**Belt Conveyors System**

Design of belt conveyor system shall be suitable for coal parameters specified elsewhere.

Slopes of conveyors, wherever applicable, shall not exceed 15 deg. depending on the lump size, and other governing factors.

The guaranteed capacity of all conveyors shall be the rated capacity.

All conveyors (except boom conveyor of S/R) shall be designed for 110% of rated capacity. The boom conveyor of S/R shall be designed for 125% of rated capacity. Design capacity of the conveyor system shall be considered for the selection of belt width, belt speed and the continuous motor rating at 50oC.

The drive chain equipment’s for various belt conveyor systems shall consist of drive motors, fluid couplings, gear reduction units, low speed flexible couplings and pulleys.

Conveyors and belt feeders shall be provided with electro hydraulic thrustor brakes to adjust the coasting time of conveyors such that there will not be any build up of material in the chutes. Further conveyor shall come to halt as early as possible.

Belt conveyor system shall be designed as per the latest edition of ‘Belt Conveyors for Bulk Materials’ published by Conveyor Equipment Manufacturer’s Association’ or equivalent International Standard.

1.6.5.1              **Construction Requirement**

**Belting**

The belting shall be of either synthetic fabric such as Nylon/Nylon, Polyester/Polyamide etc. with rubber covers of adequate flexibility to give a troughing angle of 35 deg. For all the conveyors the number of plies, cover thickness, factor of safety etc. shall be as per the recommendation of belt manufacturer, but not inferior to the followings:

                        Belting

                        Type                                        Synthetic Fabric of Nylon / Nylon,

Polyester / Polyamide, etc.

                        Cover Grade                             Fire resistant      (Conforming to Canadian

standard association CAN/ CSA M-422- M87 Grade – C.

                        Cover Thickness (without -ve tolerances).

                        (a)        Face                             5.0 mm (min.)

                        (b)        Bottom                         2.0 mm (min.

                        No. of plies                               Minimum 4

                        Drive Arrangement

                        i) Snub drive                             For motor ratings upto 160 kW and         for

motor ratings above 320 kW.

                        ii)  Dual tandem drive                 For motor ratings not covered above.

                        Factor of Safety             10 (Minimum)

                        Normal Working tension             Less than 80% of max. allowable

                        at design capacity                       working tension

Carrying idlers shall be provided with three equal rolls with troughing angle of 35 deg. and 2 deg. forward tilt (except in case of reversible conveyors).

In no case, shall the diameter of the idler roll be less than 152 mm for both carrying side and return side.

Roller used in idlers shall be made from ERW steel tube.  Wall thickness shall be minimum 4.0 mm without any negative tolerance. The rollers shall be mounted on EN-8 or equivalent material spindles by means of heavy duty ball bearings, preferably seize resistant type (SKF/Equivalent), of 30 mm size for carrying idlers and 20 mm size for return idlers. The bearings shall be adequately sealed and lubricated for life. The rolls shall be supported from fabricated steel brackets. Fixing arrangement of rollers with brackets shall be drop-in type. For adjusting the alignment of the idlers, slotted holes shall be provided in idler supporting base plates.  Direction of belt travel shall be clearly marked on the brackets of carrying idlers.

Idler rollers shall be waterproof, dust proof and weather proof against a high velocity water jet.  All idlers shall be provided with minimum tripple labyrinth dust seal.

Impact idlers used at the loading and transfer point shall be so designed as to avoid direct loading impact, belt damage and excessive punishment to the carrier. The material used in construction of this type of idlers shall be of resilient type.

The return idlers for all conveyors shall be single roll type.  For conveyors longer than 400m, two roll return idlers with 10 deg. troughing angle shall be provided.

The self-aligning idlers shall be direct acting type, complete with actuating rollers fitted with the ball bearings and mounted inclined towards the belt.  The idler frame shall be suitably cradled about a vertical pivot, supported in bearing over a fixed plate.  Adequate sealing arrangement shall be provided to prevent contamination of the lubricant by dirt and moisture.

Transition type troughing idlers shall be used adjacent to all pulleys to permit proper support of the loaded belt near the pulleys without excessive stretch of the belt edges. The transition idlers shall be provided with preferably adjustable concentrator (end) rolls and long center rolls to suit the troughed belt contour between the last regular troughing idler and the adjacent pulleys. The transition length and the number of the transition idlers shall be selected depending upon the tensions, type and size of belt, number of plies and other necessary governing factors.

All the conveyors shall be provided with one self cleaning type rubber disc return idler located near the head pulley for cleaning the return belt.

Proper arrangement shall be provided in the brackets of all types of  idlers for preventing the rollers from coming out of the brackets during normal / abnormal conditions.

1.6.5.2              **Belt Cleaners**

**External Belt Cleaner**

Spring loaded scraper type cleaner with modular segmented and replaceable polyurethane scrapers blades complete with main cleaner, pre-cleaner along with accessories and necessary fines chutes shall be furnished for all belt conveyors, tripper head pulley and belt feeders at discharge pulleys. The modular units shall be easily replaceable. The scraper assembly shall be easily maintainable from outside without any interference with the chute arrangement and assembly.

**Internal Belt Cleaner**

V-plough type belt cleaner made of mild steel flats and hard rubber strips with automatic wear adjustment and necessary accessories shall be furnished for cleaning internal surface of the conveyor belt.

1.6.5.3              **Belt Take-up Arrangement**

Automatic take-up of gravity type shall be generally provided with necessary take-up arrangements complete with bend pulleys, take-up pulley, with its supporting / sliding assembly, wire ropes for suspending the separate take – up weight sliding assembly close to the ground, counter weights and other accessories. Suitable guards, marked up scale attached to the frame to monitor belt stretch and access/maintenance platforms with handrails all around etc. shall be provided.  Adequate access from conveyor gallery/transfer house/ground etc., as the case may be shall be provided to inspect, repair and maintain the gravity take-up arrangement. Suitable arrangements shall be provided for clearing accumulated coal from various platforms to ground level. Guides of take up pulley/counter weights shall be sufficiently strong so that they do not bend during belt snapping.

The prime consideration should be to locate the automatic take-ups at a place where these will work best, in relation to the drive, to keep belt tension at a minimum.  Other considerations such as available space, maintenance considerations and the economics of the location should also be taken into account while designing.  Take up shall not be located over buildings..  Height of take-up guide structure shall be sufficient to allow the take-up weight movement up and down for all operating conditions of conveyor and to allow minimum two (2) vulcanising lengths margin in the belt or percentage of conveyor length (2.5% for synthetic belting) whichever is larger.  Suitable guides shall be provided both for take up pulley and take up weight.

Hoists with monorails for holding take-up pulley and weight in case of belt changing, vulcanising etc. shall be provided.  2 M safety fencing along with suitable gate and locking arrangement shall be provided around gravity take-up at the base level / ground level.

Irrespective of take-up location, the travel zone of take-up weight shall start from a suitable height above ground.

Suitable buffer arrangement shall be provided to arrest the fall of take-up pulley in order to avoid damage of the pulley assembly in case of belt snapping.  Similar buffer arrangement shall be provided for take-up weight also in case of take-up weight travel zone terminating above a building floor.  Suitable sandpits shall be provided at ground below the take-up weights.

In case of double stream conveyors, a partition of 3mm steel plate shall be provided between the two take-up pulleys along entire travel zone of take-up pulleys. Intermediate platforms shall be provided in the take-up zone for maintenance of take – up pulleys / counter weight.

Take-up weight shall consist of multi-blocks and not of single block to facilitate adjustment in weight if required during operation.  Weight of the blocks shall be in descending order and single heaviest piece shall be suitable for easy handling.

1.6.5.4              **Hold Back Devices**

Suitable hold back devices for preventing running back of the conveyor belt in case of conveyor being stopped in loaded conditions due to power failure or during normal operational delays shall be provided to give positive protection.  The hold back shall instantaneously engage without shock and be capable of protecting equipment and personnel.  It shall be released instantly when ‘power’ resumes or the ‘delay’ is removed.  The holdback devices shall be integral with gearbox.

1.6.5.5              **Pulleys**

Pulleys shall be provided as required for various conveyors. In determination of pulley diameter, no account shall be taken of the pulley lagging.  The nominal diameter and face width of the pulleys shall be as stated in IS:8531.

The snub pulleys on each conveyor shall be located to provide a belt wrap on the drive pulleys of not less than 220 deg. wrap is envisaged for single snub drive only.

All drive pulley surfaces shall be hot lagged with vulcanised natural rubber lagging grooved in diamond pattern.

All non-drive pulleys shall be vulcanised natural rubber lagged (hot) with plain lagging.

The rubber to be used for lagging of pulleys shall confirm to following specifications The rubber lagging of pulleys and method of lagging and testing the same shall conform to IS:4682.

                        Pulleys

                        General (for all types of Pulleys)

                        (i)         Minimum shell               16 mm

                                    thickness

                        (ii)        Minimum end disc                     24 mm

                                    thickness

                        (iii)       Maximum allowable                   5 minutes

                                    deflection of shaft

                                    at the hubs

(iv)       Pulley  shaft  diameter Margin of minimum 20% shall be considered on maximum tension for arriving at the shaft dia.

                        Drive Pulleys

                        (1)        Minimum shell thickness 16 mm

                        (2)        Lagging                         Hot lagged with vulcanised natural

            rubber

                        (3)        Lagging thickness                       12 mm thick grooved in diamond                                                                                                pattern with grooves 6 mm wide x 6                                                                                            mm deep

                        (4)        Minimum angle of wrap 220° degrees

                        (5)        Maximum Out of                       0.5% of nominal diameter

                                    roundness

                        Other pulleys

            (1)        Minimum shell thickness 16 mm

            (2)        Lagging                         Hot lagged with vulcanised natural

rubber

            (3)        Lagging thickness                       12 mm thick plain

                        Rubber for lagging

            (1)        Type                                        Natural rubber blended with styrene

butadiene rubber.

            (2)        Hardness                                   55 to 65 durometer (Shore A)

            (3)        Elongation                                 Over 300%

            (4)        Strength                                    160-200 kg/cm2

            (5)        Abrasion loss                             250 mm3 as per DIN 53516

            (6)        Specific Gravity             1.4 to 1.5

            (7)        Adhesion Strength                      10 kg/cm (minimum)

                        Bearings for Pulleys

                        (1)        Type                                        Heavy duty roller type

            (2)        Casing                                      Horizontal Split Type

            (3)        Sealing                          Dust tight with double labyrinth                                                                           seals.

            (4)        Lubrication                                Greasing arrangement with conical                                                                                  head shape nipples.

                        Pulley Material                   Mild steel conforming IS:226 / IS : 2062.

The pulleys shall be made from mild steel conforming to IS:2062 (Tested Quality). However for conveyors with in line magnetic separators, at head end the pulleys and the shaft shall be of non-magnetic stainless steel.

All the pulleys shall be keyed to forged steel shafts of EN-8 or equivalent material of adequate proportion running in heavy duty roller bearings with proper greasing arrangement.  The plummer blocks for pulleys shall be of horizontally split type construction with minimum (4) nos. bolts holding the two split halves and with min (4) nos. foundation bolts.  The plummer blocks shall be dust tight with double labyrinth seals. Conical head shape nipples conforming to IS:4009, suitable drain plug and eye bolt shall be provided. Side covers of plummer blocks shall be heavy duty metallic sheets. No plastic components shall be used.

Pulleys shall be mounted on machined & ground surfaces.  Suitable guards shall be provided for all tail pulleys and bend pulleys for safety of operating personnel.

Suitable stiffening arrangements shall be provided in all pulleys.  For selection of pulley shaft dia of all the pulleys, a margin of atleast 20% shall be considered on the maximum tension.  Selection of pulley diameter, shell thickness, stiffening and shaft diameter shall be subject to approval of Project Manager during detailed engineering.

Pulleys of same diameter shall be completely interchangeable in totality and component wise. To have interchangeability of same diameter pulleys procured under separate contracts for a station, the bearing center distance of pulleys shall be subject to approval of the Owner. The adjustments required shall be done by the Contractor at no extra cost to the Owner.

1.6.5.6              **Belt Protection Equipment**

            a)         **Pull chord Switch**

Pull chord type (manually reset type) emergency stop switches shall be located on both sides of belt conveyors along the walkways for the entire length of conveyors for emergency stopping of conveyor at spacing of 30 Meters. The enclosure shall be of cast aluminum with degree of protection IP-65. It shall have a separate terminal box with a separate hinged cover which shall be totally sealed from main box containing actuating mechanism / limit switch etc. Local pull chord actuation shall be provided by means of mechanical flap. Each switch shall have two NO and two NC contacts, which shall be wired out to the terminal block. The terminal block shall have facilities of cable looping. The Contact rating of the switches shall be rated for atleast 5 Amps, breaking at 240 VAC at 0.3 p.f. lagging. Adequate length of rope and all accessories shall be furnished.

            b)         **Belt Sway Switches**

Belt sway switches of self resetting type shall be furnished one pair at 50 meter intervals to limit belt sway to permissible extent. The enclosure shall  be of cast aluminum having degree of protection of IP-65. It shall have a separate terminal box with a separate hinged cover totally sealed from the main box containing actuating mechanism/ limit switch etc. Each switch shall have two NO and two NC contacts one for alarm and one for trip, which shall be wired upto terminal block. The terminal block shall have facilities for cable looping. The contacts of the switches shall be rated for at least 5 Amps. breaking at 240 VAC at 0.3 p.f. lagging.

            c)         **Zero Speed Switch**

Zero speed switch shall be non-contact (proximity) type electronic switch. Mounting arrangement/ location shall be such that operation, effective sensing distance, sensitivity etc. shall not be effected by accumulation of dust on rotating part or surface of probe. Adequate mechanical protection by means of non-metallic shields shall be provided on top of the switch to prevent any damage due to falling coal / metallic pieces etc. In built initial start up delay and nuisance, tripping delay through timers shall be provided. Each switch shall have two NO and two NC contacts wired out to the terminal blocks. The contact of the switches shall be rated for atleast 5 Amps. breaking at 240 VAC at 0.3 p.f. lagging. The monitoring unit shall have cast aluminum body having IP-65 degree of protection. A separate terminal box with a separate cover, which shall be totally sealed from main box, shall be provided. Terminal blocks shall be suitable for terminating 1.5 mm sq. standard copper cable.

            d)         **Under belt switch**

These switches shall be installed under the belt for detecting the presence of material on the belt whose contacts shall in turn be used for operating solenoid valves of dust suppression system elaborated elsewhere. The switch and its operating arrangement shall be suitable for working in dusty areas. The minimum degree of protection of switch shall be IP-62. The switch shall be capable of detecting three events simultaneously as follows :

i)          Belt loaded

ii)         Belt running at more than preset speed.

iii)        Preset initial start delay.

            e)         **Chute Blockage Switches**

One no. chute blockage switch of proven type (subject to approval of the Employer) shall be provided at a suitable height on each leg of the conveyors chute nearest to the skirt boards. Chute blockage switch shall trip the feeding conveyor in case of Chute blockage and protect the feeding conveyor equipment.

The switch and its operating arrangement shall be suitable for working in dusty areas.  The minimum degree of protection of switch shall be IP-62.  Local indication of chute blockage switch actuation shall also be provided.  Location of chute block switch shall be such that washing/cleaning of chute by pipe / rod does not affect it.

1.6.5.7              **Drive Equipment**

Rating of all drive motors of conveyors shall not be less than 120% of the power required at drive motor output shaft at specified design capacity.

                        Suitable Drive Chain Equipment’s like electric motors, gearboxes (where applicable), fluid couplings (where applicable), flexible couplings and other accessories shall be provided for all the belt conveyor systems, paddle feeders, vibrating grizzly feeders, vibrating feeders (if applicable), crushers, mobile trippers, various pumps of dust suppression system, fans for ventilation system, monorail electrical hoists and other equipment’s specified in this specifications.  Various requirements as spelt out in the Technical Specifications for individual equipment’s shall be taken into consideration while designing the associated drive chain equipment’s.

**Gear Boxes**

Gear Boxes shall be of sealed type and mounted on machined or ground surfaces.

The gearboxes shall be designed for 24 hours continuous duty.   For thermal and mechanical rating of the gearbox the data sheet shall be referred to. Gearboxes with cooling coils are not acceptable.

The gears used shall be helical conforming to IS:3681 (latest revision) or worm reduction units or spiral bevel speed reduction units conforming to suitable Indian Standards.  The dimensions of the shaft end shall conform to IS:3688 or its latest revision.  Above 40 kW drive rating, all gearboxes shall be helical or bevel helical type only.

Recommended oil grade shall be compatible with gear internals like material of bearing, cages. Further, all gearboxes shall have suitable breather plugs.

**Couplings**

**Flexible Couplings**

Approved type of couplings shall be used for power transmission depending upon duty requirements.  The design of the coupling shall be such that it can take shock and misalignment without sacrificing its efficiency.  Flexible couplings shall be provided on low speed side of gearbox for all conveyors. Flexible couplings shall be geared type.

**Fluid Couplings**

Fluid couplings shall be provided in all the drive machinery for belt conveyor systems and coal crushers if the actual power requirement at motor output shaft is more than 30 kW.  The fluid coupling for LT motors shall be of traction type.  Cooling water coils for traction type fluid coupling shall not be accepted.  Scoop tube type fluid coupling shall be provided for conveyors with HT motors and coal crushers.  Suitable electrically operated actuators shall be provided for scoop tube operation from local as well as remote.  Suitable provision for alternate manual operation shall also be kept.  If required by the equipment designer, separate pump with motor shall be provided for circulating the fluid coupling oil through oil cooler.  Independent arrangement for forced cooling water supply using 2X100% capacity pumps to oil cooler shall be provided by bidder.  Suitable interlock using flow switches shall be provided in both oil as well as water lines to trip the drive motor in the event of flow in either lines falling below/ acceptable levels.  Suitable pressure indicators and flow indicators shall be provided in the cooling water lines along with all relevant valves, strainers and accessories.  Necessary interlock shall also be provided so that the HT motor cannot be started from remote / local unless position of scoop tube permits no load start of the motor. Tripping of downstream equipment while the system is under normal operation shall result in scoop tube re-positioning to permit no load run of the concerned HT motor.

1.6.5.8              **Conveyor Galleries**

All overground and overhead conveyors shall be located in suitably enclosed bridge structure.  Structural steel bridges of adequate width and depth (3000 mm clear head room for under ground and 2700mm for overground) shall be provided complete with conveyor bottom deck plates, seal plates, walkways of chequered plates with anti-skid arrangement(s) hand rails (on both sides of each conveyor belt except where equipment like paddle feeders, stacker/ reclaimers, trippers etc. traverse over conveyor), conveyor supports etc.

The conveyor bridge shall have permanently colour coated steel sheeting covers on roof and both sides, properly screwed or locked to steel structure as required.  Adequate provision of windows shall be kept.  A continuous slot opening of 500 mm shall be provided on both sides just below the roof sheeting.

The floors of outdoor conveyor galleries shall be designed and constructed as follows:

All conveyors shall be provided with 12 G steel seal plates throughout the length of the conveyor gallery in such a way that complete gallery bottom surface area forms a single water proof floor. It is envisaged to clean the conveyor gallery with water periodically.  All the water / coal slurry  shall be suitably guided to down comers (min 300 mm dia) provided at every trestle. Each downcomer shall lead the coal slurry into a 2 m3 brick wall tank at ground level having 2 Nos. decanting taps at suitable elevations. Decanted water shall be led to the nearest storm water drain of the Owner.  Necessary arrangement shall be provided to avoid choking of downcomers by bigger coal lumps and for cleaning of choked downcomers.

The conveyors shall be provided with continuous steel decking plate of minimum 3 mm thickness.

Structures and floors shall be so designed as to provide suitable space for routing of 200 NB fire fighting pipe with water, and conduits. Power and control cables shall be routed outside conveyor gallery.

Steel trestles to support the conveyor bridge shall rest upon concrete foundations to be provided by the Contractor.  Complete trestle structures shall also be supplied by the Contractor. Suitable approach/access platforms with handrailings shall be provided to approach the conveyor gallery (like in case of fire) through monkey ladders on the trestles. Suitable wire mesh doors on steel frame construction lockable from outside only shall be provided in the conveyor galleries at these locations. All monkey ladders shall have cage for safety of personnel using them.

The width of conveyor galleries shall be decided by the Bidders depending on the equipment’s size and the walkway width as specified.

Provision shall be kept with platforms and ladders for crossing over the conveyors at approximately every 100m intervals of route length and min. one per conveyor.  Further provision shall also be kept with platforms and ladders for atleast two (2) crossings over the track hopper. Walkways shall be kept as follows:

                        Walkways

            (a)        Construction                  Chequered plate with antiskid arrangement.

Chequered plate steps shall be provided where conveyor slope exceeds 10 degrees. (Totally sealed so that no water falls down while washing.)

            (b)        Central walkway            1100 mm clear (no infringement allowed)

                        width

            (c)        Side walkway    800 mm clear (no infringement allowed)

width                            (for single conveyors, the width of side walkways shall be 800 mm on one side and 1100 mm on the other). (no infringement allowed)

                        Side Windows

            (a)        Spacing (Center             25.0 m on each side (in staggered

                        to center)                      fashion)

            (b)        Size                              1.5 m x 1.5 m

            (c)        Window material           Refer Civil Section