other recognised Standards such as IEC, BS, VDE, and IEEE will also be considered if it ensures performance equivalent to or superior to Indian Standards.

The components and materials used and the equipment supplied shall conform to high standards of design, engineering and workmanship and shall be suitable for efficient operation and reliable service in steel plant conditions.

II.  Design Basis
   - Design capacity of equipment - 20% more than designed stream capacity of feed conveyor to be considered while calculating motor power

   - Pillow blocks
     a) Material - cast iron / cast steel
     b) Bearing - Self aligning spherical roller bearing
     f) Life - 40,000 working hrs (min.)
     g) Construction - Horizontal split type (one end fixed and the other end expansion type)

   - Reducer
     a) Service rating of 1.5 times the calculated shaft kW and thermal capacity of gear box shall be better or equal to that of motor
     b) Material - fabricated or cast steel
     c) KW rating shall be not less than 1.25 times the motor kW. Higher value of `a’ or `c’ will be considered
     d) No worm gear except for travelling gate

07.02  TECHNICAL SPECIFICATION
• All equipment shall be designed, manufactured, supplied, erected, tested and commissioned in accordance with relevant Indian Standards and International Standard where applicable in addition to the requirement mentioned herein.

• The Supplier shall make his own calculation in respect of motor kilowatt to ensure satisfactory performance of the equipment.

• Standardisation of components and assemblies shall be carried out to the maximum possible extent to ensure interchangeability.

• All equipment shall be designed such that all components are easily accessible for inspection, repair and maintenance.

• The gate shall be capable to allow half flow on to each receiving conveyor or full flow on to one conveyor or to the other conveyor.

• The gate casing shall be fabricated out of 6 mm thick MS plates with liners and conical portion of the diverter shall be made of 10 mm thick MS with 5 mm thick stainless steel/SAIL HARD liners. The gate shall move inside a totally enclosed steel framework mounted below the discharge hood of the feeding conveyor. Positive to and fro motion for the two positions shall be imparted to the gate supporting frame through rack and pinion arrangement driven by bevel geared drive. Material of construction of the pinion and rack shall be minimum C45 or EN8.

• The gate shall be capable of changing the direction of material on remote mode of control even when the material is being discharged from the conveyor pulley.

• The drive shaft shall be made of C45. Antifriction ball / roller bearings shall be used throughout.

• Speed of the gate shall be 30 mm / sec.

• Limit switches for positioning and position indication shall be provided.

• Provision for manual operation of the gate shall also be provided at the extended motor shaft. Manual force required shall not exceed 25 kg.

• Rubber buffers on the gate shall be provided at both ends inside the casing.

• The gate shall be supported on the steel floor beams.

• 2 numbers inspection windows (hinged type and dust tight) shall be provided on drive side of the casing.

• All bolts except those with nyloc nuts shall be provided with lock nuts or spring washers.

• No cast iron parts shall be used (except for pillow blocks).

07.03 DOCUMENTATION

1. List of drawings /data to be submitted along with tender
a. General arrangement drawing of gates showing overall dimension, profile, material of construction, weight etc.
b. List of commissioning spares proposed by the Tenderer.
c. List of spares for two years operation.
d. Duly filled up questionnaire.

2. **List of drawings to be submitted for approval by successful tenderer**

Drawings listed hereinafter shall be submitted to the Purchaser/ MECON for approval, starting within one month of issue of letter of intent and prior to the commencement of fabrication.

a) General arrangement drawing of gates showing overall dimension, profile, material of construction, weight, bill of materials etc.
b) In addition to the above, the Purchaser/ Consultant reserve the right to insist on submission of calculations/ for component selection.

3. **Drawing/data/calculation for reference to be submitted by successful tenderer**

- Procedure for testing and commissioning.
- Instruction for storage /erection, testing & commissioning.
- Catalogues/literatures
- Operation and maintenance manual.
- Final test certificates

a) For reference & records.
   i. Part list, bill of materials and specification.
   ii. Major sub-assembly drawings of drive, safety features, lubrication details etc.
   iii. List of spares, consumables, special tools and tackles.
   iv. Operation and maintenance manuals.

**07.04 Questionnaire**

The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

01. Name and address of the Tenderer : 
02. Previous experience of the Tenderer : 
03. List of similar equipment supplied along with user’s certificate : 
04. Location / Nos. off 
05. Designation 

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06. Capacity through

07. Material of construction of different parts

08. Total weight and weight of individuals parts

09. Type of liner and thickness

10. Motors

   a) KW rating :
   b) RPM :
   c) Type :

11. Gear Boxes

   a) Make :
   b) Type :
   c) Reduction ratio :
   d) Torque rating (kg-m) :
   e) Overall efficiency :
   f) Wt. of Gear box (kg) :

12. Couplings

   a) Make and type of high speed couplings :
   b) Make and type of low speed couplings :
   c) Weight (kg) :


08 WEIGH HOPPER

08.01 Scope Of Work

1. The scope of work of the Tenderer shall consist of design, engineering, manufacture, inspection, assembly, painting, supply and transportation to site, testing and commissioning of load cell mounted weigh hoppers, complete with rod gates, hydraulically operated gates, material Present Detector (MPD) and all accessories required.

The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

2. The scope of supply and services of the Tenderer shall include the following:
   a) Mechanical
      – Each equipment shall be complete in all respect including, its drive units, cables, safety switches, structural, mechanical and other standard accessories.
      – Provision of necessary fixtures, supporting angles and brackets required for mounting and supporting the equipment & drive with floor / bins.
   b) All Electricals and controls

08.02 TECHNICAL SPECIFICATION

1. Each weigh hopper shall be provided with 3 nos. compression type strain gauge/ pressductor load cells and gates/ feeders as required for the application and indicated in the Technical Specification Data Sheet elsewhere.

2. The weigh hoppers shall be fabricated out of 10 mm thick (minimum) M.S. Plates (IS:2062-1992) and shall be of welded construction with one bolted joint for ease of maintenance/handling. Inner surface of the hopper shall be provided with Stainless steel (SS- 409) liners. Liner plates shall be bolted to the mother plates. Size and shape be such that handling is convenient.

3. The weigh hoppers shall be designed to discharge the required materials onto the conveyors uniformly in the specified discharge time in normal feed as well as choked feed condition. Feeding to conveyor will be uniform throughout the discharge time.

08.03 ELECTRICAL DETAILS

1.1 Microprocessor based Individual Weighing Controller (IWCs) with digital display and keyboards – for Belt weigh feeders/ Loss in weigh feeders

1.2 VFD drive for speed control of AC motors of belt weigh feeders with necessary switchgears, incoming choke, output reactors if required, protective devices, communication links with IWC, input/output for remote start/stop, interlocking, indication lamps, controls, metering, potential free contacts for remote status indication like ON/OFF/TRIP/ converter fault (to be wired to PLCs), motor protective devices at field etc. Technical features of VFD drive shall be as per General specification for electrical system(GS-03).
1.3 Individual Belt Weigh feeder panels housing IWC (Intelligent weighing controllers) controller & VFD drive, DOL starters for vibrating hoppers interlocked with belt weigh feeders.

1.4 Microprocessor based Bin weight measuring panels with digital display and keyboards with auto taring and auto calibration facility. Bin Measurement panels housing IWC controller (IWC Controllers for more than one Bin can be combined in one panel).

1.5 Beltweigh scale panels (if any as per Mechanical scope) housing microprocessor based measuring indicator with digital display and keyboards with auto taring and auto calibration facility.

1.6 Provisions for Communication with DCS/PLC

   Belt Weight feeder IWC, Bin weigh measuring controller & Belt Weigh Scale IWC shall be able to communicate 100% with purchaser’s PLC/DCS on the plant communication bus as selected (like Profibus DP) by Tenderer.

1.7 Load cells, techogenerators, field junction boxes, limit switches etc. for Belt weigh feeders, Bin level measuring systems, Belt weigh scales (if any).

1.8 Common local control station for Belt weigh feeders & Vibrating hoppers (as applicable) housing Local /Off/Auto selector switches, Start/stop push buttons, speed increase/decrease, TPH indicators etc.

1.9 Local Indicator panels for Bin weighing control & Belt weigh scales (if any)

1.10 LT AC motors for belt weigh feeders & vibrating hoppers.

1.11 Calibration weights for belt weigh feeders.

1.12 Supply of dummy load cells for various Bunkers (BLMS system)

1.13 Features for Belt slip detection in case of weigh feeders, like tail end tacho or other suitable measures shall be provided by Tenderer.

2.1 DESIGN BASIS FOR BELT WEIGH FEEDER/LOSS IN WEIGH FEEDER

   The consistency of the feed rate shall be guaranteed within +/- 0.5% of the set value within the operating range of 10% to 100% of rated capacity. The weighing control shall be totally automatic with close loop control. The feed rates of different materials shall be calculated by the computer and set points of Belt weigh feeder shall be set by the computer through PLC. In case of computer failure manual setting (remote manual) and operation of feeders shall be possible.

2.2 CONTROLLER PANELS OF BELT WEIGH FEEDERS/LOSS IN WEIGH FEEDER PANEL

   The IWCs for control of Belt weigh feeders/ LIWs shall be microprocessor based having automatic weighing and calibration facilities. The system shall be complete with protection against overloading. Accuracy of Belt weigh feeders shall be +/-0.5% or better of preset feed rate.

   It shall be possible to operate the Belt weigh feeders under the following modes:

   Local - Volumetric
   Local - Gravimetric
   Remote - Gravimetric (remote manual/PLC automatic)

   Under remote mode of operation, following control shall be possible.
Remote - From IWC panel
Remote - From HMI station at BF control room.
Microprocessor shall be provided with each IWC as per standard design/system requirement. IWC shall generate signal for material feed rate in t/hours. The IWC shall compare the actual feed rate with the set point feed rate and generate a suitable correction for the VVVF converter of belt drive. The signal shall change the belt speed and accordingly provide the desired feed rate. It will be complete with auto calibration, auto tare, auto belt slip/drift monitoring facilities etc. The stored values after calibration shall not change due to power failure.
Belt Weigh feeder panel housing above IWC & VFD drive shall also be provided with following control equipment/facilities.

Main incoming MPCB/MCCB (50kA) for incoming power supply
Control transformer (415/110V) with MPCB (50kA) at primary, MCBs at secondary.
MPCB, Power contactor (min. 25A), thermal overload relay, necessary auxiliary contactors, ON/OFF/TRIP indication lamps for each motor of bin vibrating hoppers.
Necessary Power supply units, conversion equipment.
DP MCBs for incoming UPS power supply and its distribution to all panels.
Panel illumination lamps (fluorescent tubular).
Start/stop push button, selector switches as required.
Power ON indication.
Power and control terminals.

The IWC shall have following features (minimum)
Actual flow rate indicator.
Set rate feed indicator.
Totalised amount indicator.
Belt load indicator.
Belt speed indicator.
Deviation indicator.
Fault messages (separate lamps).
Operational mode selector switch for gravimetric/volumetric/calibration mode selection.
Auto taring & calibration.

Following displays and messages shall be possible for all the operating and calibrating functions:
Set point.
Normal/Maintenance/Calibration modes.
Actual feed rate.
Belt load (Platform load).
Belt speed.
Totaliser value.
Deviation error between set and actual feed rate.
Service data such as measured value, controller output, control signal level etc.
Event messages/fault messages.

The above shall be available on each IWC on digital display unit in central control room. Display and messages listed above shall also be made available on VDU of PLC/DCS.

Panel Construction features.
Floor mounted, free standing.
Dust and vermin proof.
CRCA sheet steel clad.
Minimum 2.0 mm thick for panels.
Suitable to withstand vibrations to be encountered in steel plant applications.
Cubicles with illumination lamps, door switches, space heaters and adequate sockets for soldering. All control blocks plug-in-type with necessary test sockets. Units shall be self-contained and serviceable. Power wiring - Min 2.5 sq.mm. Cu Control wiring - Min 1.5 sq.mm. Cu The panel door shall be provided with toughened glass in front of controllers for viewing of display units without opening the panel door. All control devices and indicators shall be mounted on the front. Two numbers earthing studs shall be provided with the panel for external earthing. All power, control, and signal terminals of different voltages shall be segregated. 20% spare terminals shall be provided in the panel.

3.1 BIN/WEIGH HOPPER LOAD CELLS AND LEVEL MEASURING SYSTEM:

Design Basis for Bin Level Measuring System
Load cells shall be of high precision strain gauge type, hermetically sealed, robust in design, shock proof and insensitive to overload, temperature, vibration, electrical noise etc. Enclosure class shall be IP 67
Load cell shall be provided with ambient temperature compensating device up to 55 deg. C. Provision shall be kept to neutralise the error caused due to application of transverse forces. Max. Measurement error permitted is +/- 1%

3.2 CONTROL PANEL FOR BIN LEVEL MEASUREMENT (BLM) HOUSING IWC

Bin level measurement system shall be microprocessor based having automatic weighing, taring and necessary calibration facilities. The system shall be complete with protection against overloading. Accuracy of weighing +/-0.1% or better. The controller shall have digital display and keyboards, indication, alarm, annunciation etc. It will be complete with auto calibration, auto tare facilities etc. The stored values after calibration shall not change due to power failure. The controller shall be complete with built-in power supply unit, CPU, program memory, A/D & D/A converters, etc. The above will be of modular design using standard PCBs and connectors. It should communicate actual weight/level, conditions for bin empty, level low, level high etc to Automation system.

4.1 BELT WEIGH SCALES

The IWPs for control of belt weigh scales shall be microprocessor based having automatic weighing and necessary calibration facilities. The system shall be complete with protection against overloading. Accuracy of belt weigh scale shall be +/-0.25% or better of flow rate. Microprocessor as per standard design/ system requirement shall be provided each IWP. Microprocessor shall multiply load cells and conveyor speed signal in digital form to generate signal for material conveying rate in T/Hours. It will be complete with auto calibration, auto tare etc. The stored values after calibration shall not change due to power failure. The following displays and messages shall be available for all the operating and calibrating functions:
Conveying rate in TPH.
Belt load (Platform load)
Belt speed.
Totaliser value.
Service data such as measured value, controller output, control signal level etc.
Event messages/fault messages.
Auto taring & Error corrections.
The above shall be available on each IWC on digital display unit. Display and messages listed above will be made available on VDU of in central control room.

Panel Constructional feature
Shall be same as for Weigh feeder panels.

5.0 DIGITAL TECHGENERATORS

It will be of robust construction and designed to give guaranteed accuracy of feed rate. It shall generate consistent output pulses of positive or negative polarity as applicable by accepting shaft rotation. The output pulses shall be suitable for feeding into high impedance electronic circuit/instrument for digital measurement and control. The enclosure class shall be IP 67. It will be provided with ambient temperature compensating device.

Arrangement of mounting of techogenerators and its coupling with AC motor shall be decided considering ease of maintenance.

6.0 LOCAL CONTROL BOX (LCB) FOR BELT WEIGH FEEDERS/LOSS IN WEIGH FEEDER & LOCAL INDICATION BOXES FOR BLMS & BELT WEIGHERS.

Each belt Belt weigh feeder/Loss in weigh feeder shall be supplied with a local box with following features.

Sheet steel (2.0mm thick) construction.
Wall/structure mounted type.
Hinged door, dead front type.
Enclosure class IP-55.
To be painted as per standard procedure agreed.
Internal wiring with 1.5 sq.mm copper conductor.
The box shall be wall/structure mounted type and be complete with cable glands and lugs.
The LCB shall be provided with the following:
Local – Off – Remote selector switch.
Start/Stop push buttons
Emergency stop push button (press to lock turn to release type)
Increase/decrease PB for speed setting
Feed rate actual (TPH meter – digital type).
Start/stop push button for bin vibrator
Indication lamps.
Any other device required for satisfactory operation of BWFs to be decided during detailed engineering.
Each local indication box for BLMS/Weigh Scales shall have digital indication of Bunker level/feed rate.

7.0 LOAD CELLS

Compression type suitable for weigh hoppers and material presence detectors on BF charging conveyer.
Enclosure class IP 67
Strain gauge/pressductor type
300% over load capacity.
Suitable for maximum 70°C.
Temperature compensation up to 50 deg C.
Capacity of the Load cell for BLMS system shall be as per details given under mechanical part. However, final rating of load cells shall have safety margin of minimum 150% of the rating calculated. Load cell accuracy 0.04%
Complete with excitation source, transmitter, amplifier, junction boxes, special cables, etc.
1. Drawings and documents to be submitted by the Tenderer with tender the Tenderer shall submit the following technical drawings & technical data/ information along with tender for weigh hopper without which the tender shall be considered as incomplete & may not be considered for acceptance.

   a. Drawing showing general arrangement of the equipment, general description of design consideration and all the assumption made by the supplier.

   b. Detailed specification for the equipment offered & mounting/ accessories etc., together with descriptive literature/ catalogues etc.

   c. Details of load cell such as type, rating, make and other details.

   d. Calculation substantiating selection of equipment.

   e. Specification of materials of construction of major parts/ components along with standards and chemical composition.

   f. Catalogues/leaflets for all equipment including bought-out items. Details of bought-out items with makes shall be given separately.

   g. G.A. drgs for the equipment/ system including sections and details giving relevant information, binding dimension.

   h. Standard/ special accessories being considered for supply along with the equipment.

   i. Requirement of tools and tackles for erection and maintenance.

   j. Requirement of utilities and services.

   k. The tenderer shall also duly complete the “Questionnaire” & submit along with the quotation without which the offer may not be considered.

2. List of drawing/documents to be furnished by the Successful Tenderer

The following drawing/ document are to be submitted by the Successful Tenderer within one month of placement of order:

   a. General arrangement drawing of equipment showing full details of weigh hoppers in plan and section along with design calculations.

   b. Quality assurance plan for inspection

   c. Requirement of tools and tackles for erection.

   d. Part list, bill of materials and material specification.

   e. Major sub assembly drgs., details of liner plates, safety features etc.

   f. List of spares, special tools and tackles.

   g. Operating and maintenance manuals.
3. **List of drawings/documents to be furnished along with equipment by the Successful Tenderer**

   a) All approved GA drawings, complete assembly and sub assembly drawings of the equipment.
   
   b) Drawing of all equipment/component received from sub suppliers.
   
   c) Engineering and design calculations.
   
   d) Test reports and inspection reports
   
   e) Instruction manuals for testing and commissioning
   
   f) Operation, maintenance and safety manuals in ten copies
   
   g) Requirement of special tools and tackles, if any, for subsequent maintenance
   
   h) Detail drawing and specifications of all wearing out parts and parts subject to breakage during normal operating conditions.
   
   i) List of spare parts with drawings, sketches, specifications and manufacturer’s catalogues.

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**08.05 QUESTIONNAIRE**

The Tenderer shall submit the following details along with the quotation of the equipment.

1. General arrangement drawing showing overall dimensions and mounting details of the hopper.
2. Capacity of weigh hoppers - effective and geometric
3. Material and liner of weigh hopper and thickness.
4. Details of feeding Chute to weigh hopper
5. Material & liner for Chute and thickness
6. Total weight of the equipment and weight of individual parts.
7. Weighing accuracy.
8. Weighing range.
10. Response time, repeatability.
11. Taring time, repeatability.
12. Load cell
   i. Make and type
   ii. Model No.
   iii. Quantity/hopper
   iv. Measuring principle
   v. Enclosure class - IP 67
   vi. Rated capacity
   vii. Details of output signal.
   viii. Deflection related to rated cap.
   ix. Rated output signal to rated cap.
   x. Zero unbalance related to rated cap.
   ix. Maximum temperature.
   xii. Compensated temp. range.
xiii. Temp. effect on zero unbalance
xiv. Temp. effect on related output
xv. Over load capacity
    - Safe limit
    - Ultimate limit
xvi. Accuracy
xvii. Hysteresis
xviii. Linear error

13. Connecting cable
    - Type of cable
    - Size of cable
09 BELT WEIGH SCALE

09.01 Scope Of Work

The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser’s site, unloading, handling and storage at site, insurance during storage, erection supervision, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics and standard accessories of electronic micro-processor based Belt Weigh Scales as covered under this specification.

The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

- Two years maintenance spares.
- Commissioning spares as required during testing and commissioning of the equipment.
- Insurance spares.
- Required quantity of initial fill of oil, grease, lubricants, hydraulic fluid etc. and other consumables which are necessary for cleaning/ flushing including erection, testing and commissioning the equipment shall be in the scope of supply of the Tenderer.
- Necessary tools and tackles for each equipment required for maintenance, testing or inspection of the equipment.

09.02 TECHNICAL SPECIFICATION

1. General

Belt weigh scale for measurement of flow rate and total-quantity shall be provided at specified locations as per relevant requirement as indicated in data sheets.. System shall be complete with flow rate indicator, totaliser, control panel etc.

2. Codes & Standards

The design, manufacture, inspection and testing of Belt Scales shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Belt Scales shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted.

IS:11547 Electronic weighing in motion system
3. **Equipment Specification**

The weigh scale shall be automatic and electronic type. It should be designed for continuous automatic weighing, metering of coal flow.

Each belt weigh scale shall comprise of a belt weigh scale platform with minimum 4 nos. weighing idlers. It shall have unitised construction for ease of installation and shall be fully floating type (without pivot points). Minimum 3 nos. hermetically sealed load cells of precision strain gauge type shall be applied in tension to support the weigh bridge. The load cells shall have 100% overload protection and shall be structurally safe upto to 250% of rated belt scale capacity.

Belt scale shall be electronic microprocessor based with its program stored in non-volatile memory.

It shall be provided with self diagnostic features for trouble shooting of the entire belt scale system.

Fully automatic zero and span calibration facility shall be provided. The electronic systems offered by the Bidder shall include all signal conditioning, power amplifiers and printed circuits etc. The printed circuits shall be encapsulated against dust and moisture.

Belt scale shall be provided with flow rate total quantity etc. Remote flow rate indicators shall also be provided in the Central Control Room (CCR).

The flow rate indicator shall have minimum 4 digits. The flow totalizer should have 8 digits display scale with reset facility.

Complete belt scale system shall be suitable for 50°C ambient temperature and 100% relative humidity. It shall be suitable for out door installation in a dusty area. The electronic circuit enclosure, sensors housing shall be dust and watertight. The electronic printed circuits shall be encapsulated with epoxy or other suitable material for protection against dust and moisture.

Minimum three years battery back up power failure protection shall be provided.

Belt scale shall be designed for a range of 20% to 120% of rated capacity with an accuracy of at least ±0.5% throughout its range.

Supply of test weights for calibration of belt scales shall be the tenderer’s responsibility.

Local panel for belt belt scale shall be of sheet metal.

Other Electrical details shall be as given under cl.no. 08.03 :Electrical Details

**09.03 DOCUMENTATION**

1. **List of drawings /data to be submitted along with tender**
   
a. General arrangement drawing with bill of material of equipment showing overall dimensions.

b. Supplier’s name for components & catalogues for these items shall be furnished.

c. List of commissioning spares proposed by the Tenderer.
d. List of recommended spares for two years maintenance of plant and equipment.

e. List of tools and tackles to be supplied with the plant and equipment.

f. Duly filled up questionnaire.

2. **List of drawing/documents to be furnished by the Successful Tenderer**

   The following drawing/document are to be submitted by the Successful Tenderer within one month of placement of order:

   a. General arrangement drawing of equipment showing full details of BWS.

   b. Quality assurance plan for inspection

   c. Requirement of tools and tackles for erection.

   d. Part list, bill of materials and material specification.

   e. Major sub assembly drgs., safety features etc.

   f. List of spares, special tools and tackles

   g. Operating and maintenance manuals.

3. **List of drawings/documents to be furnished alongwith equipment by the Successful Tenderer**

   a) All approved GA drawings, complete assembly and sub assembly drawings of the equipment.

   b) Drawing of all equipment/component received from sub suppliers.

   c) Engineering and design calculations.

   d) Test reports and inspection reports

   e) Instruction manuals for testing and commissioning

   f) Operation, maintenance and safety manuals in ten copies

   g) Requirement of special tools and tackles, if any, for subsequent maintenance

   h) Detail drawing and specifications of all wearing out parts and parts subject to breakage during normal operating conditions.

   i) List of spare parts with drawings, sketches, specifications and manufacturer’s catalogues.

09.04 **Questionnaire**

<table>
<thead>
<tr>
<th>Type</th>
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<tr>
<td>Operation</td>
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</tbody>
</table>
No. of floating idlers : 
Load Cells Details : 
Overload protection 
Capacity : 
Flow Rate Indicator 
Flow totalizer 
Accuracy : 
Calibration :
10 VIBRATION ISOLATION SYSTEM

10.01 Scope

- This specification broadly covers design, engineering, supply and erection of vibration isolation system for crushers and other such equipment.
- Scope shall include all steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring unit dampers like steel shims, adhesive pads etc.
- All frame(s) pre-stressing of spring elements.
- Static and dynamic analysis of the vibration isolation system with the RCC top deck and the crusher shall also be included.

10.02 Codes and Standards

For the design of crusher foundations, the latest revisions of following codes shall also be referred:

(ii) IS: 2974 (Part-IV) -1979 code of practice for design and construction of machine foundations - Foundation for rotary type machines of low frequency.
(iii) IS: 1893-1991 (Criteria for earthquake resistant design of structures).

10.03 Technical Specification

- Detailed dynamic analysis shall be done for the top deck together with springs and dampers and natural frequencies & amplitudes of vibration shall be determined. A mathematical model of top deck shall be formulated with three-dimensional beam / plate finite elements for the purpose of analysis with the springs idealized with vertical and horizontal stiffness. The mass of the machine together with the top deck shall be considered for analysis.
- Natural frequency upto at least 10% above the operating frequency shall be determined and these frequencies shall be checked against the design criteria. Forced response dynamic analysis shall be carried out for the operating condition, unbalance forces using a sinusoidal forcing function. Unbalance forces as applicable for the crusher, shall be used for the purpose. The dynamic forces from the analysis shall be used for structural design with suitable fatigue factor.
- The vibration isolation system shall be designed for at least 90% isolation efficiency.
- Spring system being supplied shall be of such stiffness that a ratio of at least 10 (ten) should be possible to be adopted for the stiffness of supporting structure with respect to the stiffness of the spring system in each direction to achieve decoupling between the two (The stiffness of spring system being lower).
The foundation system shall be designed such that a **frequency ratio** (ratio of operating frequency to the fundamental natural frequency) of at least 3.5 is achieved. In addition, the first bending frequency of the RCC deck shall be 20% above the operating frequency.

The calculated amplitudes shall not exceed following limits under the specified conditions.

- **b)** 250 microns in case of one millimetre eccentricity in the rotor.
- **c)** 250 micron mean-to-peak for unbalance in case of one hammer broken condition.
- **d)** Amplitudes need not be checked for three hammers broken condition. It is sufficient to check static strength under this condition.

The amplitude limits mentioned above are in both vertical and horizontal directions. The amplitudes shall be calculated at critical points on the top surface of the RCC deck. The amplitudes shall be checked for the most unfavourable superposition of modes in any direction. However, phase difference between the maximum amplitudes occurring in different directions due to the rotating vector may be considered while superimposing the modes.

Transient resonance, which may occur during the start-up or coasting down condition of the crusher, shall be checked and the amplitudes in such a condition should not exceed one-and-half times those at operating speed for each design condition.

The following criteria shall apply for the design of the top deck:

- **a)** Dead loads, live loads, seismic loads and dynamic loads shall be considered for the design. The most unfavourable combination shall be considered for design.
- **b)** Seismic loads shall be assumed to act together with dynamic loads for a one-millimetre eccentricity in the rotor. However, seismic loads and dynamic loads arising out of hammer breakage need not be considered together.
- **c)** Fatigue shall be considered while designing for dynamic forces. A fatigue factor of 2.0 shall be used on all dynamic forces to arrive at the equivalent static force for the purpose of design.
- **d)** Working stress method shall be used for the design of RCC deck. In survival condition, 10% overstressing may be permitted.
- **e)** The RCC top deck shall be of M-25 grade of concrete as per IS: 456:1978.
- **f)** Fatigue need not be considered for the three hammers broken condition.
- **g)** For calculating unbalance forces, the heaviest hammer (plain or toothed) shall be considered.

The vibration isolation system, all accessories and the supporting structure shall be designed to withstand seismic loading in addition to dead loads, live loads and dynamic loads. The seismic co-efficient shall be taken as per the zone defined by IS: 1893-1991 criteria for earthquake resistant design.

**10.04 DOCUMENTATION**

1. **List of drawings /data to be submitted along with tender**

   a) General arrangement & Sections drawing of vibration isolation system showing overall dimension and details.

   b) Name of supplier.
c) Duly filled up questionnaire.

2. **List of drawings to be submitted for approval by successful tenderer**

   Drawings listed hereinafter shall be submitted to the Purchaser/MECON for approval, starting within one month of issue of letter of intent and prior to the commencement of fabrication.

   a) General arrangement drawing of the vibration isolation system showing overall dimension and details including bill of material etc.

   b) Static and dynamic analysis of the vibration isolation system with the RCC top deck and the crusher shall also be included.

   c) All calculations.

   d) In addition to the above, the Purchaser/Consultant reserve the right to insist on submission of calculations for component selection.

3. **Drawing/data/calculation for reference to be submitted by successful tenderer**

   a) General arrangement drawing of the vibration isolation system showing overall dimension and details including bill of material etc.

   b) Static and dynamic analysis of the vibration isolation system with the RCC top deck and the crusher shall also be included.

   c) All calculations.

   d) Procedure for testing and commissioning.

   e) Catalogues/literatures

   f) Operation and maintenance manual.

10.05 **Questionnaire**

   The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

   01. Name and address of the Tenderer :

   02. Previous experience of the Tenderer :

   03. List of similar equipment supplied along with user’s certificate :

   04. Location / Nos. off

   05. Equipment for which intended :

   06. Material of construction of different parts:

   07. Building in which the VIS is located :

   08. Total weight and weight of individuals parts:
11 TRAVELLING TRIPPERS AND BUNKER SEALING ARRANGEMENT

11.01 Scope

1. The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser’s site, unloading, handling and storage at site, insurance during storage, erection supervision, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics and standard accessories of Travelling /Trippers & Bunker Sealing Arrangement, as covered under this specification.

2. The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

3. The scope of supply and services of the Tenderer shall include the following:
   a) Mechanical
      – Each equipment shall be complete in all respect including, its drive units, cables, safety switches, structural, mechanical and other standard accessories.
      – Provision of necessary fixtures, supporting angles and brackets required for mounting and supporting the equipment and feed chute.
   b) Electricals and controls

4. Two years maintenance spares.

5. Commissioning spares as required during testing and commissioning.

6. Insurance spares.

7. Required quantity of initial fill of oil, grease, lubricants, hydraulic fluid etc. and other consumables which are necessary for cleaning/flushing including erection, testing and commissioning the equipment shall be in the scope of supply of the Tenderer.

8. Necessary tools and tackles for each equipment required for maintenance, testing or inspection of the equipment.

9. Statutory approval wherever required shall be taken by the Tenderer for the equipment being supplied by them from relevant state/central authorities.

10. The scope of work shall stand supplemented by such details as are given in this specification, tender drawing, and instruction to the Tenderer, General Conditions of Contract (GCC), or any other part of the document.
11.02 Technical Specification

1. The tripper shall be designed as per IS: 14386-1996.

2. Travel drive of trippers shall be individual wheel drive, independent of the main conveyor drive and shall be through electric motor, helical gear box etc. Chain drive shall not be used. Tripper shall be provided with D.C. electro-magnetic brake for stopping the same at desired location. Travel speed of trippers shall not exceed 0.2 m/sec

3. The traveling tripper shall consist of belt scraper with adjustable rubber strip, rubber lagged head and bend pulleys complete with shaft bearings, chutes, stops and limit switches, brakes etc. The tripper shall have two-way discharge chute which shall be capable of discharging material into the bunker openings.

4. Traveling trippers shall be of adequate length with proper slope of conveyor idlers to match with the flow properties of material being handled. The maximum inclination of the conveyor belt on the tripper shall not be more than 12°.

5. Vertical and horizontal guide rollers shall be provided to control sway and uplift of the belt in unloaded condition. The tripper shall run on standard flat bottom Indian Rails at least of 60 lb/yd. Wheels shall be double flanged with parallel tread running on anti-friction bearings and shall have min hardness of 350 BHN. Material of wheel shall be forced steel / cast steel.

6. Traveling trippers shall be equipped with manually operated rail clamps and rail cleaners and jacking pads.

7. Diverter gates on two way or three way chutes shall be electrically operated.

8. Power supply to the tripper shall be given through motorized cable reeling drum with trailing cables, cable trays for resting the trailing cables and end limit switches for protection against over travel of the tripper. The cable reeling drum and trailing cable of each tripper shall be suitable for the entire length of the bunker bay. The cables shall have copper conductors, proper insulating material and braided armoring in accordance with IS: 691.

9. Position indicators shall be provided as per requirement of control logic. Operating push buttons for local control and emergency stop shall be within easy reach of the operator on the main conveyor walk way.

10. All stipulation regarding belt pulley, belt scraper, idlers, safety guards, wind guard, access for maintenance etc. specified for belt conveyors, diverter gates and discharge chutes shall be applicable for the traveling tripper.

11. The rating of tripper travel motor shall be adequate to move the tripper smoothly either in forward or opposite direction to belt direction under fully loaded conditions. Coefficient of friction shall be taken as maximum 0.15.

12. Minimum two drive axles shall be provided for tripper travel. Arrangement shall be provided at the starting point of the tripper to avoid folding of belt.

13. Provision shall be kept for automatic tripping of bunker bay conveyor in event of traveling tripper getting dragged (i.e. travel speed in excess of rated speed).
14. The supporting structures for the rails with necessary end stops shall also be supplied under this specification. Suitable belt hold down guide pulley shall be provided over the concave curve of belt over tripper.

15. The bunker sealing arrangement shall keep the bunkers sealed and prevent dust emission into tripper room.

16. Separate openings shall be provided on the bunker floor of each bunker to measure level of material in the bunker. Hinged door/flaps shall be provided on these openings.

17. Suitable gratings are to be provided in between bunkers in the tripper travel zone. Opening size shall be decided during the detail engineering stage.

18. Suitable dust cover shall be provided over tripper head pulley. Serrated rubber seal shall be provided at open side to prevent dust nuisance. Suitable dust tight access doors shall be provided. Counter weighted type belt cleaner shall be provided below the tripper head pulley to cleaning the carrying side of the belt.

19. Suitable access platform of Chequered plate with ladders, hand railings and walkways on both sides shall be provided for access/maintenance of equipment on tripper. Also crossover platform shall be provided with tripper so that operator can cross the belt through the same.

20. Continuous deck plates shall be provided below carrying idlers on the trippers.

11.03 DOCUMENTATION

1. Drawings/document to be supplied by the Tenderer

a) General arrangement drawing of Mobile Tripper showing overall dimension, profile, idler spacing, LT drive arrangement, motor kW etc. along with chutes, scraper, skirt boards, switches, wheel load, wheel spacing, wheel diameters, power supply arrangement for travel drive etc.

b) Details of bought-out items & component list.

c) List of commissioning spares proposed by the Tenderer.

d) List of recommended spares for two years maintenance of the equipment.

e) Duly filled up questionnaire given below.
2. Drawings / documents to be supplied by the successful bidder for approval.

a) For approval.

General arrangement drawing showing the following:

i. Constructional feature.

ii. All dimensions and technical parameters as per technical specification.

iii. LT drive & their arrangement

iv. Motor ratings.

v. Speeds.

vi. Maintenance and repair provision.

vii. Operating weight.

viii. Any other information for making the GA drawing complete.

b) For reference / records.

i. Major sub-assembly drawings of drives, safety features, lubrication arrangement etc.

ii. List of spares, consumables, special tools & tackles.

iii. Operation & maintenance manuals.

11.04 Questionnaire (To be filled by by Tenderer)

1. The Tenderer shall also furnish the following questionnaire and submit with his offer. This data shall form a part of the contract with Successful Tenderer.

General

01 Name and address of the Tenderer : 

02 Previous experience of the Tenderer : 

03 List of similar equipment supplied : 

04 Tripper Details

05 Sealing belt details : 

06 List of drgs./ literatures enclosed with the offer. : 

07 Drive details
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<td>a)</td>
<td>KW rating :</td>
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<td>b)</td>
<td>RPM :</td>
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<td></td>
<td>a) Type :</td>
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<td>b) Bearing</td>
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<td>Expected life (hrs) :</td>
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<tr>
<td>a)</td>
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</tr>
<tr>
<td>b)</td>
<td>Type :</td>
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<tr>
<td>c)</td>
<td>Reduction ratio :</td>
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<tr>
<td>d)</td>
<td>Torque rating (kg-m) :</td>
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<tr>
<td>e)</td>
<td>Overall efficiency :</td>
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<td>f)</td>
<td>Wt. of Gear box (kg) :</td>
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<th>Couplings</th>
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<tr>
<td>a)</td>
<td>Make and type of high speed couplings :</td>
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<tr>
<td>b)</td>
<td>Make and type of low speed couplings :</td>
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<tr>
<td>c)</td>
<td>Weight (kg) :</td>
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<th>Belt cleaners – type</th>
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<tr>
<td></td>
<td>Weight (kg) :</td>
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12 IN LINE MAGNETIC SEPARATOR (ILMS)

12.01 Scope Of Work

- The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser’s site, unloading, handling and storage at site, insurance during storage, erection supervision, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics and standard accessories of **In-Line Magnetic Separator** as covered under this part of the specification.

- The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

- The scope of supply and services of the Tenderer shall include the following:
  
a) Mechanical
     - Each equipment shall be complete in all respect including, its drive units, cables, safety switches, structural, mechanical and other standard accessories.
     - Provision of necessary fixtures, supporting angles and brackets required for mounting and supporting the equipment.
  
b) Electricals

- All fixing bolts and nuts including foundation bolts shall be included in the scope of supply of Tenderer.

- Two years maintenance spares.

- Commissioning spares as required during testing and commissioning of the equipment.

- Insurance spares.

- Required quantity of initial fill of oil, grease, lubricants, hydraulic fluid etc. and other consumables which are necessary for cleaning/flushing including erection, testing and commissioning the equipment shall be in the scope of supply of the Tenderer.

- Necessary tools and tackles for each equipment required for maintenance, testing or inspection of the equipment.

- Statutory approval wherever required shall be taken by the Tenderer for the equipment being supplied by them from relevant state/central authorities.

- The scope of work shall stand supplemented by such details as are given in this specification, tender drawing, and instruction to the Tenderer, General Conditions of Contract (GCC), or any other part of the document.
12.02 TECHNICAL SPECIFICATION

- General

Inline Magnetic Separators shall be provided for continuous and automatic extraction and discharge of tramp magnetic pieces from coal being discharged from conveyors as specified. The sets shall be complete in all respects with motor, drives, magnets, in line belts, hoppers, chutes, tramp-iron boxes and all electrical ancillaries like control panels etc. Inline Suspended Magnetic Separator (ILMS) shall be provided for picking up tramp magnetic pieces buried under coal from moving coal over Conveyor as specified.

- Codes & Standards

The design, manufacture, inspection and testing of In line Magnetic Separators shall comply with all the currently applicable statutes, regulations and safety codes in The Magnetic Separators shall conform to the latest edition of standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility.

- Equipment Specification

Magnet core material shall be pure annealed iron or equivalent high permeability magnetic material. The coil shall be of aluminum wire with class ‘H’ insulation, to limit the absolute temperature of the winding to 140 deg. centigrade. The ILMS shall be silicon oil cooled.

The ‘Force Index’ i.e. the product of flux density in gauss and rate of change of flux density w.r.t. distance, at the bottom of falling material trajectory shall be 100,000 (gauss x gauss/inch) minimum in hot condition for mounting height of 400 mm. However, the strength of the magnet shall not be less than 1000 gauss in hot running condition at 400 mm distance. The minimum strength of the magnet shall be 1000 gauss at the specified mounting height at the centre of Belt width. Bidder shall to select magnet width to suit above.

Mounting height of 400 mm shall be taken between top of conveyor belt or bottom of falling material trajectory and the surface of magnetic separator belt. Characteristic curve of magnet with the value of flux density varying between 50 mm to face of conveyor belt shall be provided. The cross section of magnet shall be suitably designed to provide sufficient area for magnetising the coil effectively covering full cross section of the discharge material. The magnetic separator shall be located such that it picks-up tramp iron from coal trajectory after it has been discharged from head pulley.

The tramp magnetic pieces buried under coal picked up by the magnetic separator shall be discharged suitably to ensure that it falls into the tramp iron chute, which shall be provided upto ground level. All conveyors with magnetic separator at head end shall have non-magnetic SS pulleys and shafts.

The motor and the gear reduction unit for driving the in-line belt shall be adequate sized with minimum 20% margin to avoid any over loading during operation. Suitable zero speed switch shall be provided. No Chain/belt drives shall be accepted.

The belt shall be designed to withstand high temperature at the bottom of the magnet and any serious damage due to the impact of the sharp edges of the tramp iron. The belt shall be provided with rubber cleats spaced suitably. The belt shall be of fire resistant grade. Side rollers shall be provided to keep the belt aligned.
The idlers and the pulleys supporting the belt shall be manufactured to the best engineering practices and shall conform to relevant Indian Standards

Material to be separated as tramp iron by ILMS:
- The maximum weight of 50 Kg having 'L/D' > 5 of iron or steel piece of any shape (except sphere) below the material heap of 250 mm.
- MS round bar with 'L/D' > 5
- MS Bolt ‘L’ = 5 X Diameter.
- MS Nuts with Diameter ‘L/D’ > 10 mm

• Construction Requirement

The magnetic separator units shall be supported by suitable structural member from the top by taking support from the operating floor beams with turn buckle arrangement to facilitate the necessary adjustments during operation.

ON/OFF control push buttons with indicating lamps shall be provided at the local station. The materials of chutes and hoppers associated below the ILMS shall be SS-304 in the magnetic zone. Other chutes shall be made of MS

Suitable arrangements shall be provided in the magnet for keeping the coil of the magnet dry from atmospheric condensation when the magnetic separator is not in use.

12.03 Documentation

1. List of drawings /data to be submitted along with tender
   a) General arrangement drawing with bill of material of equipment showing overall dimension, motor kW (if any), drive arrangement etc. details of limit switches along with load data, weight etc.
   b) Supplier’s name for components (like motors, coupling, gearbox etc.) catalogues for these items shall be furnished.
   c) List of commissioning spares proposed by the Tenderer.
   d) List of recommended spares for two years maintenance of plant and equipment along with itemised price.
   e) List of tools and tackles to be supplied with the plant and equipment.
   f) Duly filled up questionnaire given

2. List of drawings /data to be submitted by successful tenderer
   a) General arrangement drawing with bill of material of equipment showing overall dimension, motor kW (if any), drive arrangement etc. details of limit switches along with load data, weight etc.
b) Supplier’s name for components (like motors, coupling, gearbox etc.) catalogues for these items shall be furnished.

c) List of commissioning spares proposed by the Tenderer.

d) List of recommended spares for two years maintenance of plant and equipment along with itemised price.

e) List of tools and tackles to be supplied with the plant and equipment.

12.04 **QUESTIONNAIRE**

Type : 
Suspension device : 
Location of ILMS : 
Force index (As defined earlier) :
Strength of magnet at the specified mounting height :
Mounting height :
Weight of total assembly :
Magnetic Separator belt :
   (i) Drive Unit 
   (ii) Belting 
   (iii) Discharge 

Tramp Iron Items :
   (i) MS cube of 20 mm size 
   (ii) Brake shoe of Railway Wagon (Cast Iron15 Kg.) 
   (iii) MS plate of 250 x 250 x 100 mm size. 
   (iv) Shovel Teeth and spikes. 
   (v) MS round bar of 50 kg with L/D ratio not exceeding 5 

Control :
Magnetic Cooling system :
Location of silicon rectifier unit :
13 METAL DETECTOR

13.01 Scope Of Work

The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser’s site, unloading, handling and storage at site, insurance during storage, erection supervision, testing, inspection, commissioning, guarantee testing and handing over to the client including all electrics / electronics / microprocessors and standard accessories of Metal Detector as covered under this specification.

The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

- The scope of supply and services of the Tenderer shall include the following:
  a) Mechanical
    - Each equipment shall be complete in all respect including, its drive units, cables, safety switches, structural, mechanical and other standard accessories.
    - Provision of necessary fixtures, supporting angles and brackets required for mounting and supporting the equipment.
    - The Tenderer shall also include supervision services at site during erection, testing and commissioning of the equipment supplied by them.
  b) Electricals
    - All fixing bolts and nuts including foundation bolts shall be included in the scope of supply of Tenderer.
    - Two years maintenance spares.
    - Commissioning spares as required during testing and commissioning of the equipment.
    - Insurance spares.
    - Required quantity of initial fill of oil, grease, lubricants, hydraulic fluid etc. and other consumables which are necessary for cleaning/flushing including erection, testing and commissioning the equipment shall be in the scope of supply of the Tenderer.
    - Necessary tools and tackles for each equipment required for maintenance, testing or inspection of the equipment. The list of such tools and tackles shall be furnished and included in offer.
    - Statutory approval wherever required shall be taken by the Tenderer for the equipment being supplied by them from relevant state/central authorities.
    - The scope of work shall stand supplemented by such details as are given in this specification, tender drawing, and instruction to the Tenderer, General Conditions of Contract (GCC), General Technical Specification (GTS) or any other part of the document.
13.02 TECHNICAL SPECIFICATION

- **Codes & Standards**

  The design, manufacture, inspection and testing of Metal Detectors shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The Metal Detectors shall conform to the latest edition of standards codes, which ensure equal or higher performance than those specified, shall also be accepted. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility.

- **Equipment Specification**

  Metal detectors shall have high reliability with enough sensitivity to detect 25 mm aluminium sphere below the burden of material. It shall also detect other metals like brass, copper, stainless steel, manganese steel, bars, scraps etc.

  The equipment shall have provision for automatic static calibration with adjustable sensitivity.

  Metal detectors shall be completely solid state using latest state of art technology. It shall be suitable for 50°C ambient and RH of 100%. The search sensor shall be protected from rain and direct sunlight by means of a non metallic covering other than wood. Control unit shall have adjustable controls for sensitivity, ON/OFF push buttons, reset table operation counter, audio-visual alarms local remote selector switch and all other necessary controls for trouble free operation of metal detector. It shall be suitable for mounting on wall, column, structure, etc. with IP-65 degree of protection. It shall be constructed from FRP of thickness not less than 2 mm.

  The metal detectors shall also have the following features:

  - The coils shall be protected against being struck by an oversized material/ coal.
  - In order to counteract interference from external sources such as motors, lighting and radio-transmitters, and to nullify the effect of climate changes/ aging, dual receiver coils are to be used.
  - In order to allow passing of metal belt fasteners without giving alarm and at the same time detection tramps, suitable arrangements shall be provided.
  - In case a few non-magnetic idlers or non magnetic deck plates are required, the bidder shall provide these. However, these shall be metallic. Wood is not be used.
  - LED display of COAST COUNT to indicate the number of pieces of tramp iron detected since last reset shall be provided so that the operator is alerted for the pieces of tramps, if any, between tramp marker and coil before restoring conveyor.
  - TOTAL COUNT, which is not resettable, shall also be provided on the same LED display on demand.
  - The location of tramp metal pieces shall be indicated by liquid colour spray.
  - Construction Requirement

    Fiber glass enclosure (with IP-65 degree of protection) shall be provided for all type of coils.
Suitable tramp metal markers shall be provided.

Local control panel shall be provided with IP-65 degree of protection.

13.03 Documentation

1. List of drawings /data to be submitted along with tender
   a) General arrangement drawing with bill of material of equipment showing overall dimension and details.
   b) Supplier's name for components & catalogues for these items.
   c) List of commissioning spares proposed by the Tenderer.
   d) List of recommended spares for two years maintenance of plant and equipment.
   e) List of tools and tackles to be supplied with the plant and equipment.
   f) Duly filled up questionnaire.
   g) The Tenderer has to furnish one copy of the specification drawing duly signed by him as a token of acceptance along with the list of deviation from tender documents.

2. List of drawings /data to be submitted by the successful tender
   f) General arrangement drawing with bill of material of equipment showing overall dimension & details.
   g) Supplier's name for components & catalogues for these items shall be furnished.
   h) List of commissioning spares proposed by the Tenderer.
   i) List of recommended spares for two years maintenance of plant and equipment along with itemised price.
   j) List of tools and tackles to be supplied with the plant and equipment.

13.04 Questionnaire

Type & Name of Supplier
Sensitivity
Enclosure
Control
Calibration
Tramp metal markers
14 CHARGING HATCH

14.01 SCOPE OF WORK

The scope of work of the Tenderer shall include design, engineering, manufacture, fabrication, assembly, testing and inspection, packing, dispatch, transportation, delivery FOR Purchaser’s site, unloading, handling and storage at site, insurance during storage, erection supervision, testing, inspection, commissioning, guarantee testing and handing over to the client including all standard accessories of Charging Hatches.

The scope of the Tenderer shall be deemed to include all such items which although are not specifically mentioned in the specification, but are needed to make the equipment complete in all respect for its safe, reliable, efficient and trouble free operation.

- The scope of the Tenderer shall also cover inclusion of necessary fixtures, supporting angles and brackets required for mounting the charging hatches.
- Necessary sealing work required for arresting the dust shall also be under the scope of the Tenderer.
- The scope of work shall stand supplemented by such details as are given in this specification and instruction to the Tenderer, General Conditions of Contract (GCC), or any other part of the document.

14.02 TECHNICAL SPECIFICATION

Charging hatches are meant for hermetically dust sealing of bunkers during feeding of materials by feeding conveyors.

- The working principle of charging hatches shall be as follows:

Raw materials after being discharged from conveyor shall fall into the respective bunkers through charging hatches. When material is discharged at any section of the inclined removable slide plate by a shuttle belt conveyor, the pressure generated by the falling material shall be able to push the respective curtain plates to make the required opening for being fed to bunker.

The flaps of charging hatch, normally closed, shall open under dead weight of material and close of its own under gravity after the materials falls into bunker. Thus the dust emitted by falling material is hermetically sealed.

The charging hatch assembly shall rest on the Insert Plates provided in the respective bunkers.

The plate used shall be of Mild Steel construction and minimum 10 mm thick. Diameter of the cross rods shall be minimum 32 mm.

There shall be only one uniform size of charging hatches for all the bunkers.
14.03 DOCUMENTATION

1. Drawing and documents to be submitted with tender

The Tenderer shall submit following technical drawings & technical data/ information with tender for charging hatches without which the tender shall be considered as incomplete & may not be considered for acceptance.

a) General description of design consideration and all the assumption made by the supplier.

b) Typical GA drgs for the equipment/ system including sections and details giving relevant information, binding dimension etc.

c) Standard/ special accessories being considered for supply along with the equipment

d) The questionnaire filled in

2. List of drawing/documents to be furnished by the Successful Tenderer

h. General arrangement drawing of equipment showing full details of charging hatches in plan and section along with design calculations.

i. Quality assurance plan for inspection

3. List of drawings/ documents to be furnished alongwith equipment by the Successful Tenderer

1. All approved GA drawings, complete assembly and sub assembly drawings of the equipment.

2. Drawing of all equipment/ component received from sub supplier.

3. Engineering and design calculations.

4. Test and warranty certificate for each item of equipment.

5. Test reports and inspection reports.

6. Instruction manuals for testing and commissioning.

7. Operation, maintenance and safety manuals.
14.04 QUESTIONNAIRE

1. Make

2. Nos of charging hatches offered / length of each hatch :

3. Gross weight of each charging hatch :

4. Material of construction of charging hatch plate

5. Liner materials used, type, thickness, fixing arrangement

6. Any other information as the Tenderer thinks necessary for installation, operation and maintenance of equipment
15 CRANES AND HOIST

15-A FOUR/Double Girder EOT Crane

15-A.01 The scope of work covers design, manufacture, fabrication/assembly, shop testing, painting, supply, storage, erection, testing & commissioning of cranes complete with electicals and standard accessories with attachments to be installed as covered in data sheets in Technical Specifications. Relevant codes and practices for the cranes shall be used for SAIL units relevant IPSS shall be used unless otherwise stated.

- All the equipment shall be of reputed make and proven quality with regard to their performance. The make shall be as per approved list of Purchaser/Consultant.

- The crane shall be inspected and tested during different stages of its manufacture (starting from raw materials till the completion of the crane) by the Purchaser/ his authorized representative at the Supplier's or his sub-supplier's works as per the inspection procedure mutually agreed between the Purchaser or his authorized representative and the Supplier. Inspection shall be regarded as a check up and shall be in no way binding on the Purchaser.

15-A.02 TECHNICAL SPECIFICATION

01 General

i) EOT cranes shall be designed, manufactured and tested in accordance with the latest revision of IS: 807-1976, 3177-1999, 4137 and IPSS.

ii) The crane components shall be standardized to keep the number of spares to the minimum.

iii) All parts requiring replacement or inspection or lubrication shall be easily accessible without the need for dismantling of other equipment or structures. All electrical cables shall be so laid that they are not liable to be damaged and can be easily inspected and maintained and when necessary any damaged cable can be accessed and replaced individually.

iv) All components for cranes of identical capacity and duty shall be interchangeable. Cranes of the same capacity and duty shall be identical in all respect unless otherwise required.

v) No cast iron parts shall be used except for electrical equipment and no wood or other combustible material shall be used unless specifically mentioned otherwise. Deviations, if any, to this clause shall be permitted only with the specific approval of the Purchaser.

vi) All machinery or equipment included under this specification must be equipped with safety devices and clearances to comply with recognized standards and Purchaser's requirements along with safety codes and statutes prevalent at the place of installation of the equipment.

vii) For welded construction such as that of bridge girders, end-carriages, rope drums, gear-boxes etc. steel shall be as per IS: 2062-1992 quality. For welding these members low hydrogen electrodes shall be used.

viii) All wheels, couplings, open gears etc. shall be provided with covers, opening on strong hinges. All heavy covers shall be provided with inspection windows.

ix) Where down shop leads are located below runway rails, guards shall be provided on the crane to prevent the hoist ropes from coming in contact with down shop leads.
x) All bolts except those with nyloc nuts shall be provided with grip lock nuts or spring washers.

xi) For outdoor cranes all electrical and mechanical equipment which are exposed to weather shall be completely covered or made weather proof. The covers shall be segmental to facilitate easy dismantling and assembly.

xii) The end-carriages shall be fitted with substantial safety stops to prevent the crane from falling more than 25 mm in the event of breakage of a track wheel, bogie or axle. These stops shall not interfere with the removal of wheels.

xiii) Fasteners for pedestal blocks, motors, gear-boxes etc. shall be easily removable from the top. Studs or body bound bolts shall not be used as fasteners for mechanical items except for fixing cover.

xiv) Power & control cables shall be clamped in-groups separately. All trailing cables shall be clamped with PVC or non-metallic clamps. Group de-rating factor shall be appropriately taken according to the recommendations of the cable manufacturers based on the method of laying and number of cables being laid together.

xv) Guards of approved design, which will push forward off the track, any object placed across it, shall be attached to each end of the end carriages.

xvi) Parts of steel frames carrying machinery shall be provided with doubling plates of adequate thickness, riveted or welded and machined to true surface.

xvii) Defects in the material like fractures, cracks, blow holes, lamination, pitting etc. are not allowed. Rectification of any such flaw is permissible only with the approval of the Purchaser.

02 Tolerances: The Tenderer / Supplier shall ensure that the crane shall be manufactured as per the tolerances specified below:

<table>
<thead>
<tr>
<th>Tolerance Description</th>
<th>Tolerance Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Span over LT wheels</td>
<td>± 6 mm upto 40 metres</td>
</tr>
<tr>
<td>(ii) Wheel base</td>
<td></td>
</tr>
<tr>
<td>• LT</td>
<td>± 5 mm</td>
</tr>
<tr>
<td>• CT</td>
<td>± 3 mm</td>
</tr>
<tr>
<td>(iii) Difference in diagonal</td>
<td></td>
</tr>
<tr>
<td>• LT</td>
<td>± 5 mm</td>
</tr>
<tr>
<td>• CT</td>
<td>± 3 mm</td>
</tr>
<tr>
<td>(iv) Long travel wheel alignment</td>
<td></td>
</tr>
<tr>
<td>(v) Tilt of wheels or balancer axle</td>
<td></td>
</tr>
<tr>
<td>(vi) Trolley wheel gauge</td>
<td></td>
</tr>
<tr>
<td>(vii) Trolley track gauge</td>
<td></td>
</tr>
<tr>
<td>(viii) Difference in height between trolley rails (H) in relation to the trolley track gauge (S) shall be within the following tolerances:</td>
<td></td>
</tr>
<tr>
<td>Upto 2500</td>
<td>4</td>
</tr>
<tr>
<td>Above 2500 and upto 4500</td>
<td>6</td>
</tr>
<tr>
<td>Above 4500</td>
<td>10</td>
</tr>
</tbody>
</table>

(ix) Horizontal bend of girder in plan : Span / 2000

(x) Shift of the web plates of main & end girders from vertical over height `H' measured near the mid span & close to the main diaphragm : H / 200

(xi) Twist of the main girder : Span / 1500

(xii) Axis of the flange plates from the axis of the beam : H / 250

(xiii) Tolerances on camber

- Upto 4 mm : (+) 4 (-) 0
- Above 4 mm and upto 8 mm : (+) 5 (-) 0
- Above 8 mm and upto 16 mm : (+) 6.3 (-) 0
- Above 16 mm and upto 31.5 mm : (+) 8 (-) 0
- Above 31.5 mm and upto 63 mm : (+) 10 (-) 0

(xiv) Over buffer length (Over buffer dimension on two sides shall be same) : ± 5 mm

(xiv) Height of center of buffer (from top of track rail) : ± 5 mm
03 The crane after erection shall be tested as follows:

i) Insulation tests and other tests mentioned in IS: 3177-1999 shall be carried out.

ii) Deflection Test: The deflection test of the bridge girders shall be carried out as per IS: 3177-1999. After the deflection test with safe working load, the crane shall be tested for deflection with 25% overload and there shall not be any permanent set after the removal of the load.

iii) Speed Tests:
   a) All motion of the crane shall be tested with rated load on all notches at the time of commissioning of the crane at site and the speeds shall be attained within the tolerance limit.
   b) All motions of the crane shall be tested with 25% over load in which case the specified speeds need not be attained but the crane shall show itself capable of dealing with the overload without difficulty.

iv) Brake Tests:
   a) The hoist brakes shall be capable of braking the movement with rated as well as overload. However, the braking path with rated load shall not exceed hoisting speed/120 for class 2 duty cranes.
   b) The long travel and cross travel brakes shall be capable of arresting the motion within a distance in meters equal to 10% of the speed in meters/min. and the retardation due to braking shall not exceed the values as given in the table below:

<table>
<thead>
<tr>
<th>Working condition</th>
<th>Retardation, according to percentage number of driving wheels (in m/sec²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>100</td>
</tr>
<tr>
<td>Outdoor</td>
<td>0.9</td>
</tr>
<tr>
<td>(When ( u = 0.12 ))</td>
<td></td>
</tr>
<tr>
<td>Indoor</td>
<td>1.5</td>
</tr>
<tr>
<td>(When ( u = 0.2 ))</td>
<td></td>
</tr>
</tbody>
</table>

Legend \( u = \) Friction Factor

v) The crane shall be completely assembled and tested in the Supplier's works for full load and 25% overload on hoisting and cross traverse motion, in presence of Purchaser's representative in addition to other tests as specified in IS:3177-1999.

04 STRUCTURAL DETAILS:

i) The crane bridges shall be of welded double/single web box construction and shall be designed as per IS: 807-1976 and/or AISE NO. 6. The materials of construction shall be weldable mild steel in compliance with the relevant standard. However, high strength weldable structural steel also may be used wherever required in compliance with the relevant standards.

ii) The crane bridge girder upto 12-m span shall be in one piece. Girders above 12 m span may be spliced. The number of such splices shall not exceed 2 upto 36 m span. Beyond 36 m span, the number of splices may be 3. Splices shall be designed to resist all the forces and
moments to which it is subjected to, plus 50% thereof.

However, in no case the strength developed by the splice shall be less than 50% of the effective strength of the material.

Splices shall be proportioned and arranged so that the gravity axis of the splice is in line with the gravity axis of the members joined so as to avoid eccentricity of the loading.

iii) Black bolts shall not be used in the main structure of the cranes.

iv) Cross travel rail shall be fixed to the bridge girders by clamping only and not by welding.

v) Transverse fillet welding on load carrying members shall be avoided. All butt welds on tensile zone shall be X-rayed.

vi) Plates, bars, angles and where practicable other rolled sections used in the load bearing members of structures shall not be less than 6 mm in thickness.

vii) The end-carriages shall be of double web plate box construction and shall be connected to the girders by welding at shop or by large gusset plates and fitted bolts to ensure maximum rigidity. Drop stops and jacking pads shall be built-in features of the cranes. Full length chequered plate platforms shall be provided along both sides of the cranes in order to ensure easy access to crane crab, long travel gears and other parts. Safety railings shall be provided on crane bridges and crab frame. Access to the operator's cabin shall be via staircases only and not through ladders. Platforms to facilitate inspection and dismantling of long travel wheels and main current collectors shall be provided.

viii) Operator's cabin shall be of welded construction and located below bridge girders. Closed operator's cabin shall be provided with adequate glazing to ensure good vision in all directions and glazing shall be accessible for cleaning from cabin itself.

Cabin suspension bolts shall be fitted in the reamed holes and the accessibility of these bolts is to be ensured for regular checking

Easy accessibility is to be ensured for cleaning of cabin glasses of fully closed cabin.

ix) The closed cabins shall be equipped with circulating and exhaust fans whereas open cabins shall have only circulating fans.

x) Air-conditioned cabins, if provided, shall be provided with double glazing & heat insulation. The temperature inside the cabin shall be maintained at $25 \pm 2^\circ$ C.

xi) All the cabin floors shall be covered with heat and electrically insulated material. The cabin shall also be equipped with adjustable swivelling type upholstered chair.

xii) The crab frame shall be made of steel plates and rolled sections in welded construction. Crab frame shall be fabricated in one piece if there are no transport limitations. If the trolley is fabricated in more than one piece due to transport limitation, the design of the splice shall be such that one unit of mechanism mounted on one part of the trolley, does not come over the other part.

xiii) Foot-walks shall be of sufficient width to give at least 500 mm clear passage at all points except between railing and bridge girder where this clearance may be reduced to not less than 440 mm.
xiv) Bottom of the drive mechanism of Bridge, Trolley & hoist shall be covered by the platform to avoid any free fall of the loose components lying near to the reducer.

xv) The platforms along the bridge girders and over the crab shall allow convenient access for replacement, inspection, lubrication etc. for different mechanical and electrical components.

xvi) The minimum thickness of chequered plates shall be 6 mm O/P for indoor cranes & 8 mm O/P for outdoor cranes.

05 MECHANICAL DETAILS :

i) Rope drums

Rope drums shall be of cast steel or fabricated out of rolled steel plates. Fabricated drums shall be stress relieved before machining. The grooves of the drum shall be smooth finished. Rope drum shall be flanged at both ends.

ii) Rope sheaves

Rope sheaves shall be of cast steel or fabricated out of rolled steel plates.

iii) Wire ropes

The wire rope shall be hemp cored for all cranes. Ropes shall be regular right hand lay as per IS : 2266-1989. The construction of the ropes shall be 6 x 37 upto 16 mm diameter and 6 x 36 above 16 mm diameter. Wire rope provided in the hoist mechanism shall be in two pieces. Rope balancers shall be provided on the Trolley frame to accommodate two piece rope system.

iv) Hook block

The sheaves shall be fully encased in closed fitting guards fabricated out of steel plates. Smooth opening shall be provided in the guards to allow the free movement of rope, and holes shall be provided for drainage of the oil.

v) Gears & gear-boxes

Straight and helical spur gearing shall be used for all motions. Worm & bevel gearing may be used in exceptional cases with the specific approval of the Purchaser. All first reduction gears shall have helical teeth. All pinions shall be integral with the shaft. All gears shall be hardened and tempered alloy steel having metric module. Overhung gears shall not be used.

Surface hardness for pinion shall be 255 to 300 BHN and for gears it shall be 215 to 260 BHN. Difference in hardness of pinion and gear shall not be less than 20 BHN. All cast steel gear shall be tested by Gamma Ray. All gears shall be enclosed in oil tight gear-boxes. Gearboxes shall be of high grade cast iron/cast steel or fabricated and split at each shaft centrelines. Fabricated gearboxes shall be stress relieved before machining. For Cross-travel and Long-travel motions, vertical gear-boxes with ‘T’ split may be used.

vi) Connection between rope drum & gear-box

One of the following arrangements shall be adopted for connecting the rope drum with the gear-box.
Flexible joint, incorporating flexible geared coupling housed within the drum. Fully flexible geared coupling between the drum and gearbox.

Drive of the drum by means of spur ring mounted on the drum shall be avoided as far as practicable.

vii) Wheels

Crab/crane wheels shall be double flanged. Wheels shall be mounted in anti-friction roller bearing housed in `L' shaped bearing brackets for easy removal during maintenance. Flange-less wheels with guide rollers are also acceptable.

Solid wheels shall be of forged rolled/cast steel. Wheels from 400 mm diameter and above may consist of hardened, rolled / forged steel tyre of not less than 60 mm thickness, shrunk on to cast iron center.

viii) Coupling

Motor shaft shall be connected to the gearbox-input shaft through flexible shock absorbing coupling. Rotating parts shall be suitably covered by 3.15-mm thick sheet steel hinged covers for safety. In case of single motor central drive for Long travel motion, output shaft of the gear-box shall be connected to the line shaft through half geared couplings. Intermediate lengths of the line shaft may be connected through solid flange couplings. Half geared couplings with floating shaft shall be provided between the wheel and the wheel and the line shaft.

ix) Bearings & bearing housings

Anti-friction bearings shall be used throughout except where required otherwise for technical reasons.

x) Buffers

Spring loaded type buffers shall be provided on all the 4 corners of the bridge girders and the end carriages for cross and long travel motions respectively.

xi) Brakes

The brakes shall be provided for all motions on the high-speed pinion shaft of the gear train. For hot metal hoists, two brakes shall be used per motor.

xii) Lubrication

Grouped grease lubrication system shall be used for class M3, M5 and M7 duty cranes. Lubrication of the gears and pinions in the gear-boxes shall be splash fed from the sump. In case of three reductions, vertically mounted gearbox (having limited motion), an oil pump shall be fitted to ensure lubrication of all gears.

06 ELECTRICAL DETAILS

06.01 Scope of supply

The scope of supply covers all electrical equipment commencing from Power Distribution Board (PDB), Isolator, cables, complete down shop leads (DSL) system in the shop and main current collectors on the crane and all other electrical items beyond the main current.
collectors of the crane i.e. DSL main current collectors, power disconnecting switch on bridge platform after main current collectors, protective and control switch gear, motors, control and brake panels, resistors, brakes, limit switches, all power and control cables, socket outlets, lighting distribution panel and lighting fixtures with lamps, festoon cable system for crane trolley magnet/ grab and cable reeling drum, if specified for grab/magnet, master controllers, indicating lamps, push buttons, earthing materials etc. The scope of work also includes complete assembly and wiring and testing of crane at site, erection and testing and commissioning of all electrical equipment, supply of all commissioning spares with minimum quantities as indicated in clause no 04.26, (a) ii of this T.S. All sundry erection materials required for installation and connecting up of electrical equipment with cable laying and fixing accessories shall be included in scope of supply by Tenderer.

Purchaser will provide 02 nos of 415 V, TPN, 50 Hz of required rating at the incomer of the individual PDB. Purchaser will indicate the required number of PDB with incomer rating, length, number of runs and size of power cables.

06.02 Standards

The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the IPSS in respect of items for which IPSS have been issued; otherwise, to the relevant IS specifications (latest revision). In case the Tenderer is not in a position to comply with certain IPSS/BIS specifications, or in respect of certain items for which there are no IPSS/BIS specifications, the Tenderer may base his proposals on IEC recommendations or other reputed national or international standards subject to the approval of the Purchaser.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India and the Government of Chhattisgarh and with the Indian Electricity Rules.

06.03 Climatic conditions

The ambient temperature conditions met within the different shops/ units of the steel works complex will be as indicated in General Specification GS-01.

For specific areas and shops, the ambient temperature conditions indicated above shall be taken into consideration and equipment suitably derated where necessary. For areas not covered above, equipment selection and derating shall generally be based on Ambient temperature of +50°C.

The equipment offered shall be suitable for smooth, efficient and trouble free service in the tropical humid climate prevailing at Bhilai, CG and under the ambient temperature conditions indicated above for the different shops and areas. In hot areas of higher temperature conditions, the equipment shall be adequately protected against damage from radiant heat and hot air.

The equipment shall be designed to give efficient and reliable performance under heavy steel mill conditions and shall be such that the risks of accidental short-circuits due to animals, birds or vermins are obviated.

06.04 Power supply and Standard voltage levels

The following standardized voltage levels shall be adopted:

a) LTAC : 415V, 3 phase, 50 Hz, 4 wire solidly earthed system. Power supply be made available at this voltage only.
Other voltages shall be obtained by providing transformer/rectifier unit with MCBs on both primary and secondary side and ±5% and ±10% taps on transformers secondary.

240 V, 110 V AC

c) Socket outlets for
   Hand lamps : 24 V, single phase, 50 Hz, AC obtained through suitable transformers
   Hand tools : 240 V, 15A, 2 pin plus earth with plug interlocked switch

d) Electro-magnetic brakes : 220 V, DC obtained through individual brake control panels.

e) Monitoring and signaling in electronic installations, mimic panels : 24/48 V. DC

f) Illumination/ lighting : 240 V, AC

The three phase symmetrical short-circuit ratings of the switch gear at 415 V shall be 50 kA for 1 second.

The system/unit/equipment shall be designed so as to be suitable for the following variations in voltage and frequency:

<table>
<thead>
<tr>
<th>Voltage</th>
<th>Frequency</th>
<th>Description</th>
<th>HELD Docs</th>
<th>Document Mathematics 2007</th>
<th>STEM 2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Permissible variations with rated performance, rated current and control effectiveness maintained</td>
<td>+10%</td>
<td>+3% &amp; -6%</td>
<td>For LT system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permissible variations for control and regulation equipment with rated performance and control quality maintained</td>
<td>+10%</td>
<td>+3% &amp; -6%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Voltage dip on the starting of largest LT motor shall be limited to 20% of the nominal voltage at the motor terminals. Total voltage dips on starting of large motors on crane shall be limited to 3% on crane and 8% in DSL system.

06.05 Trolley Lines and Power Supply Arrangements for Cranes (DSL System)

01. Trolley power conductors

Crane trolley lines for LRS crane shall be sectionalized with two separate feeding points. Two fully rated MCCB / Isolator shall be provided for each incomer feed point to crane DSL. Sectionaliser MCCB / Isolator shall be provided between the two incoming ACBs with necessary padlocking arrangement. In normal operation the sectionalising MCCB/ACB shall be OFF. The MCCB/ACB and cables upto trolley lines shall be provided by supplier.

Isolator panels shall be provided for the repair section for maintenance by the Purchaser. Necessary DSL arrangement for repair section shall be provided by Tenderer.

When two or more cranes are fed from the same trolley line, hospital bays (repair sections) shall be provided with sectionalizing isolator so that repair or maintenance of any crane can be carried out without disturbing the operation of the other cranes. Boarding or access platform shall be arranged within the limits of each repair section for approach to be crane.
The conductors shall be supported at 3000 mm intervals by insulators mounted on brackets welded to crane girders. Typical drawings indicating details of trolley line power conductors, supporting insulators, brackets, expansion joints, parallel aluminum bus, signal lamp assemblies etc. shall be furnished by successful Tenderer.

Trolley power conductors shall be of mild steel angel sections. The section shall be straight, unbranded and smooth on the running surface. Joints between lengths of angles shall be welded and all welds shall be finished flush with parent metal. The conductors shall be painted with anticorrosive paint, except for contact surface. Parallel aluminum buses shall be provided as specified. The maximum continuous length of power conductor section shall not exceed 30 m without an expansion joint in between. The power conductors shall be made from standard rolling length. The jointing of standard lengths shall be made by 100% but welding and top surface finished smooth by grinding to get free movement of the current collectors.

In order to provide electrical continuity across the expansion joints the power conductors on both sides of the joints shall connected by stranded aluminum conductor jumper, fitted with steel Aluminum strap and lugs suitable for the steel angle sections.

02. Insulators and trolley line holders

The insulators used for the manufacture of trolley line holders shall be preferably steatite, tufnol or porcelain insulation material having substantial mechanical strength specifically against blows and vibrations. They shall be capable of withstanding the impact and shocks resulting from operation of the machine. The creepage distance of the insulators shall not be less than 80 mm.

The insulators used shall have flash over values and mechanical strength not less than the following:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry flashover voltage</td>
<td>25 kV</td>
</tr>
<tr>
<td>Wet flashover voltage</td>
<td>12 kV</td>
</tr>
<tr>
<td>Ultimate mechanical strength</td>
<td>1000 kA</td>
</tr>
</tbody>
</table>

The trolley line holders shall generally conform to the design shown in the drawing to be furnished to the successful Tenderer. All sharp edges shall be ground smooth. The porcelain insulators shall be manufactured and tested as per IS: 1445 –1997

03. Supporting brackets

The trolley line conductors shall be mounted on holders. The holders shall be bolted on to brackets which in turn shall be welded on to crane girder at stiffeners at regular intervals. In normal run, intermediate type of brackets shall be used, but when sectionalizing gaps or expansion joints are provided, sectionalizing type of brackets shall be provided.

04. Steel to Aluminium straps

These are meant for connecting parallel aluminium bus, at expansion joints, power supply cables from load break switch. They shall be complete with MS cadmium coated bolt nuts, spring washers, lugs etc.

05. Signal lamp assembly

Signal lamp assembly shall be industrial, heavy duty dust tight and water proof in construction suitable for indoor or outdoor locations. The units shall comprise three lamps for three phase with red glass lens and reflectors. The lamp shall be provided with dropper resistance connected in series with the lamp and the resistance shall be rated for continuous
inclusion in the circuit. Alternatively, a built-in transformer may be provided to suit the lamp voltage.

06. Aluminium parallel bus

These buses shall be of E.C. grade aluminium. They shall be free from any deformity in profiles.

06.06 Current Collectors

2 nos. per trolley line shall be provided. The collector shoe will be of heavy duty design and chamfered at both ends, each rated for 100% of total crane rating. Double collectors on each earth trolley line shall be provided and these shall be similar to those on power trolley line. Collector shall be multi hinged for self–aligning. Collector will be designed in such a way that load is transmitted not no the insulators but on the insulator stud to avoid damage to insulators.

06.07 Power distribution on crane

One adequately rated load break manual isolator with locking facility shall be provided immediately after current collectors on incoming line on the crane. The isolator shall be capable of carrying current of two largest motors.

Power from the isolator shall be taken to the air circuit breaker to be provided outside the operator’s cabin or on the bridge depending on the availability of space. In case of pendant operated cranes, this circuit breaker shall be located in protective panel located at bridge platform.

The breaker shall be provided with under voltage, over load and short circuit releases. The breaker shall also be with earth fault protection. The breaker can be closed only when:
- All master controller handles are in neutral position.
- One of the stator or directional contactors are in closed positions.
- Emergency corner switches not operated.
- Door/Gate switch are not actuated and gravity limit switch for hoist motion not operated. Power for lighting and magnet circuits shall be tapped from the incoming side of isolators near current collectors.

06.08 Power supply for CT. motion

Flexible trailing cable systems mounted on retracting support system shall be used. The system shall consist of insulated multi-conductor or several single conductor cable with permanent termination on the bridge and on the trolley. The flexible trailing cables shall have ample length and shall be supported by means of properly designed movable clamps. These clamps shall be fitted with rollers and shall run freely on a guide rail allowing relative movement of bridge and trolley without undue stress or wear on the suspended cable. The flexible cable shall be EPR insulated CSP / PCP sheathed type.

or rotating trolley cranes, power supply shall be through festoon cable arrangement / rotary current collector. Cable reeling drum or cable basket shall be used for power supply to the magnet from the trolley. Two spare turns of cable provided on cable reeling drum. The cable reeling drum shall be directly driven by hoist mechanism, a clutch shall also be provided to disconnect the drum from hoist mechanism.

06.09 Meters

Ammeter and voltmeter with selector switches shall be provided on the incoming line in operator’s cabin.
Ammeter and voltmeter shall be provided on DC side for Electromagnets.

06.10 Control features

All controls shall be fully magnetic, operated through master controllers. All travel motions shall be provided with plain rotor resistance control with plugging. For long travel drives, the electrical control shall be grouped for the individual pair of motors separately in case of four motor drive and each pair of motors shall be able to drive the crane at reduced acceleration and speed. As an anti-skewing measure, out of a pair of motors for LT., if one drive motor trips, the other drive motor shall also be switched off. For pendant control, plugging shall be avoided for travel motion.

Brakes shall not be used for speed control.
Synchronization of separate drives where required shall be done with the used of solid state thyristor control.

For all hoist motions, except where creep speed is required, plain rotor resistance control shall be provided on all master controller notches in the hoisting direction. The rotor resistance shall be cut out gradually when moving from lower to higher notches such that current peak of 2 times the rated current is not exceeded. In the lowering direction of the motion, controlled lowering shall be provided using one/ two plugging notches, one single phasing notch and one/ two super synchronous power lowering notches. For obtaining creep speed, conventional methods like planetary gear system, DC. injection (where requirement calls for creep speed in lowering direction only) etc. may be offered.

Hoist control circuit shall also be provided with anti-drop feature i.e., whenever the master controller is brought back to zero position from higher notches in both directions, the motor shall automatically be connected to hoisting direction for some time (time adjustable through timers) to avoid the downward drift of the load. Brakes shall be clamped in zero position of the master controller.

06.11 External control of auxiliary hoist and CT of LRS Crane

Tenderer shall supply one no. of Ground Control Post in Pedestal for installation in PCM control room. The control post shall have following facilities:

a) Control on PB- This shall transfer the control of CT and auxiliary hoist from cabin, master controller to ground control post and will not allow LT motion from cabin.

b) For CT and aux. Hoist 4 push buttons each (total 8 PBs) shall be provided on ground control post for following application:

- 10% speed of hoist & lower
- 30% speed of hoist & lower
- 10% speed of CT forward & reverse
- 30% speed of CT forward & reverse

The control post shall be connected to the main control of cabin on crane through hear resistance flexible cable with copper conductor arrangement and plug and socket system. The socket shall be fixed to the cabin. The no. of pins for socket, no. of additional aux. Contactor, no. of cores for flexible cable to achieve the above control shall be decided by the Tenderer during detail engineering and shall be included in the scope of supply of Tenderer. Further, Tenderer shall quote radio control system to achieve the above control requirement as an optional feature. Cost for the radio control option shall be indicated separately.

06.12 Thyristor control drives
Thyristor control shall be provided for all the cranes operating in areas where ambient temperature is more than 50 deg.C and for Mixer Charging Crane. Control shall be achieved through master controllers for each direction. Rated and creep speeds are to be provided in each direction i.e., hoisting and lowering. Creep speed shall be 10% or lower as per operational requirements of rated speed. The thyristor regulator shall be fully controlled and suitable for four quadrant operation.

Speed control of the slipring motor shall be achieved through regulation of stator voltage with resistance in the rotor circuit, if necessary. The reversal of direction shall be through thyristor / magnetic contactor which shall open and close at zero current.

The continuous rating of the thyristor shall be at least 2.0 times the motor rated current at mechanical KW and the converter shall be designed and rated for load requirement taking care of peak currents during acceleration, normal operation and regeneration conditions. The dv/dt and di/dt rating of the thyristors shall be suitably selected.

The repetitive PIV rating of semiconductor devices shall not be less than 2.5 times the peak of normal system voltage. Thyristor bridges shall include R.C. snubber circuits across the thyristor, high speed semi-conductor fuses with micro-switches for monitoring of failure.

Closed loop regulation suitable for the system with various feedback such as speed, current etc. shall be provided. Speed feedback shall be through tacho-generator of permanent magnet type mounted on the non-driving end of the motor shaft. The regulation shall include ramp generators, potentiometers for various setting, various regulators, signal conditioners, logic command module sequence, module, trigger module, zero and over speed monitor, torque less protection module etc. as per the requirements. The control and regulation equipment shall be able to maintain their rated performance and control quality even under conditions of variation of +10% and -15% in voltage and +5% in frequency. A zero current sensing device shall be incorporated. The reversing of stator contactor shall be done at zero current. Braking down to zero speed shall be electrical with mechanical brake setting only at zero speed. Protective features like anti-drop etc. shall be incorporated to prevent load setting. The circuitry shall also provide for the protection against failure of motor torque such that the mechanical brake sets in such cases. All other features of conventional crane controls shall also be built into the scheme. The following shall also be provided on the A.C. side.
- Surge suppressor
- Over current protection
- Overload protection
- Single phase protection
- Phase sequence protection
- Ammeter and voltmeter with selector switches
- Isolating switches

Control and auxiliary supply shall be provided with separate transformer and under voltage protection. The test shall be performed as per IEC: 146. Details of the system offered shall be furnished along with necessary single line diagrams and block diagrams.

All the control modules shall be grouped in a sheet steel enclosure. The control module cards shall be made of epoxy glaze and suitable for plugging into the racks. The cards shall be locked into the rack, which carries a sealing bar and assists locking of the cards thereby cutting down on the wear of the printed circuit connector contacts which can be subjected to high rate or vibration and further avoid the disconnection of cards from the connector. The thyristor panel shall be suitably mounted so that little vibrations are reflected to the components and connection.
The cables for the thyristor controller and associated equipment shall be laid and clamped separately on the crane as far as possible.

06.13 VFD control drives

VFD control shall be provided for cranes operating in areas where operating temperature is 50 deg. C. Control shall be achieved through master controllers for each direction. Rated and creep speeds are to be provided in each direction i.e., hoisting and lowering. Creep speed shall be 10% or lower as per operational requirements of rated speed. The VFD shall be fully controlled and suitable for four quadrant operation.

06.14 Variable Voltage Variable Frequency (VVF) Drive

1.0 Basic design particulars
- Digital control technology with vector control (with / without PG as per requirement).
- IGBT based with sine coded PWM control.
- Industrial and continuous duty.

2.0 Type of connection
Three phase frequency converters with rectification and inversion i.e. variable voltage and variable frequency output with current source / voltage source (PWM) inverters.

3.0 Overload capacity
- 150% of the rated current for 1 minute following 100% load & to meet the drive overload capacity.
- 200 % for 3 sec.

4.0 Efficiency
More than 96% at full speed and load.

5.0 Input power supply
- 415 V AC + / - 10%.
- 3 phase.
- 50 Hz + / - 5 %.
- 4 wire neutral earthed system.

6.0 Regulated power supply for reference setting
- Voltage variation of (+/-) 0.1 % with an input variation of +10% - 15%.
- Steady state regulation of (+/-) 0.25% guaranteed against 100 to 200 % load disturbance and + 3%, -6% input supply frequency variation.

7.0 Input reference voltage
- 10 V DC to O V to + 10 V DC / 0 - 10 V DC / 4 mA to 20 mA.

8.0 Output frequency
- 0.5 - 400 Hz.

9.0 Output frequency resolution
- 0.01 Hz.

10.0 Starting torque
- 150 % / 1 Hz. (without PG)
- 150 % / 0 RPM (with PG)

11.0 Torque accuracy
+ / - 5 %.

12.0 Speed control accuracy
+ / - 0.02 %.

13.0 Ramp rate
Linear acceleration and deceleration adjustable independently from 0 to 999.9 seconds.

14.0 Vibrations
Suitable to withstand vibrations more than 0.5g.

15.0 Main power components in incoming AC side
- ACB/MCCB with 50 KA rating
- Matching input isolation transformer / line reactor for harmonic and noise suppression.
- AC line surge suppression network.
- Input contactor.

16.0 Converter –Inverter
- Diode bridge/ Thyristor bridge for AC/DC.
17.0 Load side components

- Filter network
- Over-load relay for each motor.
- Output contactor in output side.
- Output reactor / terminator

18.0 Diode Bridge

- Minimum ratings of Diode cells.
  - PIV rating : 2.5 times the peak value of line voltage
  - dv/dt rating : 200V/microsecond for voltage control and 1000V/microsecond for inverter control.
  - di/dt rating : 100A/microsecond.

19.0 Protective features

- AC line surge suppression network and overvoltage protection.
- Phase sequence protection and monitoring
  - Under voltage in DC bus
  - Over voltage in DC bus
  - Over speed monitor
    - Over load
    - Earth fault
  - Instantaneous over current
  - Transformer fault, if applicable
  - Cooling fan failure – Stall monitor for motor alarms.

20.0 Annunciations

- Following faults shall be annunciated in keypad of the drive / HMI.
  - AC line surge suppression network and overvoltage protection.
  - Under voltage in supply network
  - Phase sequence protection and monitoring
    - Under voltage in DC bus
    - Over voltage in DC bus
    - Over speed monitor
      - Over load
      - Earth fault
    - Instantaneous over current
    - Transformer fault, if applicable
    - Cooling fan failure
    - Stall monitor for motor alarms.
    - Motor fault (winding / bearing temperature, vibration) as applicable
    - Loss of frequency command

- Shall be able to store at least 16 previous faults in memory on FIFO sequence.

21.0 Meters

- Output voltmeter and ammeter with selector switches.
- Input voltmeter and ammeter with selector switches
- Output frequency meter
### General Technical Specification

#### 22.0 Selector switches
- KW meter for drive ratings above 200 KW.
- Local / Remote.
- Auto / Manual.
- Main / Bypass.

#### 23.0 Pushbuttons
- Trip reset.
- Start.
- Emergency stop.

#### 24.0 Lamps
- Drive ready.
- Drive trip.
- R, Y, B phase power ON.
- Control supply ON.

#### 25.0 Regulation & control facilities
- Reference speed setter
- Ramp generator
- Speed feedback
- Current feedback
- Trigger module
- Pulse transformers
- Logic control module
- Sequence module
- PID control
- Zero speed / over speed monitor as applicable.
- Momentary power loss restart.
- Auto tuning.
- Current limiter
- Counter current / regenerative braking unit as applicable
- Active electronic components used shall be of industrial grade hermetically sealed.
- Output signals for fault alarm, frequency arrival, running signal.

#### 26.0 Remote control facilities
- Shall have transducer to monitor the outputs like motor speed at remote place / HMI.
- Facility to accept speed reference from HMI / engineering station.

#### 27.0 Operator panel
- Shall be mounted on the front door of the unit.

#### 28.0 Membrane keypad
- The keypad shall be logically designed for two operating areas with required number of keys.
- Local operator control like local start / stop, Jog forward / reverse.
- Programming.

#### 29.0 LCD display
- Display shall be black lighted, enabling viewing in extremes of lighting conditions.
- Display shall be in alphanumeric (in English only)
- 16 characters, 2 lines.
- All the last 16 faults stored in memory (in FIFO sequence) shall be displayed by scrolling.

#### 30.0 Construction features
- Floor mounted, free standing
- Dust and vermin proof
- Sheet steel clad
- Minimum 2.5 mm thick for panels.
- Minimum 2.0 mm thick for doors and side covers.
- Suitable to withstand vibrations to be...
31.0 Enclosure and ventilation

- Units shall be self contained and serviceable.
- Enclosure conforming to IP-52 or better with weather proof enclosures.
- Units shall be provided with cooling fans and louvers at the bottom sides.
- All louvers shall have fine mesh behind them.
- Ventilation through individual ventilation ducts, from bottom not acceptable.

The VVVF shall have a separate module / card for hoisting / lowering motion.

06.15 Panels

There will be separate panels for each motion in addition to the protective panels and resistance panels.

- All panels shall be of free-standing floor-mounting construction, suitable to withstand vibrations encountered on crane. Hinged doors shall be provided for closed type panels.
- Panels shall be front wired. Front wired live points of bottom most equipment shall be mounted at least 350 mm above the bottom cover of the panel. Panel shall be fabricated from 2.0 mm thick steel sheet.
- Power and control terminals shall be segregated. 10% spare terminals shall be provided in each panel.
- Equipment in the panel shall be so mounted that their removal or replacement from the front is easy.
- Separate control panel for each motion shall be provided.
- Panels shall be of closed type when mounted on bridge platform.
- The panels shall be mounted along the girder facing the hand railing. Sufficient clearances shall be provided between the panels. A minimum clearance shall be provided in front of the panels for walkway and approach as per I.E. Rules. The panels shall be supported in the back from the girder to avoid vibrations. Open type panels may be used for installation inside the box girders. In this case, adequate lighting and ventilation shall be provided for the room.

06.16 Switchgears

- Each mechanism motor shall be provided with MCCB, contactors on stator and rotor sides, oil dash pot type over load relays and suitably rated rotor resistances. In case of thyristor controlled drive, each mechanism motor shall be provided with breaker / switches, transformer, thyristor, rotor resistances, contactors on stator and rotor side etc. Each motor shall be fitted with a tacho-generator for speed feed back. The overload capacity of thyristors shall be as per IEC. The speed range shall be 0-120% of rated speed.
- MCB shall be provided in the control circuit of each motion.
- Each brake circuit shall be provided with a suitable contactor.
- Rating of contactor selected for any mechanism shall be at least 50% higher than the respective motor full load current for the mechanism at 40% duty cycle. The minimum rating of the contactor used shall be 30A and the life of each contactor shall not be less than 10,000 hrs. of operation.
- Reversible directional contactors shall be inter locked both mechanically and electrically.

06.17 Motors
Heavy duty reversible crane service, totally enclosed fan cooled, foot mounted, wound rotor motor conforming to latest edition of IS: 325-1996 shall be used for various drives. Class of insulation shall be F/F (Stator/Rotor) with temperature rise limited to that for ‘B’ Pullout torque to the not less than 225% and 275% of full load torque corresponding to 40% CDF for class M3 & M5 and class M7 & M8 duty cranes respectively.

Motor selection shall be done as per IS : 3177 – 1999.

The main motor shall have following speed ranges:

a) Class M3 & M5 duty cranes:
   - Main & auxiliary hoist  750 rpm
   - Long & cross travel  1000 rpm

b) Class M7 & M8 duty cranes:
   - Main & auxiliary hoist  600 rpm
   - Long & cross travel  750 - 1000 rpm

All motors shall have the terminal box at top. Frame sizes shall conform to IEC Standards. Horizontal foot mounted and with tapered shaft extension.

While selecting the motor rating following shall also be taken into consideration:

- Duty type S4 & S5
- Cyclic duty factor
- Number of switchings per hours
- Type of controls used
- Inertia of the motor and mechanism
- Ambient correction factor
- Service factor
- Derating for thyristor control
- Wind pressure

Maximum permissible operating speed shall be 250% of synchronous speed or 2000 rpm whichever is less. Over load capacity 150% of full load current for 2 minutes without damage or permanent deformation.

06.18 Brakes

Brakes shall be D.C. electromagnetic type confirming to AISE Standard. The brake coils shall be made of copper and of insulation class ‘F’.

Brakes shall be designed to fail safe whenever the current is interrupted either intentionally or by failure of the main supply.

Brake circuit forcing shall be provided for D.C. brakes. D.C brake circuit shall be switched off on D.C. circuit for quick operation of brake.

A separate set of parking brake for L.T. motion shall be provided for each out door crane. Power supply for these brakes shall be obtained from protective panel.

06.19 Limit switches

Roller lever operated, resetting limit switches shall be provided for all travel motions. For each hoist motion, a rotary cam type over hoist and over lower, self resetting limit switch shall be provided. This limit switch shall have independently adjustable cams for hoisting and lowering motion. The cams shall have adjustability such that end limit can be set to within 100 mm of the hoisting or lowering motion. In addition to this, a back up ultimate limit switch of series/ shunt gravity type shall be provided to prevent over hoist. The later shall be of manual reset type. In case of cranes handling hot metal, the gravity limit switch shall preferably be of shunt type. Provision shall be made to bridge the gravity type limit switch contact by push button/ switch or any other means to lower the load. An indication shall be provided to the operator whenever this limit switch has operated. Suitable limit switch shall be
Anti-Collision Devices
In cranes where two or more cranes are operating in the same bay (at same or different level) all cranes shall be provided with suitable Anti-collision system. Anti-collision device shall be optical type. A sound signal shall be provided to the crane operator when they are at certain safe distance apart (preferably distance to be adjusted as a function of speed at site) and crane shall stop. After few seconds, it shall be possible to run the cranes towards each other (or only one crane can move towards the other) till buffers of the cranes meet by providing “by pass” in the operators cabin. Anti-collision shall also be provided on trolley for twin trolley cranes along with suitable by pass arrangement.

Resistances
Air cooled, robust, heavy duty, corrosion resistant punched stainless steel (AISI-406) grid type. Resistance shall be in step wise execution. In a particular box the rating of resistances shall be the same to the extent possible. Resistance shall have vibration proof only. Rated for 10 minutes duty. Continuous duty rating of resistances shall be provided in case of hoist motions controlled by thyristor converters. Maximum temperature of resistor elements shall be limited to 2750°C at desired duty. Suitable tapping points shall be provided. Resistance boxes shall be mounted in racks that permit independent removal of any selected box.

Master controller
Cam type master controller with joy stick type lever shall be used. Separate master controllers for hoist, LT & CT shall be provided. Dual master controller operated with single handle shall not be used. Master controller for each motion controls shall have four / five notches in each direction. Master controller shall have three positions i.e Lift - Off - Drop. It shall have spring return from drop position to Off position.

Lighting, socket outlets, bells etc.
Lighting shall be provided in operator’s cabin, staircases, platforms and working areas. Minimum 4 nos. 400 watts high pressure sodium vapour flood lights equally spaced (under crane girders) about the crane span shall be provided along with shock absorbing and anti-swing suspension arrangements. More numbers of fittings shall be provided if required for cranes with longer span and/or longer height of lift. Fluorescent lamps with necessary fittings shall be used for operator’s cabin, staircases, platforms etc. Adequate number of hand lamp socket outlets (2 Pin, 10A, 24V) and power socket outlets (3 Pin, 20A, 240V) shall be provided along with switches socket & switch shall be interlocked suitably. A hand lamp (160W SLS lamp with enclosed type battery and wire guard) along with sufficient length (15m) of cable with a plug shall also be provided for each crane. An alarm bell shall be provided on each crane.

Electromagnets
All magnets shall be suitable for steel plant application and shall be welded construction. Magnets shall be rated for 230 V DC and suitable transformer – rectifier units shall be provided for feeding them. Rectifiers shall also be suitable protected by suitable protective device.
Magnets shall be class ‘H’ insulated, at least 50% rated, copper conductor would and shall have surge suppressor box and separate in terminal box for termination of cable. Magnets for production cranes handling hot products shall be 75% rated. Surge suppressor shall be compact, non-linear resistor silicon carbide thyrector, variator or metrosil type. Each magnet shall be provided with suitable plug socket unit. One earth terminal on magnet to be connected to spare core in magnet cable. Wherever specified, a set of batteries, a battery charger, one annunciation system and other accessories shall also be provided along with magnet so that the magnet can hold the full load for at least 20 minutes in case of power failure.

06.25 Equipment in operator’s cabin or on pendant unit

a) In case of pendant controlled crane following shall be included on the pendant unit:

<table>
<thead>
<tr>
<th>Push button for</th>
<th>Hoist slow, hoist fast, lower slow, lower fast, left cross traverse, right cross traverse, forward long travel, backward long travel, emergency stop conditions.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch for</td>
<td>Lights and bells</td>
</tr>
<tr>
<td>Lamps for</td>
<td>Power ‘ON’ indication and emergency corner switch operation.</td>
</tr>
</tbody>
</table>

b) In case of cabin operated cranes:
The operator’s cabin shall contain the following:
- Master controllers for all the motions and magnet (wherever applicable).
- Emergency stop push button.
- Foot switch for alarm or bell.
- Switches for all lighting equipment on crane.
- Switches for air conditioner, exhaust fan and for cabin fan.
- A fire extinguisher.
- Insulating mat and operator’s chair.
- Cabin light.

Annunciation panel with indication lamps for power ‘ON’ control ‘ON’ emergency corner switch operated, ammeter and voltmeter with selector switches.

c) In case of master controller operated cranes:-
In this case there should be the facility of controlling the crane from the control pulpit. All the control facility available in case of operating from the operator’s cabin is duplicated in the control pulpit through the cable.

d) Radio remote control:-
- In this mode of control system, all the 3 motions
  - Hoist.
  - Cross travel.
  - Long travel.
  can be controlled.

The system shall have capability to provide range of 1.5 times the long travel distance of the crane.

In the case of signal failure, all motion shall come to a safe stop. The system shall have facility of controlling speed in two steps:-
Slow speed on the first step of the breaker contact / pushbutton of the radio remote control representing the first or second notch of the master controller. Full speed on the second step of the breaker contact / pushbutton of the radio remote control representing the final notch of the master controller.

Transmitter :-

Transmitter shall have following features:-

- Constructed with sophisticated microprocessor technology and surface mounted electronics.
- Transmission type :- FM FSK
- Transmission speed :- 9.6 Kbps.
- Built in self test for all functions.
- Transmitter shall consist of switching breaker, dial switch and push buttons.
- Switching breaker shall be non locking to zero position or maintained function.
- Indications :-
  - Operation status
  - Battery status
  - Indicators that display information from crane.
  - PIN -code (Personal Identification Number)
  - Internal antenna.
  - Rechargeable battery.
  - Battery 7.2 V NiCd
  - Operating time :- About 8 hours.
  - Different operating frequencies (minimum 16 nos.)
  - Two hand upstart.
  - Stop push button.
  - Operating conditions :- Areas having large temperature variations, dusty, more vibrations, oil and humidity.
  - Operating temperature range :- Min. 10 deg.C to Max. 60 deg.C
  - Protection class : IP - 54.
  - Casing material : Polycarbonate / ABS plastic.

Receiver :-

Receiver shall have following features :-

- Upto 20 functions exclusive safety relays (for transmitting preset reference values to VFD in the crane).
- 2 safety relays (for control of main contactor)
- Power supply suitable for 240 V AC, 6 A.
- Minimum 16 different operating frequencies.
- Two redundant microprocessors for monitoring each others.
- Cyclically redundancy checks check for high security of transmitted radio messages.
- Frequency scanning in the receiver.
- Memories last 10 users.
- Interlocking of the relays.
- Momentary or latched relay functions.
- Two hand up start (to avoid unintentional start).
- Protection class : IP - 65.
- Casing material : Aluminium profile for fast mounting on DIN rail.

Operating temperature range :- Min. 10 deg.C to Max. 60 deg.C

06.26 Enclosure Class

a) For indoor operations
06. 27 Cables

Power cable suitable for 3 Phase, 4 wire, AC power supply system. All cables shall have stranded copper conductors. Control wiring shall be with 2.5 mm² copper; minimum size of power cable shall be 4.0 mm². Fixed wiring on cranes shall be carried out with PVC insulated. PVC sheathed armoured cable or HRPVC insulated HRPVC sheathed cable or better. All flexible cables (i.e. cables for magnet, trolley, feed, pendant unit etc.) shall have copper conductor, EPR insulation and CSP / PCP sheathing or better. All cable shall be suitably de-rated for grouping and higher ambient temperature.

All cables shall be of 1100 Volts grade. All accessories like cable glands, clamps, pipes, wire and terminal marks etc. shall also be provided. Cable laying and terminations shall be such that the chances of cables getting damaged is remote. Cable sizes shall be selected considering motor rated current.

In all passages and on trolley the cable shall be laid in trays and shall be covered by similar trays and properly clamped & fixed.

a) LT Power Cable
1.1 kV, heavy duty power cable, 4/3 core with stranded sector shaped (sm) or with compact circular stranded (rm/V) or circular stranded (rm) Copper conductors as applicable, PVC insulated suitable for 70°C operation as per IS:5831-1984, core stranded together provided with a common covering of PVC inner sheath, galvanized round steel wire armoured and PVC outer sheathed, multi core conforming to IS:1554 (Part-I – 1988) Type TWY.

b) Control Cables
1.1 kV, circular stranded (rm), annealed copper conductor, PVC insulated suitable for 70°C operation, as per IS:5831-1984, cores stranded together provided with a common covering of PVC inner sheath, galvanized round steel wire armoured and PVC outer sheathed, multi-core similar to IS:1554- (Part-I)-1988, Type YWY.

c) Flexible Trailing Cable

06.28 Earthing

A ring earthing system shall be provided on the crane. Each and every electrical equipment shall be connected to this earthing at least at two points. However the electronic circuit insulated earth wire shall run in panel and terminate at main earth connection only at one point. The earthing shall be connected to the fourth trolley line in DSL system through 2 nos of current collector. Additionally current collectors shall also be provided on crane rails for earthing on crane. All these collectors shall be connected to earthing ring.
An earth core shall be provided in trolley feed cable and the magnet. The cable reeling drum shall have a separate slipring for earthing purpose. It shall conform to general specification for earthing. Rubber mattings shall be provided in front of the protective and control panels. All bonds between earth conductors and crane parts shall be welded if possible, or rivetted and soldered. Where screwed bonds are made, care shall be taken that there is satisfactory contact surface and nuts shall be locked to prevent their loosening. Earth connections to equipment shall be made by means of multi strand flexible conductor to adequate section. The earth ring on the crane/ machine shall be connected to the plant earthing system through to gantry rails. Each end of each gantry rail shall be bonded to the plant earthing system.

In addition, intermediate earthing bond shall also be provided on the rails at every 60 m in case of longer tracks. Flexible copper bonds shall be provided across any gap in the running gantry rail.

For mobile equipment with flexible cables, one separate copper conductor of adequate size shall be provided for earthing.

### 06.29 Colour code for electrical equipment

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Description of equipment</th>
<th>Colour</th>
<th>Paint shade No. as per IS : 5-1991</th>
<th>Equivalent RAL Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>MOTOR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>6.6 kv motors</td>
<td>Light Gray</td>
<td>631</td>
<td>7042</td>
</tr>
<tr>
<td>2.</td>
<td>LT AC Motors (415v or below)</td>
<td>Brilliant Green</td>
<td>221</td>
<td>6010</td>
</tr>
<tr>
<td>3.</td>
<td>Large Custom Built DC Motors</td>
<td>Light gray</td>
<td>631</td>
<td>7042</td>
</tr>
<tr>
<td>4.</td>
<td>DC 460 V Motors</td>
<td>Azure Blue</td>
<td>104</td>
<td>5000</td>
</tr>
<tr>
<td>5.</td>
<td>DC Motors upto 250 V</td>
<td>Oriental Blue</td>
<td>174</td>
<td>5018</td>
</tr>
<tr>
<td>II</td>
<td>Mounted Electrics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Equipment installed on or along with motor ( Viz Tacho-generators, brake etc.)</td>
<td>Same as that or motor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Equipment installed on mechanism but separate from mtor (Viz. Limit switches, pull cords, speed switches, load calls, photo elec. relays etc.)</td>
<td>Light Gray</td>
<td>631</td>
<td>7042</td>
</tr>
<tr>
<td>III</td>
<td>Transformers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Outdoor transformers (incl. Their associated equipment/ panels installed outdoors)</td>
<td>Aluminum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sl. No.</td>
<td>Description of equipment</td>
<td>Colour</td>
<td>Paint shade No. as per IS : 5-1991</td>
<td>Equivalent RAL Code</td>
</tr>
<tr>
<td>--------</td>
<td>--------------------------</td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dark Admiralty Gray</td>
<td>632</td>
<td>7012</td>
</tr>
<tr>
<td>2.</td>
<td>Indoor transformers</td>
<td>Light Gray</td>
<td>631</td>
<td>7042</td>
</tr>
<tr>
<td>IV</td>
<td>Switchgear of substation</td>
<td>Brilliant Green</td>
<td>221</td>
<td>6010</td>
</tr>
<tr>
<td>1.</td>
<td>6.6 kv switchgear</td>
<td>Light Gray</td>
<td>631</td>
<td>7042</td>
</tr>
<tr>
<td>2.</td>
<td>415 switch gear (Substation equipment)</td>
<td>Brilliant Green</td>
<td>221</td>
<td>6010</td>
</tr>
<tr>
<td>V</td>
<td>Control Gear</td>
<td>Light Admiralty Gear</td>
<td>697</td>
<td>7001</td>
</tr>
<tr>
<td>1.</td>
<td>All control panels (MCCs, PDBs, thyristor panels etc.)</td>
<td>Light Admiralty Gear</td>
<td>697</td>
<td>7001</td>
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<tr>
<td>2.</td>
<td>Light distribution board</td>
<td>Brilliant Green</td>
<td>221</td>
<td>6010</td>
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<tr>
<td>3.</td>
<td>Fire fighting panel</td>
<td>Post Office Red</td>
<td>538</td>
<td>3002</td>
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<td>4.</td>
<td>Local control box</td>
<td>Light Gray</td>
<td>631</td>
<td>7042</td>
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<tr>
<td>5.</td>
<td>PLC, UPS, Control desk</td>
<td>Light Gray</td>
<td>631</td>
<td>7042</td>
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<tr>
<td>6.</td>
<td>Mimic panel</td>
<td>Light Gray</td>
<td>631</td>
<td>7042</td>
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<tr>
<td>VI</td>
<td>Miscellaneous Equipment</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1.</td>
<td>Junction boxes</td>
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<td>631</td>
<td>7042</td>
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<tr>
<td>2.</td>
<td>Conduit pull boxes</td>
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<td>631</td>
<td>7042</td>
</tr>
<tr>
<td>3.</td>
<td>Light fittings</td>
<td></td>
<td>631</td>
<td>7042</td>
</tr>
<tr>
<td>4.</td>
<td>Welding sockets/ power</td>
<td>Green</td>
<td>221</td>
<td>6010</td>
</tr>
<tr>
<td></td>
<td>sockets</td>
<td>Light Orange</td>
<td>557</td>
<td>2000</td>
</tr>
<tr>
<td>5.</td>
<td>110 V and 24 V transformer, sockets, lamp sets etc.</td>
<td>Canary yellow</td>
<td>309</td>
<td>1016</td>
</tr>
<tr>
<td>6.</td>
<td>Earthing strip</td>
<td>Black</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Battery charger</td>
<td>Brilliant Green</td>
<td>221</td>
<td>6010</td>
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<tr>
<td>8.</td>
<td>DC DB</td>
<td>Oriental Blue</td>
<td>174</td>
<td>5018</td>
</tr>
<tr>
<td>9.</td>
<td>Battery charger cum DC DB</td>
<td>Brilliant Green</td>
<td>221</td>
<td>6010</td>
</tr>
</tbody>
</table>
15-A.03 DOCUMENTATION

1. Information to be furnished by the Tenderer along with the tender:

The tenderer shall submit adequate sets of following technical drawings & technical data/information with tender for cranes without which the tender shall be considered as incomplete & may not be considered for acceptance.

a) General arrangement drawings/clearance diagram of the cranes.
b) Filled up questionnaire
c) List of commissioning spares
d) List of spares for two (2) years normal operation and maintenance
e) List of insurance spare for each crane   
f) List of special/maintenance tools & tackles.
g) Un-priced copy of list of equipment.
h) List of Preferred Makes.

2. List of drawings/documents to be furnished by the successful Tenderer for approval

a) General arrangement drawing of crane showing full details in plan and sections.
b) General arrangement drawing of trolley/hoist blocks.
c) Quality Assurance Plan for inspection.
d) Detail specification of motor indicating type, KW, rpm, starting torque requirement, class of insulation, type of enclosure, frame size etc.
e) Power requirement, details of motors, control scheme.
f) List of spares for 2 years normal maintenance.

3. List of drawings/documents to be submitted along with equipment by the successful Tenderer

a) GA drawings, complete assembly and sub assembly drawings of the equipment.
b) Drawings of all equipment/component received from sub supplier.
c) Test and warranty certificate for each item of equipment.
d) Test reports and inspection reports.
e) Instruction manuals for testing and commissioning.
f) Operation, maintenance and safety manuals.
g) Requirement of special tools and tackles.
h) Detail drawing list and specifications of all wearing out parts and parts subject to breakage during normal operating conditions.
i) List of spare parts with drawings, sketches, specifications and manufacturer's catalogue.

15-A.04 QUESTIONNAIRE (DOUBLE GIRDER/FOUR GIRDER EOT CRANE)

1. DPR/TPR/ Crane No.
2. No. Off
3. Type of Crane
4. Supplier/ Make
5. Capacity (t)
6. Span (m)
7. Duty Class
8. Speeds (normal & Creep ) m/ min
a) Main hoist & creep
b) Aux. Hoist & creep
c) Cross travel
c) Long travel

9. Height of lift (m)
a) Main hook
   Above floor
   Below floor
b) Aux hook
   Above floor
   Below floor

10. Crane rail height above floor (m)

11. Max wheel load (t) (without impact)

12. Type of cabin

13. Type of hook:
a) Main hook
b) Aux hook

14. Location (Indoor/ Outdoor)

15. Hook approaches (m)
a) Main hook
b) Aux hook

16. No. of rope falls, dia, construction, & breaking strength for
   a) Main hoist
   b) Aux hoist

17. Gantry rail size

18. Crab rail size

19. Over buffer dimension (m)

20. Wheel base

21. Wheel diameter for
   a) LT wheel
   b) CT wheel

22. Handling attachments

23. Special features (weighing device etc)

24. Motor:
   (Type, kW, rpm starts/ hr enclosure etc)
   a) Main hoist
   b) Aux hoist
c) Cross travel
d) Long travel

25. Type of control for each motion with corresponding characteristic curve:

26. Method of obtaining creep speed:

27. Power supply
   - Power supply S.L.D:
   - Electric equipment specification

28. Control voltage

29. Ambient temp/ Environment

30. Total weight of the crane (t)

31. Break up of crane weight (t)
   a) Structural
   b) Mechanical
c) Electrical

32. Total weight of the crab (t)

33. Code of design

34. General arrangement drawing, incorporating the front and side elevations, plan, hook
approaches, location of cabin/ pendant, down shop lead, clearance dimension, handling attachments and other relevant characteristics of the crane.

35. Details of swiveling / rotating arrangement, if any, along with scheme.

36. Any other information
15-B SINGLE GIRDER EOT/US CRANE

15-B.01 The scope of work of the Tenderer shall consist of design, manufacture, inspection, assembly, and painting at manufacturer's shop as well as at site after erection, supply and transportation to site, unloading and re-conservation at site, erection testing & commissioning of Single Girder EOT / Under Slung Cranes of various capacity.

15-B.02 Technical Specification

- Single girder cranes shall be designed, manufactured, assembled and tested in accordance with the latest revision of IS:807, IS:3177, IS:3938 and other relevant codes and practices for the cranes to be used in steel plants, steel industry (IPSS) unless otherwise stated.
- The components of the hoist shall be designed, manufactured, assembled and tested in accordance with the latest revision of IS:3938 and shall be of standard make.
- All working parts requiring replacement or inspection or lubrication shall be easily accessible without the need for dismantling of other equipment or structure.
- All electrical cables shall be so laid that they are not liable to be damaged and can be easily inspected and tested.
- For out-door cranes all electrical and mechanical components which are exposed to weather shall be completely covered or made weather proof. The covers shall be in segments to facilitate easy dismantling and assembly.
- No cast iron parts shall be used except for electrical equipment and no wood or other combustible material shall be used unless specifically mentioned otherwise.
- Where down shop leads are located below runway rails, guard shall be provided on the crane to prevent the hoist ropes from coming in contact with down shop leads.
- All bolts except those with nyloc nuts shall be provided with grip lock nuts or spring washers.
- All trailing cables shall be clamped with PVC or non-metallic clamps.
- Steel frames carrying machinery shall be machined to true surface.
- All gears and bearings shall be lubricated by splash lubrication/ grease as required. All greasing points shall be easily accessible.

15-B.03 Structural Design

- The crane structure shall be designed in accordance with the latest revision of IS:807.
- The bridge girder shall consist of main and an auxiliary structure where necessary.
- End-carriages shall be fabricated from rolled steel sections or plates, or both, welded together to form a box.
- End-carriages shall be of ample strength to resist all stresses likely to be imposed on them under severe conditions, including collision with other cranes or stops. The length of the end-carriage shall be such that no other part of the crane is damaged in collision.
- The end-carriage shall be fitted with safety stops to prevent the crane from falling more than
25 mm in the event of breakage of a track wheel or axle. Suitable jacking pads shall be provided on each end-carriage for jacking up the crane while changing track wheels.

- For single girder EOT cranes with central L.T. drive, full length M.S. chequered plate platform shall be provided along the bridge girder for mounting and access to long travel drive, current collection system, control panels, etc. A clear head-room of minimum 2000 mm shall be made available over the top of platform from the bottom cord of the roof truss.
- Black bolts shall not be used in the load bearing structures of the crane. Also high tensile friction grip bolts shall not be used unless approved by the Purchaser.
- Bolts used in shear shall be fitted into reamed holes.
- Transverse fillet welding on the load carrying members shall be avoided.
- All butt welds on structural members, subject to tensile stress, shall be x-rayed.
- Plates, bars, angles and where practicable, other rolled sections used in the load bearing members of the structure shall not be less than 6 mm thick.
- Steel sections and plates, used for construction shall be of the latest revision of IS:2062 quality.

15-B.04 Mechanical Equipment

a. Design of Mechanisms

Each mechanism of the crane shall be modular in construction with built in facilities for easy dismantling and maintenance of each assembly as an independent unit.

b. Rope Drums

Fabricated rope drum shall be stress relieved before machining. For the cranes used in steel plants, the material of the rope drum shall be limited to C.S. / M.S.

c. Wire Rope

The wire ropes shall be regular right hand lay hemp cores as per IS: 2266/1989. However, ropes working under water and in corrosive atmosphere shall be galvanized and shall have steel core. For rope arrangement with 2 falls, wire rope shall be of non-spinning type. For the cranes in steel plant, selection of wire rope shall be as per IPSS.

d. Rope Guides

Suitably designed rope guides with pressure ring/ rope tightener shall be provided for each lead of rope from the rope drum to prevent the rope from overriding, loosening or rope coming off the groove.

e. Rope sheaves

For cranes in steel plants, material shall be either CS/MS. Bottom block sheaves shall be provided with suitable guards to retain the rope in the sheave groove. Equalizer sheave/ bar shall be arranged to turn and swivel to maintain rope alignment under all circumstances.

f. Wheels

For single girder EOT cranes, the wheels for long travel motion shall be double flanged with straight tread. The width of wheel tread shall be greater than the rail head by 30 mm. For under slung cranes hoists block, the wheels shall be single flanged with straight/ taper tread to suit the track beams. Minimum diameter of the LT wheels for S.G. EOT cranes shall be 320 mm. However, in case of steel plant duty cranes the combination of wheel diameter and
rail size shall be ensured. Wheels shall be of forged/ rolled/ cast steel with minimum hardness of 200 BHN in case of single girder under slung cranes running on rolled steel joist and 300 BHN for EOT cranes and for under slung cranes/ hoists running on wear resistant flats welded to rolled steel joists. Minimum diameter of CT & LT wheels for under slung cranes shall be 150 mm.

g. Long Travel Drive

a) For Single girder EOT Cranes

Individual wheel drive (one wheel in each end-carriage) shall be provided when the crane span exceeds 13 meters. All parts of the long travel drive shall be located above the platform and easily accessible. The gear-box mounted on platform with foot mounted motor and brake shall be connected with driving wheel by means of locating shaft and flexible geared coupling. The use of open gearing, chain and sprocket, pulley and belt etc. is not permitted.

b) For under Slung Cranes

Dual drive arrangement located at either end of each end carriage shall be provided. Flange mounted geared motors may also be used.

h. Hoist and Cross-Travel Drive

The hoist and cross travel motions shall be combined in one block which shall be designed as per IS:3938/1983. It shall be ensured that skidding does not occur under any condition. (REFER SPECIFICATION FOR ELECTRIC HOISTS BELOW)

i. Gearing and Gear-boxes

Straight and helical spur gearing in metric module shall be used for all motions. Worm gearing shall not be used. All gears shall be of hardened and tempered alloy steel with machine cut teeth. Hardness for pinion shall be 220 BHN and for gears it shall be 200 BHN. All gearings shall be enclosed in oil tight gear-boxes. Fabricated gear-boxes shall be stress relieved before machining.

j. Bearings and Bearing Housing

Ball and roller anti-friction bearings shall be used throughout unless otherwise specified. Anti-friction spherical roller bearings shall be provided for live axles of travel wheels. Housings shall be split on shaft centre line to permit removal of the shaft. The underside of the base of each bearing pedestal shall be machined and shall bear upon a machined surface.

k. Couplings

Flexible coupling shall be used between the LT motor and gear-box and between gear-box out put shaft and wheel shaft. In case of single motor central drive for LT motion, out put shaft of the gear-box shall be connected through solid flange couplings. Half-gearied couplings with floating shaft shall be provided between the wheel and the line shaft.

l. Hook Blocks
Hook blocks shall be of enclosed type leaving openings for ropes only so that ropes do not run off the sheaves. Standard swivelling shank hooks, mounted on thrust bearings shall be used unless otherwise specified.

m. **Brakes**

Electro-magnetic brakes shall be provided for each motion on the high speed pinion shaft of the gear-train.

n. **Buffers**

The crane shall be provided with rubber buffers on the four corners of the end-carriages unless otherwise specified. For electrically operated hoists, steel stops at all the four ends of the track beam shall be provided.

15-B.05 **ELECTRICAL DETAILS (to be followed cl.no.15-A-02-06)**

15-B.06 **DOCUMENTATION**

1. **Drawings and documents to be submitted by the Tenderer with Tender**

The tenderer shall submit adequate sets of following technical drawings & technical data/information with tender for cranes without which the tender shall be considered as incomplete & may not be considered for acceptance.

   a) General Arrangement drawings of cranes/hoists / attachments & signed copies of Clearance diagramme

   Duly filled in questionnaire.

2. **List of Drawing/ Documents to be furnished by the Successful Tenderer for approval / reference**

   a) General Arrangement drawings of cranes/hoists / attachments & signed copies of Clearance diagramme
   a) Quality assurance plan for inspection.
   b) Specification of oils and lubricants and other consumables and their quantity and frequency of change.
   c) Detailed layout plan and sections for power supply system. (Angle Bus bar/Shrouded Bus Bar/ Festoon Cable etc.)
   d) DSL / Trolley line arrangement layout.

3. **List of Drawings/ Documents to be furnished alongwith equipment by the Successful Tenderer**

   01. Requisite no. of sets of all GA drawings, complete assembly and sub assembly drawings of the equipment.
   02. Drawing of all equipment/ component received from sub supplier.
   03. Engineering and design calculations.
   04. Test and warranty certificate for each item of equipment.
   05. Detailed erection schedule and manuals, assembly/ erection drawings, erection sequence, special precautions to be followed during assembly/ erection (these shall be despatched three months prior to FOT/FOR delivery).
06. Test reports and inspection reports.
07. Instruction manuals for testing and commissioning.
08. Operation, maintenance and safety manuals.
09. Requirement of special tools and tackles, if any, for subsequent maintenance.
10. Detail drawing and specifications of all wearing out parts and parts subject to breakage during normal operating conditions (two sets and one reproducible and/or two sets of catalogues).
11. List of spare parts with drawings, sketches, specifications and manufacturer’s catalogue (two sets and one reproducible and/or two sets of catalogues).
12. All other drawings and documents as stipulated in General Conditions of Contract.

15-B.07 QUESTIONNAIRE (SG EOT/US CRANE)

I/ Crane No. : 
ii/ Nos. off : 
iii/ Type of crane : 
iv/ Capacity (t) : 
v/ Span (m) : 
vi/ Duty class : 
vii/ Location : 
viii/ Hoists :
   a) Speed with safe working load, m/min : 
   b) No. of rope falls supporting the load and specification of rope : 
   c) Lift of hook above floor, m : 
   d) Drop of hook below floor, m : 
   e) kW of motor at specified rating : 
   f) RPM of motor : 
   g) Make, type and size of brake : 
ix/ Cross - travel
   a) Speed with working load, m/min : 
   b) Wheel base, mm : 
   c) No. of wheels : 
   d) kW of motor at specified speed : 
   e) RPM of motor : 
   f) Make, type and size of brake : 
x/ Bridge
   a) Speed with safe working load, m/min : 
   b) Wheel base, mm : 
   c) No. of wheel on each end-carriage : 
   d) Diameter of wheel, mm : 
   e) Maximum wheel load, kg : 
   f) No. of motors : 
   g) kW of motor at specified rating : 
   h) RPM of motor : 
   i) Make, type and size of brake : 
xi/ Power supply : 
 xii/ Control voltage : 
 xiii/ Made and type of control : 
 xiv/ Total weight of crane, t : 
 xv/ Total weight of hoist, t : 
 xvi/ Break-up of crane weight, t :
   a) Structural : 

b) Mechanical

c) Electrical

xvii/ General arrangement drawing showing details as enumerated:

xviii/ List of deviations from the Purchaser's Specification:
15-C ELECTRIC HOIST

15-C.01 The scope of work of the Tenderer shall consist of design, manufacture, inspection, assembly, and painting at manufacturer’s shop as well as at site after erection, supply and transportation to site, unloading and re-conservation at site, erection testing & commissioning of Electric hoist of various capacity.

15-C.02 TECHNICAL SPECIFICATION

   a) The hoist shall be designed in accordance with IS:3938-1983.

   b) For outdoor hoists, motors, brakes & other equipment shall be covered to suit to outdoor operations.

   c) All trailing cables shall be clamped with PVC or non-metallic clamps.

   d) Defects in the materials like fractures, cracks, blowholes, or laminations are not allowed.

   e) No cast iron parts shall be used except for electrical equipments and no wood or combustible material shall be used unless specifically mentioned otherwise.

   f) All working parts requiring replacements or inspection or lubrication shall be easily accessible without the need for dismantling of other equipment or structure.

   g) All bolts except those with nyloc nuts shall be provided with grip lock nuts or spring washer.

   h) All parts of the hoist shall be thoroughly cleaned of all loose mill scales, rust or foreign matter & then painted as specified. All parts inaccessible after assembly shall be painted before assembly & assembled while paint is still wet.

   i) All parts except motors, resistors, gears, thrustors, solenoids, etc. shall be de-rusted manually & painted as follows:

15-C.03 Mechanical details

01. Wheel & drive

   The electric hoist shall run on two pairs of wheels, a pair of which shall be driven by motor through reduction gear. The wheels shall be of cast steel/forged steel, single flanged with taper / parallel treads to suit to monorail. The wheels shall be mounted on anti-friction bearings & shall be easily removable for repair & replacement. The wheel diameter shall be selected such that skidding does not take place even under unloaded condition.

02. Hoist mechanism

   The hoist mechanism shall consist of a bottom block fitted with a standard forged swivel hook of the specified capacity, supported on 2 or 4 falls of wire rope. However, non-spinning type of wire rope shall be used for 2 falls rope arrangement. The wire rope shall be wound on a grooved drum which shall be sufficiently long to accommodate in one layer the length of rope requisite for the specified lift & in addition not fewer than two turns at each anchored end & one spare groove at the opposite end. The hoist drum shall be motor driven through gears enclosed in oil filled reduction gearbox.
03. Gearing

Straight & helical spur gearing shall be used for all motions. Worm & bevel gears shall not be used with specific permission from purchaser. Preferably all first reduction gears shall have single helical teeth. All gears shall be hardened & tempered alloy or carbon steel with machine cut teeth. Surface hardening of teeth is not acceptable. All gears shall be enclosed in oil filled gear box except when not possible.

04. Couplings

Each motor shall be connected to its gear drive by a flexible coupling.

05. Lubrication

All gears & bearings shall be lubricated either by splash lubrication or by grease. If possible, all the lubricating points shall be grouped together in easily accessible positions.

06. Bearings

Ball & roller antifriction bearings of reputed make shall only be used, with minimum bearing life as per IS: 3938.

07. Brakes

D.C. Electromagnetic brake shall be provided for each motion, however in case of conical rotor motors manufacturer’s standard brake can be used.

08. The Electric hoists shall be inspected as per IS: 3938 - 1983 and as specified in GCC.

15-C.04 DOCUMENTATION

1. Drawings and documents to be submitted by the Tenderer with Tender

The tenderer shall submit adequate sets of following technical drawings & technical data/information with tender for cranes without which the tender shall be considered as incomplete & may not be considered for acceptance.

a) General arrangement drawings of the Hoist with all technical parameters & details.

b) Duly filled in questionnaire.

2. List of Drawing/ Documents to be furnished by the Successful Tenderer for approval / reference

a) General arrangement drawing of equipment showing full details in plan and sections.

b) Quality assurance plan for inspection.

c) Specification of oils and lubricants and other consumables and their quantity and frequency of change (reference)

d) Detailed layout plan and sections for power supply system.

3. List of Drawings/ Documents to be furnished along with equipment by the Successful Tenderer

a) GA drawings, complete assembly and sub assembly drawings of the equipment.

b) Engineering and design calculations.
c) Test and warranty certificate for each item of equipment.
d) Test reports and inspection reports.
e) Instruction manuals for testing and commissioning.
f) Operation, maintenance and safety manuals.
g) Requirement of special tools and tackles, if any, for subsequent maintenance.
h) All other drawings and documents as stipulated in General Conditions of Contract.

15-C.05 QUESTIONNAIRE (ELECTRIC HOIST)

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<td>Capacity</td>
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<td>Duty classification</td>
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<td>Total weight of hoist</td>
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<table>
<thead>
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<th>02 Hoist</th>
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<tbody>
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<td>Speeds with safe working load</td>
<td>:</td>
</tr>
<tr>
<td>Lifting height</td>
<td>:</td>
</tr>
<tr>
<td>a) Above floor level</td>
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<tr>
<td>b) Below floor level</td>
<td>:</td>
</tr>
<tr>
<td>Wire ropes</td>
<td></td>
</tr>
<tr>
<td>a) Type of construction</td>
<td>:</td>
</tr>
<tr>
<td>b) Size</td>
<td>:</td>
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<tr>
<td>c) Number of falls</td>
<td>:</td>
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<tr>
<td>d) Factor of safety</td>
<td>:</td>
</tr>
<tr>
<td>Rope drum</td>
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</tr>
<tr>
<td>a) Materials</td>
<td>:</td>
</tr>
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<td>b) Diameter</td>
<td>:</td>
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<tr>
<td>Drives</td>
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</tr>
<tr>
<td>a) Type &amp; material of gear box</td>
<td>:</td>
</tr>
<tr>
<td>b) Gear &amp; pinion</td>
<td>:</td>
</tr>
<tr>
<td>c) Material &amp; hardness</td>
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<tr>
<td>Motors</td>
<td></td>
</tr>
<tr>
<td>a) Type &amp; number</td>
<td>:</td>
</tr>
<tr>
<td>b) Kw rating</td>
<td>:</td>
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<tr>
<td>c) Synchronous speed</td>
<td>:</td>
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<tr>
<td>d) Class of insulation</td>
<td>:</td>
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<td>e) Pull out torque</td>
<td>:</td>
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<tr>
<td>f) Frame size</td>
<td>:</td>
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<td>Brakes</td>
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<td>a) Type</td>
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<td>b) Size</td>
<td>:</td>
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<td>c) Torque rating</td>
<td>:</td>
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<tr>
<td>Type &amp; details of limit switches</td>
<td>:</td>
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<tr>
<td>Type of couplings</td>
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<td>Type of bearings</td>
<td>:</td>
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<tr>
<td>Lifting hook</td>
<td></td>
</tr>
</tbody>
</table>
a) Type : 
b) Material : 
  ➢ Type & details of control : 

03 Trolley
  ➢ Speed with safe working load : 

Wheels
a) Numbers : 
b) Diameter : 
c) Material & hardness : 
d) Max. wheel load : 
e) Wheel base : 

Drive
a) Type & material of gear box : 
b) Gears & pinions : 
c) Material & hardness : 
d) Kw rating : 
e) Synchronous speed : 
f) Class of insulation : 
g) Pull out torque : 
i) Frame size : 

Brakes
a) Type : 
b) Size : 
c) Torque rating : 

Type & details of limit switches : 
Type of coupling : 
Type of bearings : 
Type & details of controls : 

04 Clearance diagram indicating the basic dimensions : 

05 Type & lubrication provided : 

06 Type & size of cables : 

07 Location & control details of hoist block power feeding arrangement : 

15-D  JIB CRANE

15-D.01  Scope of work

The Jib Crane shall be designed, manufactured, assembled and tested in accordance with IS: 807-1976, IS: 3177-1999, IS: 3938-1983 and other relevant codes and practices to be used in steel plants.

The crane shall conform to various safety codes as applicable.

All parts requiring replacement/inspection/lubrication shall be easily accessible.

Inspection & testing of the hoists shall be conducted as per relevant clause of IS: 3938-1983.

15-D.02  Design standard and General Details

01. The Crane Structure shall be designed in accordance with IS: 807-1976 for the jib column and jib arm of the crane. The details of the crane structure indicated in the Single Girder EOT/US Crane part of the TS shall be followed.

02. The components of electric hoist for the jib crane shall be designed, manufactured, assembled and tested in accordance with IS:3938-1983 and shall be of standard make. The details of the electric hoist indicated in the electric hoist part of the TS (Clause 15C.00) shall be followed.

03. The Structural steel work of the jib crane structure shall conform to IS; 2062-1992.

04. The boom of the jib crane shall be from either rolled steel section of fabricated type.

05. The design of the boom shall be such that the vertical deflection caused by the maximum rated load with the hoist at the maximum jib radius position on the boom, shall not exceed 1/250 of the boom length.

06. The column of the jib crane shall be of heavy duty steel tube or fabricated / lattice structure. Proper bearing housing block for housing bearing for supporting the boom shall be provided at the top.

07. The jib arm support bearing shall be of anti friction ball/ roller bearing.

08. Base plate of the column should be provided with drilling holes of appropriate sizes for fixing the jib crane on the foundation / support.

09. The foundation bolts will be so designed that 50 percent of the bolts provided will be able to take the full load of the jib crane and the turning moments.

10. The design of the column of the jib crane shall be such that overall deflection of the jib does not exceed 1/300 of (boom length, column height) when the jib crane is fully loaded.

11. The connection between the boom and the pillar shall be designed suitably to give proper end fixing to the boom and to ensure that the play between moving members is kept to the minimum.
12. All electrical cables shall be so laid that they are not liable to be damaged and can be easily inspected and tested.

15-D.03 Documentation

Refer documentation for SG EOT /US crane mentioned above.

15-D.04 Questionnaire

Refer questionnaire for SG EOT /US crane mentioned above.
15-E MANUAL HOIST

15-E.01 The scope of work of the Tenderer shall consist of design, manufacture, inspection, assembly, and painting at manufacturer’s shop as well as at site after erection, supply and transportation to site, unloading and re-conservation at site, erection testing & commissioning of manual hoist with traveling trolley of various capacity.

15-E.02 Technical Specification of Manual Hoist with Traveling Trolley

• Ball and roller anti frictional bearing only shall be used.

• Swivelling type standard shank hook mounted on grease lubricated anti-friction thrust bearing shall be used.

• The Chain Pulley Block shall conform to class-I duty as per IS: 3832-1986.

• Load chain & operating chain shall be of calibrated type.

• Pulley used for the operating mechanism shall have suitable guards to prevent the operating chain from coming out.

• All the open gearing shall have suitable cover.

15-E.03 DOCUMENTATION

1. Drawings/ Documents to be submitted with the tender.

The Tenderer shall submit the following technical drawings & technical data/ information with tender for manual hoist with traveling trolley, without which the tender shall be considered as incomplete & may not be considered for acceptance.

   a) Typical General arrangement drawings & catalogues of the hoist.

   b) The questionnaire filled in.

2. Final drawings/documents to be furnished along with the equipment:

   a) General Arrangement drawings and all data /catalogues.

   b) Supply of report on shop tests and material test certificate.

   c) Supply of all operating manual, maintenance schedule & lubrication chart.

15-E.04 Questionnaire

1. Equipment No. :
2. Capacity :
3. Quantity :
4. Height of Lift :
5. Class of Duty :
6. Make :
7. Min\(^m\). Radius of Curvature
Of Track beam size: 

8. Max. Tractive effort (Kgs) 
   - Hoist: 
   - Travel: 

9. Movement in ‘m’
   corresponding to operating
   chain movement of 30m.
   - Hoist: 
   - Travel:

15.F CANTILEVER CRANE

The scope of work of the Tenderer shall consist of design, manufacture, inspection, assembly, painting, supply and transportation to site, testing & commissioning of Column/Pillar Mounted Cantilever Cranes as per technical parameters indicated in enclosed clearance diagrams.

15.F.01 TECHNICAL SPECIFICATION

i/ The cranes shall be designed, manufactured, assembled and tested in accordance with IS:15419-2004, 807-2006, IS:3177-999, IS:3938-1983 and other relevant codes and practices for the cranes to be used in steel plants, steel industry (IPSS) unless otherwise stated. IPSS (wherever applicable) shall also be followed.

ii/ The components of the hoist shall be designed, manufactured, assembled and tested in accordance with IS:3938-1983 and shall be of standard make.

iii/ All working parts requiring replacement or inspection or lubrication shall be easily accessible without the need for dismantling of other equipment or structure.

iv/ All electrical cables shall be so laid that they are not liable to be damaged and can be easily inspected and tested.

v/ For out-door cranes all electrical and mechanical components which are exposed to weather shall be completely covered or made weather proof. The covers shall be in segments to facilitate easy dismantling and assembly.

vi/ No cast iron parts shall be used except for electrical equipment and no wood or other combustible material shall be used unless specifically mentioned otherwise.

vii/ Where down shop leads are located below runway rails, guard shall be provided on the crane to prevent the hoist ropes from coming in contact with down shop leads.

viii/ All bolts except those with nyloc nuts shall be provided with grip lock nuts or spring washers.
ix/ All trailing cables shall be clamped with PVC or non-metallic clamps.

x/ Steel frames carrying machinery shall be machined to true surface.

xi/ All gears and bearings shall be lubricated by splash lubrication/grease as required. All greasing points shall be easily accessible.

xii/ Testing

A. At Manufacturer's Works

The supplier in the presence of the Consultant shall carry out following tests:

1. Visual check

The crane after assembly shall be visually checked for any defect in the workmanship.

2. Dimensional check

All dimensions of the crane shall be checked as per the approved general arrangement drawings. Diagonal measurement of the crane/hoist shall also be carried out in the shop before despatch to site. The dimension of the cranes after assembly shall be within the tolerances specified below:

a) Span over L.T. wheels : +3 mm

b) Diagonal on wheels     : +2 mm

c) L.T wheel alignment    : +1 mm

d) Tilt of wheel          : 1 mm/1000 mm
                           (Vertical & horizontal)

e) Over buffer length  : +5 mm
                           (Over buffer dimension on
                           Two sides shall be same)

f) Load test for hoist   : As per IS:3938-1992/3177-1999

g) No load running test of the L.T. mechanism of the crane.

B. At Site

1. Visual check

a) The crane after erection shall be visually checked for any missing/damaged parts or defects in erection. These defects/missing parts shall be made good.

b) The crane after erection will have dimensions within the tolerances enumerated earlier.

c) Deflection test, insulation test, performance test and overload test:

These tests shall be done as enumerated in IS 3177-1999 and IS:15419-2004. However, there would be no permanent set in the structures after the removal of the 125% overload. The tolerance on the lowering speed may be +20% of the specified hoisting speed instead of +10% of hoisting speed specified in IS: 3177-1999.
d) The representative of supplier shall be present at site during testing and commissioning of the crane and any defect/deficiency pointed out by the Purchaser shall be made good by supplier free of cost.

15.F.02 Structural Design

15.F.02.01 Column/Pillar Mounted Cantilever Cranes

i/ The cranes shall be designed in accordance with IS: 807 for the column and arm of the crane.

ii/ The structural steel material for the crane structure shall confirm to IS: 2062-2006 and IS: 8500-1991.

iii/. The boom of the cranes shall be from section or fabricated type with rolled section or tubular sections.

iv/ The design of the boom shall be such that the vertical deflection caused by the maximum rated load with the hoist at maximum radius position on the boom, shall not exceed 1/250 of the boom length.

v/ The column of the crane shall be made of heavy duty steel tube or fabricated/ lattice structure to ensure minimum deflection at full load. Proper bearing housing block, for housing required bearing for supporting the boom, shall be provided at the top or at suitable locations.

vi/ The arm support bearing will be either anti-friction ball roller bearing (or bush type bearing) as per design/client’s requirement.

ix/ The design of column and boom of self supported cantilever crane shall be such that overall deflection of the crane does not exceed the limit of (boom length+ Column height)/ 300 when the hoist along with load is at extreme boom radius

x/ The connection between the boom and the pillar shall be designed suitably to give proper end fixing to the boom and to ensure that they play between moving member is kept to the minimum.

xi/ Match mark shall be provided on each part of the structure to facilitate erection and alignment of the crane at site.

15.F.02.02 Mechanical Equipment

I/ Design of Mechanisms

Each mechanism of the crane shall be modular in construction with built in facilities for easy dismantling and maintenance of each assembly as an independent unit.

ii/ Rope Drums

Fabricated rope drum shall be stress relieved before machining. For the cranes used in steel plants, the material of the rope drum shall be limited to C.S. / M.S. The rope drum shall preferably have left and right hand deep groove for low abrasion and true
vertical lift and shall be sufficiently long to accommodate in one layer the length of rope requisite for the specified lift & in addition not fewer than two turns at each anchored end & one spare groove at the opposite end.

iii/ **Wire Rope**

The wire ropes shall be regular right hand lay hemp cores as per IS:2266-2002. However, ropes working under water and in corrosive atmosphere shall be galvanized and shall have steel core. For rope arrangement with 2 falls, wire rope shall be of non-spinning type. For the cranes in steel plant, selection of wire rope shall be as per IPSS.

iv/ **Rope Guides**

Suitably designed rope guides with pressure ring/ rope tightener shall be provided for each lead of rope from the rope drum to prevent the rope from overriding, loosening or rope coming off the groove.

v) **Rope sheaves**

For cranes in steel plants, material shall be either CS/MS. Bottom block sheaves shall be provided with suitable guards to retain the rope in the sheave groove.

Equalizer sheave/ bar shall be arranged to turn and swivel to maintain rope alignment under all circumstances.

vi) **Wheels**

Single flange straight or taper tread type wheels shall be used for under slung type trolley motion. The side clearance between the runway beam flange and wheel shall be 3 to 4mm on either side.Wheels shall be of forged/ rolled/ cast steel with minimum hardness of 250 BHN.

vii/ **Slew Drive**

Motorized slew drive shall be provided for cantilever cranes. The speed at the tip of the jib boom should be restricted to 15 m/min. The brake shall be mounted on the input or extension shaft of gear box. In addition end stoppers are to be mounted on the pillar. Suitable limit switches shall be provided in order to restrict the angle of rotation of the jib.

viii/ **Hoist and Cross-Travel Drive**

In case of Cantilever crane with electric hoist, hoist and cross travel motions shall be combined in one block which shall be designed as per IS:3938-1983.

In case of cantilever crane with double Jib Arm, CT and hoist mechanism shall be through trolley/crab similar to DG EOT crane.

ix/ **Gearing and Gear-boxes**

Straight and helical spur gearing in metric module shall be used for all motions. Worm gearing shall not be used. All gears shall be of hardened and tempered alloy steel with machine cut teeth. Hardness for pinion shall be 220 BHN.
and for gears it shall be 200 BHN. All gearings shall be enclosed in oil tight gear-boxes. Fabricated gear-boxes shall be stress relieved before machining.

x/ **Bearings and Bearing Housing**

Ball and roller anti-friction bearings shall be used throughout unless otherwise specified. Anti-friction spherical roller bearings shall be provided for live axles of travel wheels. Housings shall be split on shaft centre line to permit removal of the shaft. The underside of the base of each bearing pedestal shall be machined and shall bear upon a machined surface. Due allowance shall be made for impact and side thrust while selection of bearings. Wherever necessary, spherical seating type separate thrust bearings of suitable dimensions shall be used. Life of ball & roller anti-friction bearings shall be calculated in accordance with manufacturer’s recommendations and based on equivalent running time. The bearings used shall be of reputed make only.

xi/ **Couplings**

Each motor shall be connected to its gear drive by a flexible coupling. All couplings shall be cast, wrought or from forged steel, tooth portion to be heat treated to hardened HB 241-280 and also shall be designed to suit the maximum torque that may be developed.

Alignment shall be such that solid couplings mate accurately. Flexible/ fluid couplings shall be initially aligned with the same accuracy as the solid couplings.

Flexible couplings of fail safe type shall be fitted between motor shaft and gearbox extension shaft of electric hoist.

xxii/ **Shaft and Keys**

Shaft and axle shall have ample strength and rigidity and adequate bearing surface. They shall be finished smoothly and shall be provided with fillets of as large a radius as possible and/or be suitably tapered. All shafts shall be made of suitable quality of steel as recommended in IS:3177 (cl.8.2.1). Keys, key ways and splines shall be either involute or straight sided and shall conform to the relevant Indian Standards. Keys shall be so fitted and secured that they cannot work loose in service.

xiii/ **Lubrication**

All gears & bearings shall be lubricated either by splash lubrication or by grease. If possible, all the lubricating points shall be grouped together in easily accessible positions.

xii/ **Hook Blocks**

Hook blocks shall be of enclosed type leaving openings for ropes only so that ropes do not run off the sheaves. Standard swiveling shank hooks, mounted on thrust bearings shall be used unless otherwise specified.
xiii/ Brakes

Electro-magnetic brakes shall be provided for each motion on the high speed pinion shaft of the gear-train. Brakes shall be capable of bringing the fully loaded crane hoist safely to rest in shortest possible time with least possible shock and shall arrest the motion under all service condition. D.C. Spring for electro magnetic brakes shall be the compression type and shall not be stressed in excess of 80% of the torsional elastic limit of the material.

Wearing surface of all the brake drums shall be machined and shall be cylindrical, smooth and free from defects. Brake lining shall be effectively and permanently secured the brake shoe during the effective life of the lining. Wherever required DC Disc brakes may be used.

xiv/ Buffers

The crane shall be provided with rubber buffers on the four corners (two in case of cantilever cranes) of the end-carriages unless otherwise specified. For electrically operated hoists, steel stops at all the four ends of the track beam shall be provided.

15.F.03 Electrical Details (to be followed cl.no.15-F-02-06)

15.F.04 DOCUMENTATION

15.F.04.01 Drawings and documents to be submitted by the tenderer with Tender

The tenderer shall submit four sets of following technical drawings & technical data/information with tender for cranes without which the tender shall be considered as incomplete & may not be considered for acceptance.

1. General arrangement drawings of the cranes/ signed copies of the clearance diagram with the confirmation that all the dimensions shall be adhered to while preparing GA drawings.

2. Time bar chart of delivery showing break up of time required for raw material procurement, engineering, various shop activities, order placement for bought out items and their delivery to shop, assembly, testing, inspection and despatch.

3. Deviations from tender documents.

4. The questionnaire filled in.

15.F.04.02 List of Drawing/ Documents to be furnished by the Successful Tenderer (Nos. of copies shall be as per GCC)

The following drawing/documents to be submitted by the Successful Tenderer within 30 days of placement of order.

1. General arrangement drawing of equipment showing full details in plan and sections along with design calculations.
2. General arrangement drawing of hoist blocks/ trolleys.

3. Schematic control circuit diagrams for individual drives along with contactor sequence diagram and motor speed/ torque characteristics.

4. Motor power, DSL sizing, voltage drop and brake calculation.

5. Quality assurance plan for inspection.

6. Specification of oils and lubricants and other consumables and their quantity and frequency of change.

7. Cable schedule and inter connection diagrams.

8. Control schematic diagram.


10. Detail specification of motor indicating type, KW, rpm, no of starts/hr Duty, starting torque requirement, class of insulation, type of enclosure, frame size, etc.

11. Power requirement.

12. Detailed layout plan and sections for power supply system. (angle Bus bar/Shrouded Bus Bar/ Festoon Cable etc.)

15.F.04.03 List of Drawings/ Documents to be furnished alongwith equipment by the Successful Tenderer (Nos. of copies shall be as per GCC)

1. Requisite no. of sets of all GA drawings, complete assembly and sub assembly drawings of the equipment together with two copies of good quality polyester reproducible.

2. Drawing of all equipment/ component received from sub supplier together with two copies of reproducible.

3. Engineering and design calculations.

4. Test and warranty certificate for each item of equipment.

5. Detailed erection schedule and manuals, assembly/ erection drawings, erection sequence, special precautions to be followed during assembly/ erection (these shall be despatched three months prior to FOT/FOR delivery).

6. Test reports and inspection reports.

7. Instruction manuals for testing and commissioning.

8. Operation, maintenance and safety manuals.

9. Requirement of special tools and tackles, if any, for subsequent maintenance.
10. Detail drawing and specifications of all wearing out parts and parts subject to breakage during normal operating conditions (two sets and one reproducible and/or two sets of catalogues).

11. List of spare parts with drawings, sketches, specifications and manufacturer’s catalogue (two sets and one reproducible and/or two sets of catalogues)

12. All other drawings and documents as stipulated in General Conditions of Contract.

QUESTIONNAIRE
Annexure-1

(To be filled in for each crane and shall be submitted along with Tender)

B. For Cantilever Cranes
   i. Type of Crane
   ii. Capacity
   iii. Operating Speed:
        a. Hoist  b) Cross Travel  c) Slew
   iv) Jib outreach/radius:
   v. Type of Hook
   vi. Total height of lift
   vii. Wire Rope
        Dia, Construction, core, tensile designation, Min. breaking strength, no. of falls, F.O.S, make etc.
   viii. Type of Brakes
        a) Hoist  b) Travel :
   ix. Motor’s details (type, kW, Pole, %CDF, no. of start/Hr, Duty, POT, Insulation & enclosure class, qty, Make etc.)
        a) Hoist  b) Travel  c) Slew
   x. Power supply
   xi. Control voltage
   xii. Made and type of control
   xiii. Break-up of crane weight, t
        a) Structural
        b) Mechanical
        c) Electrical
16 ELEVATORS

16-A RACK & PINION TYPE ELEVATOR

16-A.01 Scope of Work

- **The scope of work** of the Tenderer shall consist of design, manufacture, inspection, assembly, and painting at manufacturer's shop as well as at site after erection, supply and transportation to site, unloading and re-conservation at site, erection, testing & commissioning of Rack and Pinion Type Passenger Elevator for Chimney. The elevator shall be complete with electrical equipment and attachment as covered under this specification. The elevator shall be installed with chimney.

- The elevator shall be complete with car cage, guides with their support, drive system, drive base, cage and door system, battery operated emergency light, alarm bell, complete electric and control system, car and hoist way illumination system, buffers, switches etc. and other necessary fixtures and accessories whether mentioned in this specification or not but necessary for successful installation, operation and maintenance of the elevator.

- The elevator shall be complete in all aspects including structural, mechanical, electrical equipment and other accessories. Any other equipment not covered in the specification but essential for proper design and operation shall be included in the scope of supply / work.

- The scope of work of the tenderer shall also include the following:
  
  Obtaining statutory clearances from statutory authorities.
  
  The elevator shall be operating with or without attendant.
  
  Supply of necessary fixtures if any required for erecting the Rack & Pinion Elevator in position shall also be under tenderer's scope of work.
  
  The scope of work shall stand supplemented by this specification, general specification on quality system, inspection and test of plant & equipment at manufacturer’s premises.
  
  Scope of work of the contractor shall also include the maintenance of the elevators by their own men, machine and materials including spares and consumables for a period of 12 months after successful commissioning of the elevator.

16-A.02 TECHNICAL SPECIFICATION

1. Mechanical details

General – The elevators shall conform to the following stipulations, in general:

a) The elevator shall be designed in accordance with applicable norms of IS: 14665-2000 (Part 1, 2 & 3) and IS14665-2001 (Part-4) and other relevant IS specifications and subject to any modifications and requirements specified herein after.

b) The elevator shall be suitable for continuous 24 hours round-the-clock operation.
c) The Rack & Pinion type passenger elevator cage shall be fabricated with steel construction with floor made of chequered plate and of minimum 6 mm thick over plain and suitably braced to ensure rigidity.

d) The elevator cage shall be provided with manual operated horizontal sliding opening door. The cage doors shall be provided with glass panels. The elevator shall be suitable for operation in a dusty atmosphere of power plants. Cage roof shall also be provided.

e) The cage floor shall be covered with rubber sheet.

f) The elevator shall be of rectangular cross section enclosed on three sides. The drive machine shall preferably be located on top of elevator cage.

g) Necessary hand railing all around drive machine shall also be provided to a height of 1.2 m. The power supply to the drive machine shall be through fixed and flexible power cable using cable guiding devices located on the elevator cage and at regular intervals on the elevator way.

h) Necessary precaution shall be taken in designing the cage to avoid undue vibration or side movement of cage during operation.

i) Safety hooks shall be provided in cage to prevent the same from detaching from the mast.

j) The mast shall be in sections of rectangular tubular structure of adequate height to facilitate quick erection at site. The rack shall be bolted to the lattice/ truss type masts. The rack shall be aligned and fixed to the mass using dowels. The mast shall be firmly attached to the chimney wall using anchor bolts and adjustable wall ties.

k) The section of the mast shall be inter-linking section for coupling for various mast sections like square section to rectangular section. These sections shall be complete with racks. The mast tube shall be of heavy-duty type.

l) Adequate numbers of spring buffers shall be fitted under the elevator cage directly on the floor/ base frame with suitable concrete or steel foundation. Buffers shall be located symmetrically with reference to the vertical centre line of the cage frame within a tolerance of 50 mm. The stroke of the spring buffer for car shall be equal to or greater than 40 mm.

m) Spring buffer shall be capable of supporting, without being compressed solid, a static load equivalent of two times the weight of car and its rated load for car buffers.

n) The elevator drive mechanism shall essentially consists of a reversible electric disc brake motor, over speed governor (centrifugal brake), gear coupling, worm reduction gear unit, drive pinion and progressive type positive action safety device etc.

o) The brake mechanism shall be provided with suitable means for adjustment of brake torque and magnetic air gap. The mechanism shall be of the “spring reset type” and not “gravity operated counter weight type”.

p) The brake position shall be such that double shaft extension is provided so that the brake pulley is not the same as the coupling face.

q) The worm reducer with extended shaft and the drive pinion mounted on it shall be of adequate ratio and of heavy-duty type. The worm wheel should be of special phosphorus bronze / equivalent with centrifugal cast and the worm shaft of special nickel chrome steel /
equivalent and case hardened. The drive pinion and rack shall be made of forged carbon / alloy steel with adequate hardness for the service intended.

r) The drive pinions shall be firmly engaged to the rack by means of rollers, mounted on the antifriction bearings, at the back of the rack. The pressure exerted on the rack shall be adequate to ensure proper backlash between the rack and pinion.

s) Double locks shall be provided so that the cage door shall not open during movement of elevator.

t) Cams operated double limit switches shall be provided to ensure cage stops at all landing positions.

u) The pinion shall be connected with two separate automatic braking systems, which shall activate when there is power failure or the elevator exceeds its maximum speed.

v) The elevator cage shall be provided with necessary switches including emergency bell switch and floor indicator. It shall also be provided with overload alarm and protection.

w) All parts requiring replacement or inspections or lubrication shall be easily accessible without the need for dismantling of other parts / equipment.

x) Provision shall be kept for emergency exit on top of the car in the event of fire or any other emergency.

y) A selector switch and a set of push buttons shall be provided on the top above the ceiling of the car to operate the elevator locally for inspection and maintenance. The selector switch when set to position “Inspection” shall exclude control from other places and movement of the car in the desired direction shall be effected by the push buttons. For normal operation of the elevator, the selector switch shall be set to the position working. It shall be possible to operate the elevator only when the appropriate button is kept in pressed condition.

z) Provision shall be made to prevent the opening of any landing door when the car is passing that zone in response to a call from another landing.

16-A.03 Testing & Commissioning

The testing and commissioning of the elevators shall be done in presence of the representatives of the manufacturer and owner.

The elevator after erection shall be tested as follow:

- Load test with 100% and 110% of rated load as per IS: 14665 - 2000.
- A static load test with 125% of rated load as per IS: 14665 – 2000 to check that the brake will sustain the car.
- All other tests on electrical system as mentioned in IS: 14665 - 2000.
- Any other test felt necessary by Owner and supplier to ensure proper functioning and installation of the lift.
- Demonstration of the functioning of all safety provisions made available in the elevator.
16-A.04 Design construction and performance requirement.

01. Load:

The elevator shall be designed to lift the pay load in addition to weight of the car itself and other accessories.

02. Speed

The elevator shall travel at a speed of 40.0 m/min.

03. Size

The inside dimensions of the platform of the car (clear inside) shall be ~1200mm X 1200mm. The inside clear height of elevator shall be 2200mm.

04. Travel and landings

The lift car shall travel from the landing floor from reference elevation to top landing as specified in the technical parameters/ data sheets. In between these two levels the car shall stop at every intermediate platform levels as specified.

05. Wire Rope

The car and counter weight shall be suspended by steel wire ropes. The number of wire ropes and size of wire rope shall be so chosen that highest factor of safety is achieved as per standard. Not less than three independent suspension ropes shall be used. The minimum diameter of rope shall be 12 mm and factor of safety 12.

06. Car

Car frame

- The lift car shall be carried in a complete frame of steel, which shall be sufficiently rigid to withstand the operation of the safety gear without permanent deformation to the car frame. The car structure shall be of steel with special painting or of stainless steel.

- At least four renewable guide shoes with renewable linings or set of roller guides shall be provided two at the top and two at the bottom of the car frame.

Car enclosure

- The car shall be enclosed on all sides by means of car body and door. The sides of the car shall be lined with heavy gauge stainless steel sheet panel properly braced and reinforced. The enclosure shall be flush on the inside and securely fastened to the platform. The car body floor shall be of M.S steel construction with chequered plate top. Side panels shall be of stainless steel grade 304 and roof of stainless steel over M.S frame.

- The car shall be equipped with handrails on three sides, fan with grills and suitable lighting with fittings. The light shall be left on during the whole time of use.
Necessary provisions shall be made for adequate ventilation of the car. Ventilation opening shall be provided in the enclosure roof as per requirement of IS: 14665-2000 (Part-3). A separate switch shall be provided in the car for the fan.

The enclosure of the lift car shall withstand a trust of 35 kgs applied normally at any point, excepting any vision panel, without permanent deformation.

Car platform

Car platform shall be constructed of structural steel shapes or securely fastened with steel flooring covered with rubber sheet / PVC tiles flooring. The platform shall be designed on the basis of rated loads evenly distributed. The car floor shall comprise a smooth non-slip surface.

Since the car-leveling device will be used, subsequent aprons of sufficient depth shall be fitted to the car floor to ensure that no space is permitted between the threshold and the landing while the car is being leveled to a floor.

16-A.05 DOCUMENTATION

1. Information to be furnished by the Tenderer along with the tender:

The tenderer shall submit adequate sets of following technical drawings & technical data/information with tender for elevator without which the tender shall be considered as incomplete & may not be considered for acceptance.

a) General Arrangement of the Elevator indicating details.

b) Filled in questionnaire

2. List of drawings/documents to be furnished by the successful Tenderer for approval

a) General arrangement drawing of elevator showing full details in plan and sections.

b) Quality Assurance Plan for inspection.

c) Test and inspection certificate.

d) List of spares for 2 years normal maintenance.

3. List of drawings/documents to be submitted along with equipment by the successful Tenderer

j) GA drawings, complete assembly and sub assembly drawings of the equipment.

k) Drawings of all equipment/component received from sub supplier.

l) Test and warranty certificate for each item of equipment.

m) Test reports and inspection reports.

n) Instruction manuals for testing and commissioning.

o) Operation, maintenance and safety manuals.

p) List of spare parts with drawings, sketches, specifications and manufacturer's catalogue.

16-A.06 QUESTIONNAIRE (R&P TYPE PASSENGER ELEVATOR)

1) Name of manufacturer:

2) Nos. Off:

3) Type of elevator:

4) Capacity:
General Technical Specification

1) in Kg

2) Number of passenger

5) Rated Speed (m /min)

6) Total travel (m)

7) Nos. of floor to be served

8) Floor levels

9) Size of elevator well / mast

10) Internal size of elevator car

11) Construction, design and finished car body work :

12) Type of car door

13) Type of landing door

14) Type of landing & car door operation

15) Car entrance

i) Number, size and type of doors.

ii) Cars open in front.

16) Total Weight

i) Mechanical component

ii) Structural item

iii) Others

17) Headroom required above top landing

18) Elevator operation

19) Method of control

20) Ambient temperature

21) Quantity of Motor

22) Power consumption

23) Leveling accuracy

24) Emergency power supply provided?

25) Intercommunication facility provided?

26) Brief description of control features and safety interlocks provided
16-B FREIGHT CUM PASSENGER ELEVATOR

16-B.01 Scope Of Work

- The scope of work of the Tendererer includes design, engineering, manufacture, assembly, inspection and testing, painting at manufacturer's shop as well as at site after erection, supply including dismantling for transportation, packing, forwarding, loading and transportation to site, receipt, unloading, storage and re-conservation at site, erection, testing and commissioning of the elevators at site.

- Obtaining statutory clearances from statutory authority.

- Scope of work of the contractor shall also include the maintenance of the elevators by their own men, machine and materials including spares and consumables for a period of 12 months after successful commissioning of the elevator.

16-B.02 TECHNICAL SPECIFICATION

1. Mechanical Details

The elevators shall conform to the following stipulations, in general:

The passenger and freight elevator shall preferable be designed , manufactured, erected tested and commissioned in accordance with latest edition of IS: 14665 (Part-1 to5). However, the elevator confirming to other reputed codes like BS,DIN, JIS or equivalent is also accepted. The components of the elevators shall be standardized to keep the number of spares to the minimum.

a) The elevator will be installed inside the building to facilitate movement of man and material to various floor levels and shall operate from lower most level to top most level and will be located at identified location as shown in enclosed TS drawing.

b) The elevator shall be equipped with all standard safety systems such as Bell and cranking in case of power failure, emergency rescue battery back-up, hand wheel connected with motor shaft for manual lowering of elevator to the nearest landing level incase of power failure, limit switches, indicators, over speed safety governor for car, emergency light fittings, etc.

c) Lift shaft is to be provided with adequate lighting.

d) The elevator shall be suitable for continuous 24 hours round-the-clock operation.

e) The motor for the elevator shall be squirrel cage induction motor with speed resistance control/VVVF control for controlling the speed during starting and stopping at landings.

f) Trouble-free performance of the elevator incorporating the operational, controlling and safety requirements, as specified, is to be guaranteed.

g) A selector switch and a set of push buttons shall be provided on the top above the ceiling of the car to operate the elevator locally for inspection and maintenance. The selector switch when set to position “Inspection” shall
exclude control from other places and movement of the car in the desired
direction shall be effected by the push buttons.
For normal operation of the elevator, the selector switch shall be set to the
position working. It shall be possible to operate the elevator only when the
appropriate button is kept in pressed condition.

h) Provision shall be made for a safety gear, which shall operate in case of free fall
or over speeding of elevator car or counter weight in the descending direction.
This safety gear, while freezing the cabin mechanically to the guides, shall also
interrupt the control supply through a limit switch.

i) The particular landing door shall open only after the elevator car has stopped at
the landing. Additional provision shall be made for opening of the landing door
in case of emergency by means of a special key. The landing doors shall be so
designed that their closing and opening is not likely to injure a person.

j) Provision shall be made to prevent the opening of any landing door when the car
is passing that zone in response to a call from another landing.

k) At all the intermediate levels “Up” & “Down” call buttons with indicators shall be
provided. Car position indicator shall also be provided at all levels. At ground
level, “Up” call button with indicator & at top most level “Down” call button with
indicator shall be provided.

l) The circuit which supplies current to the motor shall not be included in any twin
or multi-core trailing cable used in connection with the control safety devices/
signaling equipment.

m) Safe access for maintenance and removal of all mechanical and electrical parts
shall be ensured, without additional scaffolding.

n) For other details relevant BS standards shall be followed.


01. Wire Rope

The car and counter weight shall be suspended by steel wire ropes. The
number of wire ropes and size of wire rope shall be so chosen that highest
factor of safety is achieved as per standard. Not less than three independent
suspension ropes shall be used. The minimum diameter of rope shall be 12mm
and factor of safety 12.

02. Car

Car frame

- Every lift car shall be carried in a complete frame of steel which shall
be sufficiently rigid to withstand the operation of the safety gear without
permanent deformation to the car frame. The car structure shall be of
steel with special painting or of stainless steel.

- At least four renewable guide shoes with renewable linings or set of
roller guides shall be provided, two at the top and two at the bottom of
the car frame.
Car enclosure

- The car shall be enclosed on all sides by means of car body and door. The sides of the car shall be lined with heavy gauge stainless steel sheet plate properly braced and reinforced.
- The enclosure shall be flush on the inside and securely fastened to the platform. The car body floor shall be of M.S steel construction with chequered plate top. Side panels shall be of stainless steel grade 304 and roof of stainless steel over MS frame.
- The car shall be equipped with handrails on three sides, fan with grills and suitable lighting with fittings. The light shall be left on during the whole time of use.
- Necessary provisions shall be made for adequate ventilation of the car. Ventilation opening shall be provided in the enclosure roof as per requirement of IS: 14665 (Part 3/Sec 1 & 2)-2000. A separate switch shall be provided in the car for the fan.
- The enclosure of the lift car shall withstand a thrust of 35 kgs applied normally at any point, excepting any vision panel, without permanent deformation.

Car platform

- Car platform shall be constructed of structural steel shapes or securely fastened with steel flooring covered with PVC tiles flooring. The platform shall be designed on the basis of rated loads evenly distributed. The car floor shall comprise a smooth non-slip surface.
- Since the car leveling device will be used, subsequent aprons of sufficient depth shall be fitted to the car floor to ensure that no space is permitted between the threshold and the landing while the car is being leveled to a floor.

Car roof

- Car roof shall be covered with sheet metal to prevent dripping of lubricants from ropes-sheave bearings. The top flooring shall be of steel with decorative false ceiling. A three pin plug socket with a switch for head lamp shall be fitted on the top of the car for use during maintenance. The roof shall be strong enough to support at least two persons.
- Provision for slow speed (1/2 of rated speed) operation from car top in up and down directions in independent mode shall be made to facilitate maintenance of devices in the hoist way. Necessary fittings shall be provided for this purpose.
- Difference in levels of the car floor and landing shall not exceed the figures indicated in IS 14665 (Para 3/Sec 1 & 2)-2000 under heading “Leveling Accuracy”.
- Suitable lubrication system shall be provided for guide rails as well as for other items.

Car Door

- The elevator car shall be provided with collapsible type doors.
The door of elevator shall open at all the platform levels.

Car door shall have a clear opening of 1800 mm wide x 2200 mm high. The door operation shall be manual.

**Hoist Way Door**

- Horizontally collapsible type doors having a clear opening of 1800 mm wide x 2200 mm high shall be provided at each of the landing for elevator door

**Door Hangers & Tracks**

- Hangers and tracks for car door and each having a clear hoist way door shall be provided. Suitable material shall be used to minimize the noise. Ball bearing rollers or equivalent arrangement shall be provided to take upward thrust of the doors. Suitable devices shall be provided for transmitting from one door panel to the other.

- All required material for landing entrance e.g. extruded aluminum or equipment sills, struct angles, headers etc. shall be provided.

**Door operation for car door and hoist way doors**

- The doors operations shall be manual. The necessary door cushioning device shall be provided.

- Necessary safety devices shall be provided to prevent the movement of the car until the car door and hoist way doors are closed properly.

03. Car Self-Leveling Device

The elevator shall be equipped with automatic self-levelling devices to bring the car to the floor landings. These self levelling shall be correct for over travel or under-travel and rope stretch.

04. Control and operation

The elevator control i.e. the system governing starting or stopping the elevator machine, determine the direction of the travel, regulating the rate of travel, regulating the rate of acceleration and deceleration and controlling running speed of the moving member shall be through 3 phase two speed squirrel cage induction motor. The AC drive motor for the elevator shall be accelerate or decelerate the elevator according to requirement. Reversal in direction of movement of the elevator shall be achieved by reversing the motor 3phase supply.

The operation of the elevator i.e. method of actuating the control shall be “Selective Collective Automatic Operation” as per clause 3.41.3 of IS 14665 (Part2/Sec1) : 2000 with and without attendant. All accessories required for the “collective operation as outlined therein, namely selector and its driving shall be furnished complete.

The controller shall be preferably microprocessor based.

05. Car Position Indicator in Car
A signal indication shall be provided by the appropriate numeral (which shall be floor no./ level of respective floor) being illuminated when the car is passing the corresponding floor. The indication shall remain illuminated when the car is stopped at a floor. Up & Down direction jewel lights shall also be provided. The car position indicators are needed to be provided at all landings.

Provision to indicate lift capacity in Kg as well as in terms of person, shall be made available in the car. Other signals like “over load” “Lift is under maintenance” etc. shall also be provided.

06. Push Button Station and Call-Registered Tell-tale Lights at Hoist way

A single ‘Up” and “Down” push button at terminal landings and “Up” “Down” each push intermediate landing including call register light for each push button shall be provided. These shall remain illuminated till the call is answered.

07. Emergency Exit

The elevator car shall be provided with an emergency exit of adequate dimension.

08. Terminal Buffers

The terminal buffers shall be provided for stopping the car and the counter weight at the extreme ends of travel. All structural steel members required to install the buffers shall be supplied by the lift supplier.

09. Counter-Weight s and Counter-weight Frames

Counter weight sections shall be mounted on structural metal frames so designed to retain the weights securely in its place.

Counter –weight frame shall be guided on each guide rail by upper and lower guiding members attached to the frame

A substantial metal counter- guard of required length shall be provided at the bottom of the hoist way.

A compensating chain of adequate strength connecting car bottom and counter weight frame shall be provided for balancing the car and counter- weight while running with minimum load condition.

10. Guides for Car and Counter- weight

Car and counter- weight guides shall be of rigid steel and shall be continuous throughout the entire length and shall be provided with adequate steel bracings and stiffeners. Guide for both car and counter weight shall meet the requirement of IS: 4666-1980. The necessary lubrication device for guide rail shall be provided.

11. Terminal Limit Switches and Final Limit Switches

Terminal limit switches for normal operation shall be provided to slow -down and stop the car automatically at terminal landings and final limit switches shall be provided to automatically cut off the power and apply the brake, when the car travel beyond the terminal landing.
3. The elevator after erection shall be tested as follow:

   a) Load test with 100% and 110% of rated load as per IS: 14665 - 2000.
   b) A static load test with 125% of rated load as per IS: 14665 – 2000 to check that the brake will sustain the car.
   c) All other tests on electrical system as mentioned in IS: 14665 - 2000.
   d) Any other test felt necessary by Owner and supplier to ensure proper functioning and installation of the lift.
   e) Demonstration of the functioning of all safety provisions made available in the elevator.

The contractor shall arrange for weights, slings, wire ropes, stop watches and other necessary equipment/ instrument to carryout the test.

16-B.03 DOCUMENTATION

1. Information to be furnished by the Tenderer along with the tender:

   The tenderer shall submit adequate sets of following technical drawings & technical data/ information with tender for elevator without which the tender shall be considered as incomplete & may not be considered for acceptance.

   a) General Arrangement of the Elevator indicating load data, details of various openings in machine room floor as well as lift well shaft, buffers etc.
   b) Filled in questionnaire
   c) List of commissioning spare,
   d) List of spares for two (2) years normal operation and maintenance
   e) List of insurance spare for each crane
   f) List of special/ maintenance tools & tackles.

2. List of drawings/ documents to be furnished by the successful Tenderer for approval

   a) General arrangement drawing of elevator showing full details in plan and sections.
   b) Quality Assurance Plan for inspection.
   c) Test and inspection certificate.
   d) List of spares for 2 years normal maintenance.
   e) List of insurance spare for each crane
   f) List of special/ maintenance tools & tackles.

3. List of drawings/documents to be submitted along with equipment by the successful Tenderer

   a) GA drawings, complete assembly and sub assembly drawings of the equipment.
   b) Drawings of all equipment/component received from sub supplier.
   c) Test and warranty certificate for each item of equipment.
   d) Test reports and inspection reports.
   e) Instruction manuals for testing and commissioning.
   f) Operation, maintenance and safety manuals.
   g) Requirement of special tools and tackles, if any, for subsequent maintenance.

16-B.04 QUESTIONNAIRE

01. Name of manufacturer :
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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>02.</td>
<td>Nos. Off :</td>
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<tr>
<td>03.</td>
<td>Type of elevator :</td>
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<tr>
<td>04.</td>
<td>Capacity,</td>
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<td></td>
<td>i. in Kg :</td>
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<td></td>
<td>ii. Number of passenger :</td>
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<tr>
<td>05.</td>
<td>Rated Speed (m /min) :</td>
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<tr>
<td>06.</td>
<td>Total travel (m) :</td>
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<tr>
<td>07.</td>
<td>Nos. of floor to be served :</td>
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<tr>
<td>08.</td>
<td>Floor levels :</td>
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<tr>
<td>09.</td>
<td>Size of elevator well / mast :</td>
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<tr>
<td>10.</td>
<td>Internal size of elevator car :</td>
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<tr>
<td>11.</td>
<td>Construction, design and finished car body work :</td>
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<tr>
<td>12.</td>
<td>Type of car door :</td>
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<tr>
<td>13.</td>
<td>Type of landing door :</td>
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<tr>
<td>14.</td>
<td>Type of landing &amp; car door operation :</td>
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<tr>
<td>15.</td>
<td>Car entrance</td>
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<tr>
<td></td>
<td>i. Number, size and type of doors. :</td>
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<td>ii. Cars open in front. :</td>
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<td>iii. Power or manual operation :</td>
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<tr>
<td>16.</td>
<td>Total Weight</td>
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<tr>
<td></td>
<td>i. Mechanical component :</td>
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<td>ii. Structural item :</td>
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<td>iii. Others :</td>
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<td>17.</td>
<td>Headroom required above top landing :</td>
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<tr>
<td>18.</td>
<td>Elevator operation :</td>
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<tr>
<td>19.</td>
<td>Method of control :</td>
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<td>20.</td>
<td>Ambient temperature :</td>
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<tr>
<td>21.</td>
<td>Quantity of Motor :</td>
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<td>22.</td>
<td>Power consumption :</td>
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<tr>
<td>23.</td>
<td>Leveling accuracy :</td>
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<tr>
<td>24.</td>
<td>Emergency power supply provided? :</td>
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<tr>
<td>25.</td>
<td>Intercommunication facility provided? :</td>
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<tr>
<td>26.</td>
<td>Electric power supply</td>
</tr>
<tr>
<td></td>
<td>i. Power Voltage (AC) :</td>
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<td></td>
<td>ii. Phase :</td>
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<td></td>
<td>iii. Cycles :</td>
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<tr>
<td></td>
<td>iv. Wire system :</td>
</tr>
<tr>
<td></td>
<td>v. Control voltage (DC) :</td>
</tr>
<tr>
<td>27.</td>
<td>Motor Details</td>
</tr>
<tr>
<td></td>
<td>i. Make :</td>
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<td></td>
<td>ii. Kw rating :</td>
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<td></td>
<td>iii. Frame size :</td>
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<tr>
<td></td>
<td>iv. Speed :</td>
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<td></td>
<td>v. Duty cycle :</td>
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<td></td>
<td>vi. FL amperes :</td>
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<tr>
<td></td>
<td>vii. Class of insulation :</td>
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<tr>
<td></td>
<td>viii. No. of permissible starts per hour :</td>
</tr>
</tbody>
</table>
17 TRANSFER CARS

17.01 SCOPE OF WORK

The scope of work of the Tenderer includes design, engineering, manufacturing, assembly, shop testing, painting, supply, transportation to site, unloading & storage, erection, testing and commissioning of Transfer cars complete with mechanical and electrical components.

01 The supplier shall ensure that the transfer car is manufactured as per the tolerances specified below:

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Track gauge</td>
<td>± 3 mm</td>
</tr>
<tr>
<td>02</td>
<td>Diagonal of wheels</td>
<td>± 3 mm</td>
</tr>
<tr>
<td>03</td>
<td>Travel wheel alignment</td>
<td>± 1 mm</td>
</tr>
<tr>
<td>04</td>
<td>Tilt of wheels or balancer axle</td>
<td>± 1 mm</td>
</tr>
<tr>
<td>05</td>
<td>Wheel base</td>
<td>± 3 mm</td>
</tr>
<tr>
<td>06</td>
<td>Wheel base</td>
<td>1000 mm (horz. &amp; vert.)</td>
</tr>
<tr>
<td>06</td>
<td>Travel speed at full notch with rated load, voltage and frequency shall be + 10% and – 5 % of specified speed.</td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>All the axles with wheels shall be parallel to each other. Permissible deviation from parallelism shall not be more than 1 mm for every 1000 mm length.</td>
<td></td>
</tr>
</tbody>
</table>

No load test:

The transfer car shall be run in both the directions at maximum speed with no load. During this period, the speed and noise shall be checked. The bearing lubrication system shall also be checked for proper operation. At the end of this test, no part shall be excessively heated.

Speed test:

a. Travel motion of the transfer car shall be tested in both directions with rated load on all the notches and the speeds shall be attained at various notches as per approved speed-torque curve of the transfer car within the tolerance limits indicated under clause 03.10.06. The absorbed power as well as the speed shall be recorded and compared with guaranteed values. At the end of these tests no parts shall be excessively heated.

b. Travel motion of the car shall be tested with 25% over-load in which case the specified speeds need not be attained but the car shall show itself capable of dealing with the overload without difficulty.

Brake Test

The travel brakes shall be capable of arresting the motion within a distance in meters equal to 10% of speed in metres/minutes when travelling with rated load at rated speed, provided there is no skidding.
17.02 TECHNICAL SPECIFICATION

• GENERAL
  a) The transfer car shall be designed, manufactured and tested in accordance with the relevant clauses of IS: 3177-1999. The standards referred there in and subject to any modifications and requirements specified in this specification.
  b) The transfer car components shall be standardised to keep the number of spares minimum.
  c) All parts requiring replacement or inspection or lubrication shall be easily accessible without the need for dismantling of other equipment or structures. All electrical cables shall be so laid that they are not liable to be damaged and can be easily inspected and maintained.
  d) For welded construction such as that of main frames, gear boxes and other load bearing members, steel shall conform to IS: 2062-1992.

For welding these members low hydrogen electrodes shall be used as per IS 81-1991 grade E8 –542 -C-83H.

• STRUCTURAL DETAILS

Transfer car structures shall be designed in accordance with IS: 807-1990 taking the following additions/deviations into account.

  a) Black bolts shall not be used in the main structures of the transfer car.
  b) Bolts used in shear shall be fitted into reamed holes.
  c) Transverse fillet welding on load carrying members shall be avoided.
  d) All butt welds on structural members subject to tensile stress shall be X-rayed.
  e) Minimum thickness of chequered plates for platforms shall be 6 mm over plain for indoor transfer cars and 8 mm over plain for outdoor transfer cars. Chequered plates shall not be considered for strength calculations of load carrying members. Chequered plates shall be supported on a frame of beams adequately designed to take the rated load anywhere on the transfer car platform.
  f) The under frame shall be fitted with substantial safety stops to prevent the transfer car from falling more than 25 mm in the event of breakage of track wheel, bogie or axle. These safety stops shall not interfere with the removal of the wheels.
  g) Suitable jacking pads at a height of 300 mm from rail top shall be provided on under frames for jacking up the transfer car when changing track wheels. Jacking pads shall not interfere with the replacement of track wheels.
  h) Main frame shall be fabricated in one piece unless there are transport limitations. Connection between the two parts of the frame shall be done by machined bolts or rivets.
i) All the mechanical and electrical equipment shall be placed below the top plates.

j) The maximum settlement of the platform under rated load shall not exceed 2-3 mm limited to span/1000.

k) Chequered plate steps suitably welded at convenient location on either side of the transfer car shall be provided for climbing up on the platform wherever necessary.

**Drive Suspension Frame**

a) All the driving mechanism such as motor, brake, gear box etc. shall be mounted on a rigid rolled section steel frame and suspended below the under frame with one end resting on the drive axle on anti-friction bearing, while the other end shall be elastically fastened to the under frame through helical compression springs. Drive Mechanism shall be protected from heat by providing heat shield on heat exposed area.

b) Clearance between ground and bottom most portion of the car shall not be less than 100 mm.

• **MECHANICAL DETAILS**

a) **Wheels**

   • Solid wheels of forged, rolled or cast steel conforming to 55C8 of IS: 1570 - 1961 shall be used.

   • Wheels shall be heat treated to have a hardness of BHN 300 to 350 on the rolling surface and flanges to a depth of not less than 10 mm with a smooth pass to the non-hardened zone.

b) **Axles**

   Axle shall be made of class 4 steel to BE: 1875-1992.

c) **Axle Box Assembly**

   The material of axle box casting shall conform to steel as per IS: 1030-1989 grade-1.

   Spring seats, wherever required, shall be finished by machining.

d) **Springs**

   All helical compression springs shall be designed in accordance with IS: 7906-1976 Part-1.

   Spring ends shall be finished square with respect to its axis.

   The spring shall be designed on the basis of virtually infinite life i.e. to withstand ten million load cycles or more without failure.
e) **Axle Box Frame**

Axle box frame of cast steel or fabricated steel construction shall be stress relieved and accurately machined. The parallelism between the faceplate and their perpendicularity with the top surface shall be closely maintained.

f) **Buffers**

Spring loaded or other better type buffers shall be fitted on the four corners of the transfer car for ensuring soft dashing of transfer car against stop.

Buffers shall be rigidly bolted in place, preferably along the centre line of transfer car track such that the bolts are not in direct shear.

Buffers shall be designed to absorb the kinetic energy released at 50% of the full load rated travelling speed, the average rate of deceleration not exceeding 4.8m/sec² at 40% of the rated travelling speed.

Buffers shall have a contact surface of not less than 125mm in diameter and mounted so as to provide 100mm clearance between the fixed structures and car outreach when buffers of transfer cars are fully compressed.

g) **Drive mounted on transfer car**

For travel motion central drive shall be used. It shall be mounted as close as practicable to be the centre of the car.

Drive shaft coupling shall be as near to the bearings as possible.

All parts of the travel drive shall be easily accessible for inspection, maintenance and removal from topside of platforms.

h) **Gearing**

Straight and helical spur gearing shall be used. Worm and bevel gears shall not be used. Surface hardness for pinion shall be 255 to 300 BHN and for gear it shall be 217 to 255 BHN. Difference in hardness of pinion and gear shall not be less than 20 BHN.

i) **Gear Box**

All gear shafts shall be supported in anti-friction bearings.

In gearboxes splash or automatic lubrication systems shall be used.

The gearbox shall be fabricated of cast steel. Fabricated gearbox shall be made of minimum 8-mm thick steel plate and shall be stress relieved.

Covers shall be split horizontally at each shaft centre line and fastened and arranged so that the top half can be removed for inspection and repair without disturbing the bottom half. Vertical gearbox may be provided with T-splits.

Directly above the mesh line of teeth, there shall be hand-hole with oil tight bolted covers.

The gearboxes shall be provided with breather vents, oil level indicator, dipsticks and easily accessible drain plugs.
Radial clearance between the gear box inner surface and the outside diameter of the gears shall be at least 1.25 times the depth of the largest gear tooth inside the gear box or 20 mm whichever is higher. The facial or side clearance between the inner surface of the gearbox and the face of the gear or pinion shall be at least 20 mm.

Gearbox shall be mounted on machined surfaces and shall have machined feet. Shims shall not be used.

g) Bearings

Only anti friction bearings shall be used. Rated life of anti-friction bearings shall not be less than 40,000 hours.

h) Couplings

Motor shaft shall be connected to gear box input extension shaft through flexible gear couplings with crowned teeth. Gear coupling shall also be provided between gearbox and axle wheels if required.

All couplings shall be of forged steel and shall be designed to suit the maximum torque that can be developed.

Hardness of gear coupling casing shall be more than 340 BHN and that of toothed bush shall be more that 340 BHN. Bolt connection of couplings shall be easily accessible for inspection and tightening.

i) Brakes

Double shoe brake shall be provided for the drive of the transfer car and shall be mounted on the input pinion shaft of the gearbox. The brake shoe shall be of hinged type.

Brake drum shall be forged or of cast steel and shall be completely machined and dynamically balanced. Diameter of the brake drum shall be selected from preferred number series. Width of the brake drum shall be 10 mm more than the width of the brake shoes of each size. Hardness of the brake drum shall be 300 to 350 BHN.

Braking against travelling shall be capable of arresting the mote within a distance in metres equal to 10% of speed in meters /minute when travelling with rated load and speed, provided there is no skidding.

Adequate means shall be provided on outdoor transfer car for securely anchoring the same to the rail when not in use. Co-efficient of reserve of the holding force shall not be less than 2 considering maximum wind pressure.

In case of power failure there shall be automatic braking of the transfer car.

Brake shoes shall be of cast or forged steel.

j) Shafting

Shafts and axles shall also be checked for endurance and strength. In proportioning shafts, allowance shall be made for keyways and splines.
n). **Lubrication**

Grouped grease lubrication system for bearings shall be provided for transfer cars. Minimum internal diameter of grease pipe shall be 6mm. The pipe shall be securely fixed and protected from damage and assessable throughout.

Effective protection shall be provided to prevent ingress of dust on the lubricant and such protection shall also be weather proof on outdoor transfer car.

### 17.03 DOCUMENTATION

1. **Information to be furnished by the Tenderer along with the tender:**

   The tenderer shall submit adequate sets of following technical drawings & technical data/information with tender for elevator without which the tender shall be considered as incomplete & may not be considered for acceptance.

   a) General Arrangement of the Transfer car indicating load data, details of various openings in machine room floor as well as lift well shaft, buffers etc.
   b) Filled in questionnaire
   c) List of commissioning spare
   d) List of spares for two (2) years normal operation and maintenance
   e) List of insurance spare for each crane
   f) List of special/maintenance tools & tackles.
   g) List of Preferred Makes.

2. **List of drawings/documents to be furnished by the successful Tenderer for approval**

   a) General arrangement drawing of Transfer car showing full details in plan and sections.
   b) Quality Assurance Plan for inspection.
   c) Detail specification of motor indicating type, KW, rpm, starting torque requirement, class of insulation, type of enclosure, frame size etc.
   d) Power requirement, details of motors, control scheme.
   e) Test and inspection certificate.
   f) List of spares for 2 years normal maintenance.
   g) Ordering specification for operating consumables/supplies.

3. **List of drawings/documents to be submitted along with equipment by the successful Tenderer**

   a) GA drawings, complete assembly and sub assembly drawings of the equipment.
   b) Drawings of all equipment/component received from sub supplier.
   c) Test and warranty certificate for each item of equipment.
   d) Test reports and inspection reports.
   e) Instruction manuals for testing and commissioning.
   f) Operation, maintenance and safety manuals.
   g) Requirement of special tools and tackles, if any, for subsequent maintenance.
17.04 QUESTIONNAIRE (TRANSFER CAR)

1. Load carrying capacity
2. Track gauge
3. Platform size (length X width)
4. Maximum side over hang
5. Top of platform from rail top
6. Maximum deflection of platform under Maximum working load
7. Total length of travel

01. Weights

1. Total weight of the transfer car (t)
2. Break up of weight
   a) Electrical
   b) Mechanical
   c) Structural
3. Weight of the heaviest part/assembly to be handled by the maintenance tackle

02. Parameters

1. Travelling speed (m/min) with maximum working load
2. No. of travel wheels
3. Wheel spacing
4. Wheel base
5. Diameter of wheel
6. Maximum & minimum wheel load with or without impact
7. Over buffer dimension

03. Wheels

1. Type of construction
2. Material of construction
3. Hardness

04. Gears and gear Box

1. Make
2. Type
3. Material of construction for gear box
4. Material of construction for gear and pinion
5. Hardness of gear and pinion
6. Total reduction ratio
7. Total no. of reduction

06. Track rail size

07. Couplings

1. Make and type of couplings between
   a) Motor and gear box
   b) Gear box and shaft
   c) End shaft and axle

08. Make and type of limit switches
09. Make and type of bearings

10. Motors detail
   a) Type, make and frame size
   b) kW rating at 40% & 60% CDF and ambient temp.
   c) Motor rpm
   d) No. of start/ hr
   e) Class of insulation
   f) Derating factor considering for ambient temp.
   g) Calculated motor power
   h) Frame size kW at specified duty

11. Brake
   a) Make, type and size
   b) Minimum braking torque as per catalogue
   c) Surface hardness & material of brake drum

12. Make and type of other electrical equipment
    Such as panels, contactors, etc.

13. Wiring, trade name and class of insulation

14. Cable reeling drum
    a) Type and make
    b) Diameter
    c) Cable size, type, makes & totals length
    d) System of cable drum actuation
18 FORK LIFT TRUCK (ELECTRICALLY OPERATED)

18.01 SCOPE OF WORK

The scope of work of the Tenderer shall consist of design, engineering, assembly, shop testing, painting, supply, testing and commissioning at site of Fork Lift Trucks complete with accessories and attachments as covered under this specification and attached equipment data sheet read along with GCC.

18.02 TECHNICAL SPECIFICATION

1. Design Standards and General Details
   a) The fork lift truck to be supplied under this specification shall be complete with all attachments, auxiliaries and accessories which are not specifically mentioned in the specification but are required to make equipment complete in all respects to fulfill the requirements of the prescribed duties, guaranteed performance and safe operation.
   
   b) The unit offered shall be new, unused and best of its kind. The unit shall also conform to the latest edition of the applicable Indian Standards and Regulation. Wherever the unit offered is not in accordance with the relevant Indian Standards and Regulations, the copies of the Standards to which the equipment conforms shall be submitted along with the proposal. Each unit shall have a printed sketch showing the load capacity at different load centres for safe operation.
   
   c) In case, due to standardisation of the products by the Manufacturer, the Tenderer is not able to quote for the exact specified capacity, he may quote for the next higher standard capacity. The unit offered shall be able to meet all the requirements of its specified duty. It would be preferred that the Tenderer shall quote for the equipment strictly conforming to the “Technical Specification and Equipment Details.” In case the unit offered has modifications and deviations, then the details of such modifications and deviations shall be clearly indicated. The reasons for such deviations shall also be clearly stated.
   
   d) All surfaces and parts except gears, bearings, etc. shall be properly cleaned / sand blasted/ chemically treated to remove all loose mill scale, rust, mud, foreign materials and then suitable corrosion resistance coating shall be applied to make the equipment fit for indoor /outdoor services in tropical weather conditions.
   
   e) The equipment shall be applied with two coats of final paint of approved quality and colour before despatch from the works.
   
   f) The equipment shall have sufficient lubrication arrangement so that bearing and other parts do not get unusually heated in course of operation. Sufficient lubrication points shall be provided wherever necessary and all such points shall be easily accessible. The Tenderer shall specify the lubricants and also the quantity required for six months period along with tender.

2. Mechanical Details
   a) The fork lift truck shall meet the stability requirements as per IS:4357-1957 (Reaffirmed -1990) for rated load capacities. The values of stability factor shall be as per IS:5040-
b) Brakes shall be hydraulic power assisted.

c) Mechanical hand brake for parking shall be provided.

d) Tilt and lift & auxiliary functions of the fork lift truck shall be hydraulically operated.

e) Operator's seat shall be of cushioned and adjustable type. Driver's overhead guard & load back rest shall also be provided.

f) A rigid towing attachment complete with pin or hook shall be provided at the rear of the truck.

g) All hydraulic hose pipes shall be suitably protected from damage during operation.

h) Suitable check valves shall be provided to ensure safety & control the lowering speed in case of loss of hydraulic pressures.

3. Electrical Details

a) The drive motor shall be designed and installed to meet the service conditions of battery operated fork lift trucks. It shall be suitable for operation from 48/36 V battery and shall be supplied completely wired up with the battery, control and protective equipment as well as indicating instruments mounted on the dashboard.

b) The motor shall be series wound traction type. The rating shall be adequate for normal service condition as well as for driving the truck up a gradient as specified. The motor shall be minimum of class "F" insulation.

c) Replaceable covers for easy inspection, replacement and adjustment of carbon brushes shall be furnished.

d) The terminals of the motor shall be mounted on a terminating plate and all leads brought and terminated thereto. For repair and maintenance, it shall be possible to disconnect the motor from its terminals and take the motor out without disturbing any other ancillary equipment.

e) The motor shall be mounted on resilient pads suitable for the service conditions.

f) Dash board shall be equipped with the following:

   a) Battery discharge indicator / ammeter.
   b) Instrument pannel lights.
   c) Switches for lights.
   d) Key type starting switch.
   e) Any other instruments, switches, as necessary.

   g) The drive controller shall be suitable for speed variation in number of steps both in forward and reverse direction of movements.

   h) Head lights and tail lights suitable for night operation shall be provided.

   i) Electric or equivalent horn shall be provided. A bulb horn shall also be provided.
j) The fork lift truck shall be powered by a rechargeable electric storage battery of lead acid type and of reputed make.

k) The battery shall be used to supply power to the electrical drive motor and auxiliaries of battery operated fork lift truck.

l) The battery shall be installed within a heavy sheet metal enclosure mounted on top of the fork lift and wired suitably to the drive motor and other auxiliaries.

m) Battery shall be designed to withstand electrical and mechanical shocks.

n) The battery shall have capacity to meet the duty specified.

o) A low voltage protection shall be incorporated in the battery circuit to prevent excessive discharge of the battery. The sheet steel enclosure shall be provided with adequate ventilation and a cover for easy replacement. The enclosure shall be painted with acid resistant coat of paint. The cover shall be provided with lifting handles and arrangement for locking.

p) The battery shall be supported on porcelain insulators fixed on to the containers. The battery terminal posts shall be provided with connector bolts and nuts effectively coated to prevent corrosion. Lead coated copper connectors shall be used to connect up the cells of the battery set. The electrolyte used shall be of battery grade sulphuric acid conforming to IS:266.

18.02 Questionnaire

<table>
<thead>
<tr>
<th>SL NO</th>
<th>PARTICULARS</th>
<th>DETAILS</th>
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<tbody>
<tr>
<td>i)</td>
<td>Equipment No</td>
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<td>ii)</td>
<td>Model</td>
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<td>iii)</td>
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<td>ix)</td>
<td>Gradability</td>
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<td>x)</td>
<td>Travel speed on level surface</td>
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<td>Laden/Unladen, km/hr</td>
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<td>xi)</td>
<td>Lifting &amp; lowering at rated capacity laden/unladen, m/s</td>
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<td>xii)</td>
<td>Lowering speed at rated capacity laden/unladen, m/s</td>
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<td>xiii)</td>
<td>Height of lift, mm</td>
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<td>xiv)</td>
<td>Overall height mast lowered, mm</td>
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<td>mast raised, mm</td>
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<td>xv)</td>
<td>Free lift, mm</td>
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| xvi)  | Fork        | Spreading of forks, mm  
|       |             | Overall width x length, mm |
| xvii) | Overall dimensions | length of fork, mm  
|       |             | Width, mm  
|       |             | Height with guard, mm |
| xviii)| Outer turning radius, mm |
| xix)  | Aisle width (90 deg turn) |
| xx)   | Total weight unladen kg:  
|       |             | with battery |
| xxi)  | Motor details | Traction motor :KW x Rating  
|       |             | Pump motor :KW x Rating |
| xxii) | Speed control |
| xxiii)| Tilting angle of mast  
|       |             | Forward/ Backward, degree |
| xxiv) | Working hours |
| xxv)  | Ambient temp. |
| xxvi) | Working environment |
| xxvii)| Attachment |
| xxviii)| Battery charger unit suitable for  
|        |             | power supply |
| xxix) | Traction Battery  
|       |             | Voltage, V  
|       |             | Capacity x Rating |
|       |             | Weight, Kg |
| xxx)  | Axle load Front/Rear,  
|       |             | Kg in laden Condition |
| xxxi) | Any other special feature |
19  VULCANIZING MACHINE – MOBILE BELT CHANGING UNIT

19-A  BELT VULCANIZING MACHINE

Belt vulcanizing machines for belt splice of various widths (as indicated in data sheets) shall be supplied. The machine shall be easy to handle type. Heating element for Hot Belt Vulcanizing Machines shall be preferably of flexible type. The equipment shall be suitable for vulcanizing of entire splice width in single setting. It shall be capable of applying uniform pressure over splice by pneumatic or hydraulic means.

19-B  MOBILE BELT CHANGING UNIT

19-B.01 Scope of work

Mobile, truck-mounted belt-changing devices for quick replacement of conveyor belts of various widths shall be provided. The equipment shall safely unwind belts as well as wind and replace worn out belts. The equipment shall be provided with belt change reel stands, power belt reelers including pipe shaft, half split bush bearing at ends, geared motor etc.

It shall consist of a truck or tractor unit and a trailer platform mounted with equipment required for belt changing.

19-B.02 Design Data

1. The truck / tractor shall be complete with following facilities:
   a) Cabin with seating facility for minimum 5 persons and a driver. The cabin shall have latest driving facility for driver.
   b) It shall be equipped to tow 30t-loaded trailer on road with upward gradient of 1 in 12 (minimum).
   c) It shall be of reputed make and model complete with all the necessary attachment to drive in the night and dust/ hazardous condition without any external support.
   d) Tools & tackles for maintenance of truck / tractor / platform trailer including hydraulic jack for lifting the truck / tractor / trailer for wheel changing.

2. The belt-changing device mounted on the platform trailer shall have following features:
   a) The trailer platform has min 12 numbers rubber tyred wheels (8 numbers on 2 rear axles and 4 numbers on 2 front axles). It shall have suitable turning devices for achieving low turning radius to enable it to be maneuvered by the truck/tractor on narrow plant roads and its easy placement at proper locations for belt changing operation. The trailer platform shall have min. 4 nos. out-riggers for application during belt changing operation.
   b) It shall consists of a manual winch (with 60m of wire rope for threading the old belt to the empty reel), spring loaded cable reeling drum (with 60 m of power cable), individual drive assemblies for rotating an “Empty reel” (for pulling the old belt out of the conveyor system and winding the same on the reel) and a “Loaded belt reel” (to un-wind new
belt out of the reel), equipment for maintaining constant circumferential speed of both belt reels and complete with motor starter panel, electrical controls I instrumentation. The system shall also be provided with 4 numbers mandrels (to put inside the wooden belt reels for rotation, 2 numbers working, 2 numbers spare) and 2 Nos. wooden reels (for belts), along with any other accessories that may be required to for belt changing operation.

c) The drives for “Empty reel” and “Loaded belt reel” shall have electric motors, reducers, resilient couplings and brakes. (Alternatively, low speed-high torque hydraulic motors with power pack etc mounted on the platform trailer, may also be considered). Adequate pulling force as per the requirement or 20t (whichever is more) shall be considered.

Both the drive systems shall act in tandem to maintain constant circumferential speed of both drums at 15 m/min. Provision of creep speed shall also be kept for intended operation. The whole system shall be electrically/electronically controlled to maintain constant speed of incoming and outgoing belt.

d) Spring loaded resilient coupling/ twin diaphragm resilient coupling shall be provided on output side of gear box, between fluid coupling & gear box and between motor & fluid coupling for drives with motor rating above 30kW.

e) Two Nos. of belt gripping devices (one for old and one for new belt) including fasteners & necessary rope fixing arrangement shall be provided. It shall be made of Aluminium alloy and shall be mounted on self-locking chuck to ensure safety of operator. One spare gripping device meant for spare belt shall also be provided.

f) The trailer platform shall have two sets of “A” frames for mounting the “Empty reel as well as “Loaded belt reel”. The two reels shall be mounted individually on mandrels (minimum 100 mm square bars/hollow sections) of adequate length, for supporting them over pivot block of respective “A” frame. The belt reels shall be “locked” longitudinally on the mandrels. One end of the square bar is coupled with drive mechanism through love-joy coupling. Mandrel shall be placed on a chuck so that after placement it can be locked with chuck. Both sides of mandrels shall be placed on bearing block to offer least resistance during operation.

g) Adequate space on the truck deck shall to be provided for transporting vulcanizing unit, tool kit box, belt stretching device, mounting of MCC and for standing and movement of operating personnel. Dimension of vulcaniser shall be intimated to the successful Bidder.

h) The trailer shall be designed and selected such that it can remain stable during operation of the winch considering the rope pull from any possible direction. Out riggers and ballast (if necessary) shall be provided in the trailer. The maximum speed of the vehicle shall be 25 km/h.

i) All gears of the gearbox shall be of hardened and tempered alloy or carbon steel with machine cut teeth. The bearing-supporting block for pivoting the mandrel shall be horizontally split type with easy mounting facility. All gears shall be splash lubricated and bearings shall be grease/splash lubricated. Gearbox shall be totally enclosed.
j) Circumferential speed of the belt at the stabilized condition of changing shall be minimum 15m /minute. Suitable thyristor control / resistance control shall be designed to maintain constant circumferential speed of incoming & outgoing belts from the individual “Reels”. Suitable speed sensors required for maintaining constant circumferential speed shall be provided. The control panel for operation of the belt-changing device shall be mounted on common based frame. In case of hydraulic motor, the panel shall be mounted on power pack.

k) 60 m length of cable shall be supplied with suitable connector for connecting to the source of power provided in the gallery/ Jn. Houses. Suitable spring loaded cable reeling drum shall be provided on the trailer to wind the cable.

19-B.03 DOCUMENTATION

1. Drawings and document to be submitted by Tenderer
   a) Technical Parameters, constructional features and details of Equipment along with General Arrangement drawings.
   b) Motor rating
   c) Operating weight
   d) Filled up Questionnaire

2. List of drawings /data to be submitted by the successful tender
   a) General arrangement drawing with bill of material of equipment showing overall dimension & details.
   b) Supplier’s name for components & catalogues for these items shall be furnished.
   c) List of commissioning spares proposed by the Tenderer.
   d) List of recommended spares for two years maintenance of plant and equipment along with itemised price.
   e) List of tools and tackles to be supplied with the plant and equipment.

19-B.04 Questionnaire

Type & Name of Supplier

Technical Parameters: