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1- INTRODUCTION

“Nominal” and “Design” capacity of the project is equal to 2340 dtph and 2700 dtph fresh ore feed conditions respectively. The plant is “Designed” to accommodate the “Maximum” conditions.

2- SCOPE

This document covers the minimum requirements for design, engineering, procurement, and construction of equipment and packages for Copper-Moly concentrate plant project. Each equipment and/or package, as a minimum, shall be designed, fabricated, inspected, tested, and erected according to the Standards and codes referenced here. Contractor should be assured about using last revision of all codes and standards.

All activities must be done based on contract documents by contractor and should be submitted to Employer for review and approval.

3- DOCUMENTS

Relevant drawings and documentation shall be provided by the VENDOR in accordance with the requirements of the "Vendor Documentation Requirement Schedule" (VDRS), contained in the Material Requisition. The documentation shall be submitted strictly in accordance with the timings indicated on the VDRS.

The VENDOR document type catalogue, which forms part of the VDRS, describes specific requirements regarding content, format and submission details for drawings, data sheets and manuals etc.

Review of VENDOR'S drawings, calculations and other documents by the CONSULTANT does not relieve the VENDOR of the responsibility for correctness under the terms of the order.

In addition to the number of Installation and Operating Instructions specified in the

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VDRS, one approved copy of these documents shall be packed with the Package for delivery to Site. The equipment manifest should include these documents.

4- SITE CONDITION

For Site Condition Refer to Appendix 1 of contract attachments.

5- CODES & STANDARDS

All mechanical equipment must be designed, manufactured and tested in accordance with the latest available version of the following codes, standards or specifications. Where appropriate, the equipment specifications will include references to specific sections of the following codes and standards:

- ASHRAE American Society of Heating Refrigerating and Air Conditioning
- API American Petroleum Institute
- ASME American Society of Mechanical Engineers
- DIN Deutsche Industrie Normen
- ANSI American National Standards Institute
- ISO International Standard Organization
- ABMA Anti-Friction Bearing Manufacturers Association
- ISA Instrument Society of America
- ACI American Concrete Institute
- AMCA Air Moving Control Association
- AISC American Institute of Steel Construction
- AISI American Iron and Steel Institute
- ASLE American Society of Lubrication Engineers
- IESNA Illuminating Engineering Society of North America
- ASTM American Society of Testing Materials
- AWS American Welding Society
- CEMA Conveyor Equipment Manufacturing Association
- CMAA Crane Manufacturer Association of America

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- IEC International Electro Technical Commission
- ICEA Insulated Cable Engineers Association
- FSA Fluid Sealing Association
- FEM European Federation of Materials Handling and Packaging Manufacturers
- MPTA Mechanical Power Transmission Association
- MSHA US Mine Safety and Health Administration
- NEC National Electric Code
- NEMA National Electrical Manufacturers Association
- NESC National Electrical Safety Code
- NFPA National Fire Protection Institute
- NFPI National Fluid Power Institute
- TEMA Tubular Exchanger Manufacturer's Association
- UBC Uniform Building Code
- API 670 (Vibration Positioning & Bearing Temperature Monitoring)
- ASME B16.5 & ASME B16.47 (Steel & Alloy Pipe Flanges)
- ASME B31.3 (Chemical Plant & Petroleum Refinery Piping)
- BS EN 10204 (Quality Assurance)
- EEMUA 140 (Noise procedure specification)
- IEC 60034 (Motor)
- IEC 60947, IEC 60439 (Electrical Panels)

In case of difference or conflict between any referenced specifications and these specifications, the stricter shall apply.

6- GENERAL

All mechanical equipment, services and data for Copper Concentrator Expansion Plant Project shall conform to the applicable requirements herein. Equipment components shall be designed to ensure durability and trouble-free operation and for

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the purpose of interchangeability and ease of operation, equipment and component shall be, as much as possible, similar.

7- EQUIPMENT SELECTION AND DESIGN ASSUMPTION

The selection of all equipment will be based on the considerations for the process specifically whether each item of equipment meets the design objectives, in terms of capacity and quality. Other considerations include:

- Characteristics of the site (climatic conditions, seismic, altitude, surrounding conditions, corrosion, temperature, interference, transit or interactions with mobile equipment, persons, etc.)
- Characteristics of the process
- Low cost of capital (investment) and maintenance (cost/benefit ratio)
- Low operating cost
- Safety and Environment
- High reliability
- Readily available spare parts
- Standardization of components to minimize inventory
- Operating history proven in similar applications
- Overload capacity
- Local representation, start-up assistance and service after the sale
- Manufacturing capacity and compliance with delivery dates
- Complete maintenance service
- Warranties
- All equipment design must meet the Specifications, Codes and Standards applicable to and defined for the project.
- The following general design criteria must also be incorporated, when applicable:

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- The equipment must be designed utilizing conservative capacity criteria and operating speeds that ensure a high degree of reliability.
- Stand by equipment must be considered, when necessary, in order to ensure a continuous operating process.
- The equipment must be designed in a way that facilitates its operation and accessibility for maintenance.
- The equipment must be designed to operate under the conditions at the site.
- Personal protection guards must be provided around all exposed moving components, as well as all high-temperature components that are not insulated.
- Equipment that has work platforms or walkways must have stairs, walkways, handrails and baseboards, in accordance with OSHA standards and local Safety standards.
- All motors must be supplied and completely mounted in the equipment by the Vendor, in accordance with the EPC CONTRACTOR's specifications.
 - All substitutions of specified materials or components must be approved by the EPC CONTRACTOR before proceeding.
- Lubricating oil or hydraulic fluid cooling systems will preferably be by forced air.
- When machinery with rotating components is mounted on structural steel instead of concrete foundations, vibratory equipment such as pipes, ducts and other elements of resonant material must be insulated. The equipment must be mounted on elements or materials that serve to absorb the vibration, whenever possible.
- When selecting materials, the high level of contamination with acidic solutions or aerosols typical of an electro winning site must be taken into account.

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- Each equipment must be of the design which meets the specified requirements of uninterrupted operation, 24 hours per day and 320 days per year, unless otherwise especially stated in the Contract above
- Capacities for all equipment shall be in accordance with the requirements specified in the area flow sheets.
- Whenever possible, standard units of equipment shall be applied.
- The design and choice of the dimensions for all parts of the equipment shall be in such manner that these parts shall not be subject to stresses in excess of the maximum limits allowed by the requirement or applicable standards, and shall be in accordance with the quality of the chosen materials under the most severe service conditions, in accordance with standards and codes specified in the Contract
- Equipment shall be provided with necessary controls and safety devices.
- Construction of equipment shall be suited to the environment and circumstance to be installed.
- The equipment shall be designed for optimum reliability, with continuous availability which is of paramount importance to the operation of plants to a maximum belt fill of 75%.
- All equipment shall be capable of starting in heavy duty state, when loaded to 100% of design capacity, of several times per hour.
- Conveyors angle shall not exceed 15 degrees to the horizontal and 5 degrees at the loading point. (Except special conditions)
- Where possible and with financial benefit, consideration shall be given to making use of as many common components as possible readily available from suppliers as far as possible.
- Provide schedules for Drives, Motors, Pulleys, Belting and Idlers used per plant to achieve spares commonality as far as possible.

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- The design of the conveyors shall facilitate general ease of access for maintenance, inspection and repairs and in particular at all points requiring routine inspection and/or adjustments.
- Accelerating, decelerating and braking forces shall be taken into account in the calculation of belt tensions and counterweight requirements under all load conditions of the belt conveyor.
- All conveyor systems shall be designed to be able to start up under full load conditions or worst case partial loading conditions. Starting equipment shall be designed that the belt is not over-stressed when started under full load or worst case partial load conditions
- The belt speed will not exceed 2.2 meters per second and belt width will not be less than 650 millimeters.

8- NAMEPLATE & LABELS

- All equipment shall be clearly and permanently labeled, to the approval of the EPC CONTRACTOR, in Persian and English.
- Each equipment covered by this specification shall be supplied complete with an identification nameplate, clearly stating the manufacturer's name, plant number, and date, together with any other information in accordance with relevant standard.
- Nameplates, labels, and their fixing screws for outdoor use shall be of stainless-steel material.
- Lettering shall be black on a white background except for danger notices, which shall have red letters on a white background.
- Each pack and equipment and / or split part of equipment should be specified with "Tag Number ", which will be defined by Supplier.

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9- MATERIAL

- All components used in the construction of the equipment shall be new and of the best quality and of the class most suitable for working condition according to standard, and also, all equipment shall be furnished with anti-fungus production.
- Readily inflammable and hygroscopic material shall not be used and also, due care shall be taken to prevent direct contact between two different metals. If such contact is unavoidable for construction reasons, special precautionary measures shall be taken to prevent galvanic corrosion.

10- LANGUAGE

All drawing design information, Documentation, Operation, and Maintenance Instructions & Correspondence shall be in English.

11- DETAILS OF MACHINERY

11-1- Environmental Control

Special care must be taken in reducing or if possible, eliminating any adverse environmental effect that the process or installations could generate, such as the emission of gases, vapors, acidified water, oil, noise, vibrations, heat, etc.

11-2- Transmissions

Unless otherwise specified, all motors shall be connected to the equipment by transmissions. As indicated below. In principle, direct driving system shall be adopted.

- A type transmission

This comprises the conditions that the driven unit operates at standard motor speeds. The connection is made directly through a flexible coupling.

- B type transmission

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This comprises other transmission conditions that the driven unit operates at different speeds from that of the motor and that speed reduction by mediation of gear reducer is required. All the component members, in any case, will be connected to each other with flexible couplings. The above applies also to speed increasers.

- **Belt transmissions**

When belt transmission is required, V-belt or gear belt transmissions shall be used. They shall be supplied as complete units that include belts, pulleys, belts-guard, clamps for belts guard and all the attachments required for the installation of the same.

- The Belts shall be supplied in standard lengths and sections.
- The grooved pulleys shall be adjusted to the latest design and construction details, with suitable materials for operating conditions.
- The pulleys shall be balanced.
- Tensioning devices shall be provided in consideration to the stretching of belts, if required.

- **Wire Rope, Chains and Fittings**

All ropes, whether fixed suspension or for general use, shall comply with all relevant Legislation and Statutory Regulations.

Rope fittings shall be securely attached to the ropes, preferably with terminal splicing standard splitter fittings or approved swaged fittings. All rope slings shall be tested to twice the required working strength. Splitter fittings shall not be used for high temperature applications. Where rope clips are specified, a minimum of three rope clips and a thimble shall be correctly fitted to make the connection.

All lifting tackle shall be supplied with test certificates.

Rope slings for general use shall be fitted with a metal tag indicating the safe working load.

Sockets, thimbles, rigging screws, stretching screws, eyebolts etc., shall have a safe working load of not less than that for the attached rope or chain.

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Wire rope and fittings that are a stationary part of a machine, and fixed guys shall be stainless steel. Chains shall comply with all relevant Acts and Statutory Regulations and shall be stamped indicating the safe working load.

11-3- Speed Reducers and Gears

- All the reducers shall be in principle built according to AGMA Standards or similar. The inner parts of the gears shall be prepared for an open-air storage time of 24 months. Gears in the equipment used for continuous, medium shock service shall be designed with a strength factor of at least 1.2 and shall be of suitable gear form and precision finish for heavy duty. Strength factors for gears for non-continuous or other duty classifications shall be according to recognized industrial standards.
- Gear wheels and spur of gear rings for intermediate gears shall be manufactured from special steel resistance to wear, if necessary.
- The reducers and the motors shall be principally mounted on a common base and be connected with flexible couplings.
- Manufacture's standard units and parts shall be used.
- All gears of speed reducers shall be housed in dust and oil tight welded steel housings or casting housings fitted with oil filling, drain and a provision for measuring the oil level.
- All gears for conveying equipment (e.g. belt conveyors, Screw conveyors, bucket elevators, etc.) shall be designed for such conditions as they can be started with equipment fully loaded with material.

11-4- Couplings

- Couplings shall be provided for connections between machines and drive unit, unless otherwise approved by the Company.
- Couplings shall be properly keyed in place.

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- Couplings shall be completely machined to a tolerance within 0.025 mm, or the manufacturer's standard, on the radius and face-to-face. Both halves of pair of coupling shall be accurately match-marked.
- Couplings shall be provided with removable safety guards.

11-5- Service Factors

- The design of all mechanical power transmission components shall be based on the service factors of at least 1.5 over the operating horsepower to be transmitted, unless otherwise specified in the Contract.
- All equipment shall be complete with approved safety devices including emergency stop devices or switches such as pull-keys.
- These devices must be not only those usually supplied with the elements of machinery, but also additional covers, guards, stairs, ladders, platforms, handrails, etc., which are necessary for the safe operation of the installation and which are obligatory requirements according to the safety standards.
- All necessary safety devices for all open gearing parts, couplings, brakes, pulleys, etc. shall be supplied in accordance with the relevant regulations.

11-6- Bearings

- Bearing Location
 - Retainer plates taking bearing thrust loads shall be bolted to shaft ends with a minimum of two high tensile screws, drilled through the head and securely locked with steel wire. Self-locking type Un-brake screws may be used.
 - Light duty rotary applications without undue horizontal thrust may be fitted with spring-type retaining rings and grooves.

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- All shaft mounted pulleys, gears, sheaves, sprockets, etc, shall be fitted to shafts, where technically possible, by means of keyed taper lock bushes
- The bearing shall be provided with a means of greasing and fitted with an efficient seal to prevent ingress of dirt and grit.
- Plummer block bearing housing shall be of cast steel.
- All bearings shall be suitably sized to provide a minimum life expectancy for time periods, as listed below, under service conditions, for which such equipment is intended. Life expectancy is defined as the number or revolutions in life of the bearing, at a given constant speed and load; that ninety (90) percent of the bearings will complete or exceed before the first evidence of fatigue develops.
- All anti-friction type bearings, as furnished integrally with mechanical equipment items, shall comply with the following requirements:
- Each pulley and shaft assembly shall be supported by one (1) fixed and one (1) floating pillow block bearing assembly.
- All Bearings Shall Have Adequate Lubricant And Dust Seals Of The Multi Labyrinth Type.

<u>Mechanical Equipment</u>	<u>(L10) Life Expectancy</u>
Transversal Cars and Winches	10.000 hours
Industrial Type Overhead Cranes	20.000 hours
Belt Conveyors	60.000 hours
Fans, Blowers, Pumps	60.000 hours
Compressors	100.000 hours
Process Equipment	100.000 hours

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- When bearings are arranged in bearing unit (pillow blocks or Plummer blocks), each pair of bearing units shall have one expansion and one fixed type housing. Plummer block housings shall, if feasible, be of split type construction in order to facilitate removal of the bearings.

11-7- Seals

- Seals for shafting shall be of the "rubbing" type (i.e. felt washer, spring steel washers and lip seals), or the "non-rubbing" type (labyrinths). These shall be selected for each application so as to preclude the ingress of dust, moisture and other contaminants and to retain within the housing the lubricants (grease or oil) used.
- Felt seals shall not be used when dusty and abrasive materials are to be handled. Their use shall be restricted to shafts with peripheral speeds less than 4 m/s and temperatures below 100 degrees Celsius.
- Lip seals, in either rubber or plastic, shall be used for peripheral speeds in excess of 4 m/s. The double lip type is preferred.
- Lip seals may be used for oil as well as grease lubrication. If single lip seals are used and the main requirement is prevention of oil leakage, then the lip should face inwards. If preclusion of dirt is the major consideration, the lip should face outwards.
- Where grease lubrication is employed in process plant and process plant auxiliaries, and also if specified on other plant, the preferred shaft seals shall be combinations of "rubbing" and "non-rubbing" seals. The "rubbing" seals shall be placed adjacent to the bearings and provision shall be made to introduce lubricant between the "rubbing" and "non-rubbing" seals.
- For high temperature applications suitable materials (e.g. teflon, carbon, etc.) shall be used for the seal surfaces.

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- Where corrosive gases or liquids are being handled, the seal materials shall be corrosion resistant.
- Where wet and extremely dirty conditions prevail, a thrower shall be provided in addition to seals.
- Thrower shall be provided above the upper bearing seal on all vertical shafts.
- The clearances between the mating surfaces on all the seal components shall ensure that friction power loss and shaft wear are kept to a minimum.
- Shafts and housing shall be machined to the limits and surface finishes recommended by the seal suppliers.

11-8- Base Plates

- Base plates shall be of cast iron or of welded construction and shall have ample strengths and rigidities against operating conditions. Grout holes shall be provided.
- The surfaces on which equipment are to be mounted shall be machine finished. Supporting surfaces for pillow blocks shall be machined, too.

11-9- Accessibility and Interchangeability

All the working parts shall be arranged in a way that offers convenience of operation, inspection, lubrication and facility of replacement with the minimum suspension of work.

All the parts in the equipment supplied, or in duplicate equipment, shall be interchangeable.

11-10-Lubrication

- The lubrication procedures recommended by the equipment manufacturer must be followed. Manual or automatic lubrication systems must be evaluated based on the equipment lubricated, the frequency of lubrication

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and the quantity of lubricant required. Special care will be taken in the application of centralized greasing systems in order to avoid generalized damage to the equipment caused by deficient lubrication due to obstructions in or rupture of the main line. For these purposes, alarms must be provided for low level lubrication and/or high pressure.

- The manufacturer shall furnish lubrication schedules called "Lubricant Data Sheet". These schedules shall include complete information and recommendations necessary for operation and maintenance of the equipment.
- All the more important lubrication points shall be designed for automatic lubrication unless they are lubricated for life.
- When circulating oil system is provided, the system shall include such items as pumps, oil storage tank, filters, coolers, piping, valves and flow indicators. Pressure and temperature alarm system shall be provided for oil systems of this type. Instrumentation shall also be provided to automatically shut down the major equipment, with the exception of the special equipment which must not shutdown mechanically, when critical values for pressure and temperatures are reached.
- Automatic centralized grease systems shall in principle is provided for equipment having multi-greasing points and requiring the frequent grease supply.
- Adequate provision shall be made for lubrication of all chain drives.
- All lubrication systems and provisions shall be arranged in a manner, permitting carrying out of the lubrication operations, without interrupting functioning of the serviced equipment.
- Gearboxes and oil baths shall be provided with filling and drain plugs, both of adequate size and located and arranged to avoid oil spillage.

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11-11-Belt Conveyors

11-11-1 Drive Units

- All drives over 30kW shall have a soft start by use of a high-speed fluid coupling or Variable Frequency drive. The selection depends on calculated start-up torque.
- High speed fluid couplings shall have a design start-up factor of 140% ~ 180% depended on selected type (Double or single delay chamber) respect to the designer calculation.
- Drives shall be positioned to enhance the most economical belt tension profile. Drives shall not be located directly below conveyor transfer points or other areas of possible material spillage as far as possible.
- All drive system with rated powered until 30 kW should have equipped torque arm and for more than 30 KW equipped with swing base.
- When long start up or maintenance speed is required the vendor shall consider lubrication options.
- Gear reducers shall be supplied complete with inspection covers, labyrinth seals with double lip seals incorporated, oil drains, oil sight glass, replaceable heavy duty dust tight breather, magnetic drain plug and lifting lugs.



- All electric motors shall be 50 Hz, IP 55 protection as a minimum supplied by the project nominated manufacturer. It should be air cooled.
- All reducers shall be of right-angle bevel/helical design and the supplier shall provide his mechanical and thermal ratings for approval.
- All drives installed, shall be sized at maximum absorbed design power based on a maximum belt fill of 75% at design capacity (maximum

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achievable tph capacity) and considering all probably resistant powers same as clogging, cleaners, scrapers, indentation effects, drive unit efficiency, etc.

- Couplings shall be fixed in position by locking element and provided with movable safety guards.
- All rotating parts of the drive shall be adequately guarded in accordance with the applicable act or standard.
- Jacking bolts and blocks shall be provided to facilitate horizontal, vertical and axial alignment of equipment.
- All reducers shall be factory run for a minimum of 3 hours as part of the final inspection, recording relevant parameters (rise temperature in bearings and oil, vibration, noise, abnormal sound, input and output shaft amplitude, reduction ratio, leakage of oil, tooth bearing, cam-clutch anti reverse device) during the run.
- Dual Independent drives shall split the torque between the primary and the secondary drive. If three equal drive units shall be used, one is connected to each side of the primary pulley shaft and the third one connected to the secondary pulley.
- The inner parts of reducers shall be prepared for an open air storage time of 24 months.
- Service factor of speed reducer should be between 1.6 until 2.
- For deceleration more than one minute, brake shall be considered respect to the safety rules. (After receiving the approval of the client)
- Holdbacks will be sized with a minimum safety factor of 1.5 shall be fitted to all conveyors where the runback force due to material on the inclined sections of the conveyor exceeds 50% of the belt friction force, excluding skirting friction.
- Runback Torque < 60kNm requires internal holdback on reducer

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- Torque $\geq 60\text{kNm}$ requires external holdback on the head pulley or primary drive shaft
- Holdback devices fitted to gearboxes shall each be sized to withstand the total run back force where multiple drives are installed.
- Internal holdback devices shall be removable from the reducer and the reducer rotation direction on the input/output shaft shall be clearly indicated.

11-11-2 Pulleys

- Conveyor pulleys diameter shall be selected respect to the rubber or steel cord belts manufacturer suggestion.
- Pulleys shall be designed for the maximum forces that can be imposed by the belt tension with due regard for the wrap of the belt on the pulley.
- Return idlers shall not be used as bend pulleys.
- Pulleys shall be fabricated from plate and machined concentric to the bore. The supplier is to confirm the finished machined shell thickness. The end disks and hub shall be designed respect to the Roark's formula of stress and strain book. Pulleys shells shall be welded construction, stress relieved and ultrasonically tested before machining and balancing.
- All pulleys shall be straight faced.
- Pulleys shall be attached to the shaft by means of Bikon, or equivalent keyless locking elements.
- The shaft shall run in two self-aligning, spherical roller bearing Plummer blocks. Each bearing shall be designed for a minimum L10h service life of 60,000 hours.
- All bearings shall be effectively sealed against the ingress of dust by means of replaceable labyrinth type seals against grit and moisture.

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Button type grease nipples shall be fitted c/w easy access filling pipes, where necessary, on all bearings.

- Pulley shafts shall deflect no more than allowable value which will be given by housing supplier requested at the hub for all belt tension cases.
- Pulley shafts shall be cold-rolled steel, CK45 or 42CrMo or better and diameters shall be calculated after due allowance has been made for fatigue and stress concentration factors.
- Where shafts terminate at bearings, the bearings are to be equipped with steel dust tight end discs. Plastic discs are not acceptable. End discs shall fit grease tight and dirt tight in the housing grooves.
- In general, it is preferred that shafts up to 100 mm diameter are not turned down at the bearing and it is only to suit the maximum bore of the coupling that turndowns will be used. The maximum turndown allowed shall be 20%.
- Plummer blocks shall be installed in such a way that the cap bolts are not under tensile load. They shall be mounted on adjustable sole plate. All plumber blocks are to be fitted with hexagonal D-type button head grease nipples. Jacking bolts with locknuts shall be provided on all sole plates for vertical and horizontal alignment of pulleys. Wide bearings centers are generally used for pulleys that are incorporated within a chute.
- Drive pulleys shall have 12.5 mm minimum thickness diamond-grooved rubber lagging vulcanized to the pulley, except for reversible conveyors which shall have plain or multi-crossed lagging as required. Rubber hardness shall be 60 ± 5 Shore A durometer scale.

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- All driven pulleys shall have 12.5 mm minimum thickness plain rubber lagging vulcanized to the face of the pulley. Rubber hardness shall be 40 ± 5 Shore A durometer scale.
- Each pulley and shaft assembly shall be supported by one (1) fixed and one (1) floating pillow block bearing assembly.
- Pillow block housings shall be adaptable for either fixed or floating bearings. Housings shall be split and dowelled for easy inspection and installation, and shall have an accurately machined base with slotted holes for mounting.

11-11-3 Idlers

- Idlers shall be designed according to CEMA Belt Conveyors for Bulk Materials-7th Edition
- Idler rollers speeds must not exceed 750 rpm
- Motor power shall be calculated using the idler friction factors in accordance with DIN 22101.
- For all loading points, the standard Impact trough idlers shall be pitched at 300 mm.
- Idler frames shall be marked with belt direction and be of the “belt friendly” tubular construction type.
- Trough and return idlers at the conveyor head and tail sections shall be fully safety guarded to prevent accidental access.
- If rollers are made of tubing, the latter shall be seamless. Outer surfaces shall be smooth and corners rounded. Each assembly of roller, shaft, bearings, seals, etc. shall be balanced and concentric.
- Bearings shall be of the high-grade anti-friction ball type with a minimum L10h life rating of 30,000 hours. ($\pm 5\%$ deviation is accepted)

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- Bearings shall be adequately sealed to retain the lubricant and effectively prevent the ingress of dirt and moisture.
- For conveyors up to 1600mm belt width, trough idler assemblies shall be of the three roller 35° off-set type.
- “Lubricated for life” type idlers are required.
- All return idlers for belt widths of 800 mm and smaller shall use a flat idler, mounted on a long drop bracket to ensure that the return belt line will be below the idler stringer.
- Trough angles of transition idlers as required by means of adjustable idler sets.
- Parts exposed to dirt accumulation shall be designed and constructed for self-cleaning as far as possible.
- Idlers to be able to be changed from access walkway without the use of special tools.
- The idler sets pitches are 0.8 to 1.2, 2.5 to 3.5 and 0.3 meter for carrying, return and impact idlers, respectively, unless special limitation occurs during detail design.
- Guide rollers are used according to the detail design of the belt conveyor. These rollers installed perpendicular to the belt edge at the carrying or return paths to prevent it from deviation. Characteristics and number of guide rollers are chosen according to the manufacturers’ recommendations and designer experience.
- For belt conveyors with a width of 1000 mm or more than 1000 mm should be installed V shape return idler set with 10-degree trough angle.

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- For belt conveyors with a length of less than 30 meters do not need to be installed self-aligning idler although one self-align shall be considered on return belt.
- For belt conveyors with a length of more than 30 meters in of conveyor should be installed every 30 meters one carrying self-aligning idler and one return self-aligning idler. For each self-aligning idler, one pair of guide roller should be installed at carrying path and one pair in return. The position and number of guide rollers may be revised at the pre-commissioning and commissioning periods. For other conveyors with length less than 30 meters, at least one self-aligning idler shall be considered.
- Each pair of guide rollers are installed on a special carrying idler support called self-aligning idler support. It can rotate due to a bearing mechanism and maximize the effect of self-aligning. Besides, all of the carrying idler supports (except for the reversible conveyors) have a slope of two degrees which is performing a self-aligning effect.
- 2 degrees' tilt angle shall be considered only for carrying idlers.

11-11-4 Belts

- All conveyor belting shall be CEMA grade II or equal DIN standard, for temperatures up to 65° C. For high temperatures, appropriate belts by hot material shall be used.
- Maximum unit belt tension shall be 10% or less of belt class rating for a fabric carcass and 15% or less for a steel cord belt.
- For plant conveyors the maximum allowable belt sag shall be limited to 2% of the carry idler pitch and 3% on the return idler pitch. For overland conveyors the maximum allowable belt sag shall be limited to 1% of the carry idler pitch and 2% on the return idler pitch.

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- Fabric carcass belts shall have a minimum of three plies and minimum top and bottom covers of 6 mm x 2 mm and have cut rubber edges. In special cases, cover thickness should be selected respect to the impact and regular rules.
- The supplier shall select the appropriate covers grade and gauge in response to the characteristics of the material conveyed and the conveyor environment.
- The conveyor designer shall conform to the belting manufactures and CEMA recommendations on suitable load support, maximum belt speed, cycle time, pulley diameters, maximum lump size capacity and correct empty belt trough and transitions.
- Conveyor belts of the same width are to be standardized as far as possible from the following widths: 650mm, 800mm, 1000mm, 1200mm, 1400mm, 1600mm, 1800mm, 2000mm, and 2200mm.
- Belt speeds shall take into account the lump size being conveyed and other factors for optimal economical design.
- Sufficient belt length shall be provided for hot vulcanized splicing and all splicing shall be hot vulcanized. Splice length shall be suggested by belt supplier and it is not in scope of conveyor designer.
- Belt turnovers for overland conveyor return strands shall be considered.

11-11-5 Conveyor Take-Ups

- All vertical gravity take-up boxes shall be provided with lifting lugs to enable maintenance personnel to rig the counter weight box to its position at the maintenance platform.
- Take-up installations shall be readily accessible, and shall be above ground level.

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- In general, all conveyors are preferred to have vertical gravity take-ups close to the head drive. However, if space constraints dictate then screw take-ups are acceptable for conveyors up to 45 meters' pulley centers.
- The take-up shall be designed to ensure that under all conditions of loading and operation sufficient tension exists in the belt to prevent slip between the belt and the driving pulley and to maintain sufficient belt tension to prevent excessive belt sag between the idlers at any point on the conveyor.
- Gravity take-ups shall be designed to accommodate as a minimum the anticipated maximum permanent stretch in the belt, the elastic stretch due to the maximum operating tension during starting plus an adequate allowance for taking up any slack in the belt during splicing. The gravity take-up shall be designed to allow sufficient storage to facilitate re-vulcanizing without adding an insert.
- Maintenance platforms shall be provided at all vertical gravity take-ups complete with access ladder, handrails, etc. All structural steelwork and pulley frame guides shall be of robust construction capable of withstanding the forces generated during starting and stopping the fully loaded conveyor.
- The take-ups shall be enclosed with guarding manufactured from heavy-duty mesh or expanded metal which shall be easily removable for maintenance purposes.
- To secure the vertical gravity take-up box in its maintenance position, locking mechanisms shall be provided on the take-up steelwork to enable mechanical locking of the counter weight box in this position, together with a lockable pin to ensure the safety mechanism has been

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locked in its fail safe position, and to prevent the safety pin from falling out.

- In the case of horizontal gravity take-ups, particular attention is to be given to the design of the carriage and carriage supports. The carriage wheels are to be V-grooved to run on inverted angle iron rails on one side only.
- The rails can be welded to the rail supports, which are to be of adequate width and strength, but care must be taken to ensure straightness before and after welding and particularly after galvanizing if applicable. Welding on cleats to the rails and bolting the cleats to the rail supports is preferred.
- The track diameter of the wheels shall not be less than 200 mm. Guides are to be provided above the wheels to prevent the carriage lifting off the rails. The guides shall not be inverted angle sections. Rubber buffers of substantial size shall be fitted to the take-up steelwork to prevent or minimize damage in the event of belt failure
- Counterweight boxes shall have a minimum 4.5 mm thick removable hood/cover to prevent intrusion of foreign materials. The cover shall be pitched at 45° to prevent the build-up of such material.
- The ballast used shall be steel ingots or plates.
- The rope diameter shall have a minimum factor of safety of 5:1 and the minimum rope diameter shall be 16 mm.
- Minimum sheave diameter is to be equal to or greater than 20 times the rope diameter.
- Provision shall be made for a vertical gravity take-up to be raised by means of a tackle system or winch and sheave system. The system

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must allow the counterweight to be safely and positively secured in place prior to working being performed on the belt.

11-11-6 Conveyor Belt Scrapers

- Scrapers shall be selected, to apply in dry conditions and shall be provided for all head and tripper pulleys as follows:
- A primary belt double row scraper-solid tungsten blade mounted on torsion bars, 10% wider than the belt width. (If any)
- A secondary scraper with double tungsten blades. (If any)
- The scraper shall be spring loaded, adjustable and must be able to be conveniently removed for maintenance purposes.
- A 'V' type plough scraper is required on the return belt at the tail pulley and on bend pulleys above the gravity take-up pulley. A 'shedder plate' is also required above the gravity take-up pulley.
- The type of scrapers must be suitable for the conditions of the product(s) being conveyed.

11-11-7 Belt Scales

Allowable location for placing belt scale is defined as following

- six (6) m minimum of undisturbed load, up and down stream of scale idlers.
- Horizontal run of belt.
- 12.5 m from Tangent Point of curve if there are vertical curves.
- At a low-tension portion of the belt
- At a low-tension portion of the belt scale accuracy requirements shall be determined in accordance with application but in no case shall be more than 1% of maximum load.

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11-11-8 Chutes & Skirts

- Rock boxes:
- Shall be built into all chutes feeding bulk material of which lump size is larger than 12.5 mm.
- Rock centering feed plates shall be at all conveyor feeding points handling non-sticky material.
- Chutes feeding sticky material shall be designated for direct material drop or belt to belt transfer.
- Conveyor chute design shall be such that the material feed onto the following conveyor is central on the belt with suitable valley angles on sliding face.
- Transfer to be of 'soft loading' type design to ensure minimal impact to receiving conveyor. The transferred material velocity at the receiving conveyor shall not be greater than the conveyor belt velocity nor significantly less. Chute surfaces subject to abrasion shall be fitted with suitable liners.
- Conveyor feed and discharge chutes shall be adequately sized and laid out to permit proper material flow under all conditions of loading, from zero to maximum design flow rates when the most arduous material characteristics specified on the conveyor data sheets apply.
- Minimum chute sliding angles to suit material flow properties.
- The head chute shall be designed with the back plate at a sufficiently steep angle to ensure that the fines and scrapings from the belt scraper do not accumulate in the chute but are fed on to the following conveyor.

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- Head chutes shall be fabricated with removable sections to facilitate access to the pulleys and belt scrapers for maintenance purposes. A hinged inspection door shall be fitted on both sides of the head chute.
- The width of skirt plates shall not be greater than 2/3 of the belt width. Skirt plates shall be lined and equipped with adjustable rubber skirt seals with a clamping arrangement as a minimum and will be subject to approval by the Purchaser or his representative.
- Liners
- Abrasion resistant liners shall be used where moving abrasive material contacts the chute.
- Steel Liner material shall have a hardness of BHN500.
- Liners shall be 10mm min for material.
- Liner plates shall be bolted to chutes.
- The maximum weight of any liner section shall be 30 kg.

11-11-9 Protection

- All Conveyor Belt protection devices shall be considered to protect main mechanical components:
- As a minimum belt misalignment, belt speed, belt tear and rip, take-up limits and blocked chute detectors shall be specified.
- Control and Instrumentation design shall allow for protective devices as well as drive protection
- A cover will be installed on the belt in open areas. This cover is called “rain cover” although it protects belt and materials from both rain and wind. It will be installed easily and provide the possibility of inspection and maintenance. The cover is just on the belt and does not cover walkways, and there are no side covers.

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11-11-10 Conveyor Structures

- The conveyor structure shall be designed generally in accordance with the requirements of applicable codes to safely withstand the loads imposed under all conditions of loading and the belt tensions on the head and tail frames during starting of a loaded conveyor shall be deemed to be 2.24 times the maximum operating tensions with the maximum design force of a jammed belt condition at the tripping of the conveyor drive motor, or the maximum breaking strength.
- Wind loads as per applicable codes for structures.
- The most economic gantry span for elevated conveyors shall be used provided it is in general conformity with the layout shown on the drawings and taking crane construction needs into account.
- All belt conveyor structures shall if possible have walk space on both sides of the conveyor. An expansion joint shall be provided on conveyor stringers.
- Gentries for conveyors shall have an 850 mm wide walkway on one side of the conveyor for belt widths up to 1200mm and where possible on both sides for belt widths over 1200mm. Maintenance access of minimum 1000mm shall be possible around the head and tail of all conveyors.
- Conveyors over roads shall be provided with decking plates to prevent spillage onto the road. A minimum clearance of 5500 mm shall be maintained over roadways. Overhead clearance signs shall be attached on each side of the structure above the roadway.
- The floor structure shall be open type with open grid flooring and handrails around the perimeter of all elevated floors.

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- The dimensions of the transfer tower shall permit adequate space around the conveyors for maintenance purposes.
- All exposed conveyors, conveying dry material shall have curved (dog-house) sheeting over the belt only to provide weather and wind protection. Elevated Conveyors without dog-house sheeting shall have wind hoops.
- Conveyor deck plates shall be provided at all feed and discharge points and above vertical gravity take-ups. As a general guide the deck plates shall be 5 meters long at the feed and discharge points and shall extend 2 meters each side of gravity take-ups.

11-11-11 Corrosion Protection

- All steelwork shall be prepared or painted in accordance with prevailing project specification.
- In the case of proprietary items such as motors, gearboxes and idlers the suppliers standard paint finish shall be acceptable provided it is of good quality and suitable for the application for which it is intended. In this regard vendors' attention is drawn to the exposed dirty conditions in which the equipment will be installed.

11-11-12 Safety Guards

- Conveyor guarding shall be provided in accordance with the requirements of Local Minerals Acts and Regulations. Guards shall, where appropriate, be installed in such a manner as to facilitate easy removal for maintenance purposes and painted to designated safety colors.
- All nip points at the pulleys shall have nip angles fitted.

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- If fluid couplings are fitted, the guards over the couplings shall be designed to prevent hot oil from the coupling being discharged beyond the guard in the event of the fusible plug melting. The guard shall consist of a metal plate covering the full width of the coupling with mesh end covers to allow free flow of air. A drip tray below the coupling shall be large enough to hold the full oil contents of the coupling and will be provided by the drive supplier.

11-11-13 Vehicle and Pedestrian Access

- Where a high probability of pedestrians is likely to occur to cross the conveyor, the designer shall provide specific cross over or cross under points at belt conveyors for pedestrians and vehicles. Distance between conveyor structure and vehicle ground level shall be at least 7 meters.
- Where more than 2,200 mm headroom is available, such accesses could be provided, and these crossings shall be clearly indicated and marked with signs and road markings.
- For the above cases the following aspects shall be addressed:
 - All designated vehicle road and pedestrian accesses underneath conveyors shall be protected by under pans.
 - All areas where a conveyor crosses over any equipment and or building, the conveyor shall be equipped with an under pan.
- Where clearance between the floor or ground level and the underside of a belt conveyor structure is more than 1,000 mm but less than 2,500 mm, access will be prevented. Minimum distance between return belt and ground level is 600mm.

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- Regarding the above under-belt guards shall be provided where maintenance is required and the risk exists that components might drop to the ground.
- These baskets shall be designed to permit access to both sides of the equipment, and to allow maintenance to be executed safely inside the basket.
- Maintenance baskets should not allow built up of spillage.
- Maintenance baskets should be designed to take the weight of two persons together with the spares being replaced and/or installed.

11-12-Oil Hydraulic Operating Systems

All oil-hydraulic components will be approved for the fluid recommended by the supplier/Contractor of the particular equipment, or if not, as specified in the appropriate technical specification.

Oil-hydraulic circuits will be designed and their components selected in order to support and minimize pressure shocks and heat generation.

The pumps will be directly coupled, with flooded suction, mounted on the side of or beneath the tank. The pump motor will be sized to operate continuously at 120% of the system operating pressure.

The hydraulic unit pumps will have pressure release valves either inside or outside the unit.

A pressure gauge must be provided in the pump suction area. All transmission components will have a service factor of 1.5, based on the hydraulic motor's calculated torque. The design pressure of all the components will be at least 150% of the maximum service pressure.

The hydraulic valves will be supported by a base, preferably using interconnected multiple blocks. The directional control valves will also be mounted on a base and

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operated by an electrical actuator. The adjustable valves will have a safety device to maintain the adjusted position.

11-13-Pneumatic Operating Systems

All the components of a pneumatic system will be designed for a minimum of 150% of the maximum service operating pressure.

All the pneumatic cylinders that have a running length of over 76 mm will have damping at both ends and will have cleaners for the stem.

The airlines must have conditioners, dryers, filters, regulators and lubricators in order to ensure the maximum duration of the pneumatic power system components. In all points underneath the airlines, automatic condensation drain cocks must be installed.

11-14-Pipeline Systems for Equipment Provided as Packages

Pipeline systems must be designed so that they require a minimum amount of disassembly for maintenance and removal of the equipment. Flanged connections must be provided in accessible locations for removal and maintenance of the equipment.

Pipeline systems must be permanently supported in order to eliminate deflections and vibrations during the operation, as well as to satisfy all the requirements of the codes. The tubing must be supported in such a way that the valves can be operated without forcing them. The valves, instruments and other components must not be supported by the tubing.

The manufacturer of the equipment will be responsible for obtaining the registrations of the pressurized pipeline systems provided and for turning over all the documentation to the EPC CONTRACTOR together with the drawings and calculations.

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11-15-Ducting

Ducting system are be used for heating, cooling and ventilation for areas. Air velocities from louvers and grills will be low enough not to cause unacceptable noise levels in areas where personnel are normally located. Velocity shall not exceed limited velocity as listed in Table 1 protection noise pollution.

Table 1. Velocity limitation in the ducts

TYPE OF DUCT	Comfort Systems		Industrial Systems		High Speed Systems	
	m/s	fpm	m/s	fpm	m/s	fpm
Main ducts	4 – 7	780-1380	8 – 12	1575-2360	10 – 18	1670-3540
Main branch ducts	3 – 5	590-985	5 – 8	985-1575	6 – 12	1180-2360
Branch ducts	1 – 3	200-590	3 – 5	590-985	5 – 8	985-1575

Ductwork, filter frames, and fan casings will be constructed of mild steel sheets stiffened with mild steel flanges and galvanized. Ductwork will be of the sectional bolted design and adequately supported. Duct joints will be leak proof. Duct lines transferring heating or cooling air for HVAC, shall be insulated.

Ducts operating above 70 °C, shall be considered for isolation as in para 16, below.

Above 90 °C, selection of material shall be decided according to

- Max operating temperature
- Corrosion protection of internal surfaces (in contact with hot gas stream)

11-16-Assembly and Testing

- All light machinery, pumps, etc., shall be assembled in the manufacturer's workshop and shall undergo a test run. All heavy machinery shall be assembled in the manufacturer's workshop, as far as reasonable,

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and shall undergo rotations or oscillations to assure operation and adjustment, or proper play.

- If the equipment is disassembled for delivery, the parts shall be adequately marked with a permanent mark of the joints to facilitate re-assembly at the plant site.

11-17-Bolts, Nuts and Washers

All bolts and nuts shall have metric threads.

The manufacturer shall supply all bolts, nuts, and washers which are requested for the connection of plant and/or equipment. Bolts, nuts, and washers galvanized shall be supplied.

Bolts and nuts, unless otherwise required for specific equipment &/or condition, following fasteners are generally used:

- A-193 B7 Bolts
- A-194 2H Nuts
- A-307 Anchor Bolts

The type of bolts, nuts, and washers (SST, galvanized or carbon steel) shall be decided according to specific conditions imposed by process or required by design.

11-18-Electric Motors

Electric motors and their basic auxiliary components must be in accordance with the "Low/Medium

Voltage Motor Specification". 3-phase, 400V and 6.6 kV, AC Electric motors are used throughout the plant, unless otherwise is specified in technical specifications.

All drives over 30kW shall have a soft start by use of a high-speed fluid coupling or Variable Frequency drive. The selection depends on calculated start-up torque.

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11-19-Motor Systems

Electric motor systems must be of the direct connection, 3-phase, squirrel cage induction type, utilizing couplings and gear reducers.

As much as possible, wherever a combination of motor, coupling, gearbox, clutch /brake is used, they must be accommodated on a single, heavy duty chassis, with all arrangements for protection, adjustments, and access (for lubrication and repairs).

11-20-Heat Exchanger

The design requirements for the equipment shall be as detailed in this specification and the data sheets.

Heat Exchangers shall be designed and fabricated in accordance with the requirements of ASME and TEMA standards. The applicable TEMA class shall be as specified in the data sheet.

The exchangers shall be designed for the most severe combination of operating and environmental conditions which may be experienced in normal operation, start-up, shutdown, upsets and by-pass with only one side fluid flow, testing and transportation. Nozzle neck or nozzle reinforcement shall not be the limiting component in determination of maximum allowable working pressure.

For fixed tube sheet exchangers, Contractor shall also perform the stress analysis due to expansion and contraction, considering the most severe combinations stated above.

If required and in order to keep the stresses within limits, suitably designed shell expansion bellows shall be included and provided by Contractor, as part of his scope. In case of stacked fixed tube sheet heat exchangers, the stress analysis shall be carried out separately for individual shells considering worst case scenarios. Tube to tube-sheet joints and configuration shall also be design checked for the expansion stresses.

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Exchanger components common to both the shell and tube sides shall not be designed for differential pressure and designed for maximum pressure and temperature of each side.

For external bolting and for components exposed to both shell and tube side fluids, the design temperature shall be the most severe one.

The minimum shell thickness shall not be less than that specified in TEMA. For carbon steel shells, when the corrosion allowance specified exceeds TEMA requirement, the minimum shell thickness shall be increased to suit.

In the design of closures, girth flanges, floating head assembly etc. for large diameter/ high pressure/ high temperature, Supplier shall demonstrate specific previous experience of their use. When specified, the Supplier/Contractor shall provide stiffness/ leakage calculations, in addition to the strength calculations as per the design code.

Due consideration shall be given to pressure relief in the event of either a fire or tube rupture when determining the shell side pressure.

Design shall avoid all features which are likely to promote crevice corrosion.

Combination of materials likely to promote galvanic attack shall be avoided unless proper precautions are taken.

Detailed information is submitted in related project specification.

11-21-Ball mill & Hammer mill

Rotary equipment as this ball mill & hammer mill shall be furnished and fully tested in accordance with relevant standards in those above standards.

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11-22-Storage Tanks

11-22-1 Shop Built Storage Tanks

Design liquid level shall be the full height of the shell (including top angle) for fixed roof design. Tanks shall be designed to permit hydrostatic testing as erected in the fully corroded condition.

Design of above ground storage tanks shall be done according to API650 Standard. Required Consideration will be implemented for indoor design temperature via HVAC equipment if needed and 8°C for outdoor design temperature, one as referenced in the project specification, site data, unless otherwise specifically noted on the data sheets. Minimum design temperature shall be site minimum ambient temperature.

Corrosion allowance shall be applied to all surfaces in contact with the process fluid by using corrosion resist material or lining protection. Corrosion allowances will be shown on the data sheet.

For fixed and removable internals, the corrosion allowance on all exposed surfaces shall be equal to that specified for the shell. Minimum thickness of internals welded to shell wall shall be 4 mm plus twice the corrosion allowance.

No corrosion allowance is required on stainless steel materials or materials protected by stainless steel unless otherwise specified.

Detailed information is submitted in related project specification.

11-22-2 Site Built Storage Tanks

Design liquid level shall be the full height of the shell (including top angle) for fixed roofs or the maximum elevation of the floating roof with a liquid specific gravity not less than 1.

Tanks shall be designed to permit hydrostatic testing as erected in the fully corroded condition.

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Required Consideration will be implemented for indoor design temperature via HVAC equipment if needed and 8°C for outdoor design temperature, one as referenced in the project specification, site data, unless otherwise specifically noted on the data sheets. Minimum design temperature shall be site minimum ambient temperature.

Where strakes differ in thickness the inside diameter of the tank shall be constant. Corrosion allowance shall be applied to all surfaces in contact with the process fluid by using corrosion resist material or lining protection. Corrosion allowances will be shown on the data sheet.

For fixed and removable internals, the corrosion allowance on all exposed surfaces shall be equal to that specified for the shell. Minimum thickness of internals welded to shell wall shall be 4 mm plus twice the corrosion allowance.

No corrosion allowance is required on stainless steel materials or materials protected by stainless steel unless otherwise specified.

Detailed information is submitted in related project specification.

11-23-Pressure Vessels

- Design of pressure vessels shall be done according to ASME SECTION VIII Div.1 or DIN standard.
- The design pressure and temperature criteria are defined in process design criteria and basis documents. Otherwise, they are specified in data sheets.
 - The strength calculations shall be in conformity with the relative design code.
- In case the code does not have provisions made for a certain type of strength calculation, the common engineering practice or other codes shall be applied.
- Pressure vessels shall be fabricated as one piece in shop.

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- Material shall be as per relevant data sheet and in accordance with ASME, SEC. II.
- The material shall be selected so as to produce an economical design for the specified design service conditions.
- All data in relevant data sheet shall be considered in construction of equipment.
- Tests and inspections shall be based on relevant ITP and code requirements.
- Corrosion allowance (C.A.) shall not be considered in strength calculations.
- Unless otherwise stated the tolerances shall be as limited by the relative design code or document.
- All welding shall conform to ASME code requirement.
- The acceptance criteria for all radiographs shall be in accordance with ASME, Paragraph UW-51.
- Heat treatment shall be based on data sheet and applicable code.
- Vendor is to include with his quotation a list of recommended spare parts as commissioning, start- up and two years' operation.
- If the required inside diameter for a vessel is lower than 800 mm, a note shall be added specifying that a piping element is acceptable. For vessels less than 1000 mm ID, flanged heads shall be specified.
- Size of manholes:
 - For vessel diameter < 1000 mm
Flanged vessel shall be considered if equipment contains internals
Otherwise, size of manholes = 18"
 - For vessel diameter ≥ 1000 mm
Toxic service size of manholes = 24"

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Non-toxic service size of manholes = 20" (or up to 24" if internals need to be removable through manhole.)

- Location of manholes is at the opposite side of the utility connection for horizontal vessel. And numbers of manholes are for vessel length/height less than 6 m a single manhole shall be provided for other vessel (length/height > 6m), two manholes to be provided at least. One manhole is each 6 m for longer / higher vessel. If vessel is equipped with internals (baffles and etc.); one manhole to be provided on each compartment.
- As a minimum requirement, all vessels shall be spot radio graphed. One spot radiograph shall be taken from each shell section at a point specified by the company inspector.
- Vortex breaker to be installed for the services pump suction or specified in data sheets.
- Drains, vents and overflow connections location: The drain of the vessel shall always be at the lowest point of a vessel. For vertical vessels they shall be connected to the bottom outlet line at the low point. For horizontal vessels the drain point shall be directly on the bottom of the drum at the lowest point ensured through vessel slope (1:100). Vent and drain diameter shall be defined as follows:

Volume or diameter of vessel (m ³ or mm)	Vent diameter (min.)	Drain diameter (min.)
$V \leq 15$ or $D \leq 2500$	2"	2"
$15 < V \leq 75$ or $2500 < D \leq 4500$	2"	3"
$75 < V \leq 220$ or $4500 < D \leq 6000$	3"	4"
$220 < V \leq 420$ or $D > 6000$	4"	4"
$V > 420$	6"	4"

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➤ Drain number:

For horizontal drums having a length greater than 6 m TL to TL, additional drain connections shall be considered. An additional drain is also required on each compartment of a vessel. On toxic service, an open drain connection (washing out) is to be provided with a blind flange. Size of open drain connection shall be of the same diameter as drain connection.

➤ Overflow:

For vessels equipped with overflow connections, the overflow nozzle line size shall be at least one size greater than the inlet/outlet nozzle, whichever is greater.

- Utilities Connections (steam out, purging): Utility connections (2" minimum) shall be sized as follows:
- Drums and heat exchangers (when applicable): 2"
- For large vertical drums, two 2" connections shall be provided for diameter larger than 4.5 meter and for horizontal vessel with a length larger than 6 meter and operating in toxic service; two 2" connections shall be provided. If vessel is equipped with internals (baffle), one 2" connection shall be provided on each compartment.
- The materials selected are those specified by the data sheets and project specification. According to the design data and geometrical characteristics of the vessels, the materials are chosen among the ASME standards cited by the basic code selected for the design and construction of the vessel.
- Whenever the manufacturer cannot use the materials specified in previous paragraph, he is authorized to propose equivalent materials to Company for approval; his choice should be substantiated by equivalences recognized by standards.

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- The number of shell longitudinal and circumferential welded joints shall be minimized. Shell rings 1800 mm or less in outside diameter shall have not more than one longitudinal welded joint.
- The maximum number of circumferential joints, exclusive of head to shell joints, shall be as follows:

L	Number
<= 2400 mm	0
<= 4800 mm	1
<= 7200 mm	2
<= 9500 mm	3

- Then one additional joint every 2500 mm of L. Where L= total length of cylindrical shell between tangent lines.
- Welded joints shall be so arranged that:
 - Visual inspection can be made with all internals in place.
 - No openings intersect with the weld seam.
 - No nozzle reinforcing pads, wear plate and etc cover longitudinal or girth joints.
 - The minimum distance between the edges of attachment welds and main seams, or between the edges of adjacent attachment welds shall be the greater of 50mm or three times the thickness of the main component (e.g. the shell).
 - Centers of the longitudinal joints of two adjacent courses shall be staggered 30-degree minimum apart and preferably be off-center relative to the vessel main centerlines. For horizontal vessels, they shall be located above the horizontal plane through the centerline of the vessel.

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- All longitudinal and circumferential joints, and in as much as possible, all pressure retaining joints, shall be double butt-welded and shall conform to type n° (1) of the CODE table UW-12. Welds inaccessible for double welding (e.g. circumferential closing joint of small diameter vessel, piping and fitting butt welds and etc.) shall be single butt weld equivalent to a double butt-welded type n° (1) of the CODE table UW-12. Attachment of intermediate heads shall be as shown in the CODE FIG UW-13.1 sketch (e).
- Heads shall be semi-ellipsoidal, in one piece for carbon, low alloy and clad, steel vessels up to 2300 mm in diameter. Other types of formed heads are not permitted.
- All vessels shall have lifting lugs or trunnions designed with a safety impact factor 2.
- Each complete vessel shall be provided with a nameplate and so located that it is easily accessible after the vessel installation. The nameplate shall be on a bracket welded to the shell. Insulated vessels shall have bracket to provide 25 mm clearance between nameplate and the outside surface of insulation.
- The spare parts shall include at least:
 - 2 sets of gaskets (including manholes gaskets)
 - 5% of studs, bolts, nuts, washers, etc. of each type (with a minimum of 2 units)
 - Other parts, such as internals, if required in the individual specifications.
- The layout and arrangement of platforms, walkways and means of access thereto must be such that the supervisory rounds can be made at various levels without requiring excessive climbing up or down.

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- Platforms over 8 m long shall be served by two means of access (stairs or ladders). These means of access shall be placed in such a way that no point between two accesses is more than 20 m from at least one of them and there shall be no blind lengths of platform exceeding 8 m.
- There shall be a platform in front of each manhole. This requirement may be waived in the case of manholes on horizontal drums of which the centerline is at a height of less than 3.75 m.
- As general rule, access to platforms shall be by fixed ladders and the upper landing shall be to the side of the ladder. However, in the case of platforms on the top of equipment, the top landing may be in front of the ladder.
- The ladders shall have a maximum height of 9 m. The ladders shall be provided with safety cages beginning at a height of 2.5 m from the bottom of the ladder.

11-24-Hoppers, Bins, Chutes, Liners and Skirts

Where bins, chutes, liners and skirts are supplied as an integral part of mechanical equipment, they shall be designed such that:

- Lining type and material, and method of application, and lining manufacturer shall be chosen in accordance with service requirements.
- They allow for the fast, smooth flow of material and avoid abrupt changes of direction, which invite material build-up and subsequent plugging.
- They have a minimum of throat constrictions.
- They are firmly supported, manufactured from a minimum of 8~10 mm plate and are suitably stiffened.
- Abrasion resistant liner shall be used on surfaces where abrasive material in movement contacts the chute.

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- Liner shall be min 6-8 mm thick for material under 25 mm lump size and shall be 10mm for material over 25 mm.
- For fine product (containing less than 1% Si) no wear plate/abrasive liners are needed.
- Liner plates shall be welded / bolted to chutes, as ease of replacement and accessibility allows, with 15mm diameter Nelson studs welded to the liners on approximately 300~600 mm center-to-center spacing.
- The maximum weight of any liner section shall be 68 kg (150 pounds).
- Skirt boards shall not be lined.
- Liner material of rubber shall be 60 durometers wear resistant flat surface rubber segment with steel T-slot for 19mm T-Bolts. When material impacts on chute surfaces at an angle between 5° and 70° corrugated surfaces segments will be used instead of flat segments.
- In all cases liner thickness will be determined for individual chute applications based on the vertical drop and material lump size.
- Chute with liner shall have removable panels to facilitate the installation and removal of the liner plates.
- Steel Liner material shall have a hardness of BHN360.
- Rock boxes chute type should be built into all chutes feeding coarse or fine bulk materials such as ore, sand and limestone to belt conveyers with the exception of fine ore under 12.5 mm lump size. In which cases rock boxes shall not be used.
- Rock box type centering feed plates should be used at all belt conveyer loading points handling non-sticky materials.
- Inspection doors shall be provided in all transfer chutes.
- Chute and Hopper angles
 - Minimum sliding angle:

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- Coarse ore 60°
- Fine ore 70°
- Sand (silica) 60°
- Limestone 60°
- Minimum valley angle:
- Coarse ore 51°
- Fine ore 63°
- Sand (silica) 51°
- Limestone 51°
- Rock box angles
 - Minimum dynamic angle of repose:
 - Coarse ore 55°
 - Fine ore 70°
 - Sand (silica) 60°
 - Limestone 60°
- Chutes handling filter cake shall be rubber sheet supported by steel framework.
- Chutes handling screen undersize shall be heavy rubber type mounted on a steel framework.
- Their valley angles are conservative and suitable for the materials handled. Any valley angle less than 60° shall be subject to approval.
- Falling material does not impact directly on sensitive receiving equipment but rather on the sloping bottom of chutes or material contained by rock boxes.
- Where equipment such as scrapers, rappers and squeezers, spray units etc. are housed within the chutes, they must be able to be removed without disturbing the main assembly.

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- Where material is in contact with the chutes, suitable liner plates shall be installed which shall be fastened by means of nib head countersunk bolts and waterproofed where necessary. Such liner plates shall be designed to allow for interchangeability. In areas of high wear with coarse materials, rail mats shall be used.
- Unless otherwise stated on the drawing, liner plates shall be arranged in a brick pattern with a gap of not more than one liner plate thickness or 10mm (approximately) between adjacent liners.

11-25-Cranes and Monorails (Rail Cranes)

- Electric overhead traveling cranes shall comply with the standards of the Crane manufacturers Association of America (CMAA), ISO, BS, ANSI, DIN or other relevant standards. All maintenance cranes shall be rated for the maximum load requirements for maintenance and general repair only.
- All maintenance cranes shall be rated for the maximum load requirements for maintenance and general repair only. Lifting requirements in excess of these loads will be provided by yard crane.
- Service classes shall be as follows:
 - Class B (light duty) for operation cranes such as in warehouses and machine shops with light requirements
 - Class C (moderate service). For maintenance cranes such as in the crushing plants and the concentrator and operations cranes for garages and machine shops with medium requirements
 - Class F (steel mill also specification). For high-speed operating cranes handling hot metal as in the smelter converter aisle.

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No.	Usage of Crane	Service Condition	Group classification of the appliance as a whole	Group classification of the mechanism as a whole		
				Hoist	Travers-ing	Traveling
1	Manually powered crane	-	A1	M1	M1	M1
2	Workshop crane for assembly purposes	-	A1	M2	M1	M2
3 a)	Power house crane	-	A1	M2	M1	M3
3 b)	Maintenance Crane		A1	M3	M1	M2
4 a)	Work Shop crane	Regular light use	A2	M3	M2	M3
4 b)	Work Shop crane	Regular intermittent use	A3	M4	M3	M4
4 c)	Work Shop crane	Intensive use	A4	M5	M3	M5

11-26-Fans & Blowers

Fans shall preferably be direct coupled to drivers through flexible coupling and the complete assembly shall be mounted on substantial bedplate. Fan casing shall be so arranging as provide ready access for removal of the rotating element when required. Constant speed fans shall be fitted with vane type damper.

- International Standards are utilized to identify tolerances for rotating equipment.
- Normally no margin is taken if the flow is constant, a 10% margin can be used if the flow is directly coming from a production separator to take into account slugging regime.

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11-27-Air Compressors

- Rotary compressors shall be furnished in accordance with relevant standards for compressors.
- The permissible speed range of the compressors for continues operation shall be clearly stated by the manufacturer.
- An independent seal oil system requires pressurize liquid for its operation. The maximum permissible noise levels apply to one meter horizontally on ear level relative to the equipment (e.g. fans, etc.).
- Unless exception is recorded by the vendor in his proposal and approved by Company, the equipment shall be guaranteed for satisfactory performance at all operating conditions specified based on project requirement.
- Any special tools required for erection, commissioning or maintenance shall be identified in the SUPPLIER/Contractor's bid and supplied with the equipment.
- Contractor shall provide full details for installing, site testing, commissioning and startup of the equipment. SUPPLIER shall provide representatives to assist the CONTRACTOR during installation, commissioning and initial start-up for all aspects of air compressor as option case.
- An outline of initial start-up procedures shall be prepared by the SUPPLIER/Contractor and shall be agreed upon by all parties before start-up.
- The Contractor shall provide recommended preservation procedures to be used during storage at site.
- Due consideration shall be given for easy accessibility to all the items for maintenance and operational requirements when designing the layout of the air

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compressor. Access shall be provided to all equipment and any area requiring maintenance. The air compressor shall be designed so that all maintenance can be carried out with the minimum special facilities/tools.

- All equipment and piping shall be neatly arranged on the skid where possible to ensure that they do not obstruct maintenance operation. The SUPPLIER shall work closely with the CONTRACTOR to ensure that the most effective layout, assuring adequate access, for maintenance, is achieved within the air compressor.
- All major components within the air compressor shall be provided with horizontal and vertical alignment bolts. All major equipment items shall be supported on shims plate at each mounting point to facilitate re-alignment at a later stage. Sufficient quantity of pre-cut shims shall be provided loose for site commissioning.
- SUPPLIER shall provide in their bid, maintenance lifting requirements for the equipment, and advice suitable method, e. g runway beam, overhead travelling crane etc. SUPPLIER shall complete and submit the Lubrication schedule provided by the CONTRACTOR.
- The equipment (including auxiliaries) shall be designed and constructed for a minimum service life of 25 years and at least 2 years of continuous operation.
- The sound level of the centrifugal compressor package boundary shall not exceed 85 dB (A) at 1 meter (or as defined by the package noise data sheet). The SUPPLIER'S proposal shall state clearly how the specified sound level limits will be met.
- Air Cooler
- The equipment shall be of the manufacturer's standard heavy-duty type.

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- The Air cooler shall be completed functional and operational units incorporated all necessary auxiliary equipment, ready to be erected on foundations supplied by others.
- Fan type shall be axial with direct drive.
- The shaft and coupling assemblies shall be dynamically balanced.
- The sound level of Air cooler and fan boundary shall not exceed 85 dB (A) at 1 meter.
- All moving parts shall be provided with sufficient lubrication and the parts that require periodic lubrication shall be provided with lubrication nipples that shall be easily accessible.
- All electrical and controls and instrumentation equipment (field instruments) necessary for operation and control of the equipment shall be furnished.
- All internal piping of the equipment shall be included in the supply. All the steel structures shall be ready shop painted. Stainless steel surfaces shall not be painted.
- The material shall be based on project specification.

11-28-Vibrating Screens

- Vibrating screen shall generally be of the dynamically balanced four (4) bearing type.
- All vibrating screens shall have dust tight enclosures and inspection doors and dust take-off opening to be determined by dust control.

11-29-Centrifugal Pumps

- The layout of pumps and associated equipment and piping shall ensure that adequate NPSH is provided to the pumps to avoid cavitation's and to

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ensure that piping can be easily disassembled to facilitate the removal of temporary strainers and/or the pump(s).

- Operating point checking on performance curve:

Note 1: Performance curve should be modified for viscous fluid (higher than 20 CST) as per hydraulic institute requirements.

Note 2: The operating point should be far from Min. Cont. Flow rate of proposed pump.

Note 3: The ratio of shut off to rated head should be in the range of 10% to 20%. Ratio limitation could be checked based on design condition of pump downstream.

- Capability to increase head rise up to (5% to 10%) with substituting new impeller (10% for main pumps) or addition of new impeller.
- Pump parts material shall be suitable for service conditions and fluid characteristic. The minimum acceptable quality is mentioned on data sheets. Vendor shall quote the better quality if recommended according to his knowledge and his experiences.
- Corrosion allowance and maximum allowable Working Pressure shall be considered and checked respectively.
- Nozzle specification should be checked by project requirements.
- Bearings and lubrication system should be checked by project requirements and also meet with those mentioned on data sheets.

11-30- Sump Pumps

- Pump sumps shall be of 6 mm minimum thick mild steel plate and shall be designed with sloping bottoms (60°) to eliminate material build up.
- Pump sumps shall if possible be cylindrical in top part and conical in bottom part.

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- Sump height (cylindrical part) = 2 times sump diameter (recommendation).
- Pump sumps shall have quick detachable drains and flush-out connections.
- Pump sumps shall be rubber lined min. 6 mm, for wear protection.

11-31- Process Pumps

11-31-1 Pump Selection

Pumps for handling solutions (electrolytes, water, acids, condensation) will be horizontal or vertical axis centrifugal pumps, preferably coupled directly to the operating motor. Materials of construction of all pumps shall be compatible with the materials to be pumped.

The pump's operating speed must not be within 20% of any critical speed.

The design will be such that the reverse rotation of the pump, resulting from the draining of the liquid from the discharge line will not damage or loosen the rotor, the coupling transmission or any other part of the pump.

The pump connections will meet ANSI standards, and will be adequate for joining with standardized flanges corresponding to the piping specification.

The size of the electric motor will be such that it will not overload in any operating range of the rotor selected. The motor's capacity will not be less than 115% of the maximum operating capacity.

Parts subject to wear will be readily accessible and replaceable with minimum interference with the pipeline installation.

Pumps will be supplied complete with shaft and bearings for heavy service in accordance with specifications. The shaft will have a mechanical seal resistant to corrosion and abrasion to avoid leakage, and stuffing boxes will not be used. Where possible, the same pumped liquid will serve as a lubricant.

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Pumps for chemical processes will be selected in accordance with the latest version of the ANSI/ASME B73.1M or B73.2M standard. The materials of construction and guarding must comply with specifications on capacity, safety and service.

Positive displacement pumps will be horizontal, and the joints will have flat faced ANSI flanges, unless this is not advantageous for a specific service.

All pump casings will be designed for a minimum of 1.5 times the maximum working pressure.

11-31-2 Pump Flow Rate

The flow rate selected for each pump must correspond to the design flow rate indicated in the process diagrams.

11-31-3 Discharge Pressure

For these calculations, the specific gravity of the solution must be taken into account. A fouling factor must also be taken into account.

Calculations of pressure drops due to friction in the pipelines will be determined. For pressure drops associated with certain equipment, such as heat exchangers or flow meters, information from their suppliers will be used.

11-31-4 Suction Pressure

Suction pressure will be determined based on the following parameters:

- Input pressure: corresponds to the minimum normal operating pressure in the tank from which the fluid is pumped.
- Static head in the suction line.
- Pressure drop in the suction line.

For centrifugal pumps calculated NPSH available will be at least 10% or 1.0 m. greater than the NPSH required for the selected pump. For other types of pumps, a similar margin of safety should be taken at suction part of pump, if possible.

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More pump characteristics will be indicated in the corresponding technical specification.

11-32-Bag Filter

The equipment shall include at least, but not be limited to the following:

- Filter casing with inlet and outlet connections
- Supporting steel structure of casing
- Filter baskets with bags
- Mounting base, service platforms (top of filter)
- Shut-off valves
- Slide gates
- Flexible joints at inlet and outlet of gas duct connections
- Flexible joint at dust outlet
- Electrical heating coils in the filter hoppers, inclusive distribution and automation cabinet
- Internal pipes and valves within the filter needed for automatic operation
- Automatic air-pulse cleaning device with differential pressure transmitter and timer
- Terminal box for monitoring signals to be connected to Process Control System (PCS, supplied by others)
- Electrification including terminal box and terminals of each electrical equipment

The above listed equipment is to be furnished as complete package, which shall include at least labor and material for design, fabrication, testing and delivery.

- Equipment shall be manufacturer's standard type ("heavy duty type").
- The design must be such as to minimize the possibilities for material build-up.

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- The equipment shall be equipped with lifting lugs for handling of subassemblies.
- The bag filter house casing shall be provided with service doors to ensure quick and easy maintenance of the filter baskets and bags. Hoppers shall be equipped with service doors.
- For maintenance reasons the bag filter shall have two compartments, which can be operated independently.
- The gas inlet and outlet connections shall be flanged.
- Filter bags are cleaned by pressurized air shock method. The bag filter shall be equipped with an automatic, time and/or pressure difference measurement controlled, and pulse-cleaning system including a solid state timer, pressure indicators and a complete control system.

11-33-TRUCTURALSTEELWORK FOR MATERIAL HANDLING SYSTEMS

11-33-1. general

Dead load is the load

- Dead load (D-L):

Dead load is the load of structural members and mechanical parts connected to them.

- Operating loads and overloads:

As regards operating Loads and overload it is necessary to make a distinction between the conveyor bridges and buildings.

- Operating loads and overloads on conveyor bridges:

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Operating load is the material on the belt obtained considering the theoretical section of the belt plus 10% and adding a dynamic coefficient according to FEM. As overloads, an overload distributed on walkways of 100 kg/m² shall be used.

The walkways will be calculated for a locally concentrated load of 300 Kg.

- Operating loads and overloads on buildings:

Working load is the load of all materials such as the loads of lifting devices, (hoists, traveling, cranes, and dynamic loads of screen and/or vibrators).

As overloads 100 kg/m² load distributed on walkways and 500 Kg/m² load distributed on floors shall be considered.

Walkways and floors will be dimensioned for a local load of 300 and 500 Kg/m² respectively.

- Wind ($w_e - w_m$):

Hypothesis as the FEM or equivalent standards prescribed will be followed.

As operating wind, a minimum dynamic pressure of:

- 75 Kg/m² for height from 0 to 10 m
- 100 Kg/m² for height from 10 to 20 m
- 135 Kg/m² for height from 20 to 100 m

shall be considered.

- Earthquake:

As building and bridges shall be considered in seismic zone the regulations building in the country and FEM standards or equivalent shall be followed.

- Thermal changes:

Thermal changes will be considered as the FEM or equivalent standards prescriptions.

- To determine stress in structural elements the following conditions of load:

Buildings

Bridges

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1) PP+SV+DT

2) PP + SV + +We + DT

3) PP + WM

4) PP + SV + S

1) PP + SV

2) PP + SV + We

3) PP + SV + S

4) PP + WM

Shall be considered where:

PP = dead load

SV = operating loads and overloads

WM = max. wind according to site climatic condition.

We = operating wind

DT = thermal load

S = earthquake

The overloads shall be distributed in the worst way. For loading conditions 3 and 4, increase shall be limited to thirty-three percent of allowable stress.

- Fatigue stressed elements:

Fatigue tests shall be carried out on all components submitted to more than 2 million cycles under the maximum calculated effect of the forces. The reference standards are DIN-FEM.

- Permissible deformation:

The permissible deflections for the various structure types are the following:

- Roofing:

The maximum vertical deflection for bearing components of roofing shall not exceed 1/200 of the span of the related elements under working load plus overload.

- Floors:

The bearing elements of floor structures shall have' a deflection not exceeding 1/360 of the span of the related element under the action of working loads plus overloads.

If vibrating' machines. are installed on such floorings such as for instance, screens, crushers, feeders, etc., the maximum design deflection shall not exceed 1/ 1000 of the span.

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– **Bridges:**

The permissible deflection for conveyor bridges shall not exceed 1/500 of the maximum bridge span to be calculated based upon the working loads plus the overloads.

11-33-2. Structural Components

- **Structural steel stringer**

If the supporting structure of the conveyors is resting on the ground or tunnel- type bridges; the latter shall consist of two channel section girders properly interconnected and braced. A typical conveyor framework is shown in Section 17.

- **Bridges**

The minimum span between the outer edge of the rubber belt and the structural steel stringers of the belt shall not be less than 15% of the belt width for belts up to 1000 mm and not less than 200 mm for larger belts. Elevated supporting structures of conveyors may be of the self-supporting or bridge type structural steelwork illustrated in Section 17. In both cases, two lateral platforms shall be provided running alongside the conveyor and having a width of at least 700 mm.

The walking decks of such platforms shall be in expanded metal grating. The platform shall be located so as to provide easy access from the up-going and down going conveyor stations. In all cases in which elevated supporting structures are adopted, these shall be closed at the bottom by checkered steel sheets.

Emergency escapes for overhead galleries shall be provided at the location of cross-over.

Transfer towers

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Transfer towers will have to support or to contain the unloading drum as well as the driving gear of the incoming conveyor, the loading section of the outgoing conveyor, etc.

Normally, these towers shall only be Closed by roofing in Z-plate -or galvanized steel sheet. One or more projecting monorail shall be provided on which-to fix the tackle having sufficient capacity for hoisting of the heaviest- item one manual traveling hoist shall-be supplied for this purpose for each transfer tower but where height of lift is 10 meter or more, electric hoist shall be provided instead. Arrangement of lifting devices shall be adequate for bring all loads to the ground level.

The floors of these towers shall be in embossed floor plate. Pipes for discharging of any conveyor spills on the tower floor shall, be provided.

These pipes shall be fitted on the external surface of the tower structures and they shall discharge such spills at ground level. All access stairs to the various floors shall have a maximum inclination of 45°. The stair treads shall be in checkered plate.

Minimum 1000 mm clearance shall be provided around all drive installations unless otherwise agreed. A clearance of min. 800 mm shall be maintained around other floor mounted installations. Minimum 300 mm clearance shall be maintained between the flooring and any moving or rotating part of conveyor installation.

Minimum sections to be used:

The following minimum values shall be adopted for steel sections:

- Angle sections (L) with a minimum thickness of 6 mm
- Plates with a minimum thickness of 6 mm

Materials:

The materials to be used for the construction shall be the following:

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- Sections (structural shapes) St 37-2 or approved equivalent
- Plate St 42-2 or approved equivalent

12- WELDING

Welding shall be performed only by artisans who have been qualified by test, and evidence of such qualifications shall be submitted for approval if required by the EPC CONTRACTOR 's Construction Manager. An artisan shall require re-qualification if he has not been engaged in metal welding for a period of three months or more or when changing type of material, or at the request of the Construction Manager.

All qualification and re-qualification shall be in accordance with Code requirements. All welding shall be as appropriate and shall be in strict accordance with the design details as to type, size, technique and sequence. No welding will be permitted for connections carrying fatigue stress unless at the specific request of the Engineer.

All welding shall be executed strictly in accordance with the requirements of the relevant Standards (AWS).

13- NOISE LIMITS FOR EQUIPMENT GENERAL

Noise limits apply at all operating points within the normal equipment performance range.

Noise emission level of the Plant shall be as Low as Reasonably. The following shall be taken into account when making the (detailed) design. This means, amongst others, that

MCC and control room has to be provided with noise insulating material

Noise emission levels have to be taken into account for fans and other noise emitting parts of the Plant.

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Noise emission levels shall be in accordance with ISO 9612. The maximum permissible worker exposure noise level of the maximum cumulative emission from all sources making part of the Plant shall be for the control and MCC room:

- Less than 55 dB (A) with windows closed;
- Less than 75 dB (A) with windows opened;
- At all other work places less than 80 dB (A), unless stated otherwise.

14- SAFETY DEVICES

Personal safety and protection must be taken into account in all aspects of plant design and engineering.

All areas where work is being carried out must have safe means of access and exit.

Plant personnel must be isolated from sources of high temperatures.

Noise levels must not exceed 85 dBA at 1 m from the equipment.

The mechanical vibration of the equipment must be limited to acceptable levels.

All equipment shall be complete with approved safety devices. These devices must be not only those usually supplied with the elements of machinery, but also additional covers, guards, stairs, ladders, platforms, handrails, etc., which are necessary for the safe operation of the installation and which are obligatory requirements according to the safety standards.

All necessary safety devices for all open gearing parts, couplings, brakes, pulleys, etc. shall be supplied in accordance with the relevant regulations.

15- SURFACE PROTECTION & COATING

- According to EN ISO 12944-5 Surface protection shall be considered through painting & corrosion protection specification prepared by EPC

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CONTRACTOR, and approved by consultant, etc. as project's Paint Specification.

- Otherwise, supplier/Contractor's specification shall be submitted to the EPC CONTRACTOR for approval before commencement of work.
- For equipment placed outside of the buildings, and not protected by any shield when exposed directly to sunshine shall be equipped with suitable cover coating.
- Contractor standard cycles shall be applied for electrical equipment and components.
- Painting cycles and RAL shall be coordinated with project specification for painting "12005-B-XX-GNL-XXX-XXX-XXX"
- Insulation for the prevention of heat loss is designed to provide thicknesses such that the resulting cold face surface temperatures do not exceed 70 °C and maximum heat losses do not exceed the values specified in the table given below.
- Maximum of heat losses throughout the hot insulation is dependent on the service temperature of the equipment or pipe.

<i>Service (Operating) Temperature in °C</i>					
Temp	50	100	200	300	400
Heat loss in (W/m ²) outside insulation	85	113	172	232	290

- **HEAT CONSERVATION:** In order to maintain a process temperature or for energy saving by reducing the heat losses, the outer surface of insulation must be at a maximum temperature of 70° C, to ensure personnel protection as defined hereafter.

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- **PERSONNEL PROTECTION:** is necessary for protection of personnel against contact with surfaces operating at temperatures above 70° C, accessible from normal working areas and access ways.
- The material of insulation is in accordance with relevant data sheets.

16- LAUNDERS

- Flotation overflow launders shall be of "U" trough design made of 3 mm minimum thick steel plates or 6 mm oil resistant rubber or neoprene compound or equal. The launder rubber shall be mounted on an angle frame with supporting straps, and the assembly shall be floor mounted by means of supporting legs.
- Gathering launders shall be of "U" trough design made of 3 mm minimum thick steel plates or 6 mm oil resistant rubber or neoprene compound or equal, mounted on a steel frame and hung from the flotation floor above.
- Launders shall not be covered, except at feed points of gathering launders where a short cover shall be furnished to avoid splashing.
- Launders shall be sloped for efficient transportation of slurries. Minimum slopes shall be as follows:

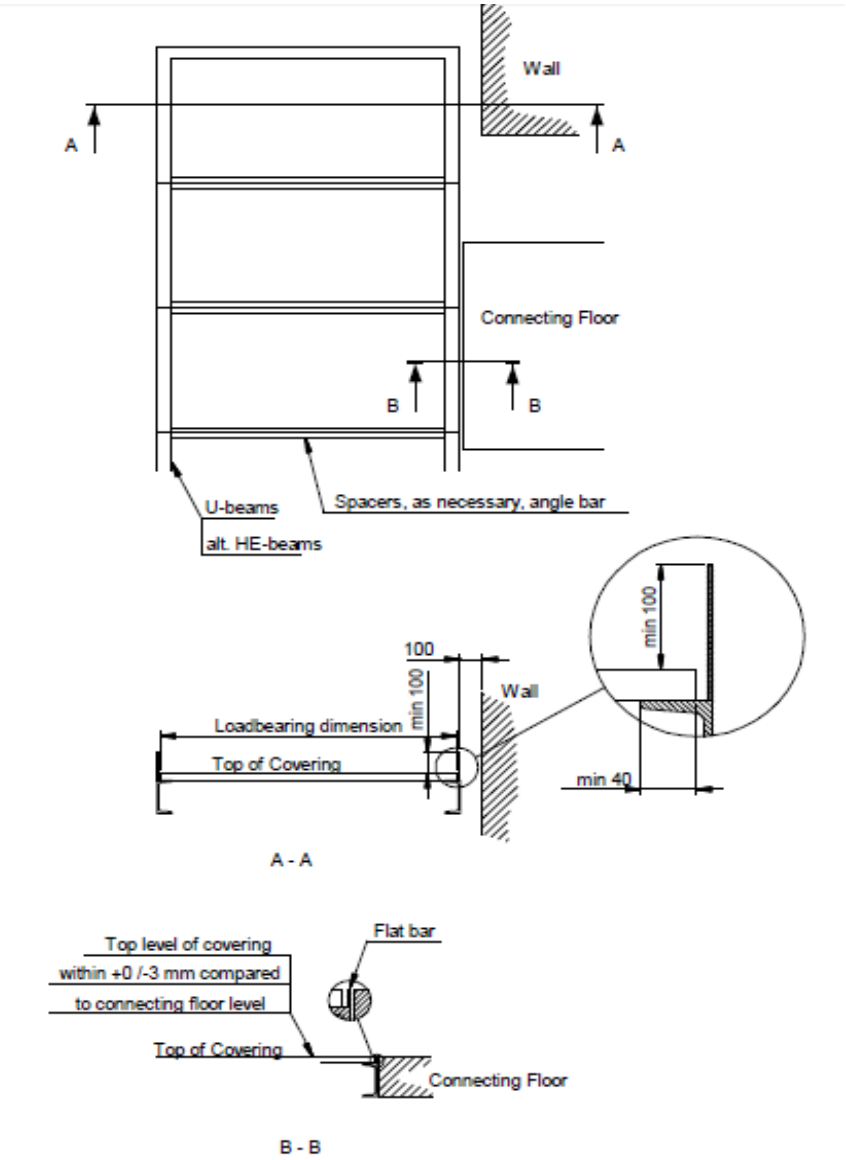
Cyclone underflow (primary grinding)	18,5°, (33.3%)
Cyclone underflow (regrind)	18,5°, (33.3%)
Flotation concentrates overflow launders	7°, (12.3%)
Flotation concentrates gathering launders	5°, (8.7%)
Flotation tailings	3°, (5,2%)

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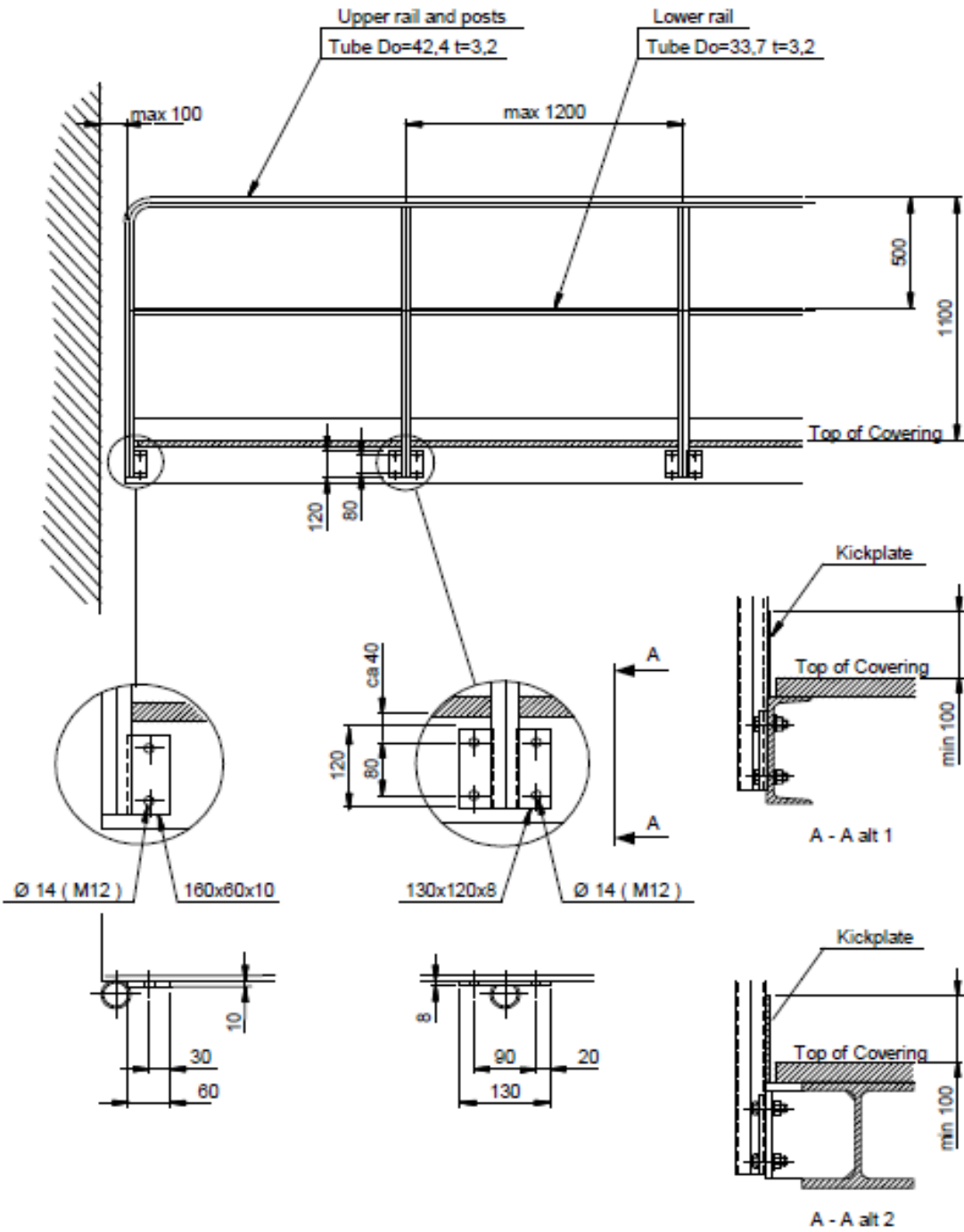
17-2- Typical Walkway, Covered with Grating

Dimension and sizes of Beams is depending of span and must be determined by calculations, shall be designed according to National and Local Regulations.

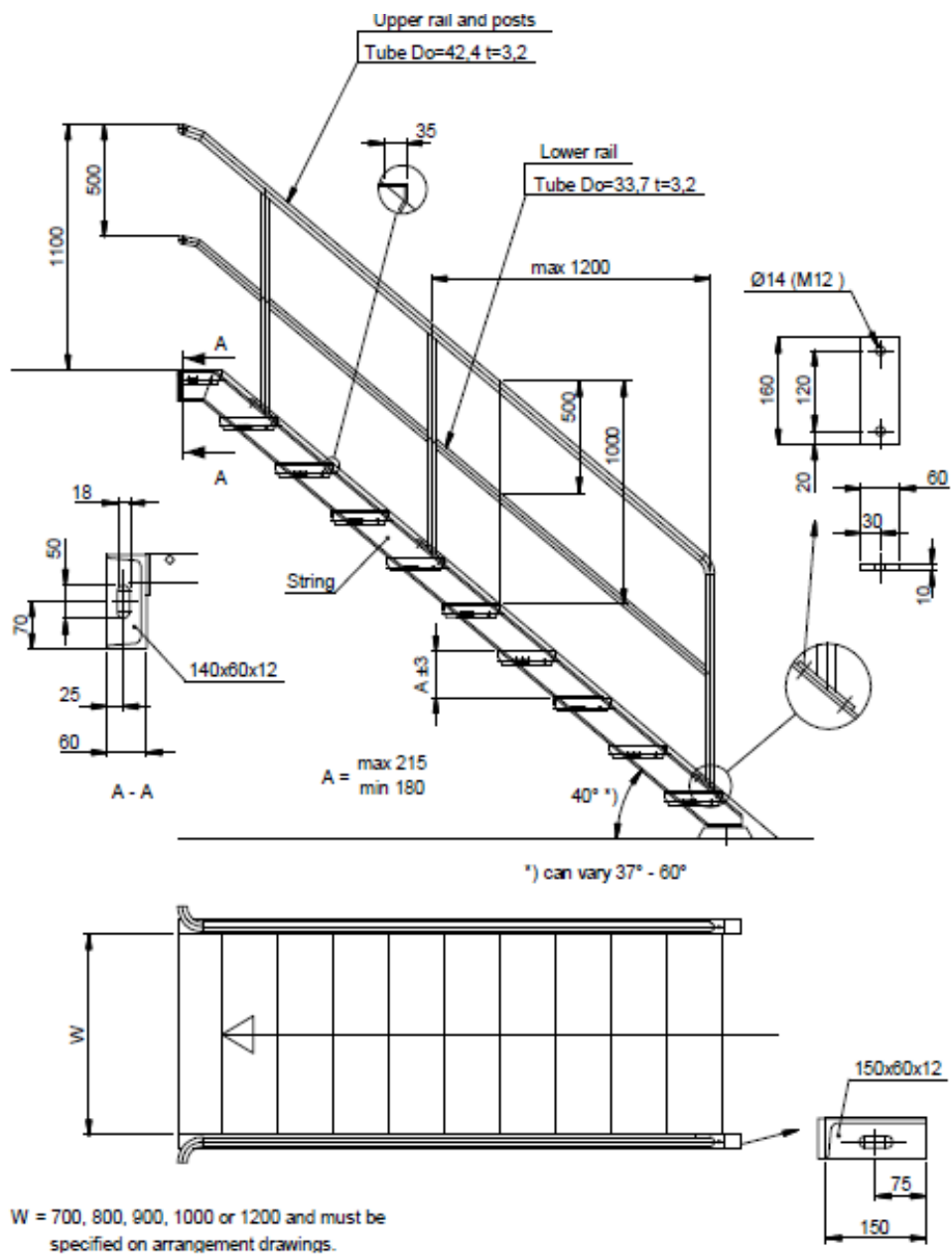
17-3- Typical Handrail For Service Platforms



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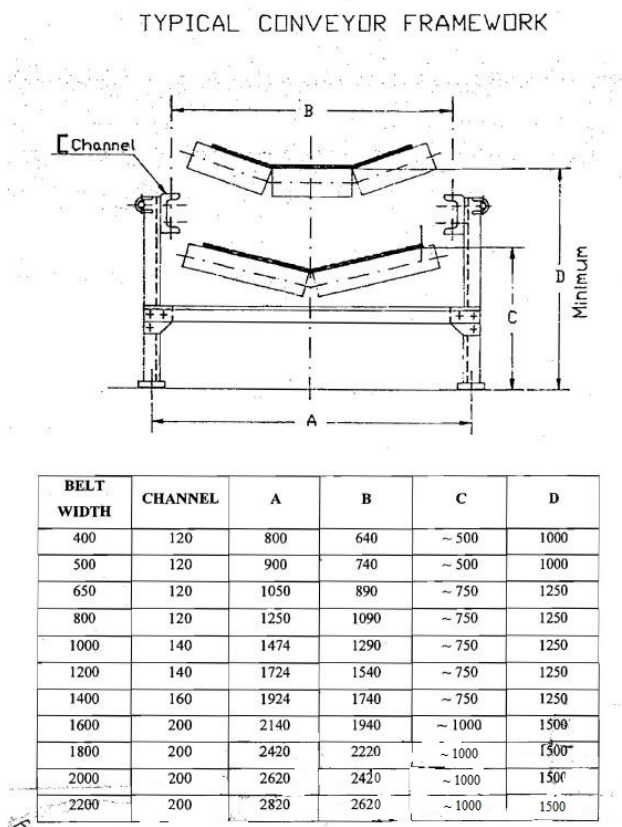


17-4- Typical Stair with Handrail

String made of U-140, String length max 6500 mm.

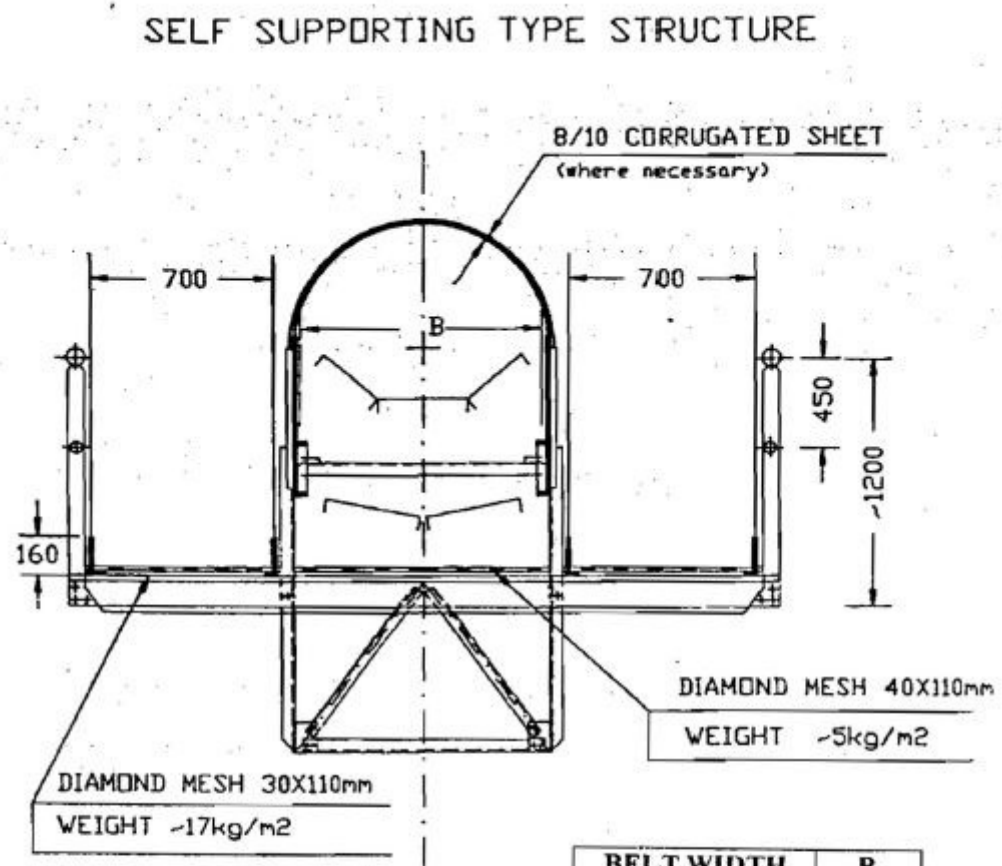
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17-6- Typical conveyor Frame work



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17-7- Typical self-supporting type structure



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17-8- Bridge type Structure

