

INTER PLANT STANDARD – STEEL INDUSTRY



SAFETY STANDARDS ON OPERATION AND MAINTENANCE OF CONVEYOR BELTS IN STEEL INDUSTRY

IPSS: 1-11-026-16

Corresponding IS does not exist

0. FOREWORD

- 0.1 This Inter Plant standard, prepared by the Standards Committee on Safety Appliances and Procedures IPSS 1:11, with the active participation of experts from member steel plants and associated organizations in the field, was adopted in October, 2016.
- 0.2 This standard has been prepared to introduce a guideline for safe working in conveyor system during operation, maintenance and belt changing activities.

1. SCOPE

To provide a guideline for safe working in conveyor system during operation, maintenance and belt changing activities. This standard is useful in preventing Hazards like Injury due to entanglement of clothing, cleaning devices, body parts etc with running parts of conveyor system, falling of material from height, Falling from height, snapping of belts.

2. Procedure

2.1 General

- i Before starting any activity in a conveyor belt, the worker must be aware of '**six direction hazards**' in the working area. 'The six directional hazard form' should be properly filled and communicated among the working group/agency.
- ii In all the activities, the worker must wear the necessary PPE.
- iii There must be proper illumination at the working area/zone in the conveyor belt.
- iv All the necessary tools and tackles should be checked prior to use in the job.
- v During working at height, necessary protections should be taken as per the IPSS safety standard No. 1-11-005-14.
- vi During working in Gas hazardous area necessary protection should be taken as per the Gas safety standard.
- vii Follow all norms of permit to work system (use IPSS Standard for permit to work 1-11-007-14).

2.2 Definition

- i Belt sway: A belt is considered to be aligned properly, when under full load or in no load the edges of the running belt consistently remain within the width of the pulley faces and within the confines of other rolling components, such as idlers. If the running belt deviates from the above definition of aligned tracking, it is called as 'belt sway'.
- ii Spillage: The fall of material from the belt conveyor.
- iii Joint preparation: Making of new joint in a belt conveyor.
- iv Joint repairing: Repairing of a damaged joint.
- v Pulley lagging: Mounting/fixing of layer of ceramic or rubber material on the face of a pulley.

2.3 Safety Precautions during *maintenance* work in a conveyor belt

2.3.1 Conveyor drive

- i Stop the conveyor belt, when it is empty. Never stop the belt in load.
- ii Ensure permit to work system is followed before starting of work (use IPSS Standard for permit to work 1-11-007-14)
- iii Before changing/replacing of any component of the drive (coupling, gearbox or motor), do the positive isolation of potential energy source (take-up unit) of the belt by holding it with a pair of suitable chain blocks. Select the chain blocks from table1. To hold take up, lift it by 6-8 inches to take GTU (Gravity take-up Unit) load by chain blocks. It is also desirable (although not a must) to place the 'I' beam/channel at correct position under the gravity take up. Internal inspection of gearbox components should be done through the provided inspection cover only and its top cover should not be opened at site.
- iv The oil level in fluid coupling should be maintained as per mentioned quantity in its manual. The slip in fluid coupling should be less than 3%.
- v In the pin-bush and gear couplings, the minimum gap between the flanges should be maintained as per the recommended value according to their size as per OEM.
- vi All the moving/rotating components of the drive should be covered by standard safety guards.

2.3.2 Counter weight

Follow steps 1, 2 and 3 of section 2.3.1.

- i Spillage material accumulated on counter weight should be removed on

- regular interval.
- ii A counterweight and its pulleys suspended above the floor or ground, in an area where an employee could walk, shall have an enclosure around the area of impact or a catch pan under the counterweight of such strength and design to hold the counterweight and pulley from dropping to the ground, floor or platform.
- iii The concrete slab type counter weight should be replaced by box type closed counter weight.
- iv The rope of the counter weight should be checked on regular interval for its strands condition and bulldog grip looseness.
- v When, two wire ropes hang the counter weight, the wire ropes should be of opposite lay. This will avoid twisting of counter weight about its vertical axis.
- vi There should be proper gap (minimum 2 mm) clearance between the 'L' Shaped guide clamp and the guideposts of the counter weight.
- vii The weight of the GTU should not be increased/decreased without consulting the designer/expert of the conveyor belt.
- viii There should be minimum 2.5 m to 3.0 m clearance between the counter weight and ground.

2.3.3 Chute (Receiving or discharge chutes)

Follow steps 1, 2 and 3 of section 2.3.1

- i Before starting any job in receiving chute, power of the preceding belt or feeding device must be isolated. Similarly, before starting any job in the discharge chute, power of the succeeding belt must be isolated. In addition the chute must be checked for loosely held material inside and cleaned before entering.
- ii The side skirt rubber should not be kept in contact with the belt. This may create longitudinal groove on belt top cover and increase friction also.
- iii The inside space between side skirt boards (left and right sides) should be two third of belt width.
- iv Never use metal plate or piece of belt as a side skirts it may damage the belt.
- v An inspection cover/window should be given in chute at the non impact-wall. The inspection window can be used for dislodging the jammed material on impact walls or inspection of inside condition of chute.
- vi To protect the mother plate of a chute, the hard faced liner or wear resistant liner plate should be fixed at the impact zone of chute walls.
- vii Before executing the welding or gas cutting job in chute, the belt below the chute must be covered by a fire resistant cloth. For welding or gas cutting work follow the safety standard of IPSS No. 1-11-020-15.
- viii There must be proper clearance between the pulley (discharge pulley or tail pulley) end face and the inside wall of the chute.
- ix If the dust content in the material handled is high, a dry fog or Dust Extraction system should be installed at the receiving chute.

2.3.4 Belt joint (Vulcanized or mechanical)

Before starting the repairing or preparing of belt joint follow steps 1, 2 and 3 of section 2.3.1.

- i Fix the jam angle with deck plate/stringer at a sufficient free length (3 m to 5 m from the joint), towards head end of the conveyor belt.
- ii To pull the loose belt, it should be clamped with a pair of angles (also called as pulling angles) at a distance of 3 to 5 m from the joint & towards tail end.
- iii Pull the belt from the pulling angles with the help of suitable chain blocks & slings.
- iv Clamp the belt with a pair of jam angles and hold it with deck plate/stringer. This should be at a suitable distance from the pulling angles & towards tail end of the conveyor belt. Before applying the adhesive the joint surface must be cleaned thoroughly and the surface should be made free from moisture.
- v In case of mechanical joints of belt, proper selection of fastener and bolt tightening should be done.
- vi If there is pocket formation at joint or the edge of the joint is found uprooted, it should be repaired immediately.

Precautions: In case of short length belt where tilting of belt is not possible, exact length of belt to be spliced to avoid the dressing.

2.3.5 Pulley

- i. Pulley should be checked for its lagging condition (if lagging is present), axial shift and its bearing condition on regular intervals.
- ii. Weld-joint condition of the disc with hub and shell of the pulley should be checked at every six months.
- iii. Before starting the repairing or checking inspection work, where pulley is required to touch, the steps explained in section 2.3.1 must be followed.
- iv. Entrapment of material between tail pulley and return-side belt should be avoided by fixing an inclined plow/scrapper on the belt at return-side.
- v. If the bearing temperature of the pulley is found above 70 °C, the grease quality, quantity and radial clearance of bearing should be checked. Always close the greasing points after completion of greasing.
- vi. The tail pulley of a conveyor belt should be guarded as per IPSS 1-11-025-15 .
- vii. Ceramic lagging on bend pulley should be avoided as it increases the friction and overall tension in the belt. If lagging is required, preferences to rubber lagging should be given.

2.3.6 Idlers

-
- i. The jammed or damaged idlers should be replaced immediately, as they have high potential of damaging the belt (specially the belt joint).
 - ii. The space between two idlers should be maintained as per standards, based on belt width and bulk density of material. For example, for a belt of width 1200 mm and carrying material of bulk density 1.2 t/m³ the distance between two troughing idlers should be 1.0 m and that for return flat idlers should be 3.0 m. Distance between two idlers below the chute to be 0.5 m to avoid belt sag which should not be more than 2%.
 - iii. The minimum distance between two troughing-trainer idler should be 15 m and that for return trainer should be 30 m.
 - iv. For better control on belt sway, the 'tru-trac'/ self aligning idlers can be used, such as, In return side, fix the idler (i) at 4.0 m away from the tail pulley. (ii) At about 2.0 m towards head end from the bend pulley of GTU and (iii) In return side, at 4.0 m away from the head pulley.

2.3.7 Deck plate

- i. Deck plate must be given below the troughing belt. It protects the entrapment of spillage material between the rotating pulleys and the belt.
- ii. The locations where the conveyor gallery is passing over the road or working area, the deck plate below the return belt must be provided.
- iii. For repairing or fixing of a deck plate, the safety standard on welding and gas cutting should be used.

2.3.8 Belt safety switches (Zero Speed Switch, belt sway switch, pull cord switch)

- i. The ZSS switch should be cleaned thoroughly on a regular interval.
- ii. The length of lever of 'belt sway switch' should be in the range of belt during belt sway. The 'pull cord switch' with LED indicator should be used and distance between two pull cord switch to be maximum 30 mtr. If length of the belt is less than 30 mtr, it should be 15 mtr..
- iii. Before repairing or changing of belt safety switches, the step 1 and 2 of section 2.3.1 should be followed.

2.4 Safety Precautions during *operation* work in a conveyor belt

2.4.1 Belt sway (Belt Tracking)

- i. Avoid working near the conveyor with wearing loose clothing or jewelry. Do not put your hands on a moving conveyor belt.
- ii. Provide proper illumination at the working zone (Minimum 60 LUS).
- iii. Ensure the '**OK**' condition of pull cord and emergency stop switch of the conveyor belt by schedule inspection.
- iv. Keep one skilled person with 'walky-talky'/ Appropriate Communication system near the pull cord/ emergency switch.
- v. Communicate with control room before aligning/tracking the running belt.

- vi. Move the trainer idler by pushing/pulling its frame from the ends only.
- vii. Do not try to move any damaged/jammed trainer idler.

2.4.2 Spillage recovery/cleaning

Follow step 1 and 2 of section 2.3.1.

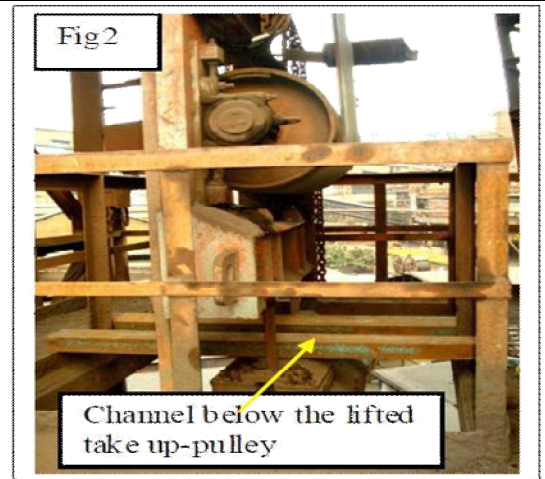
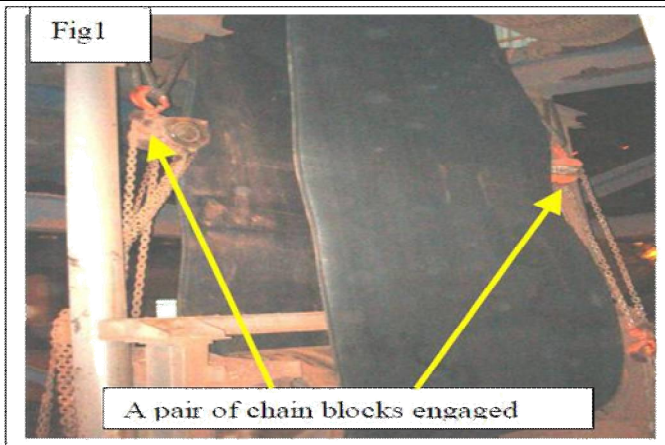
- i. Do not stand /walk on the belt.
- ii. The spillage material accumulated below the return side-belt or on the deck plate should be cleaned by hand scrappers only.
- iii. The spillage material should be collected in bucket and it should not throw down from conveyor gallery.
- iv. Throw the collected spillage material on belt, only from those positions, where the safety guards are provided on belts.
- v. Never heap up the spillage material at the tail end of the conveyor.
- vi. If the spillage material is in large amount (more than one ton), the conveyor should be taken in local operation mode. Start the belt in empty condition. Keep one person at pull cord. Communicate with control room and start throwing the collected spillage material by bucket on the running belt from the safety guard positions only or station made for this purpose.

2.4.3 Start/stop of belt

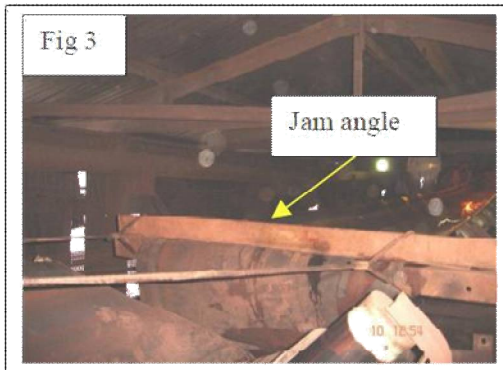
- i. Ensure proper warning/ Alarm system before starting of any conveyor with minimum 30 second delay.
- ii. If a conveyor belt needs stopping, it should never be stopped in load condition, except emergency.

2.5 Belt Changing job

- 2.5.1** New belt roll should be put on a fabricated & heavy stand and roll shaft to be locked from top on supporting points. The stand should be sufficiently heavy and stable to avoid tilting of stand while the belt is being changed.
- 2.5.2** Belt changing area should be barricaded by safety ribbon and a safety observer should be deployed throughout the job. (Follow barricading safety standard No. IPSS 1-11-022-14) .
- 2.5.3** Follow steps 1, 2 and 3 of section 2.3.1.
- 2.5.4** Belt conveyor should be put under local mode, if running of motor required for belt changing activity.
- 2.5.5** Before starting any activity in conveyor belt, do the positive isolation of potential energy source (take-up unit) of the belt by holding it with suitable chain blocks. Lift the Take-up by 6-8 inches (*Refer Fig 1*).
- 2.5.6** Take-up must be lifted and held with two numbers of suitable and tested chain blocks. Selection of chain block to be done as per the table 1.
- 2.5.7** It is also desirable to place the 'I' beam/channel at correct position under the gravity take up, to avoid the free fall of take up. (*Refer Fig2*).



2.5.8 Before cutting of old belt, it should be clamped properly with conveyor deck plate by 2 nos. of jam angles (refer Table 2) on both side of the cutting position. (Refer Fig 4).

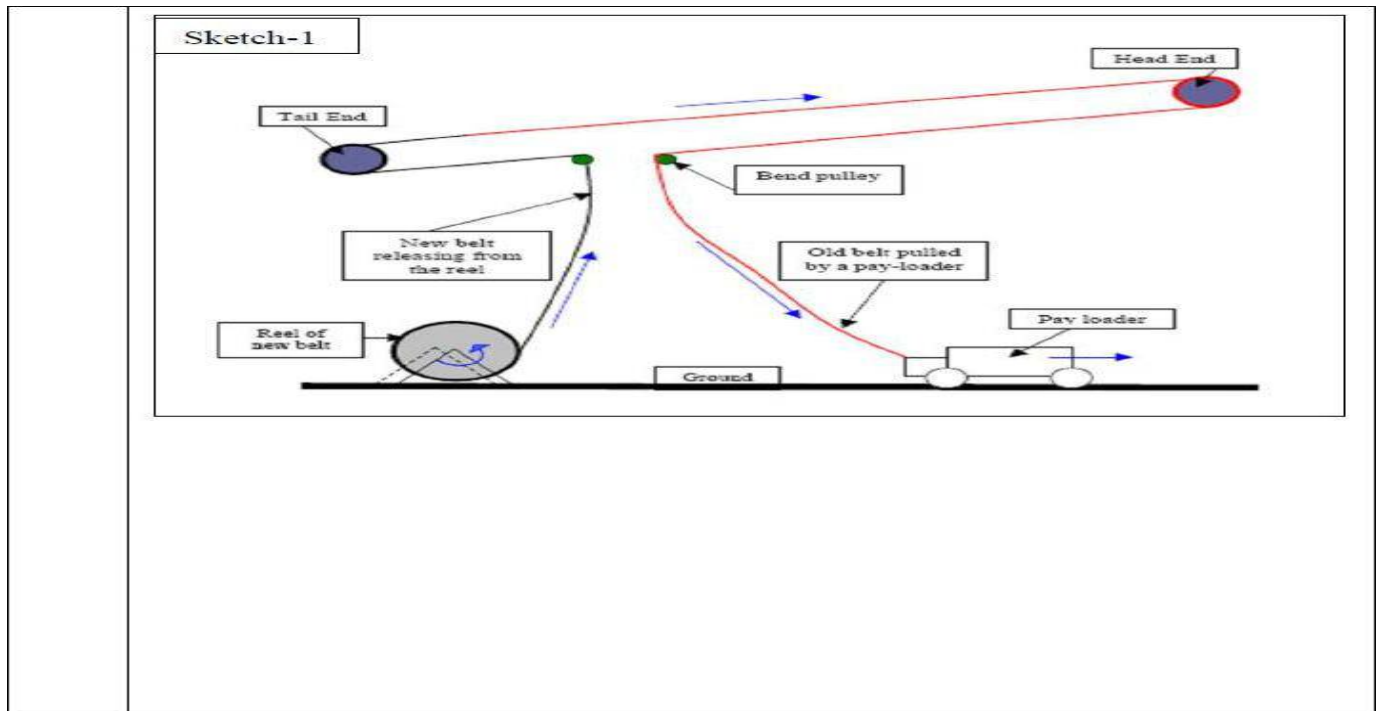


- 2.5.9** To avoid slip or damage of conveyor belt, a rubber piece should be inserted in between the jam angle & conveyor belt.
- 2.5.10** One end of new belt should be joined with old belt by plate-fasteners. During jointing, no of fasteners should be as per the given table 3.
- 2.5.11** The other end of old belt, which is supposed to be pulled out, should be clamped with holding T-shape plates. (Refer Fig 5).
- 2.5.12** Positioning the belt at a suitable place for joining the belt and stop the conveyor belt.
- 2.5.13** Do the positive isolation of all the electrical power sources of conveyor system (including preceding and succeeding conveyors)



- 2.5.14** Holding plate with D-shackle should be tied with sling and hook to the pulling device.
- 2.5.15** Release the jam angles and pull the old belt manually or by some external pulling

device (Like winch or pay loader). The new belt to be pulled from reel by inching drive with local switch. (Refer Sketch-1).



- 2.5.16** The speed of pulling device should be very slow max. 15 meter/min.
- 2.5.17** If belt is longer (more than 250M and at height), three persons should co-ordinate through Walky Talky. One with local switch operator, second with the pulling device and the third along with joint movement.
- 2.5.18** If belt gallery is at more than 15 m height from ground, when about 5 to 8 m of new belt remains in the wooden reel, pulling of belt to be stopped.
- 2.5.19** Belt to be held in gallery at any point to avoid any movement in the belt.
- i Open/un-wrap the new belt from reel and hold the free end of the new belt with 'T' shape plates & wire rope. (Refer Fig 5 & sketch-1). The rope length should be more than the height of gallery from ground.
 - ii Wrap the rope with a fixed and robust structure.
 - iii Holding of the belt in gallery to be released. Now pulling the belt and releasing rope to be done simultaneously.
- 2.5.20** The old belt should be pulled slowly and after complete replacement of old belt, both ends of new belt to be joined with plate fasteners (Refer Fig 6) and the joint to be positioned in required place for vulcanizing by using belt drive.



- 2.5.21** After all these activities performed & complete belt changing, power cut off clearance to be taken and positive isolation locking to be done properly.
- 2.5.22** If there is excess new belt before cutting, it should be hold with rope and other end of rope should be fixed / anchored with robust structure at upper level. (Refer Fig7)
- 2.5.23** After vulcanizing, idlers to be set in their position release the take-up and put tension on the belt.
- 2.5.24** Once again inspection to be done to see "Is any jam angle left intact with belt? ". If not, Job completion clearance to be given.
- 2.5.25** Ensure provision of suitable Power Outlet at suitable location for facilitating connection to hand lamp, Grinders, heaters etc.
- 2.5.26** Ensure suitable fire fighting arrangements like fire extinguishers, Fire Hydrants, Sprinklers etc.

Fig7



Table1: Table for selection of Chain block

Belt width (mm)	Belt length (m)	Chain Block size (Ton)
Up to 800	Up to 600	2T + 2T
1000	Up to 300	2T + 2T
	Above 300 - up to 600	3T + 3T
	Above 600- up to 1300	5T + 5T
1200-1600	Up to 300	2T + 2T
	Above 300 - up to 500	3T + 3T
	Above 500- up to 800	5T + 5T

--	--	--	--	--

Table 2: Table for selection of Jam Angle

Length of angle	Cross section of angle	Remarks
1.5 X Belt width (mm)	90 x 90 x 8 (mm)	1. <u>Fasteners:</u> Size-M20 grade 8.8, Quantity: 2+2 2. To avoid slip or damage of conveyor belt, at the point where jam angle has to be fixed, a rubber piece should be inserted in between the jam angle & conveyor belt.

Table3: Table for selection of belt-fastener

Belt width (mm)	Minimum No. of fasteners	Distance between two clip-fasteners
800	10	Approx - 75mm
1000	12	Approx - 75mm
1200	16	Approx - 75mm
1400	20	Approx - 75mm