Tracking and tensioning

Introduction

There are many opinions about tensioning and tracking of conveyor belting. Ammeraal Beltech has gained much experience with this phenomenon. With regard to tensioning of conveyor belting in combination with tracking, an extensive knowledge is available. This module gives directions to prevent the negative influences caused by mistracking of conveyor belting in practice.

Why prevent mistracking

The causes of mistracking are:
- » maintenance headaches;
- » downtime;
- » belt damage;
- » damage of equipment (over tensioning);
- » product damage.

Maintenance headaches

The round the clock economy is asking for an extension of the operating hours of production plants. This may result in maintenance problems caused by mistracking of the belt at any time during the day or night. In general the technical service can be called to solve these problems, but this is expensive and unpleasant.

Downtime

Most of the companies work according to a production plan. In case of downtime there is no production and the company is facing lack of earnings. Downtime has to be prevented at all times.

Belt damage

In general process and conveyor belting are valuable parts of the conveyor. Mistracking of the belt is usually resulting in considerable belt damage. This damage can usually not be repaired. It results in high and unexpected exploitation costs of the equipment. Correct tensioning and tracking of belting can prevent this.

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Equipment damage

When mounting the belt with too much belt tension usually much damage is caused to the installation. An installation is designed for the application. A belt tension higher than calculated will cause bending of the drums and shafts. Also the load on the bearings will increase. This always results in a shorter service life and possible unexpected costs.

Product damage

Product damage has to be prevented at all times. In case of food production it is intolerable that non-food substances end up in the food product. A belt running against machine parts because of mistracking results in fraying edges. These particles will eventually contaminate the product. This can be prevented by proper belt tensioning and tracking.

Causes of mistracking

Belt

When the belt:

» does not have an even length on the left and right sides;
» has differences in thickness on the left and right sides;
» shows different wear on the left and right sides;
» is not spliced straight;
» is curved or deformed;

this results in a difference in surface pressure and/or friction on the pulley drive.

Other causes can be:

» An incorrect belt tension. When the tension is too low, the belt will go in every direction. When the tension is too high, there is no correction possible because the belt cannot slip sideways on the pulleys.
» An incorrect fabric construction (not twisted SZ).
» Fabric not in the correct position (angle) in the belt (oblique weft).

Pulleys

Causes can be that the pulleys are not parallel to each other and squarely on the belt. Or the pulleys are not horizontal. Another reason is a difference in coefficient of friction over the pulley length (wrong shape, pollution, wear) or there is a difference in diameter on one side towards the other.

Note: Belt width and pulley length must gear.

Product

Possible causes are an asymmetric load, incline/decline, loading/unloading on one side, or temperature differences in combination with the loading system.

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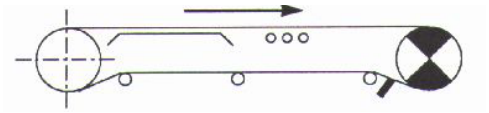
Frame
The frame might not be stable.



Belt support
The slider bed is perhaps not horizontal or there is a difference in surface smoothness. Rollers may be mounted in a tilted position or out of the perpendicular. Diameter differences can cause problems as well as pollution.

Various causes
There can be more reasons for mistracking, like a belt cleaner, side skirts, knife edge transfers or weather influences (wind).

Explanation of mistracking

Rule: A belt reaching a drum/pulley will get a deflection from the first contact between belt and drum/pulley. As a consequence the belt is running to the direction where it is touching the turning drum or pulley.

Cylindrical pulleys

When a pulley is not placed square to the belt, it will result in the situation as shown in fig. 1. The belt will move to the left as a nut does over a threaded pin, with a speed of Π D tg θ.
In the most extreme case the belt will fold on the drum.
» The belt will run to the side with the lowest tension.
» The belt runs in the direction of the perpendicular line to the contact line.
» The belt runs in the direction where it touches the turning drum or pulley first.

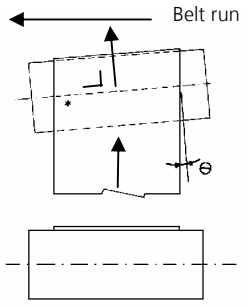


Fig. 1

Conical pulleys

Fig. 2 shows that the belt moves to the right on condition that the shafts of the pulleys are parallel to each other. The belt will run to the side with the highest tension.
» As a result of speed and tension difference the belt will show a horizontal bending just before it touches the drum.
Therefore the belt will touch the drum somewhat higher (in direction of biggest conical diameter).

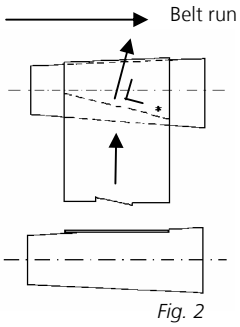


Fig. 2

Tracking and tensioning

Support rollers (tracking rollers)

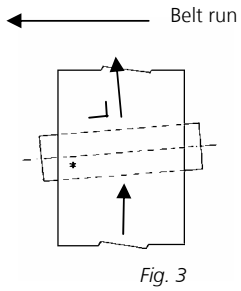


Fig. 3

The belt will run in the direction of the perpendicular line on the contact line (fig. 3).

Rule: A belt, running against a pulley or roller, will get a side deviation of the first contact spot * between belt and pulley/roller.

Fixed sliding strips or scrapers

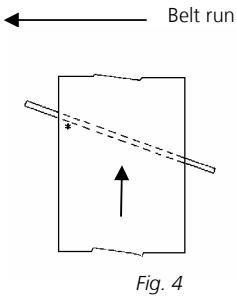


Fig. 4

A belt running on a non-moving support will, contrary to roller support, deviate in the direction of the last contact spot between belt and support.
In practice the support of fixed strips consists of:

» slider bed, beginning of the bed must be square on the belt;
» sliding strips;
» scrapers.

The same phenomenon occurs in case the support rollers do not turn or turn with difficulty.

Tensioning of the belt

The belt tension has a direct relation with the tracking behaviour. Too much tension results in very 'nervous' belt behaviour and excessive wear of machinery components like bearings and shafts. Too much tension can even result in a breaking of the shafts. Too little tension gives belt slippage on the drive drum and results in not following the crowning.

Before mounting the belt on the installation it is advisable to leave the belt for twelve hours in the room where the belt is going to be used.
When the old belt is removed, the installation can be cleaned. Then the belt can be mounted; if necessary it can be made endless on site.
The installation has to be provided with a tensioning device; in most cases this is the tail drum. The tensioning length of the installation is 1% of the belt length.

The belt has to be tensioned after mounting. The best way to do this is to mark two lines (with a pitch of 1000 mm) at both belt sides with a red pen. Then tension the belt left and right equally up to 1003 mm = 0.3% pretension. In case of heavier load over 50 kg/m^2 the belt tension can be increased to 0.5%.

In case of an installation with a knife edge this procedure is not applicable. In this case tension the belt on a running installation to the extent that slippage does not exist anymore.

Tracking and tensioning

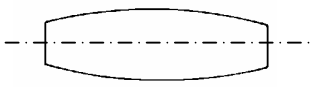
Methods to correct mistracking

Fixed tracking possibilities or adjustable by hand:

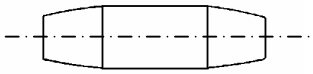
» Crowning of the pulleys.
» Tracking rollers: flat tracking roller, snub pulley, adjusting trough assembly, V-rollers/strips.
» Fixed provisions on the conveyor: side rollers, side guides.
» Fixed provision on the belt.
» Tracking ropes, tracking strips, guide rollers.
» Variable tracking: with use of the belt, tracking devices with own drive.

Crowning of the pulleys

Emergency solution or test



Convex pulley: ideal Shape, difficult to make



Cylindrical pulley with conical sides: imitation of the convex model

Apply non slip tape on a cylindrical pulley

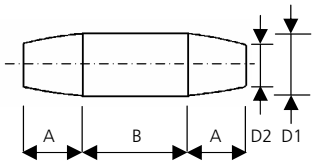
Dimension

Diameter difference = 1% but maximum 4 mm

$$\frac{D1}{D2} = \frac{101}{100}$$

D1 = largest diameter
D2 = smallest diameter

Length partition



NB: pulley length = belt width + 50 mm

Pulley length mm

(drive pulley dia. 80-300 mm)

		A	B	A
up to	400	1/3	1/3	1/3
400 -	800	1/4	2/4	1/4
800 -	1200	1/5	3/5	1/5
1200 -	1600	1/6	4/6	1/6
over	1600	300	…	300

Which pulleys to be crowned:

1. Drive drum.
2. Drive drums and tail drums when the conveyor is longer than 4 x the belt width.

Recommendations:

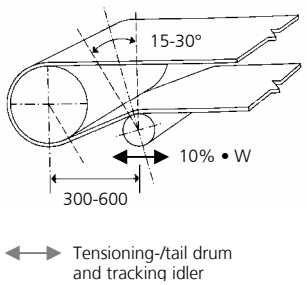
» In principle the pulleys and rollers must be adjustable (e.g. bolt ∅ 10 in hole ∅ 12).
» Pulleys preferably not at the butt end.
» For high belt speeds (v = 2 m/s) balance the pulleys.
» Never crown the knife edges or set them out of square.

Tracking and tensioning

Tracking rollers

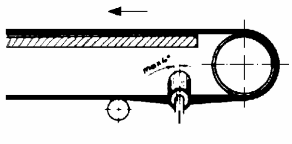
Flat (snub) tracking rollers

Mount the tracking rollers in a spot with low belt tension (usually before the return pulley). The arc of contact must be between 15° and 30°. Below 15° the contact between belt and pulley is too short, over 30° you will add tension which again will cause mistracking. There must be sufficient friction between tracking roller and belt (e.g. non-slip lagging). When the belt is heavily polluted, mounting on the inside of the belt is possible.



Adjusting snub/stow pulleys

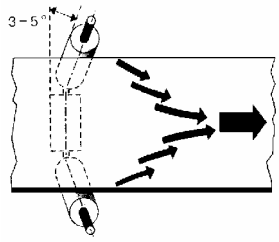
The principle is the same as the adjusting trough assembly that is mounted upside down. Mount in return part on both belt edges, under some belt tension and far from end drums (6° toe-in, 15° downwards to lateral horizontal line). When mistracking belt must run-up higher to the roll in order to face more resistant.



Adjusting trough assemblies

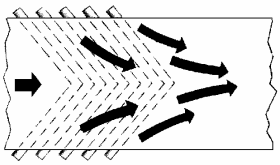
In practice one on each five trough assemblies is an adjusting one.

Note:*Think of the proper mounting, because adjusting trough assemblies are for one running direction. The rollers have to be mounted toe-in (see sketch).*



V-strips (flat belt)

This Chevron-shaped profile is pushing the belt to the center and can only be used in case of heavy belts (over 3 kg/m^2). By the thrust light belts might fold.



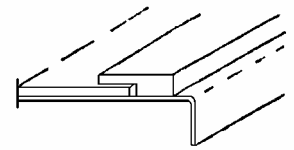
Side rollers

These are only suitable for heavy, thick belting of 10 mm thickness. They are meant for temporary mistracking, and not a continuous solution.

Note*: Support rollers and trough assemblies can also be slightly adjusted.*

Fixed provisions on the conveyor

The side guide is only suitable for correcting temporary mis-tracking and for lateral stable belts; not for very thin belts. It is no continuous solution. The material of the side guide is e.g. beech wood or nylon.



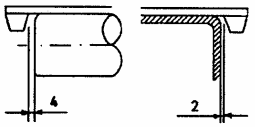
Note: *The guide must be bevelled at the side where the belt is going in. Do not mount the guide close to the exit side of a return drum.*

Tracking and tensioning

Fixed provisions on the belt

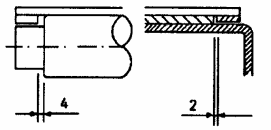
Ropes

V-guides and guide ropes (square and rectangular) can be applied on the centre line of the belt or at the sides of the belt. The guide tracks on the frame and not on the pulley. The pulley diameter for V-guides is 6 x the height of the guide, for square and rectangular ropes 10 x the height.



Strips

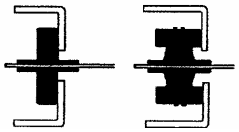
Guide strips are usually applied on the sides of the belt, the strip tracks on the frame and not on the pulley. A one-ply strip needs a pulley diameter of 1.2 x the minimum pulley diameter of the belt and a two-ply strip 1.4 x. When Amtel strips are used, the pulley diameter must be 10 x the strip thickness.



Note: *V-guides, ropes and strips have a free space towards the pulley on the bottom side. Only the belt is driven. If not, the guide will tear off the belt because of the differences in circumference speed.*

Rollers/cams

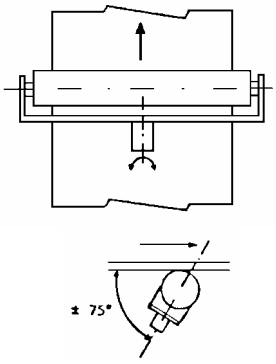
Guide rollers/cams are applied in cases of long lasting lateral forces and high demands on running straight.



Variable tracking

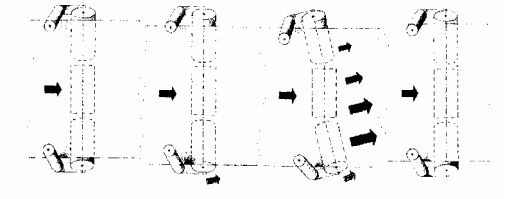
Tracking with use of the belt

A flat tracking roller is mounted on the bottomside of the belt, in the upper part in front of loading points, approx. 2000 mm before the return pulley.
Principle: when the belt goes to the right side, the tracking roller will at the right side turn in the running direction of the belt. As a result of this, the belt will be guided back to the centre. This is influenced by belt weight, product weight and friction between belt and roller.

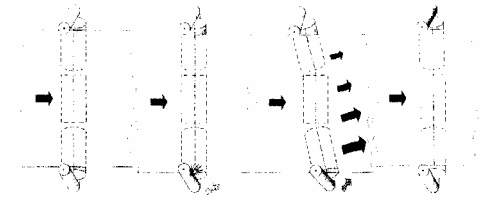


Tracking trough assemblies are used for belting with one or two running directions. The assemblies are automatically adjusting.

Belt with one running direction



Belt with two running directions



Tracking and tensioning

Tracking devices with own drive

Because of the large scale of possibilities in tracking equipment, we limit ourselves to a number of distinguishing characteristics:

» Drive: pneumatic, pneumatic/hydraulic, electric.

» Amount of tracking: minimum/maximum, proportional.

» Manner of tracking: by friction (see tracking roller), by clamping the belt (Foxwell), by influencing the belt tension.

» Manner of signalising: by direct belt contact (pneumatic tracer, micro switch), without contact (ultra sonar, photocell, pneumatic, approximation switch).

Conveyor belt problems and cures		
Stretch and slippage	Belt:	stretches excessively slips and squeals
Tracking	Belt:	creeps partly to one side creeps to one side creeps at one spot only creeps to one side at head pulley creeps to one side at tail pulley wanders irregularly
Splice and fastener	Belt fasteners pulling out Splice failure	
The belt	Ply separation Excessive top side wear Excessive pulley side wear Excessive edges wear Cover softening and cracking	

	Cause	Cure
Stretch and slippage		
	Belt stretches excessively	
	Tension on belt too high	Reduce tension to a point where belt will run without slippage; lag drive pulley
	Conveyor under-belted	Replace with heavier or wider belt
	Material build-up on pulleys / rollers	Clean pulleys / rollers
	Frozen rollers	Remove icing on the rollers to increase friction between belt and drum
	Excessive positive take-up force	Provide self-compensating take-up (spring loaded or counter-weight)
	Belt slips and squeals	
	Belt too loose → insufficient traction between belt and pulley	Lag drive pulley; increase tension slightly
	Conveyor under-belted	Replace with heavier or wider belt

Tracking and tensioning

Tracking	
Belt creeps partly to one side	
Belt splice crooked	Re-splice
Belt ends at fasteners not slit square; fasteners not joined squarely	Use a T-square for slitting perfectly square; replace with correct size fasteners
Belt slips creeps to one side	
Improper belt load	Load in direction of belt run, at belt speed, centred on belt
Frozen rollers; rollers not properly located (oblique)	Lubricate rollers, improve maintenance; relocate improperly placed rollers and check alignment with a T-square
Frame or structure crooked or not level belt shifts to low side	Check alignment by stretching a string along frame edge, make correction; level structure
Material build-up on pulleys / rollers	Clean and improve maintenance by mounting scrapers or other cleaning device
Pulleys / rollers out of line / oblique	Re-check and square with a T-square against conveyor edge
Belt creeps at one spot only	
Roller(s) - usually in front of troublespot - out of line (not perpendicular with centre line) Also see 4.2, 4.3 and 4.4	Move (in direction of belt run) that roller end to which the belt has shifted
Belt creeps to one side at head pulley	
Head pulley or preceding rollers out of line (not perpendicular with centre line)	Realign the pulley/rollers perpendicular to belt centre line, or move (in direction of belt run) that pulley / roller end to which the belt has shifted
Belt creeps to one side at tail pulley	
Tail pulley or close return rollers are out of line / oblique (not perpendicular with centre line) Also see 4.2, 4.3 and 4.4	Realign the pulley perpendicular to belt centre line, or move (in direction of *return* belt run) that pulley / roller end to which the belt has shifted
Belt wanders irregularly	
Conveyor over-belted as belt is too stiff to properly run over applied pulley diameter	Replace with proper belt or use larger pulley diameter
Improper or off-centre loading can cause belt to wander	Correct loading procedure or use a belt with V-guide
Splice and fastener	
Belt fasteners pulling out	
Incorrect size fasteners applied	Re-lace with proper size fasteners
Excessive tension on belt	Reduce tension to a point where belt will run without slip; lag drive pulley
Pulleys too small for belt thickness	Use larger pulley diameter or a thinner belt if practical
Belt tension too high caused by slippage	Increase pulley diameters to reduce belt tension and the effect of stiffness of fastener or apply an endless spliced belt
Splice failure	
Belt speed / tension too high (due to speed difference top/bottom side of belt and inner heating up due to sharp bending over too small drums)	Increase pulley diameters to reduce speed difference and heating up

Tracking and tensioning

	Pulleys too small	Increase the pulley diameter
	Bending of splice in lateral direction	Remove the cause of bending or apply an other splice (e.g. T-splice)
	The belt	
	Ply separation	
	Edge of belt worn or broken due to excessive rubbing	Check alignment of frame, pulleys and rollers
	Pulley dia. too small for applied belt or excessive tension on belt	Increase pulley dia.; reduce tension (also see 1.3)
	Damage by abrasives, acid, heat, chemicals, mildew or oil	Select a properly resistant belt
	Too much pulley crowning	Check crowning recommendations
	Excessive top side wear	
	Material build-up on pulleys / rollers	Clean and improve supervision; install scrapers or other cleaning device
	Excessive impact of material on belt	Reduce impact or use cushion rollers at the impact points
	Dirty, frozen or mis-aligned return rollers	Improve maintenance and supervision; re-align rollers by using a T-square against conveyor edge and rollers
	Excessive pulley side wear	
	Belt slipping on drive pulley	Lag drive pulley; install snub roller for better wrap around drive pulley; slightly increase belt tension
	Material build-up on belt bottomside	Remove accumulation and install scrapers to keep the bottom side of the belt clean
	Frozen or dirty rollers	Lubricate rollers; improve maintenance
	Lagging safety screws protruding pulley lagging	Tighten screws and replace lagging
	Excessive edges wear	
	Belt edges are folding up on conveyor guards or frame	Use stiffer belt if practical; provide more lateral clearance; smoothen rough areas on guards or frame
	Side loading causes belt to shift to opposite side and to rub excessively	Improve by loading in direction of belt run; use a belt with V-guide
	Material build-up on pulleys will side track belt	Install scrapers to prevent; build-up will force the belt against the frame; apply a belt with V-rope
	Cover softening and cracking	
	Damage by abrasives, acids, heat, chemicals, mildew or oil	Use properly resistant belt
	Pulley diameter too small for belt thickness	Increase pulley diameter or use more flexible belt
	Excessive belt tension	Reduce tension; lag drive pulley or provide self-compensating take-up