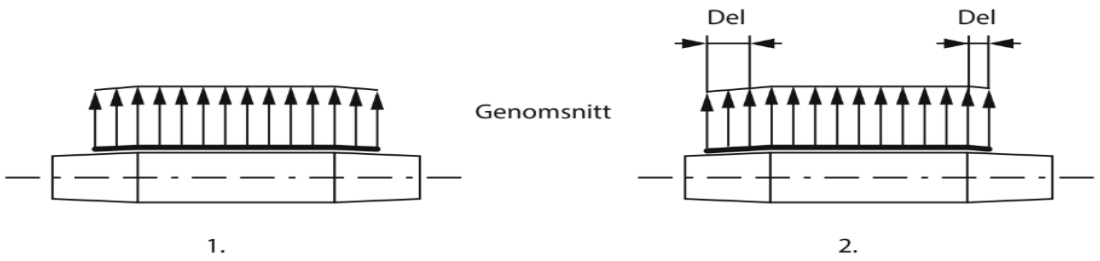
The art of conveyor belt tracking. Part 1.



Sketches above shows how a crowned pulley work. Left picture Equilibrium. Left and right pushes belt to centre position. Picture right. Left side has a stronger force to push belt until left and right have same distance to centre position of belt. This is fine for a pulley firmly mounted in a frame. Do NOT confuse yourself to believe this is the way to track a belt. Please study text below and understand. It can take some time to understand, because you have probably been fed with wrong information from too many track producers.

There is a major misunderstanding around the world how to make a conveyor belt run straight.

Belt tracking producers around the globe believe that conical or crowned rollers make the belt run straight. This is a very, very major misconception how belt tracking works.

Imagine a car tire. It has a flat surface, by changing the angle between tire and road the car moves sideways. If a crowned shape of the tire had been advantageous to the steering of a car, you can rest assured that car industry had developed crowned tires.

The only time you run with crowned tires is when air pressure is too high, resulting in wear of centre part of tire.

When a crowned belt tracker idle, it is still worn due to different peripheral speed. It cost energy and wear of belt all the time the crowned shaped tracker is installed. In other words, a crowned tracker cannot idle!!!

Tracking is the effect of moving the weight of belt sideways making the tracker swing and guide the belt back to straight line. That kind of tracker has a cylindrical surface and no wear or cost of energy. We have installations in iron ore mines with no measurable wear after 14 months of 7/24 service.

PrimeTracker also moves vertically to accommodate the vertical movement of belt when moving sideways. Thus, the full length/surface of the tracker is always in contact with belt and does the job to bring belt back to straight line. A tracker that do not allow vertical movement is only partly doing its job.

Prime-Tracker has solved the problems so many trackers suffer from. Curious?

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The art of belt tracking. Part 2.

Picture above. Artists view of *Prime-Tracker* ©.
Conveyor belt tracking boils down to two words:

A. Misalignment.
B. Misconception.

A. Misalignment of a belt installed in a conveyor can have many causes.

Belt Tracking Basics

The first step is to make sure that your conveyor is installed squarely and that the belt you are using has been cut and spliced correctly. If a conveyor has been installed out of square or the belt is not properly cut or spliced, tracking the belt will be a difficult or impossible task.

Next step to see to that all idlers are square to conveyor frame.
Normally belt shall now run centred.

There are more reasons for belt running sideways than my imagination can serve me. This is the time when a belt tracker will do the job.

B. Misconception. A belt tracker has the mission to bring belt back to straight line. This is simple and we all degree.

A tracker for return belt is one or more rolls mounted on a pivot enabling the roll to swing, often only in horizontal mood. This is fine, but many makers believe they need to add crowned or other high points on the tracker.

This is misconception and wrong doing! The tracker will have many different peripheral speeds. If the tracker is crowned, edges will run with peripheral speed activated by centre part and edges will be worn out. If tracker is in an idling position it should be running freely. This is not the case with different diameters and will act as brakes and will be in a sliding mood all the time. Consequently, tracker edges or high points are worn out, belt is worn and extra energy is consumed to make part of the tracker slide, **ALL THE TIME!**

My question is why make complicated trackers? The probable answer is that design engineers have looked at competitors and carried on. Not one single thought trying to understand why so many trackers are poor trackers with short life time, is to be seen in market place.

My believe is that engineers have looked at crowned pulleys and hoped it would work to bring tracker back after it has swung. This is a **Misconception!**

Situation is as follows. Belt runs with equal load on both sides of the pivot point. This is an equilibrium. Now belt travel sideways and tracker swing and steer belt back to equilibrium. When belt has reached the position of same load on both side of pivot the tracker is idling. This is the case with a cylindrical tracker. The load of the belt and moving sideways is all we need from a good behaving belt tracker.

One more quality is asked for to be the best tracker. It is the vertical movement. When belt moves sideways the belt tilt. Load of belt is now higher in area belt is moving to. The tracker must be in full contact with the belt along the length of the tracker to do the best tracking job. This is when tilting ability is so important. Load of belt is always distributed along full length of tracker. This is a mood not many trackers offer.

We at Versum in Sweden and Transroll in Czech Republic has done the thinking and brought *Prime-Tracker*© into the market. It is a cylindrical tracker with a rubber pivot that can´t be destroyed of intruding sand an impurity.

Prime-Tracker© does the job! Do you want more information, send us a mail.

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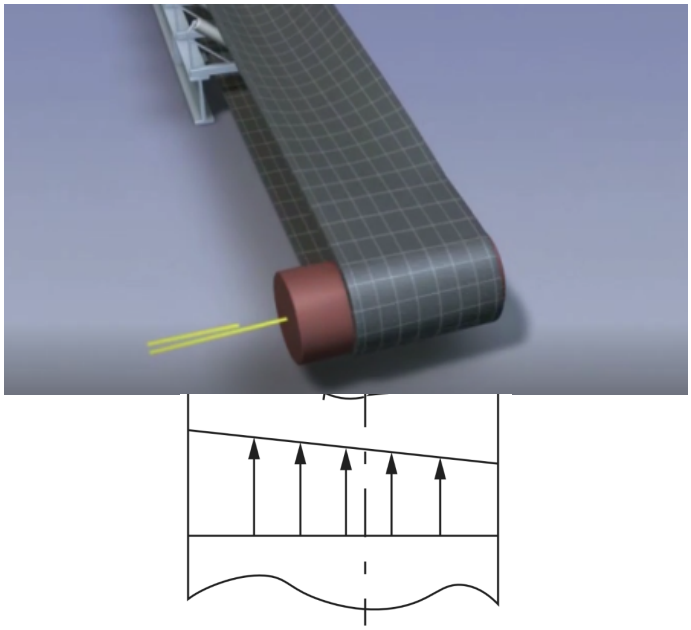
The art of conveyor belt tracking. Part 3



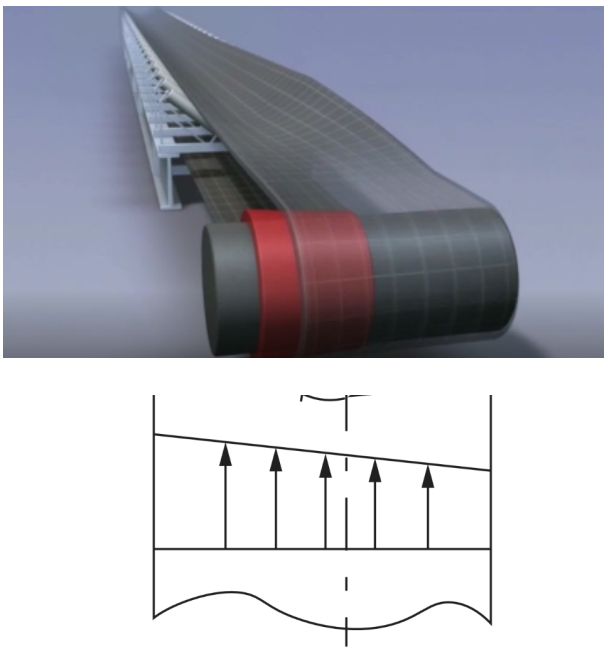
OBSERVE! The PrimeTracker sets the position of belt where it is located. Is pulley not square belt will misalign.

Compare the angle of wrap between pulley and tracker. Power of pulley is much higher than tracker due to minor belt wrap.

A drive- or return pulley not installed squarely pushes the belt to the side which has shortest distance to a line square to the longitudinal line of conveyor.

Forces acting on the belt are illustrated as arrows. Belt tension is higher on the left side and pushes belt to the right side to equalize.

Be aware that the belt is elongated when turning around pulley. An abrasion takes place and pulley will be concave. Pulley will eventually be cut in two. The pulley must be firmly mounted in the frame. Otherwise belt will move to and from. Wear down steel and create a concave surface that will make belt run unstable.



Same Phenomenon will occur when pulley has plack build up. A tracker will have problems in such case.

Tracker takes information from the area it is installed and steer the belt squarely. When belt is forced to misalign by pulley, the tracker has not the power to correct running mood. Side stiffness and angle of wrap between pulley and tracker decide running quality.

This is why pulleys must be installed squarely and free of build up plack.

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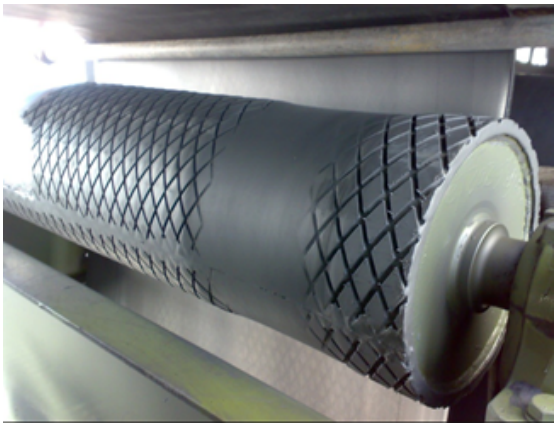
The Art of belt tracking. Part 4

PrimeTracker is a most sensitive and at the same time a powerful conveyor belt tracker.

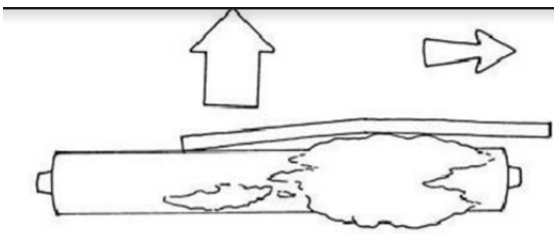
As belt moves horizontally and vertically the tracker is always in full contact with belt. The specially developed rubber pivot has no starting friction to overcome. It reacts immediately to any movement and belt is guided back to straight line.



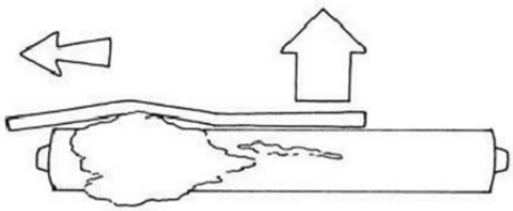
A pulley must be oriented square to longitudinal line in order to work to satisfaction. Sometimes tracker can move to and from with no known reason.

It is known that a crowned pulley makes the belt run centered. If pulley is concave there will be other "crowns" as picture to the left. There are two crowns and one concave part.

Belt will move to the highest point and tracker will bring belt back to straight line. This is repeated and is seen as tracker moving to and from.

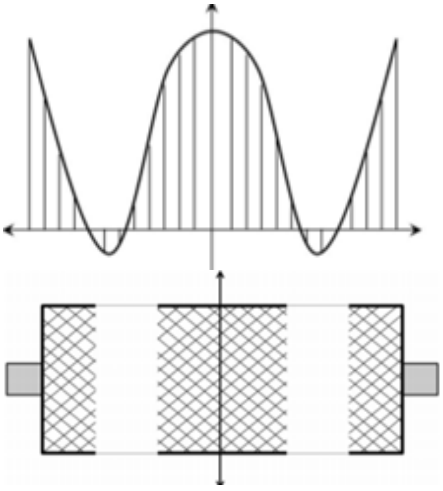


Plack build up on rolls and the same story as above. Remember the 180 degree wrap gives more power to pulley than 8 deg wrap to tracker.



Short distance between pulley and rolls can develop a belt bulb and high load on pulley. Picture to the right indicates tension in belt.

This is another pulley with three "crowns". Risk for belt searching the best crown. Tracker will have difficulties to guide the belt to a centered position.



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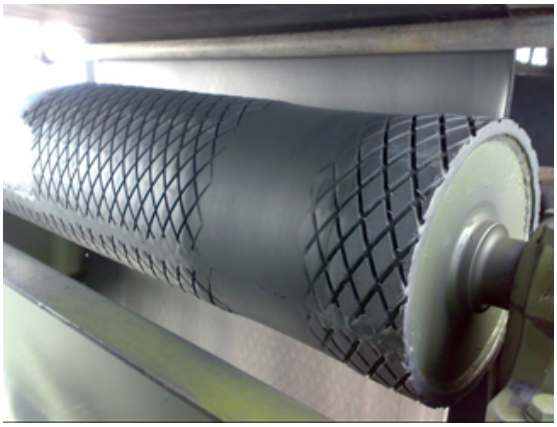

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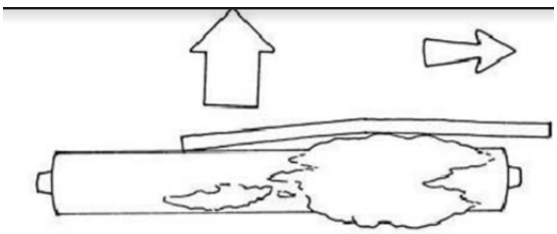

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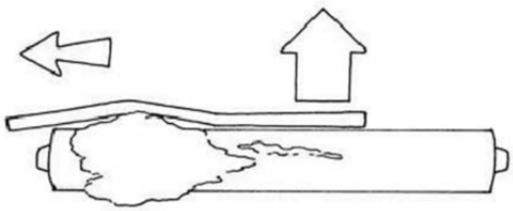

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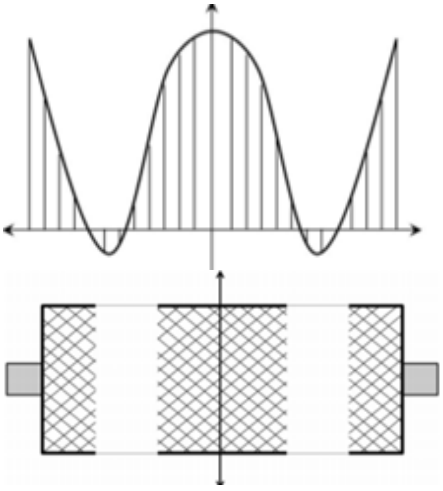

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The art of belt tracking. Part 5.

This is how Prime-Tracker work compared with other designs.

Over the last 5 years I have spent time and energy to understand why so many belt trackers do not work properly and tend to destroy themselves. The simple answer is that many trackers slide over the belt and cause abrasion instead of a rolling motion. Compare with a car. If the car moves straight ahead, tires rotate. No sliding no abrasion. Turn the wheel and the angle to road changes and car move in new direction. Still wheel rotates no sliding.

The object of my design work has been to create a belt tracker that steer the belt and let the tracker roll in an idling position.

It is a picture of a tracker with tapered ends installed on the top side of the return strand.
There is a major difference in diameter between central part and edges of the tracker. We all know that a smaller diameter has lower peripheral speed than a larger diameter on the same shaft.
The rotational speed is decided by the central part of the tracker. The speed is forced upon the edges. The edges brake and are worn away quicker than central part. It is like running a car with brakes partly working.
When belt start to misalign, the load will be higher on one edge and abrasion and sliding also higher.

Compare with V-belt transmission. You can change speed of rotation by choosing another diameter of your pulley.
Compare with the pulley below. You can choose any speed of V-belt depending on diameter of choice.

All sheaves on same shaft.
This is how a gearbox, variator or bicycle gear work.

A belt tracker with different diameters is a disgrace to the engineer who carried out the design.

In other words, the roll edges are forced to rotate faster than the contact with the belt require.

A belt tracker with two diameters try to rotate with 2 speeds at the same time.
This is not possible, and result is a position in between with sliding and abrasion of both tracker and belt.

The tracker is not idling.
The job of belt tracker is to bring belt back to the straight line.
In center position tracker must go idling until misalignment appear and then steer back to idling position.

Basic for belt tracking is that tracker must rotate freely, idling.
When misalignment appear, the tracker goes into action and steer the belt back.
A tracker with more than 1 diameter is doomed to fail.

Tracking takes place when weight of belt is higher on one side and tracker turn and steer belt back to straight line. This is the position when tracker is idling. No steering, no sliding no abrasion, just idling. That is what PrimeTracker does.

That´s why Prime-Tracker is cylindric and pivot point is a specially developed rubber bush with almost infinite life time.

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The art of conveyor belt tracking. No 7

Straight traveling conveyor belt is necessary to have good nights sleep.

Not always reached but with the help of PrimeTracker, you are on right track

Most difficult installation is often reversible short distance conveyor .

Belt runs straight in one direction but misalign in reverse direction. There are means to overcome problems that often result in severe damages on belt and conveyor.

Actions to be taken:

1. All rollers, roll stations, drive and return pulleys adjusted square to frame .
2. Install PrimeTracker. You can install tracker on top of return strand or below return strand.

Geometry of PrimeTracker is developed and calculated enabling tracker to guide belt from lowest speed to 5 m/s.

17 mm rubber thickness and absence of wear gives PrimeTracker longevity.

Compare with steering of a car. From start to full speed you are able to steer.

Some trackers need links and arms to conduct what tracker is installed to do. PrimeTracker is complete and well designed and need no links to track.

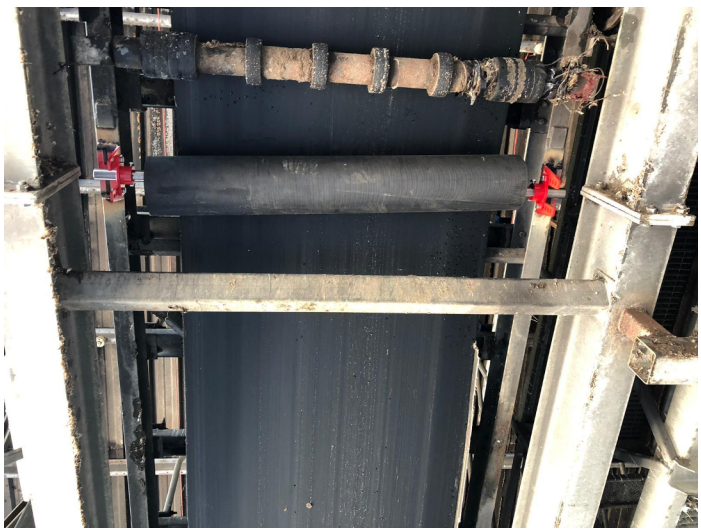
This is an installation of Prime-Tracker on top of the return strand carried out by Alex of Kronovulk Vulk & Montage in Sweden.

Belt width 1200 mm

CC = 15 m

Picture: Alex Kosanovic

After installation belt runs straight in both directions says Alex.



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Conveyor´s best friend

PrimeTracker

Art of conveyor belt tracking. Part 6.

PrimeTracker is a magic wand when installed at the right spot. If installation area is not properly chosen, tracker can be a pain in the neck. How can this be?

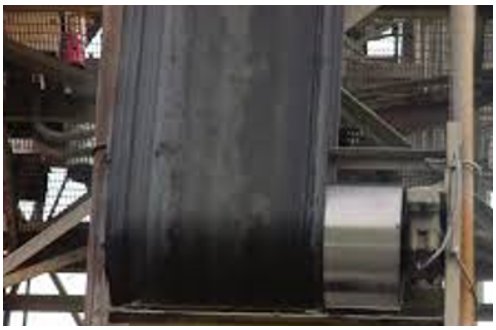
The most common installation is on return strand and before drive pulley. The tracker guide belt to run centered to pulley. Maintenance staff is often surprised that centered belt deviate when hitting pulley. Why does that happen?

Reasons can be: 1. Pulley not perpendicular to longitudinal line of belt. 2. Worn out pulley or 3. partly worn out lagging. Many more wrong doing is to be found out there.

Remember the wrap of pulley is often 180 deg or more. Tracker has only 8 deg wrap. This is why pulley must be installed perpendicular with a nice and even lagging.

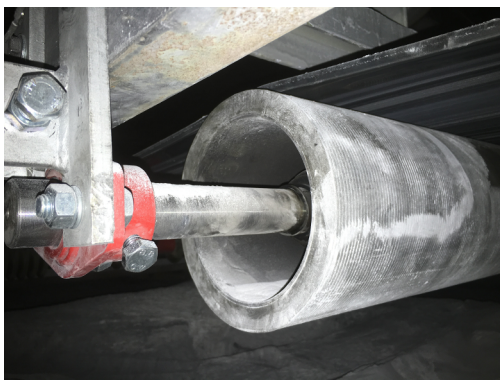
Top picture: The right side of belt will soon be worn out and end up as picture second from top.

Remember that PrimeTracker can be installed along conveyor at 20-25 m distance to keep belt centered. Rain, wind, snow and wrongly installed rollers make the best to bring belt deviate. This is where PrimeTracker is at home. Watch out for no more working rollers. Tracker will immediately compensate. Picture to the right. Belt will cut beams and support, can be saved by PrimeTracker.



Below

Correctly installed PrimeTracker



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The art of conveyor belt tracking. Part 8.

This is an article written by Bertil Wahren. Purpose is to inform technicians, whose daily work is to maintain conveyors and belts. You can read and understand what kind of maintenance required to make belts go straight and not misalign.

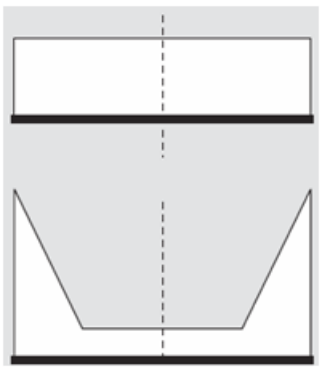
Everybody working with conveyors and belts are aware that belts do not always run straight and do deviate from straight line. We often do not understand why and how to eliminate deviation of belt.

First condition is to see if there is enough friction between driving pulley and belt. Necessary friction is dependent on lagging, and radial force.

Transition distances are frequently major concern. Distances are often too short.

Similar problems occur along conveyor when conveyor run from horizontal to climbing mode or descending.

Phenomenon appear when conveyor has a convex or concave flow. We call it a"knee"



Top picture force distribution in flat belt

Below.

Force distribution of through section

In a conveyor, function depends on friction between drive pulley and belt. Necessary friction is present when coefficient of friction is available.

Equation W= f x K

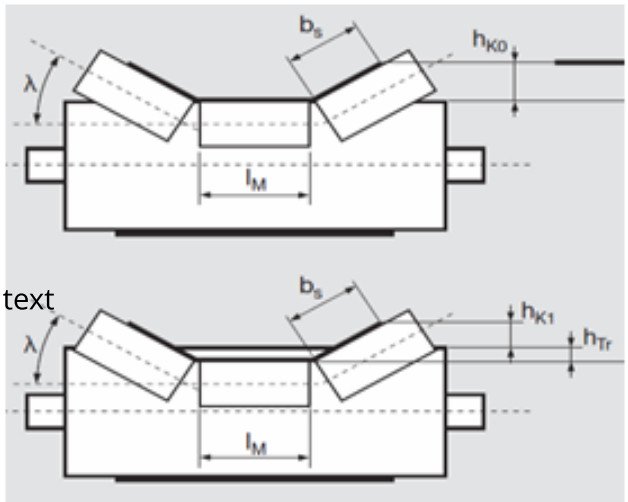
W = Force of friction

f = Coefficient of friction

K = Radial force to pulley

Coefficient of friction is dependent on pulley lagging and if pulley is dry, wet, clay, or icy.

Radial force is belt tension. This is basic to make conveyor work.



Body text

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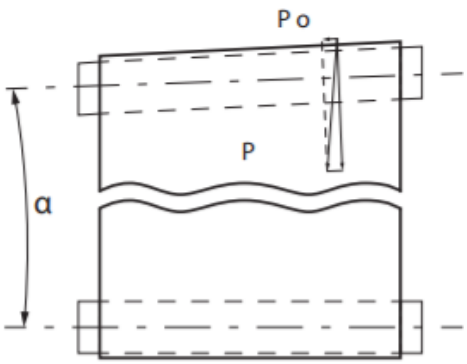
The art of conveyor belt tracking. Part 8.

A pulley must be installed 90^0 to center line of belt and frame. If not an angle alpha develop between belt and drum.

Let us call belt tension P and resultant P_0. which also will be the force that pushes belt sideways.

Equation P_0 = P sin alpha



Presume belt tension is 10 000 N and angel is 1^0 .

Equation sin 1^0 10 000 = 170 N.

A force of 170 N pushes belt sideways. Angle between pulley and belt center line pushes belt in direction of shortest distance between pulleys. See figure above.

Every deviation from 90^0 result in misalignment.

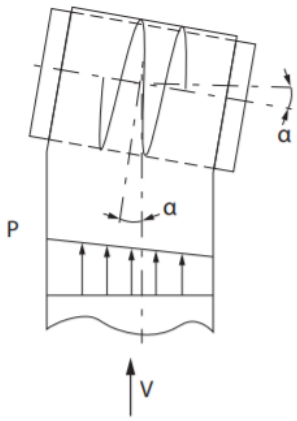
Put your ruler forward and do measurement.

One result of a pulley not square is that belt has different speed along the pulley surface.

Another result is sliding and wear of pulley friction lining and belt.

A pulley not square result in different belt tension across the pulley and at the same time force to the pulley.

Look at picture below . Length of arrows indicate difference in force pushing belt sideways.



On one side tension is higher and opposite side lower. See length of arrows. Three things happens.

1. Belt move in an arc.

2. On side of low tension pulley does break and speed is lower. Wear will appear on belt and pulley. Eventually the pulley might break.

3.Rotation of belt and different speed along pulley surface pushes belt sideways.

In this case pulley is not idling. Cost of energy, wear of belt and pulley.

It is absolutely necessary to have all pulleys and rollers square.

Maintenance and PrimeTracker will do the trick.

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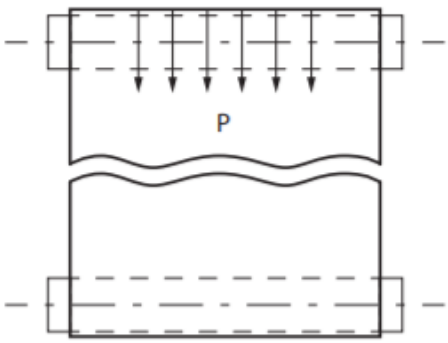
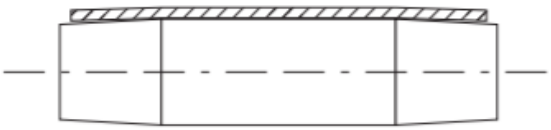
The art of conveyor belt tracking. Part 8.

Picture below shows ideal situation with equally distributed forces along pulley.

Please note that both driving and return pulley has a guiding influence of belt behavior.



An alternative way to guide belts are crowned drums



Ends are tapered.

Figure 1 is a perfect distribution of forces. Figure 2 shows an uneven distribution of forces and belt will move to the right until forces are equally distribute along pulley surface.

Note length of arrows!

As a belt traverses a drive pulley, the belt carcass has to travel a greater distance then the lagged surface of the pulley. This is due to the extra diameter added by the bottom belt cover. and the thickness of the carcass itself.

Sliding takes place between bottom belt cover and lagging. Consequence is wear of belt and lagging.

Versum has a solution and we look for a lagging producer able to cooperate and carry out tests.

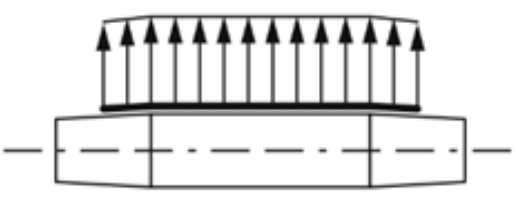
C**rowned pulleys must only be firmly mounted in conveyors.**

It is wrong thinking to use tapered ends in belt trackers.

Ends have different peripheral speed than cylindrical part of tracker and ends will suffer and wear away,

Belt trackers work to other mechanical laws than firmly mounted crowned pulleys.

This is too often mixed up.



1.

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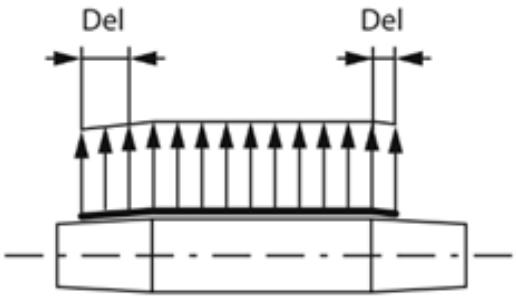

2.

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Crowning is used for belts with a certain speed. A general figure is not to be given but speed should be higher than 1,5 m/s.

There are two important parameters to be considered.

1. Difference in diameters. Large difference result in high correcting force. Also high wear as peripheral speeds are different.

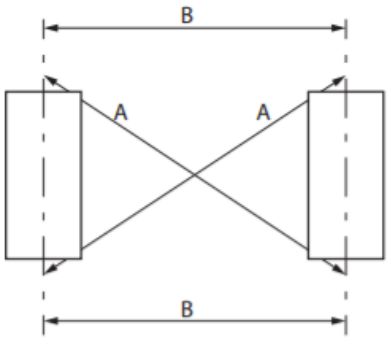
2. Transition between tapered and cylindrical part must be smooth. Risk of longitudinal cuts.

Every plaque and impurity stuck on pulley act as crowns and steer.

Measures to make belts run straight must always start with straight line and 90^0 to conveyor longitudinal line. It requires accurate installation of roller station and pulleys.

Short conveyors are sensitive of accurate distances. Definition of short conveyor is 15-20 times belt width. The shorter the more difficult to make belt go straight.

Figure below shows 4 measures, that must be equal. A and B.



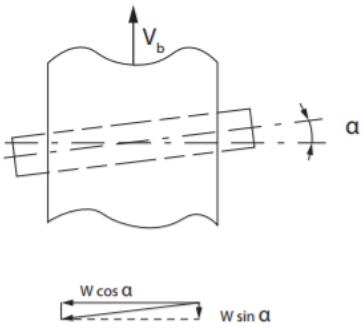
Force to push belt sideways is a sinus function.

At 1^0 pulley misalignment Sinus is 0,017

At 2^0 Sinus factor is 0,035

At 3^0 Sinus factor is 0,052

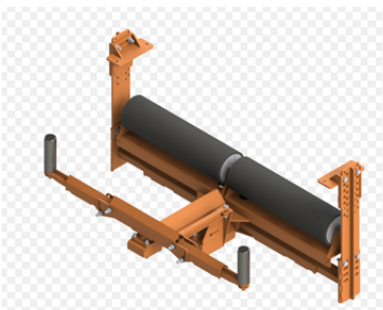
Multiply sinus factor with belt tension and result is force driving belt sideways.



There are many systems of tracking.

Below two of worst examples we have found. Links, levers, joints and rolls to obtain guiding force from belt edges.

It is obvious that belt edges are soared after some time and give wrong signals to tracker. All joints need continuous service to stay alive.



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The art of conveyor belt tracking. Part 8.

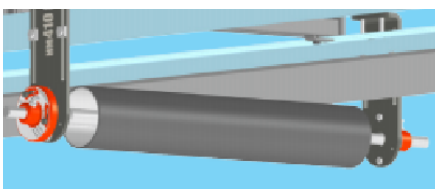
Tracking of return strand can be simple to accommodate. Most tracker take deviation signal from the moving belt. On previous page a system where vertical side roller bring information that belt deviate. A complicated sensitive system.

There are more ways to track a belt.

1. Tracker Type 1. Roller moving only in horizontal plane. When belt moves vertically tracker can not follow belt and only part of tracker is in contact with belt surface.

Tracker is heavily crowned. Roll ends are tapered. The ends have different peripheral speed compared to cylindrical part. Two speeds on same shaft result in tracker wear and not perfect tracking capacity.

Tracker type 3. A tube with a spherical bearing. Tube rubber lined. Tracker follows belt and is an excellent belt tracker. Problem could be sand and dust intrusion and consequently bearing failure.



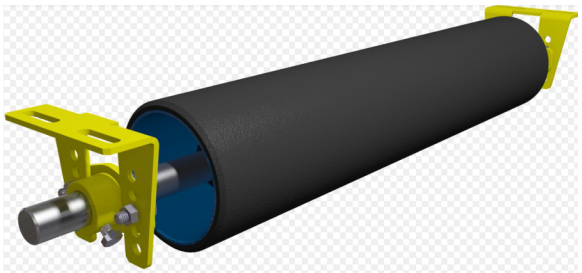
Tracker type 2. Prime-Tracker is designed with two tubes and a 38 mm shaft. The outer tube rotate and is connected to the inner tube by two ball bearings. The inner tube has an advanced rubber bush support, Prime Pivot bush. The shaft goes through the pivot bush to the side brackets.

This gives many advantages as soft suspension and accommodation to the smallest movement of the belt. No sand or dust will be in contact with the rubber. Rubber has no start friction, the least movement sideways makes the Prime Tracker guide the belt back on track.

The Prime Pivot bush is designed to allow the tracker to move in both horizontal and vertical direction.

The inner tube is protected from dust and sand by a strong corrugated rubber hose in EPDM

PrimeTracker



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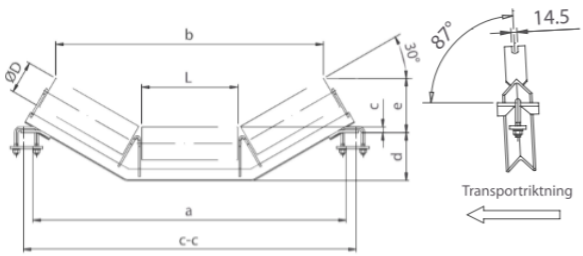
Belt tracking for load side require different technique because of roller stations are inclined.

Most common way to is to move stations 2-3^0 forward. We achieve a toe in function. Belt will run centered.

Warning: Belt will run unstable if tilted in wrong direction. If one side roller stop turning belt goes sideways



There are many different makers of troughed roller stations for load side of belts.

A center pivot makes roller station swing.

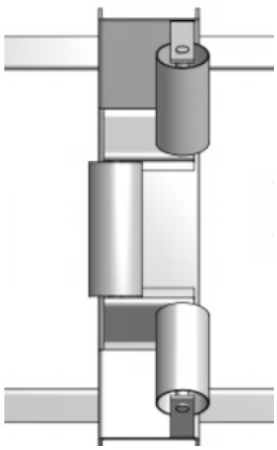
Side rollers convey information from deviating belt.

Principle is correct but it requires high forces to make station swing. After limited time belt edges are soared and do not convey correct information .

Versum has developed Prime TopTracker for load side of conveyors.

Design is based on the same principle that work to full satisfaction for PrimeTracker. A rubber pivot bush and information of belt deviation goes directly from belt to Prime TopTracker.

More information will follow when tests are finished.



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