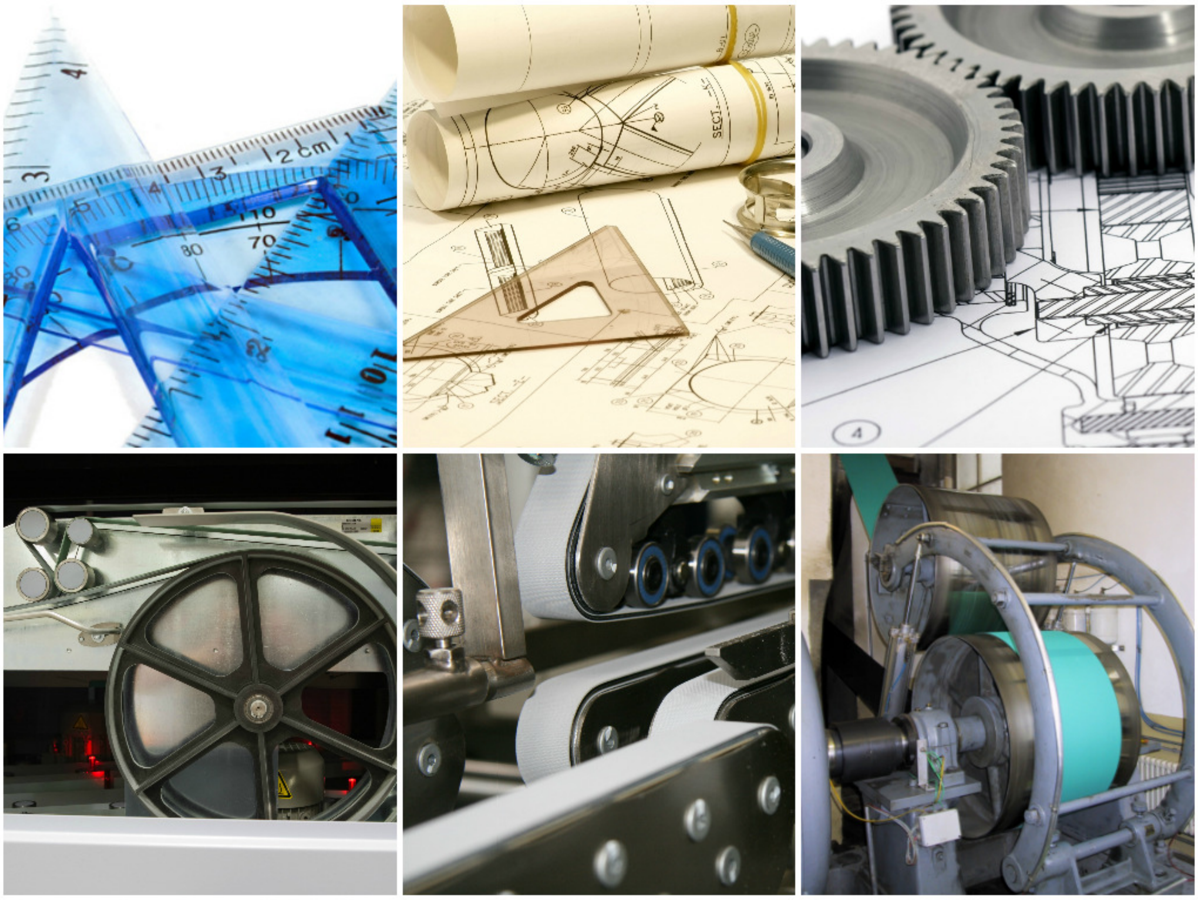


RAPPLON®
Engineering Guide

Issue for Product Managers

www.ammeraalbeltech.com

Introduction

The RAPPLON® Engineering Guide offers comprehensive technical knowledge about RAPPLON® High Performance Flat Belts and is designed to fulfil the demands of engineers, machine designers, technicians, maintenance staff and fitters.

Content	Page

Please visit us on **www.ammeraalbeltech.com** and get in contact with your local partner for further support.

Storage & Cleaning directions

Correct storing has an impact on material quality and fabrication processes and is therefore of great importance to secure quality over longer periods.

Storage location

- Belts should always be stored under cool, dust free and ventilated conditions.

Temperature / Humidity

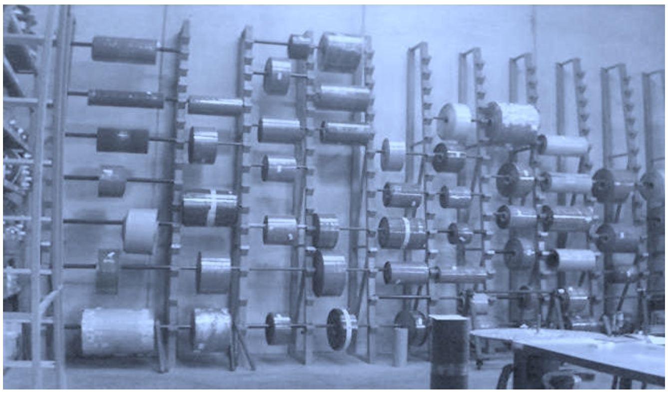
- Temperatures should not exceed -10°C or +25°C.
- Optimal relative air-humidity is approx. 65%
- Belts must be stored at a minimum distance of 1 meter from any heater.

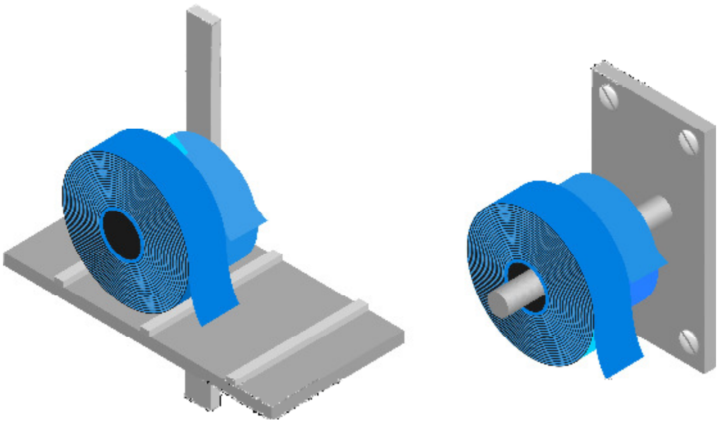
Ozone / Lighting

- The shelf life of belts can be considerably impaired by excessive exposure to e.g. oxygen, ozone, heat, humidity, solvents, UV, etc.
- Illumination should be moderate. All light sources with UV-radiation cause ozone formation and are reasons for belt damages.
- We strongly recommend to store RAPPLON® belts in UV-shielding PE-foil until usage.¨
- Belts with natural rubber are wrapped in black UV-shielding PE-foil. Use this foil to wrap remnants while storing
- Belts with polyamide foils should neither be stored close to floors nor on belt edges as this can result in camber

Chemicals

- Lubricants, acids, solvents, fuels and chemicals should not be kept together with belts in the same storage room.





Cleaning

Mostly flat belts run on well maintained machines in a proper environment. Therefore maintenance and cleaning is necessary only in exceptional cases.

- All flat belts with a chrome leather coating (LL, LT) should be treated from time to time with RAPPLON® belt spray. Hardened surfaces have to be roughened before with a wire brush. Note: Only chrome leather belts can be treated with belt spray.
- Cleaning has to be carried-out very carefully.
- Do not use any abrasive or sharply edged tools.
- Synthetic coated flat belts (GG, GT, TG, TT etc.) must not be treated with oil, grease or belt dressings. This causes a reduction of the friction value.
- Flat belts which have become dirty can be washed with warm water, to which a normal, commercial detergent has been added. Do not saturate belts! Only wipe with cloth or sponge, then towel dry

Belt length

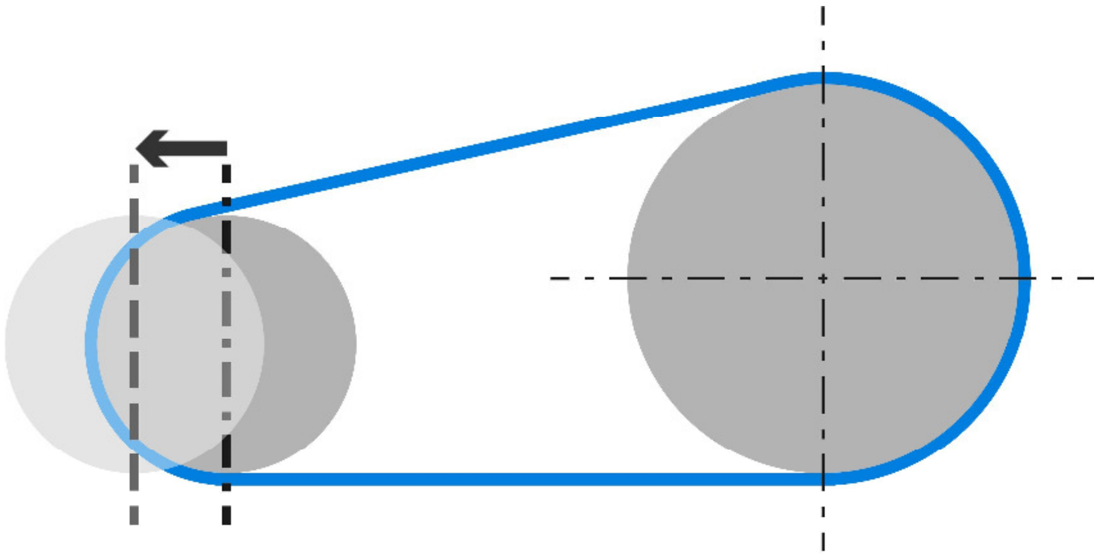
Geometrical belt length l_g — Steel tape length
The geometric belt length is the inner circumference length on an un-tensioned belt drive. The thickness and the position of the neutral layer are not considered.

Belt length must be measured when the tensioning pulley is in the innermost position in order to have enough take up to tension the belt properly. Always use steel measure tape to measure the exact length around the pulleys. The resulting value is the inner circumference length of a belt and called steel tape length or geometrical belt length. Usually the customer indicates this length when ordering a belt.

Effective belt length l_e — Fabrication belt length
The effective belt length is the length of the neutral layer of an un-tensioned belt. Here the position of the neutral layer and the belt thickness are considered. The effective belt length is therefore equal to the fabrication length. As the customer orders belts according the geometrical belt length (steel tape length) the fabrication workshops calculate and fabricate the belt endless according to the following formula:

Geometrical belt length + Thickness allowance + Splice length

Shortened belt length l_s
In some applications there is no tensioning device. Therefore the belt must be fabricated shorter in order to have the initial required elongation after installing. Simply deduct the necessary elongation from the effective belt length.



Neutral line

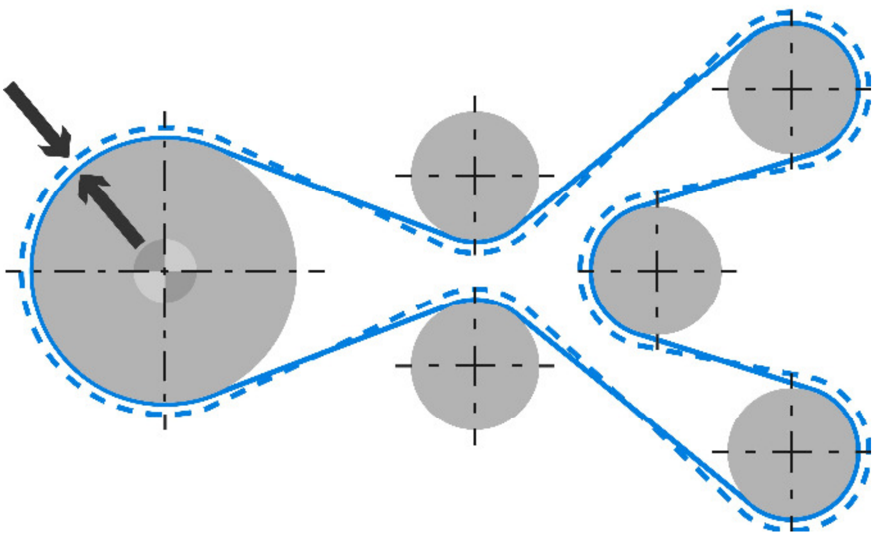
Neutral line
The neutral line is a line in the cross section of a belt along which there are no longitudinal stresses or strains. If the section is symmetric, isotropic and is not curved before a bend occurs, then the neutral axis is at the geometric centre. All fibres on one side of the neutral line are in a state of tension, while those on the opposite side are in compression.

Thickness allowance
The length of the neutral line must be calculated to get the belt length to be fabricated. Therefore the thickness allowance of the specific belt type must be considered:

Belts with symmetric design
Geometrical belt length + (belt thickness x Π 3.1416)

Belts with asymmetric design — neutral line close to outer side
Geometrical belt length + (2x belt thickness x Π 3.1416)

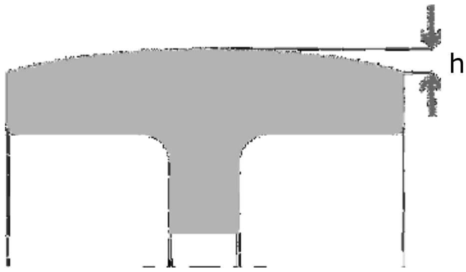
Thickness allowance multiple drives
With multiple pulley drives no thickness allowance will be added.



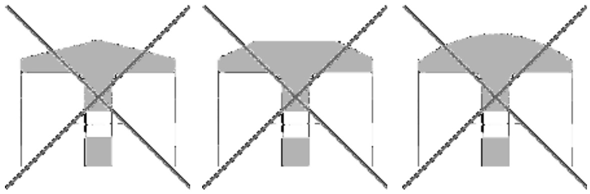
Crowning of pulleys

Crowning of pulleys
Crowning of pulleys prevent the flat belts running off. Preferably larger pulleys offering the largest arc of circumference should be crowned as they have the greatest influence on tracking the belts.
We recommend the pulley crowning according to DIN 111 and/ or ISO 100. Crowning heights larger than recommended will show loss of guiding effect, especially with laterally stiff belts.

Diameter in mm	Crowning height „h" DIN 111/ISO 100	Crowning height „h" DIN 111/ISO 100
	Pulley width 25-250 mm	Pulley width > 250 mm
40 - 112	0.3 mm	0.3 mm
125 - 140	0.4 mm	0.4 mm
160 - 180	0.5 mm	0.5 mm
200 - 224	0.6 mm	0.6 mm
250 - 335	0.8 mm	0.8 mm
400 - 500	1.0 mm	1.0 mm
560 - 710	1.2 mm	1.2 mm
800 - 1000	1.2 mm	1.5 mm
1120 - 1400	1.5 mm	2.0 mm
1600 - 2000	1.8 mm	2.5 mm



Unsuitable crown shapes
These crown shapes should definitely be avoided
as they considerably shorten the working life of flat belts.



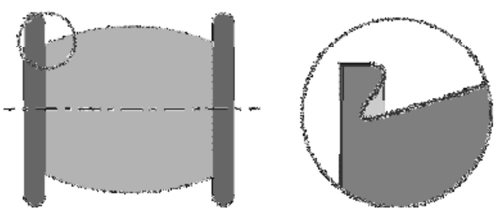
Pointed conical shape — Conical trapezoidal shape — Excessively high crown

Pulley width
The width of the pulleys should be at least 1.05 to 1.1 times the belt width.

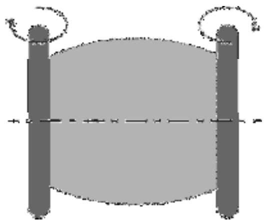
Pulley material
Preferably choose steel or cast iron pulleys. Injection moulded duroplastic pulleys show less weight but their low heat conductivity can expose the belt to unsuitable high temperatures.

Pulley surface
In order to achieve optimum frictional behaviour between the flat belts and the pulleys, the surface of the pulleys should be manufactured with a roughness RZ25 according to DIN 4768.

Flanged pulley
The use of flanged pulleys should be avoided as there is a risk of damaging the belts if they run onto the flanges. If this can not be avoided due to design considerations, then free running flanges should be installed or an undercut provided to reduce the contact area with the belt. The height of the camber should be according to the crowning table but the pulley width should be 30% wider than the belt width.



Under cut

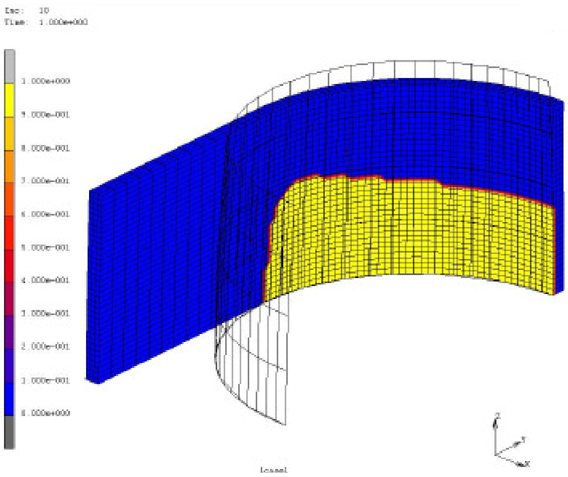


Free running flanges

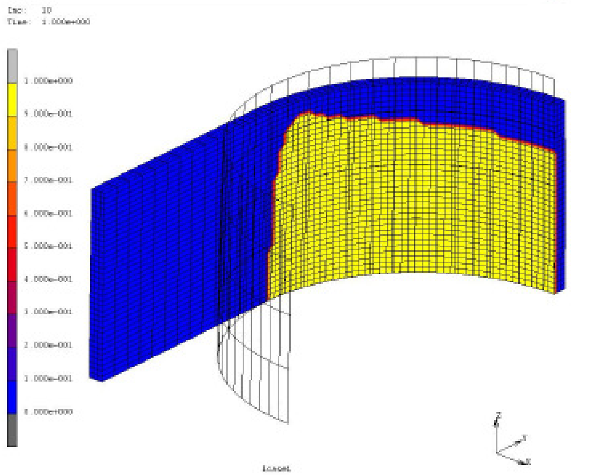
Crowning of pulleys

Analysis by finite element methods confirm the following statements:

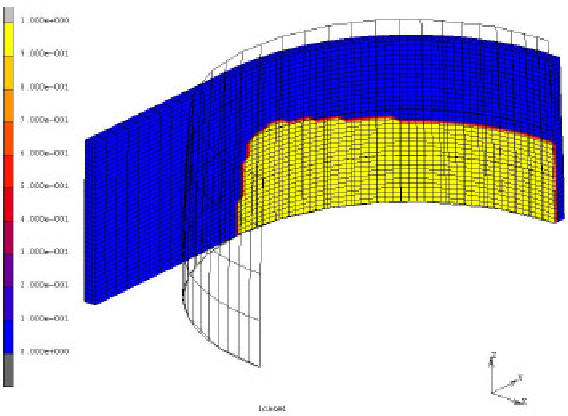
- Extensive crowning contrary to our recommendations result in reduced contact area
- Increasing the pulley diameter results in more contact area between pulley and belt
- Reduced contact area lowers the guiding properties and tracking issues will be the consequence



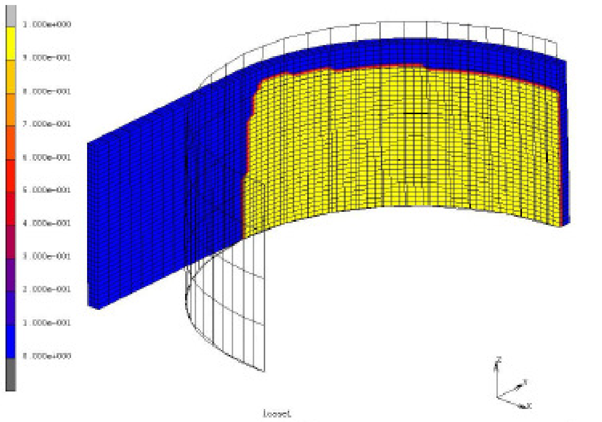
Contact area with pulley diameter 34 mm
Crowning radius 250



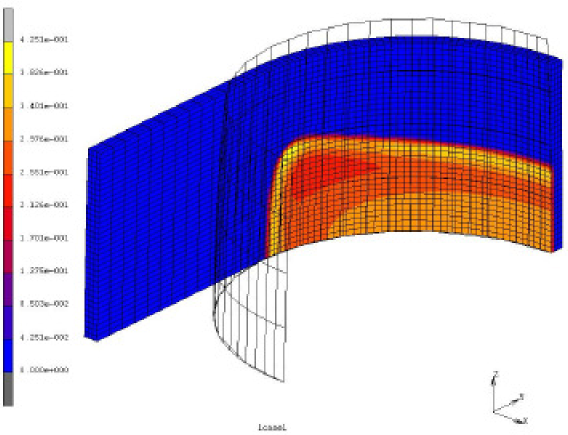
Contact area with pulley diameter 34 mm
Crowning radius 660



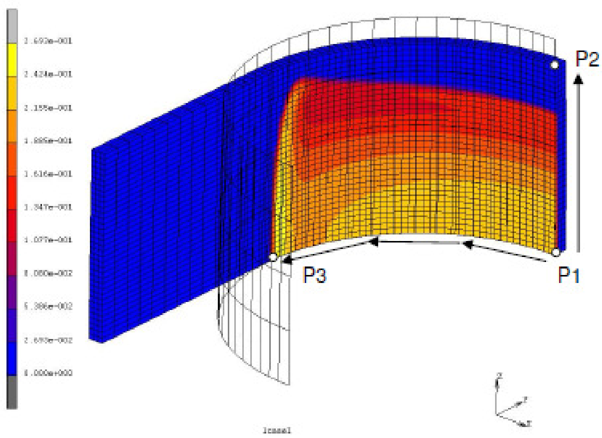
Contact area with pulley diameter 44 mm
Crowning radius 250



Contact area with pulley diameter 44 mm
Crowning radius 660



Pressure profile at pulley diameter 34 mm
Crowning radius 250



Pressure profile at pulley diameter 34 mm
Crowning radius 660

Analysis is based on a symmetric, rubber covered belt with polyester fabric tensile member:
Total thickness 1,4 mm, k1% value 3 N/mm, Force 87 N

Tensioning of belts

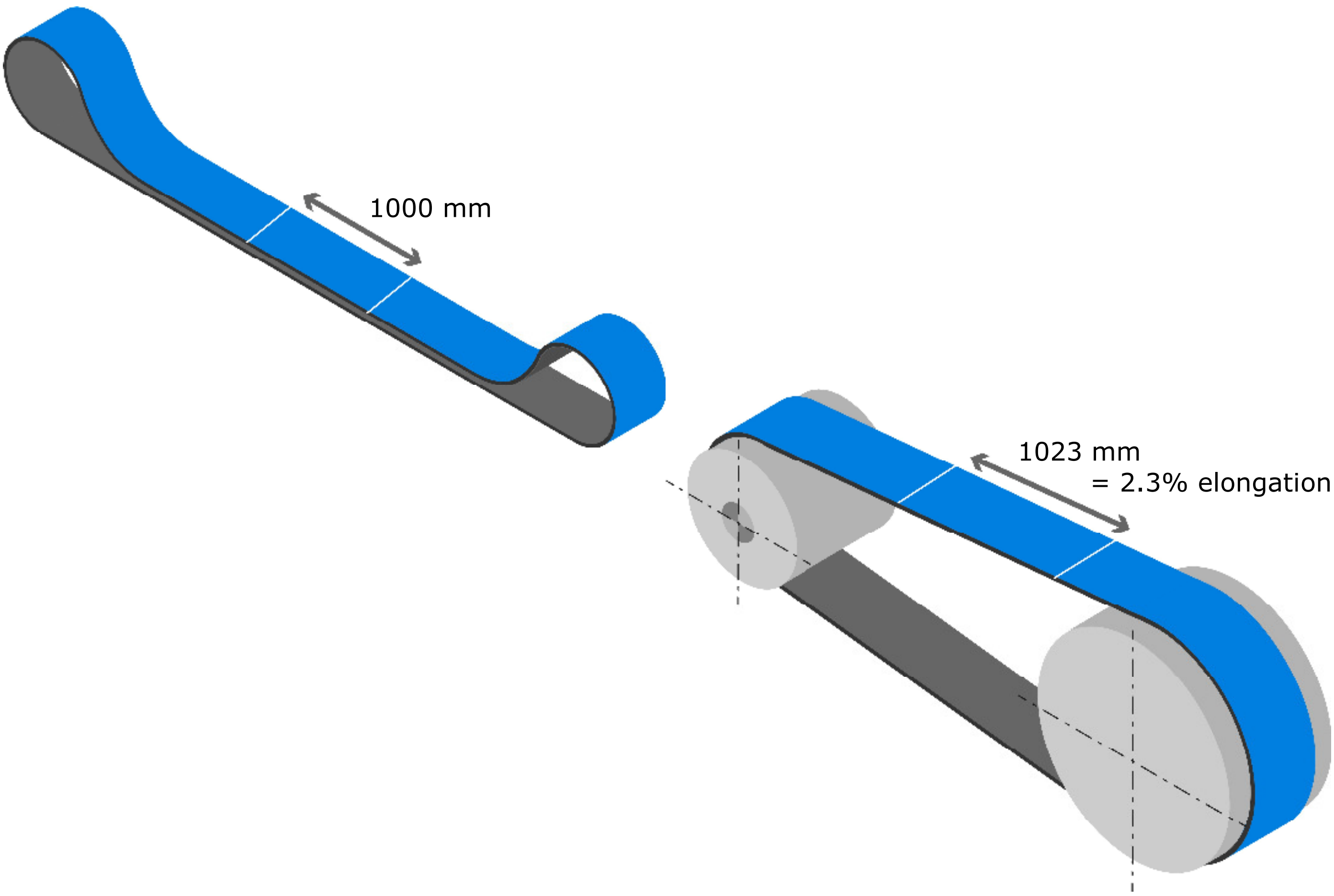
For a trouble free operation of any belt, a correct and sufficient initial elongation is required.
The initial elongation must correspond with the application and cover influences of temperature and humidity.

Measuring marks
The correct way to tension a belt after mounting is the procedure with meter marks:

- Mark two lines with a pitch of 1000 mm at both belt sides with a pen before installing.
- For short belts the measuring mark distance can be chosen shorter.
  Please note: The longer the distance, the more precise will be the tensioning accuracy.
- Then tension the belt left and right equally.
  For instance 2.3% elongation requires a distance of 1023 mm.
- Rotate the belt for several rounds and measure again. If necessary re-tension the belt to the correct value.

For drives without a tensioning device you must consider the correct tension in length by shortening the belt during fabrication.

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 little tension result in slippage on the drive drum and the belt may not follow the crowning.

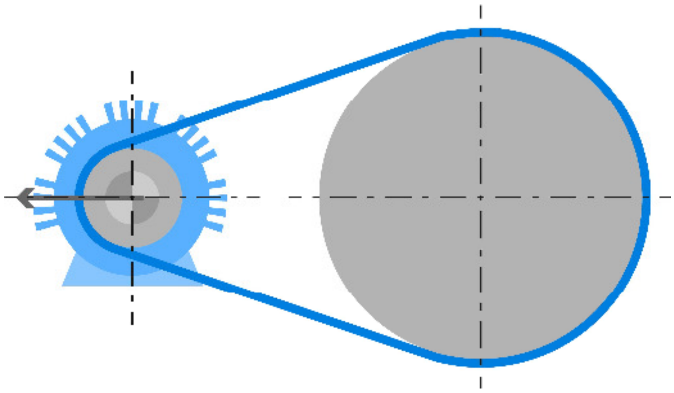


Calculate Power Transmission belts with RappCalc always.
This calculation software provides clear indications on how the belt must be tensioned to guarantee trouble-free running.

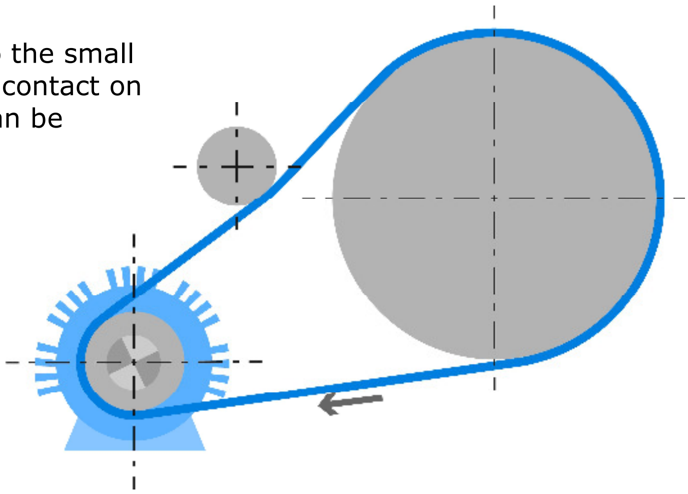
Tensioning devices

There are several systems to tension a belt. Here some typical take up systems.

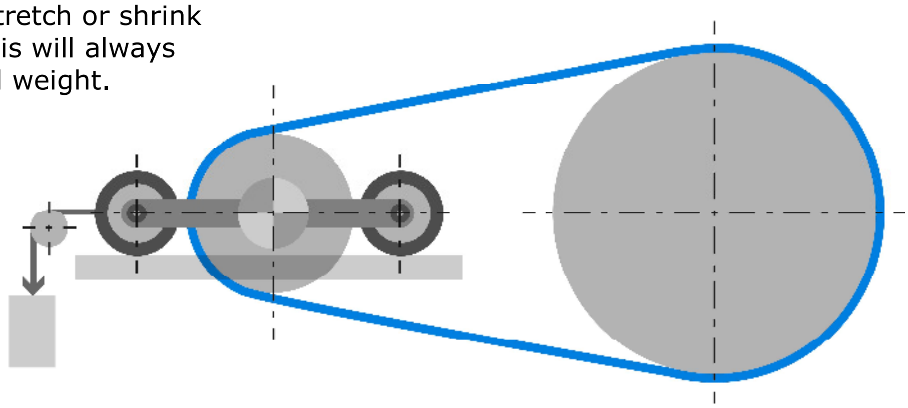
Slide rail
Common system for two pulley drives. The motor is mounted on an adjustable base which can slide. After tensioning, the base is fixed.



Tensioning roller
Tension rollers are located on the slack side close to the small pulley. They can be also used to increase the arc of contact on the smaller pulley. The pushing force of the roller can be provided hydraulic, pneumatic or spring loaded.



Tensioning skid
The motor is based on a free moving skid.
The belt in combination with the skid is then tensioned by a defined weight. Possible belt stretch or shrink show no effect on belt tension as this will always remain the same due to the defined weight.



No tensioning device
In systems without tensioning device the required initial elongation must be provided by reducing the belt length. This shortened belt length l_s is the fabrication length.

Installation on site

In some applications belts can be installed endless whereas in others joining on site is necessary. Follow the instructions to guarantee a trouble free running.

Safety first
Always stay clear of running belts as they can cause serious body injuries if touched. Pay attention to your clothes and tools as they can be pulled into the machine.
Switch off the machine and make sure that nobody can switch it on again before installation and maintenance work is finished.

Process and Transport belts — Removal and Fitting
Systems with various pulleys and long belts usually have to be made endless on site.

- Release belt tension
- Wrap both belt ends in a foil to avoid contamination with dirt or dust
- Fix the new belt with self-adhesive tape onto the old belt
- Cut the old belt (certainly behind the fixation of the new belt)
- While pulling the old belt to remove from the machine, the new belt is pulled in
- Join the belt according our joining instructions with the recommended equipment
- Tension the belt according to the instructions of the Original Equipment Manufacturer. Often these applications are equipped with automatic tensioners (spring loaded, pneumatic or others)

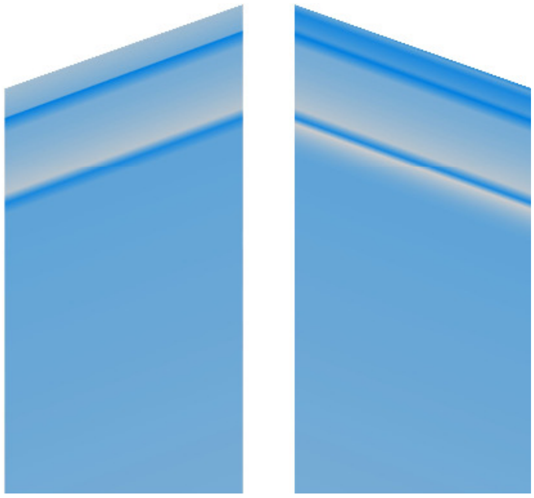
Power Transmission belts — Removal and Fitting
These applications show usually simple drive layouts with easy access. Before mounting the belt on the installation it is advisable to leave the belt for twelve hours in the room where the belt is going to be used.

- Release belt tension, make sure that the tensioning device is in the innermost position
- Cut the belt and pull them off
- Clean pulleys and other parts which can be in contact with the belt
- Check that shafts are parallel and pulleys are properly aligned
- Lay the new belt onto the small pulley first, then onto the large one. Do not force the belt over pulley edges. Avoid the use of unsuitable tools such as screwdrivers or hammer.
- Join the belt according to our joining instructions with the recommended equipment
- Tension the belt by following described procedure
- It is important to set the exact tension as calculated by RappCalc — no guess work!

Joining methods

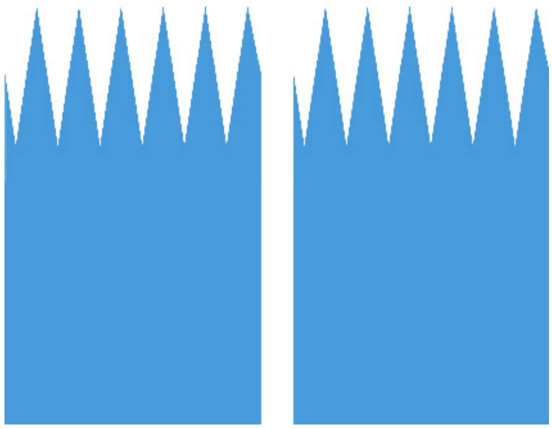
RAPPLON® Classic
The strength of a Classic joint is close to the belt strength if made by skilled and experienced staff. Once joined there are not many possibilities to check the joining quality. Therefore it is of great importance to control the whole joining process.

- Always use the article specific endless instructions
- Check your heating press periodically regarding temperature
- Check your skiving equipment periodically regarding wear of sandpaper
- Use the glue up within one week
- Keep the environment clean to avoid contamination
- Do not touch skived surfaces



RAPPLON® QuickSplice
A much faster and less sensitive joining procedure — the first choice for process applications.

- Very easy, safe and quick joining
- No need of particular training or special crew
- Visually confirmed splices without unexpected failures
- Consistent thickness over joint area for optimal operation
- No adhesives required – clean and safe for employees
- Very slim tools to allow easy joining process also in critical areas
- Perfect alignment thanks to guide rail system
- Intelligent tools with edge guides
- Bi-directional running of belts possible



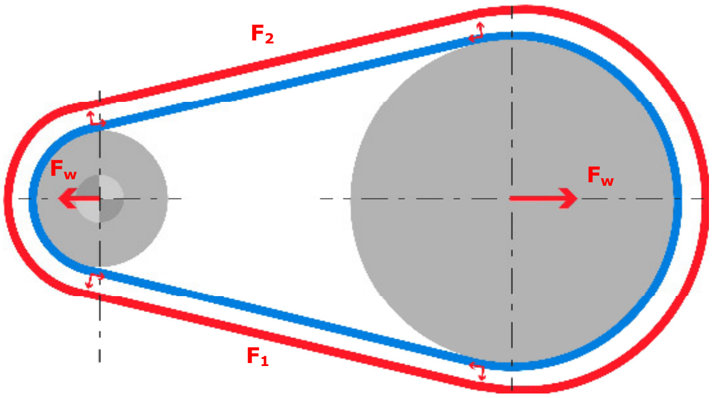
Please visit us on **www.ammeraalbeltech.com** to learn more about our comprehensive tools range.

Shaft load

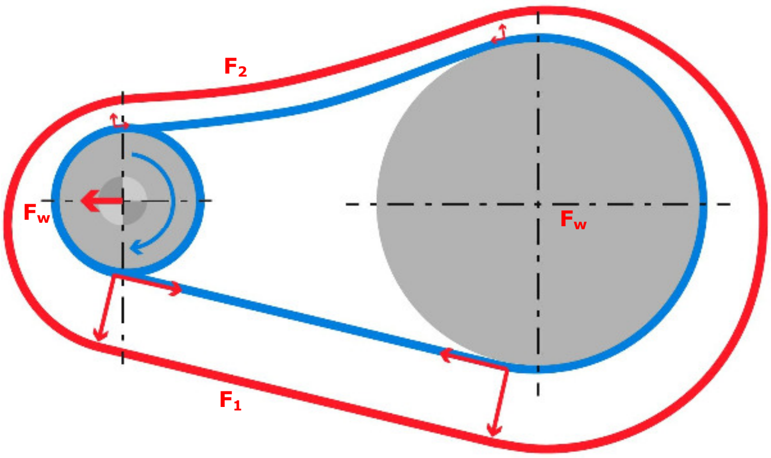
Initial shaft load
The highest shaft load appears immediately after elongation and will decrease after running in.
It is approx. 40% (depending on belt type and elongation) higher than the shaft load after relaxation due to running in.

RAPPLON® data sheets always show the tensile strength and therefore the shaft load after running in. RappCalc shows also the initial shaft load before relaxation as the equipment manufacturers have to consider this value to design bearings and shafts accordingly.

Static shaft load
The static shaft load refers to stand still or idling conditions and is higher than the dynamic shaft load.



Dynamic shaft load
The dynamic shaft load is shown under running conditions and is lower than the static shaft load due to the centrifugal force.



Impact of too high shaft loads

- Higher energy consumption
- Generate higher static loads
- Contact area on the larger pulley
- Higher forces on belts
- Noise level can be higher
- Additional costs

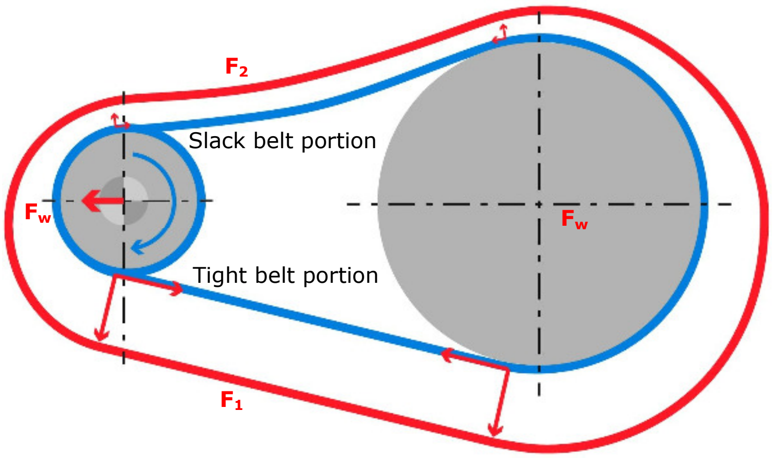
Reducing shaft load
Possibilities to reduce shaft load:

- Reduce elongation
- Tensile member with lower K1% value (weaker belt)
- Reduce belt width
- Increase pulley diameter
- Reduce climatic fluctuations
- Avoid contamination by dust, dirt or oil
- Optimize design of power transmission

Creep and Slip

Creep
In theory both pulleys linked by a flat belt should have the same circumferential speed. In fact the driven pulley runs slightly slower compared to the drive pulley. The reason is the different elongation in the tight and slack side of a belt, which creates a continuous contraction and elongation of the belt over the pulley contact area.

The result is a relative movement between belt and pulley which is known as creep.
Creep is influenced by the actual load, elastic modulus (k1%-value) and width of the belt.
To reduce creep we prefer tensile members with a high elastic modulus.



Slip
Slip leads to operational failures and belt damage, therefore it must be avoided.
In Power Transmission applications the belt runs off the pulleys in the moment slip occurs as the speed is usually high. With process and conveyor belts you recognise slip because of transport speed reduction or by a miss-tracking tendency.

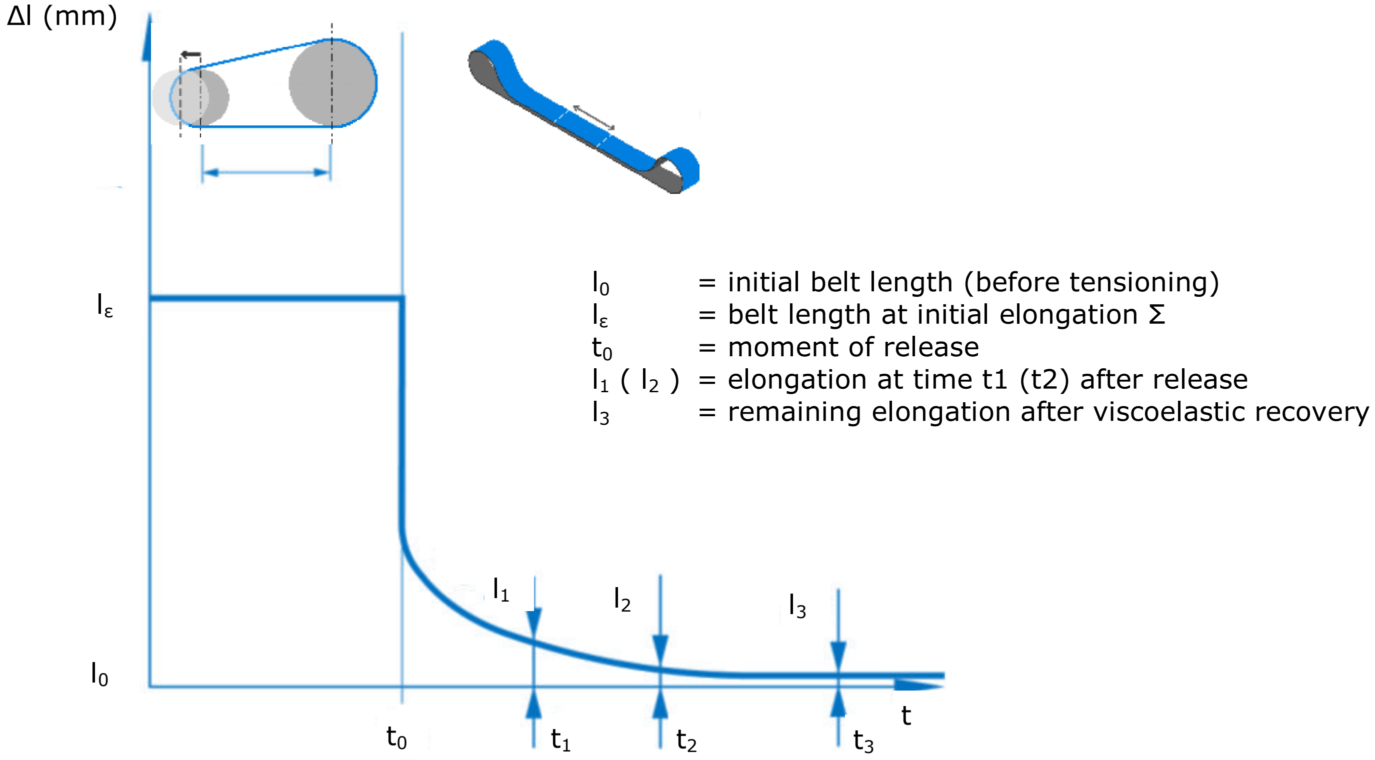
There are several possibilities for slip and counteractive measures:

Power Transmission
- The operational conditions in reality differ from the ones the belt has been calculated for.
- > Re-calculate the application to find a suitable belt
- Sudden start up
- > Check motor and consider soft start up
- The necessary elongation was not applied when installed initially
- > Check tension with meter marks and increase tension within the recommended range
- Unexpected peak loads / shock loads
- > Re-calculate the application to find a suitable belt
- Environmental conditions such as high humidity
- > Especially with PA-tensile member belts: Re-calculate the application to find a suitable belt
- Reduced friction due to oil, fat, dust or dirt
- > Clean pulley and belt, consider leather coated belts or belts with longitudinal grooves.

Process and conveyor
- The operational conditions in reality differ from the ones the belt has been determined for (extensive mass of goods, acceleration).
- > Reconsider the application to find a suitable belt
- The necessary elongation was not applied when installed initially
- > Check tension and increase tension slightly
- Reduced friction due to oil, fluids, fat, dust or dirt
- > Clean pulley and belt, slightly increase tension.

Elastic recovery

After release of tension on synthetic material it will contract in two steps and finally there still remains a certain amount of elongation.



Elastic recovery
After releasing the belt tension the belt immediately contracts.
The belt only contracts to a certain amount of its initial elongation, it does by far not reach its initial length.

Viscoelastic recovery
After elastic recovery, the belt still recovers gradually over a longer period of time. First the process is going relatively fast but gets slower and slower. The viscoelastic recovery takes days or even weeks until the viscoelastic contraction comes to a standstill. Again, the belt does not reach its initial length.

Remaining elongation
The difference of the initial belt length l_0 and the length after the viscoelastic recovery is the remaining elongation. The amount of the remaining elongation depends on the time elapsed after release. The exact amount of the remaining elongation can neither be calculated nor be forecasted because too many parameters are involved such as type of material, initial elongation, type of application (pulley diameter, number of flexings, belt speed, nominal load, stress due to shock load, operational conditions, temperature, humidity and the time used in operation before release.

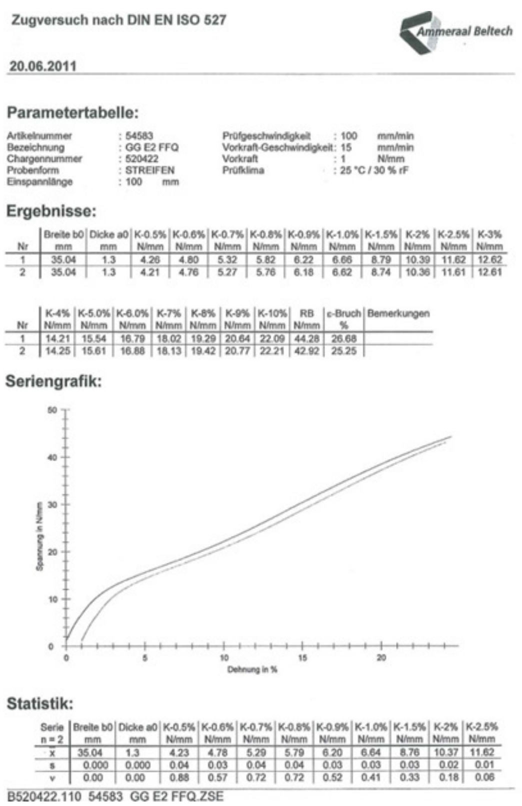
Re-installing of used belts
Double check tension when re-installing a used power transmission flat belt due to the remaining elongation effect.

Note
Customers often measure the belt length shortly after de-installation and compare the result with the initial belt length l_0 without considering the effect of the long lasting viscoelastic recovery process. Even days and weeks after release, a certain remaining elongation will be observed; this is a normal characteristic of synthetic materials.

Static tensile force at 1% elongation
(k1% static)

The correlation of force and elongation of High Performance Flat Belts is defined by the tensile force for 1% elongation (k1% value).
This value is shown immediately after the belt sample has been stretched, the relaxation is not considered!

Test procedure
The static k1% value can be measured according DIN EN ISO 527-2 / DIN EN ISO 21180 in a tensile test bench. The test sample is being tensioned to 1% of its length and the necessary force for that stretch is continuously recorded. The resulting value is shown in N/mm.



Zugversuch nach DIN EN ISO 527 — Ammeraal Beltech

20.06.2011

Parametertabelle:

Artikelnummer	: 54583	Prüfgeschwindigkeit	: 100 mm/min
Bezeichnung	: GG E2 FFQ	Vorkraft-Geschwindigkeit	: 15 mm/min
Chargennummer	: 520422	Vorkraft	: 1 N/mm
Probenform	: STREIFEN	Prüfklima	: 25 °C / 30 % rF
Einspannlänge	: 100 mm		

Ergebnisse:

Nr	Breite b0 mm	Dicke a0 mm	K-0.5% N/mm	K-0.6% N/mm	K-0.7% N/mm	K-0.8% N/mm	K-0.9% N/mm	K-1.0% N/mm	K-1.5% N/mm	K-2% N/mm	K-2.5% N/mm	K-3% N/mm
1	35.04	1.3	4.26	4.80	5.32	5.82	6.22	6.66	8.79	10.39	11.62	12.62
2	35.04	1.3	4.21	4.76	5.27	5.76	6.18	6.62	8.74	10.36	11.61	12.61

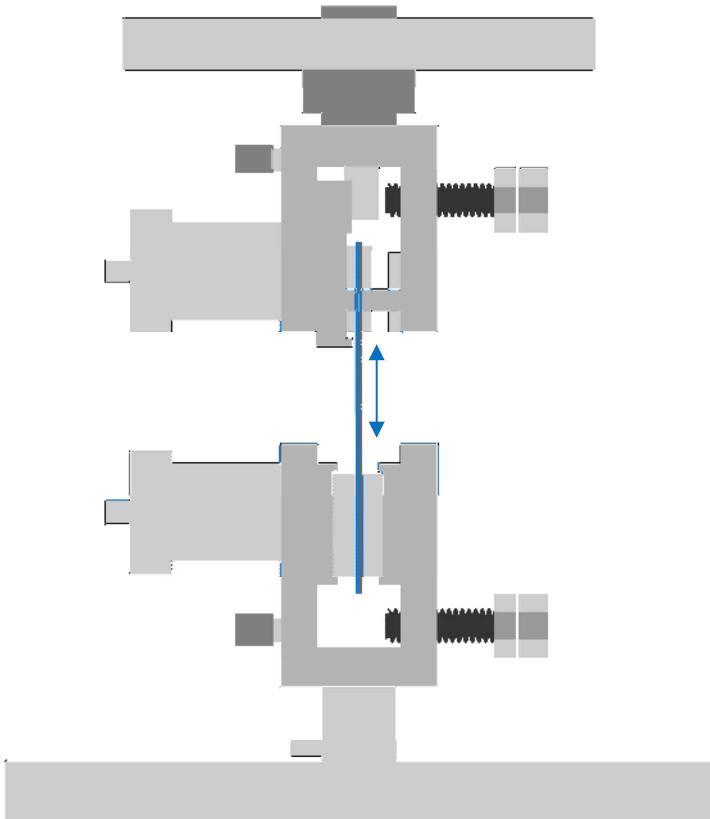
Nr	K-4% N/mm	K-5.0% N/mm	K-6.0% N/mm	K-7% N/mm	K-8% N/mm	K-9% N/mm	K-10% N/mm	RB N/mm	ε-Bruch %	Bemerkungen
1	14.21	15.54	16.79	18.02	19.29	20.64	22.09	44.28	26.68	
2	14.25	15.61	16.88	18.13	19.42	20.77	22.21	42.92	25.25	

Seriengrafik:

Statistik:

Serie n = 2	Breite b0 mm	Dicke a0 mm	K-0.5% N/mm	K-0.6% N/mm	K-0.7% N/mm	K-0.8% N/mm	K-0.9% N/mm	K-1.0% N/mm	K-1.5% N/mm	K-2% N/mm	K-2.5% N/mm
$\bar{x}$	35.04	1.3	4.23	4.78	5.29	5.79	6.20	6.64	8.76	10.37	11.62
s	0.000	0.000	0.04	0.03	0.04	0.04	0.03	0.03	0.03	0.02	0.01
v	0.00	0.00	0.88	0.57	0.72	0.72	0.52	0.41	0.33	0.18	0.06

B520422.110 54583 GG E2 FFQ.ZSE



k1% static = F (1%) / b = N/mm
F (1%) = force at 1% elongation (N)
b = belt width of test sample (mm)
l = initial length of test sample
Σ = elongation 1%

For elastic belts the force at 6% elongation is measured, resulting in k6% values.

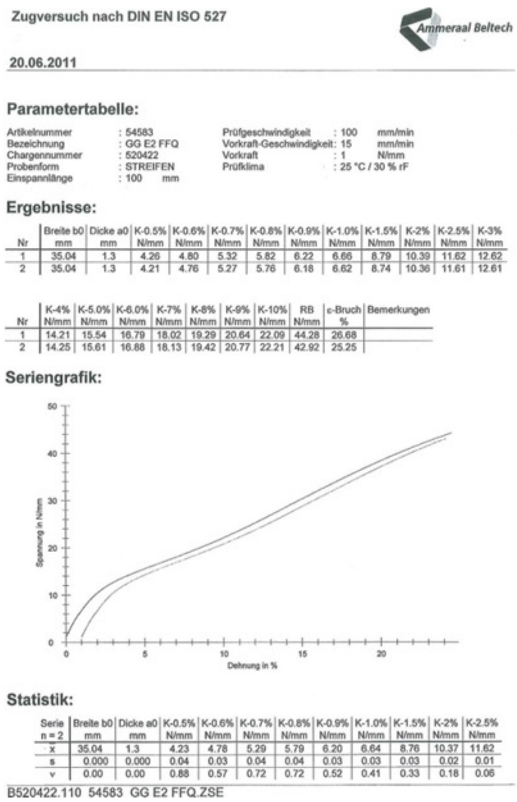
Note
This test procedure seems to be simple but there are various parameters which influence the test result: pretension, stretching speed, sample holder equipment, climate. Therefore static values can not be absolutely comparable to other belting manufacturers and can be used as an indication only.
Furthermore the practical use of the k1% static value is limited as it appears only for a short period of time, immediately after stretching.
Afterwards the value decreases because of the relaxation behaviour of the material layers. Nevertheless the value is an important indication for Original Equipment Manufacturers to calculate the maximum shaft load occurring after installation for a short time.

Relaxed tensile force at 1% elongation (k1% relaxed)

The correlation of force and elongation of High Performance Flat Belts is defined by the tensile force for 1% elongation (k1% value). This value is shown immediately after the belt sample has been stretched and decreases because of relaxation. The test procedure as following described considers the relaxation.

Test procedure

The relaxed k1% value can be measured according DIN EN ISO 21181 in a tensile test bench. The test sample is being tensioned and relaxed with a specific number of cycles to 1% of its length. The necessary force is continuously recorded. The force will be less by increasing number of cycles/period of time. The resulting value is shown in N/mm.


Zugversuch nach DIN EN ISO 527

Ammeraal Beltech

20.06.2011

Parametertabelle:

Artikelnummer	: 54583	Prüfgeschwindigkeit	: 100 mm/min
Bezeichnung	: GG E2 FFQ	Vorkraft-Geschwindigkeit:	15 mm/min
Chargennummer	: 520422	Vorkraft	: 1 N/mm
Probenform	: STREIFEN	Prüfklima	: 25 °C / 30 % rF
Einspannlänge	: 100 mm		

Ergebnisse:

Nr	Breite b0 mm	Dicke a0 mm	K-0.5% N/mm	K-0.6% N/mm	K-0.7% N/mm	K-0.8% N/mm	K-0.9% N/mm	K-1.0% N/mm	K-1.5% N/mm	K-2% N/mm	K-2.5% N/mm	K-3% N/mm
1	35.04	1.3	4.26	4.80	5.32	5.82	6.22	6.66	8.79	10.39	11.62	12.62
2	35.04	1.3	4.21	4.76	5.27	5.76	6.18	6.62	8.74	10.36	11.61	12.61

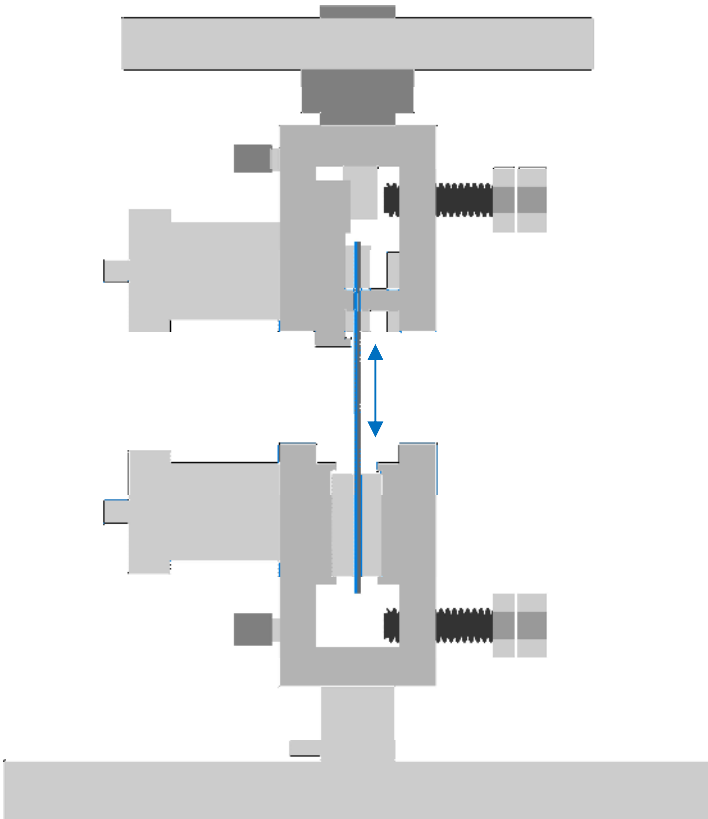
Nr	K-4% N/mm	K-5.0% N/mm	K-6.0% N/mm	K-7% N/mm	K-8% N/mm	K-9% N/mm	K-10% N/mm	RB N/mm	ε-Bruch %	Bemerkungen
1	14.21	15.54	16.79	18.02	19.29	20.64	22.09	44.28	26.68	
2	14.25	15.61	16.88	18.13	19.42	20.77	22.21	42.92	25.25	

Seriengrafik:

Statistik:

Serie n = 2	Breite b0 mm	Dicke a0 mm	K-0.5% N/mm	K-0.6% N/mm	K-0.7% N/mm	K-0.8% N/mm	K-0.9% N/mm	K-1.0% N/mm	K-1.5% N/mm	K-2% N/mm	K-2.5% N/mm
x	35.04	1.3	4.23	4.78	5.29	5.79	6.20	6.64	8.76	10.37	11.62
s	0.000	0.000	0.04	0.03	0.04	0.04	0.03	0.03	0.03	0.02	0.01
v	0.00	0.00	0.88	0.57	0.72	0.72	0.52	0.41	0.33	0.18	0.06

B520422.110 54583 GG E2 FFQ.ZSE



k1% relaxed = F (1%) / b = N/mm
F (1%) = force at 1% elongation (N)
b = belt width of test sample (mm)
l = initial length of test sample
Σ = elongation 1%

For elastic belts the force at 6% elongation is measured, resulting in k6% values.

Note

This test procedure is more time-consuming but comes as close as possible to the dynamic k1%-value after running in. The practical use of the relaxed k1% value is therefore given. Nevertheless the most precise method to measure the dynamic tensile force is the power transmission test bench.

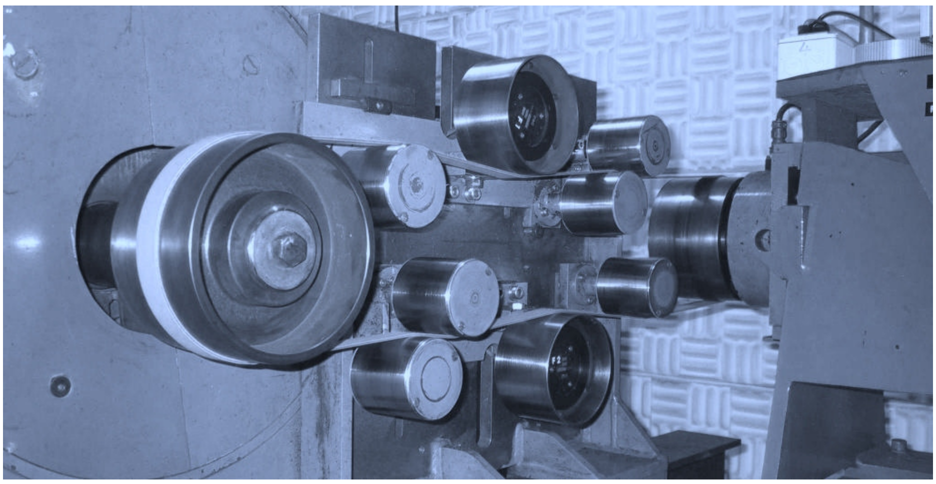
Dynamic tensile force at 1% elongation
(k1% dynamic after running in of 24 hours)

Power transmission, transport and process with High Performance Flat Belts is a highly dynamical process. High speed, high loads, maybe peak loads create high frequency loading/ unloading cycles between tight and slack side of the belt. Overall it causes complex stresses in the belt which have to be considered when calculating the correct belt for an application.
For a calculation it is therefore of great importance to know the exact correlation of force and elongation not only after relaxation but also after running in time. This is known as k1% dynamic value after running in for 24 hours.

Test procedure
The dynamic k1% value can be measured according to internal standards on a power transmission test bench.
The endless fabricated flat belt is being tensioned to 1% of its length and runs for 24 hours.
The necessary force to run is continuously recorded.
Force measuring gauges are located in the slack and tight portion of the belt.

Depending on the flat belt type the largest loss of force happens in the first 1-2 hours. Usually the flat belt has run in after 12 hours and remains steady. Further loss of force is not measurable.
The resulting value is shown in N/mm.

Note
This test procedure is extensive but shows the most precise values for all end users. In our belt specifications we show the dynamic k1% value after running in only.

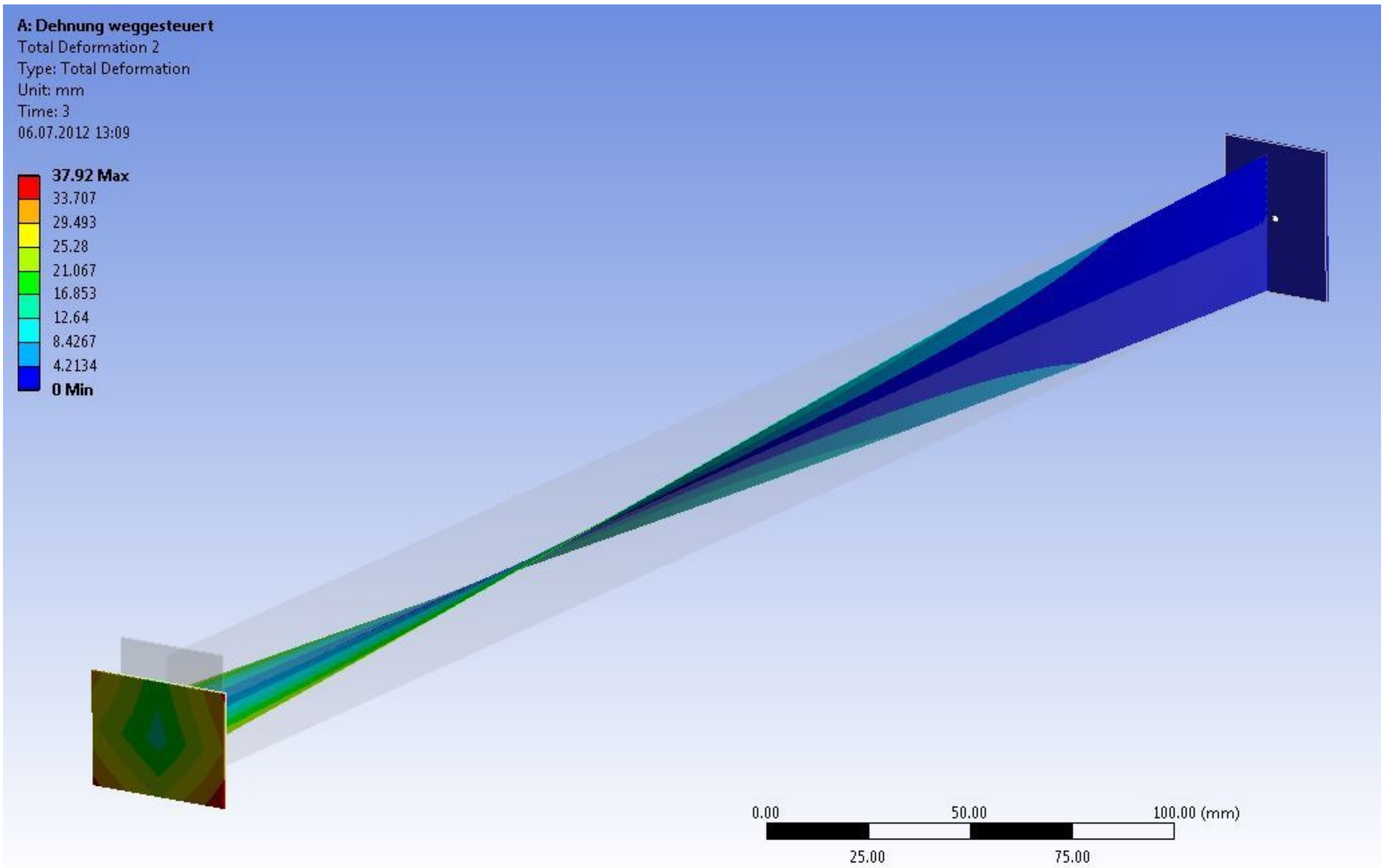


Shearing forces in twisted belts

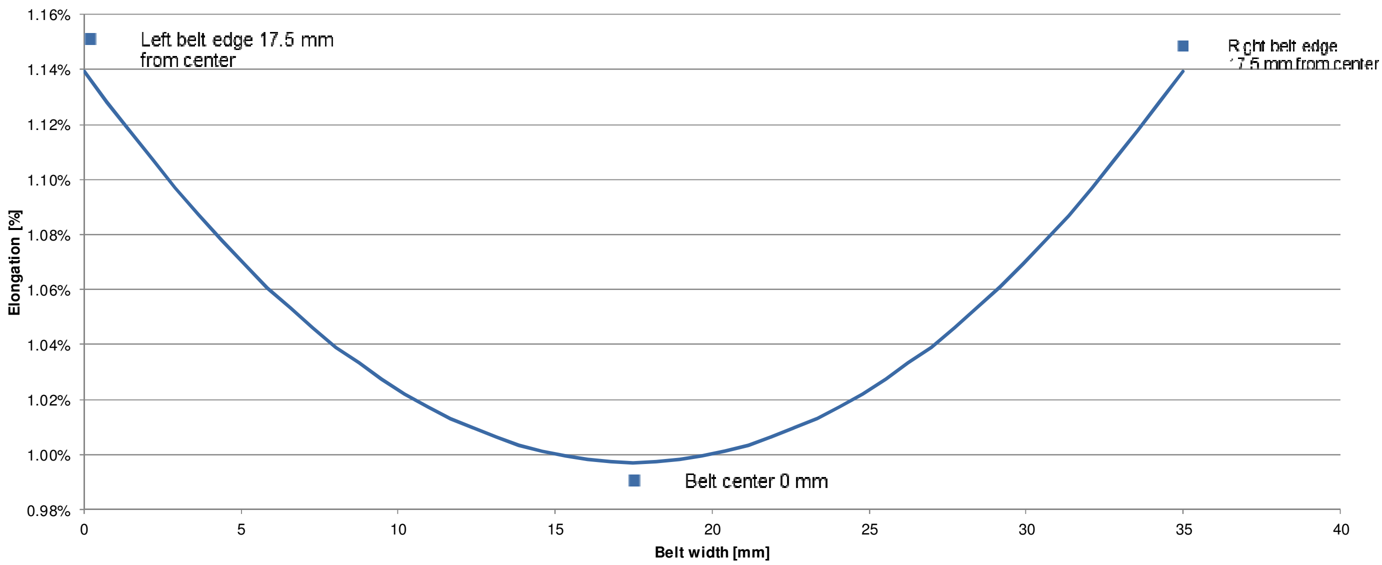
Sometimes process belts are twisted along their longitudinal axis. The resulting shearing forces increase the elongation at the belt edges significantly.

The below **Analyse by finite element methods FEM** show a rather narrow belt with 35 mm width, initially elongated to 1%. Twisting the belt within a distance of 500 mm to 90° show an increased elongation of the edges of 1.14%.

The wider the belt and the higher the initial elongation the elongation at the edges increase disproportionate. The resulting shearing forces can cause cracks at the edges or snapped belts if they exceed the tensile strength.



Belt width 35 mm, Distance 500 mm, Torsion 90°



Antistatic / High conductive

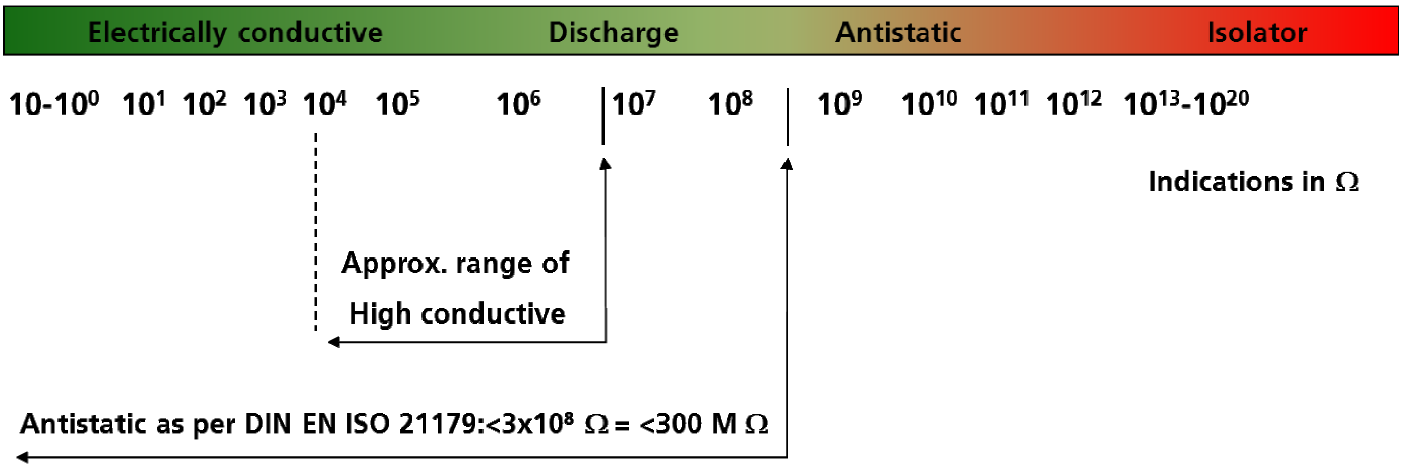
Antistatic

- AS-coating somewhere inside of the belt, embedded by isolators.
- Surfaces are isolators
- AS-coating prevents from generating to high electrostatic charges
- Friction on surface generates additional electrostatic fields or field generally can be to high

High Conductive

- Compound itself contains AS additives
- Surfaces are electrostatically conductive
- Surfaces prevent from generating electrostatic charges
- No additional fields generated by actions on surface, generated field generally extremely low

Surface resistance - static measured
The static test measures the surface resistance by using rod electrodes. The belt is antistatic if the surface resistance measured on both sides of the belt is equal or lower than $3x10^8$ (>300 MΩ).



Electrostatic charge - dynamically measured
The device measures the electrostatic charge of the running belt. Shielding plates ensure a correct measurement The belt is dynamically antistatic, if the electrostatic charge is lower than 1000 V/m.

Equipment
Installing antistatic approved products is one thing. To make sure that the belt is able to discharge the electrostatic load the following must be considered:

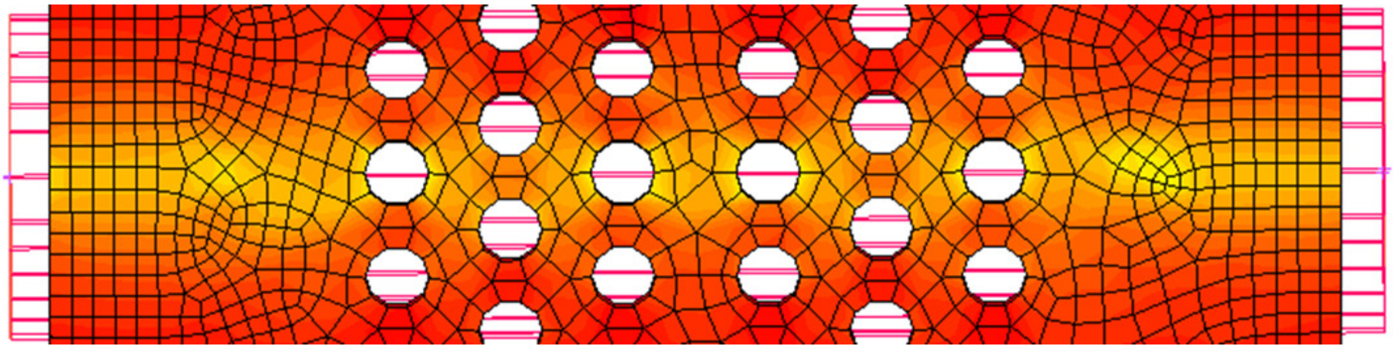
- Machine and equipment must be properly connected to the ground
- The antistatic properties of the belt deteriorate due to wear, dust and dirt
- Under special conditions (for example very dry environment) additional equipment can be necessary (for example ioniser)

Numerous systems are available to avoid electrostatic charge. The operating principle of an active ionisation is it to balance the disparity of electrons. You find these systems often in processing of foils with packaging machines.

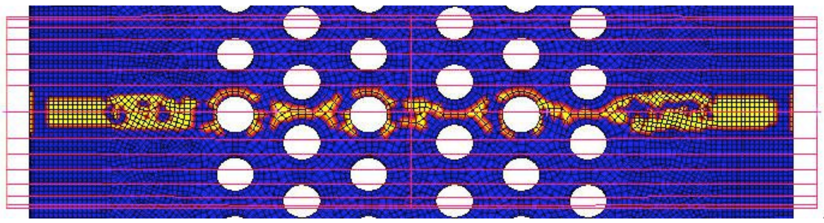
Perforation of process belts

In many industries process belts punched with holes for vacuum support are in use. Vacuum allows a faster and more precise transport. Nevertheless punching holes destroy some areas of the tensile member. The impact on the characteristic of the belt is even higher with narrower belts.
Analyses by finite element methods FEM confirm that the stress of the tensile member around the holes can be extremely high.

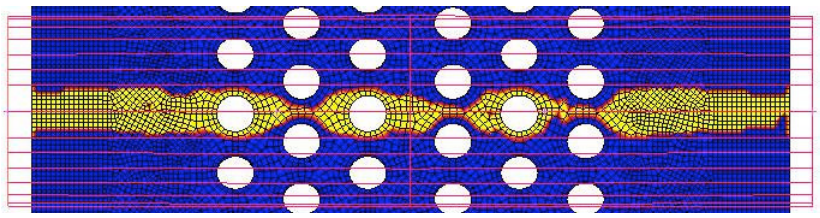
Stress of tensile member
The below example shows the stress in a perforated process belt, installed and tensioned with 0,5% elongation. While running over the pulley, the material shows an elongation of over 7% in some areas of the holes. This can exceed the tensile strength at break with fabric tensile members. Furthermore tracking of such a stressed belt is extremely difficult or even impossible.



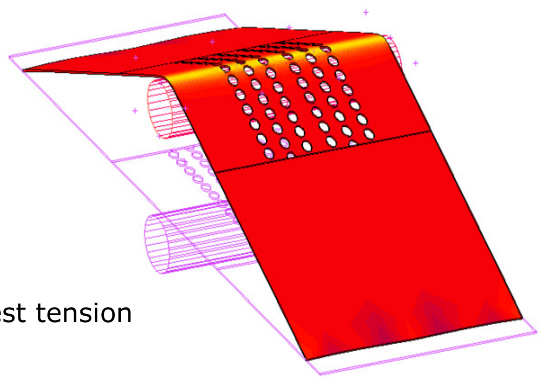
Contact surface
Looking at the contact area between pulley and belt it can be noticed that a belt with higher e-modulus shows a larger contact surface area. This is because of the higher tensile force at the same elongation value which results in a reinforcement of the belt. Certainly such belts show more guiding effect than the ones with lower e-modulus.



Contact surface area of PES-belt with e-modulus 1156 N/mm^2



Contact surface area of PES-belt with e-modulus 1613 N/mm^2



Recommendations

- Less than 25% of the belt width should be perforated
- Perforations must have a symmetrical layout
- Prefer belts with high e-modulus
- Avoid perforation in the centre of a belt as there is the highest tension due to crowning and the highest impact regarding tracking

Drive layouts Process & Transport

RAPPLON® High Performance Flat Belts in process and transport applications usually run on machines with various pulleys creating flexing and back flexing. The speed is unlikely higher compared to plied synthetic transport belts.
No matter how complex the application looks, the deciding factors to choose the right process and transport belt are rather simple:

1. Check application layout
Do the belts run over a slider bed or are they roller supported?
What are the minimum pulley diameters?

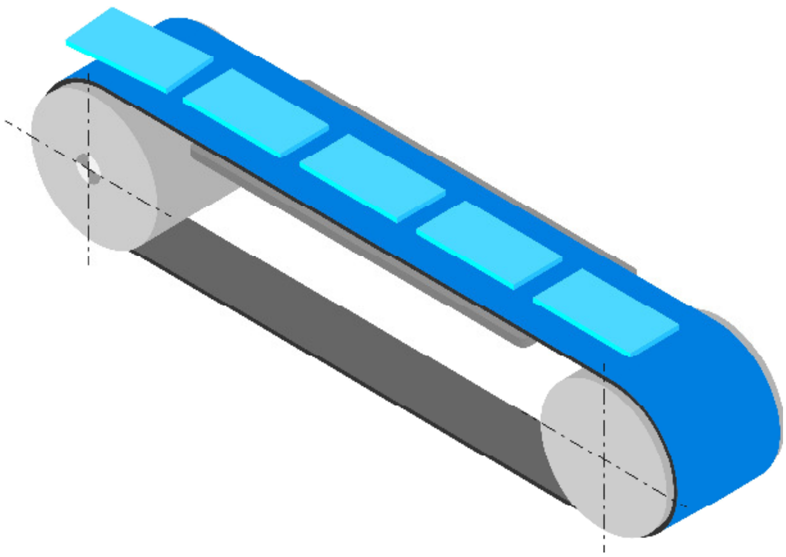
2. Define friction on running side
Depending on the application layout the friction on the running side can be defined.
See explanations on below layouts

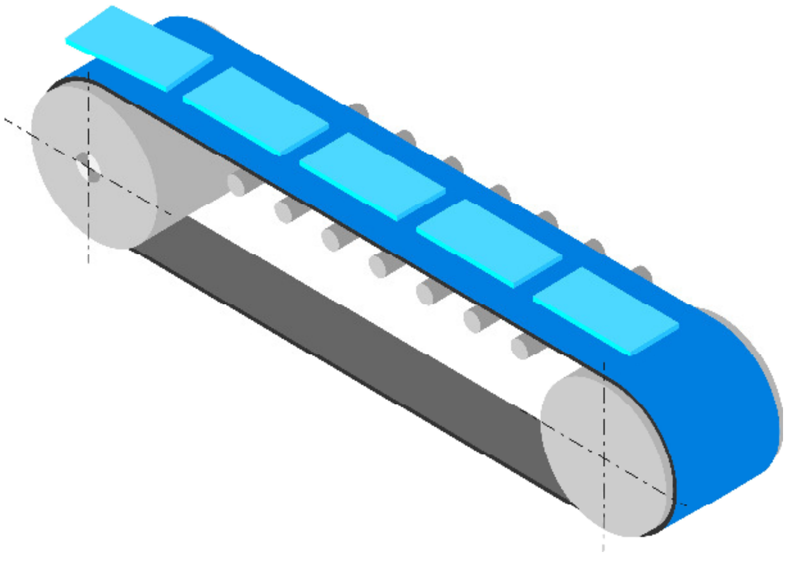
3. Define friction on transport side
Depending on the process and the goods, the friction cover can be defined.

Rubber	high grip and abrasive resistant —processing of paper, letters, etc.
Fabric	constant low grip, ideal in case of speed differences to avoid marking of goods due to relative movement
Fleece	gentle surface, ideal for decellerating sections as it is not marking goods
Polyurethane	medium grip, ideal for accumulations

4. Check thickness of belt
The belt thickness can be an important factor as the neutral layer and the belt thickness influence the circumferential speed.

Slider bed
The belt is supported by a slider bed.
Here the running side of the belt must have a low friction cover.



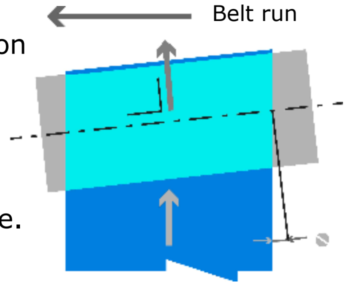


Roller support
The belt is supported by free rotating rollers. Therefore the friction of the running side is not limited. A rubber cover is recommended to improve the friction on the drive pulley.

Tracking Process & Transport

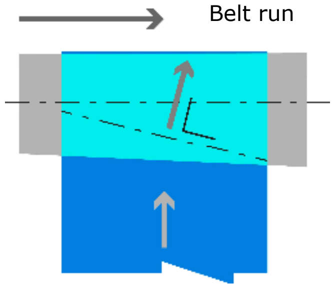
A belt reaching a drum/pulley will get a deflection from the first contact between belt and drum/ pulley. As a consequence, the belt is running to the direction where it is touching the turning drum or pulley.

Cylindrical pulleys
When a pulley is not placed rectangular to the belt, it will result in the situation as shown. The belt will move to the left as a nut does over a threaded pin.
In the most extreme case the belt will fold on the drum.

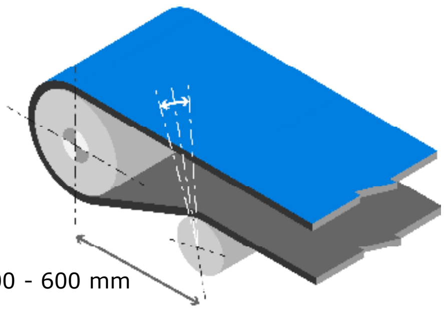


- The belt will run to the side with the lowest tension.
- The belt runs in the direction of the perpendicular line to the contact line.
- The belt runs in the direction where it touches the turning pulley first.

Conical pulleys
Here the belt moves to the right although the shafts of the pulleys are parallel to each other. The belt will run to the side with the highest tension. Therefore the belt will touch the drum somewhat higher (in direction of biggest conical diameter).

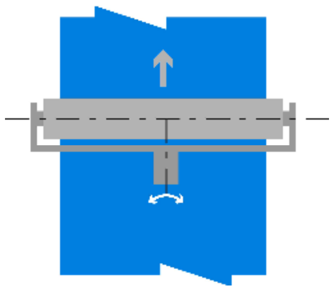


Flat (snub) tracking rollers
Mount the tracking rollers in a spot with low belt tension, usually before the return pulley. The arc of contact must be between 15° and 30°. Below 15° the contact between belt and pulley is too short, over 30° you will add tension which again will cause mistracking. There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

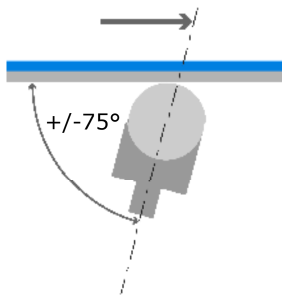


Tensioning-/ tail roll and tracking idler

Variable tracking with use of the belt
A flat tracking roller is mounted on the bottom side 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 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 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, by influencing the belt tension.
Manner of signalising: by direct belt contact (pneumatic tracer, micro switch), without contact (ultra sonar, photocell, pneumatic, approximation switch).



Tracking Process and Transport

Possible reasons for mistracking in Process and Transport applications

Belt
The below listed reasons result in a difference in surface pressure and/or friction on the pulley drive. When the belt:

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

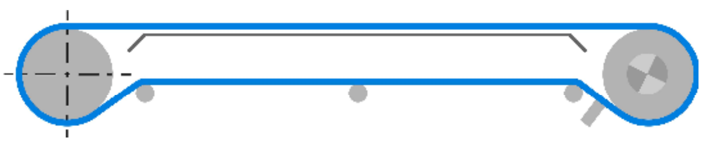
Other causes
Incorrect belt tension: When the tension is too low, the belt will go in every direction. When the tension is too high, a correction is not possible as the belt cannot slip sideways on the pulleys.
An incorrect fabric construction (not twisted SZ).
Fabric not in the correct position (angle) in the belt (oblique weft).

Pulleys
If pulleys are not parallel to each other and rectangular on the belt the result is also mistracking. Or the pulleys are not horizontal. Another reason is a difference in coefficient of friction over the pulley length (wrong shape, pollution, wear) or a difference in diameter on one side towards the other.
Note: Belt width and pulley length have to match.

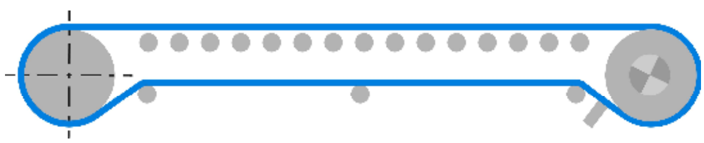
Product
Asymmetric load, incline/decline, loading/unloading on one side, or temperature differences in combination with the loading system can lead to mistracking too.

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.



Slider bed support



Roller support

Cross cutter / Sheeter

Paper is part of our life and is cut to size on crosscutters. They differ according to cut size and folio size. Cut size paper sheets are used for office and copy paper. Folio size sheets are much larger and therefore used for poster advertising and others.

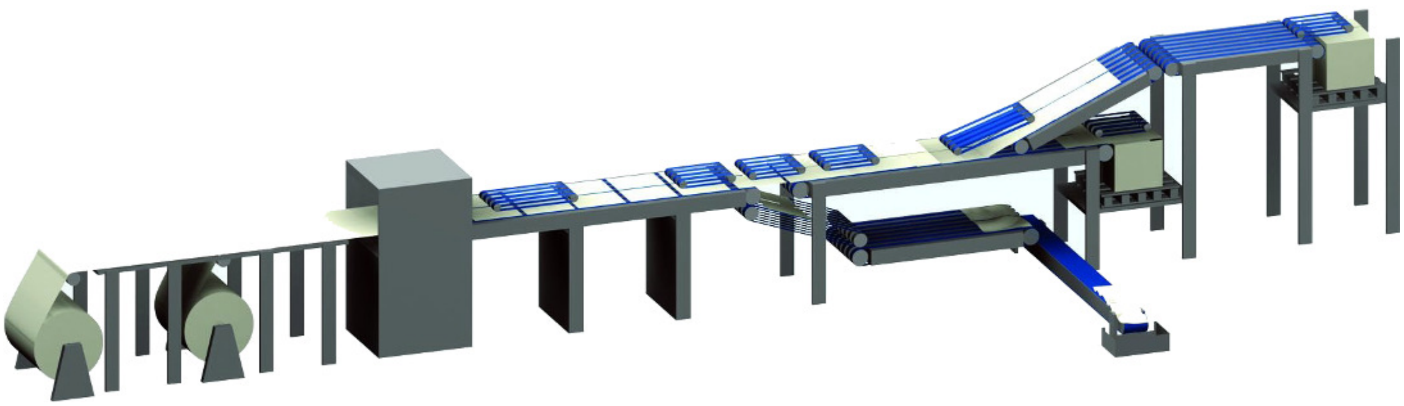
Crosscutter / Sheeter sections

Unwind station : Unwinding of one or several paper webs simultaneously
Decurling/Infeed : Eliminates possible distortions or curling of paper webs
Slitter : Rotary blades slit the paper web longitudinally
Crosscutter : Revolving knives cut the web at precisely synchronised speed
Catch section : Catch and clean cut sheets
Reject gate : High frequency scanners detect and reject non-conform products
Overlapping : Transferring and shingling of cut paper sheets
Stacker/collection : Collect sheets and form paper stacks or reams
Discharge : Discharge stacks or reams and process further (labelling, wrapping)

Belt requirements

- Constant coefficient of friction during the entire lifetime
- Positive control of relative movement between paper and belt
- Non marking surfaces
- Dimensional stability — no re-tensioning
- Permanently antistatic
- QuickSplice joining where applicable to reduce down time

Item	Description	Remarks
54582	GG P01.14 FQ	Transport
54607	GG E05.14 FFQ	Transport
54601	TT P02.12 Q	Catch section
54547	GV N20.17 FQ	Catch section
54559	UV E06.20 FQ	Catch section
54534	UU N17 RFQ	Stacker



Folder gluer

The folding and gluing process transforms a piece of flat material into a finished box. The blank is folded along pre-creased lines before adhesive is applied which will hold the product together. The entire folder gluer machine needs Flat Belts to transport and process the blanks into boxes.

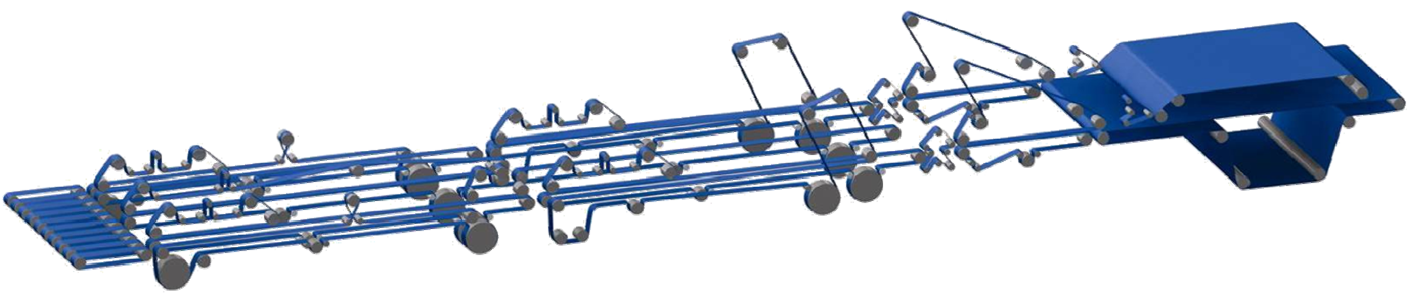
Folder gluer sections

Feeder	: Precise feeding of the blank for accurate processing
Pre breaker	: Break the creases of cartons for easier processing on automatic filling lines
Gluer	: Apply glue on the gluing flap
Folder	: Progressive folding of the final fold
Press station	: Pressing the glued flaps
Transfer section	: Ejects non-conforming cartons and shingles cartons for delivery
Delivery section	: Shingling and apply pressure to the box stream to allow good adhesive bonding

Belt requirements

- Highly flexible belt and splice
- High alternate flexing on small pulley diameters
- Abrasion resistant cover material, no glazing
- Excellent grip to paper
- Exact dimensional accuracy
- High edge stability
- Energy saving
- Long service life
- Safe tracking on high speed
- Low noise
- Standardised thickness
- Simple installation and easy tracking
- Reduced contamination effects due to suitable cover formulation

Item	Description	Remarks
54650	GG E10.30 RRQ	Energy saving, Bi-directional running, edges stabile
54651	GG E10.40 RRQ	Energy saving, Bi-directional running, edges stabile
54654	GG E10.55 RRQ	Energy saving, Bi-directional running, edges stabile
54274	GG S06.30 RRC	High edge stability
54145	GG S06.40 RRC	High edge stability
54275	GG S06.50 RRC	High edge stability
54276	GG S06.60 RRC	High edge stability



Web folder

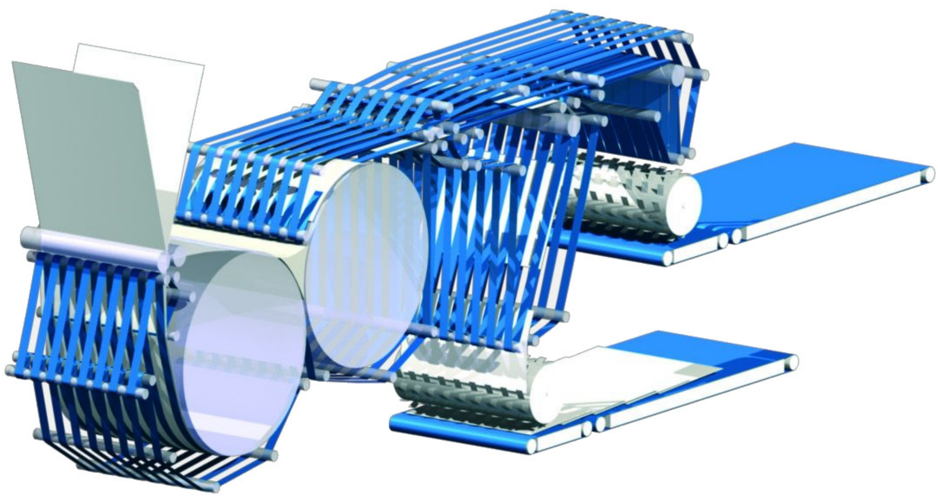
The production output of a web press is decisively influenced by the capabilities of the folder. Constant reliable high-speed is of great importance. In the folder, the tapes are reliably accelerating printed and cut sheets into the collecting cylinder, also under stringent conditions.
The relative movement between belt and the freshly printed paper is highly demanding. Special blend fabrics which cope with constant friction against abrasive paper over a prolonged service life. Materials resistant to the commonly used finishing solvents, are used to obtain longer belt life.

Web folder sections
Cutter cylinder : Cutting cylinders cut the web to single sheets, cutter belts accelerate them
Folding/Collecting : Folding, collecting single sheets and stitch them to bundles
Delivery : Shingling and transport the products to the post printing equipment

Belt requirements

- High alternate flexing at speed of over 18 m/s
- Highly resistant to paper abrasion, toluol, silicone, etc.
- Constant coefficient of friction during the entire lifetime
- Specific surface to avoid ink smearing
- Dimensional stability — no re-tensioning, High lateral stability for precise fold
- QuickSplice joining where applicable to reduce down time

Item	Description	OEM Equipment	Remarks
54598	TT E09.18 Q	KBA Magazine printing	Constant coefficient of friction during the entire lifetime Specific surface to avoid ink smearing Highly resistant to paper abrasion, toluol, silicone, etc.
54631	PG E08.18 SFQ	KBA Newspaper printing	Smooth black top cover to paper side (avoid ink smearing) Highly resistant to paper abrasion and toluol
54598	TT E09.18 Q	Cerutti	Specific surface to avoid ink smearing Improved performance on Cerutti Cassette system Highly resistant to paper abrasion, toluol, silicone, etc.
54270 54239	TT S02.10 C TT S02.10 C black	MAN Roland	TT S02.10 C initially equipped on MAN Roland Special resistant design for long service life Highly resistant to paper abrasion, toluol, silicone, etc.
54270 54239	TT S02.10 C TT S02.10 C black	Heidelberg	Outperforms original equipment competitor belt Special resistant design for long service life Highly resistant to paper abrasion, toluol, silicone, etc.
54270 54239	TT S02.10 C TT S02.10 C black	GOSS	Outperforms original equipment competitor belt Special resistant design for long service life Highly resistant to paper abrasion, toluol, silicone, etc.



Post printing equipment

There is a wide range of belts to suit different processes in post printing such as conveying, feeding, folding, stacking, laminating, cutting, shingling, addressing, bundling, packaging, punching, etc.

Post printing processes

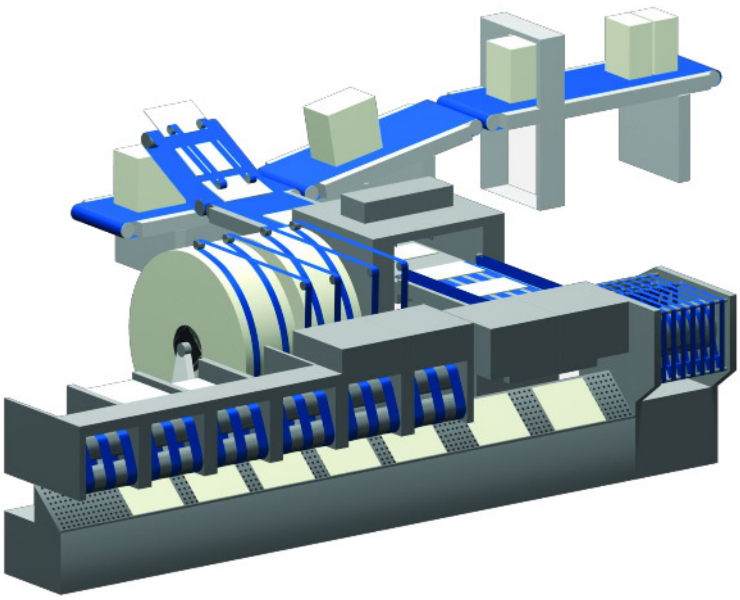
Supply products	: Conveying printed products from printer to post printing equipment
Inserter	: Insert special interest supplements and stitch them together
Trimmer	: Precise trimming of magazines and other products
Wrapper	: Wrapping products in film as an option
Stacker	: Bundling into stacks followed by palletizing and conveying

Important factors to choose the correct belt

- Application layout
- Friction cover depending on the process and the goods
- Thickness of belt
- Take up system

Common belt requests

- Easy and fast installation of tapes
- Highly flexible and durable endless joints
- Top quality cover materials for longer service life
- Optimum, consistent coefficient of friction during the entire service life
- No ink smear
- Flat laying to avoid marking
- Improved dimensional stability, insensitive to moisture fluctuations
- Permanently antistatic
- QuickSplice joining
- Elastic Process Belts for fixed shafts without tensioning device



Tube winder / Core winder

This is a demanding application regarding tensile strength, shearing forces and abrasive paper.
Please pay attention to the following remarks based on long term experiences:

- Belt width 5 - 10 % narrower than paper width
- Belt width max. 2x mandrel diameter (2x tube inner diameter)
- Watch minimum diameters (tube inner diameter)
- Watch maximum diameters (tube outer diameter)
- Watch drum diameters (~ min. belt diameter)
- All rolls must be in touch over the full belt width
- All rolls must run freely
- Different belt portions should not touch
- Avoid too high belt tensions
- Adjust belt tension after change of tube diameter
- Entire belt run must be clean (no glue, no dust)
- Clean belt manually with soft detergents
- Apply 90° high quality endless joint
- Never run belt without paper
- Possibly suggest twists

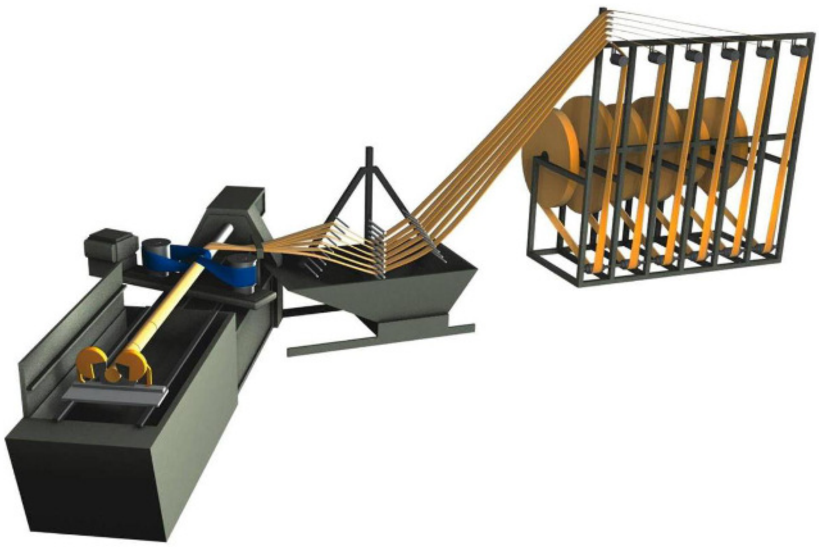

No twist


180° One-Half Twist Left


180° One-Half Twist Right


360° Complete Twist Left


360° Complete Twist Right



Belt recommendations

Item	Description	Minimum Core inner diameter in mm	Minimum Core outer diameter in mm	Maximum Core outer diameter in mm	Maximum wall thickness in mm	Minimum drive drum diameter in mm
54243	GG S07.30 RRC	30	32	50	4	40
54133	GG S09.31 RRC	40	50	80	6	60
54278	GG S11.50 RRC	40	50	120	10	80

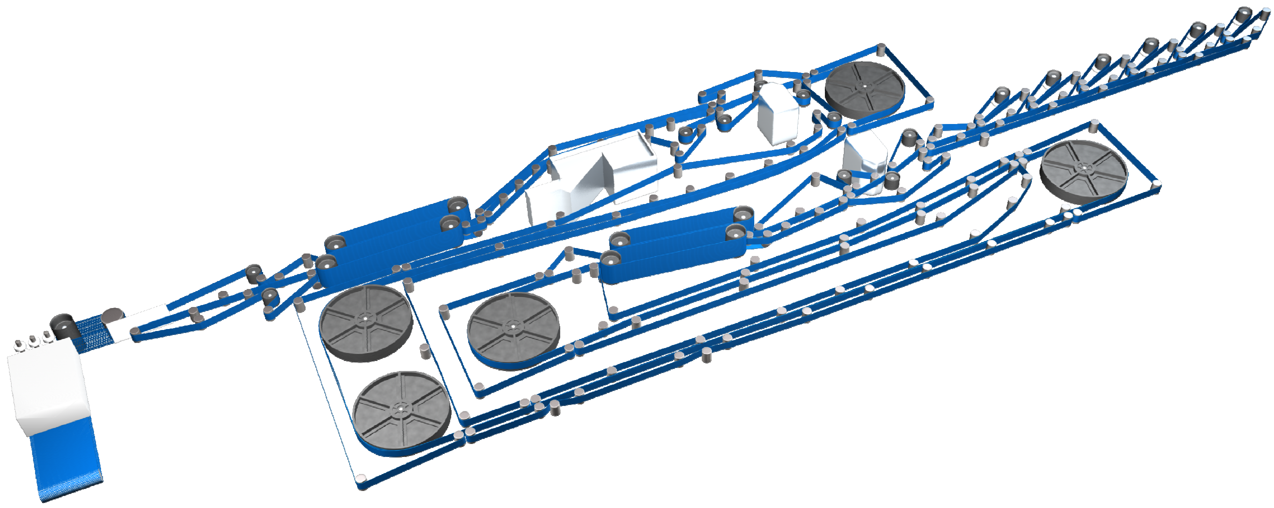
Letter sorter

The postal market of the future needs a high level of automation for a high level of service quality. Letter sorting systems sort the mail by direction, city, post box, volume mailers, street and house number – or, if desired, even by the particular mail carrier's route.
RAPPLON® belting solutions for letter sorting machines feature high operational throughput, along with extended service life and minimised energy consumptions.

Letter sorters have different sections:
1. Horizontal edger feeder
2. Pick-off
3. Leveller
4. Format control
5. OCR Optical Character Reader
6. Delay section / Video coding
7. Encoder
8. Bar code reader
9. Tier feeder
10. Stacker final two level sorter

Belt requirements
- Highly flexible belt and splice
- Abrasion resistant surface, no glazing, excellent grip
- Exact dimensional accuracy
- Energy saving
- Simple installation and easy tracking
- Low noise
- Improved anti static properties
- Minimised "Memory-effect" (deformation process of belts wrapped around pulleys at start up)

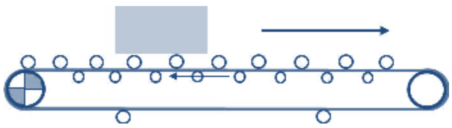
Item	Description	Application
	TEF 22 + EPC 040 red	Pick off belts
54585	GG N15 FFQ	Leveller belt
54583	GG E03.14 FFQ	Transport belt
54614	GG E08.20 RRQ	Drive belt
54585	GG N15 FFQ	Turn over belt
54557	UV N12 FQ	Bull wheel belts
54587	TU N08 FQ	Shaker belt



Live roller conveyor drive

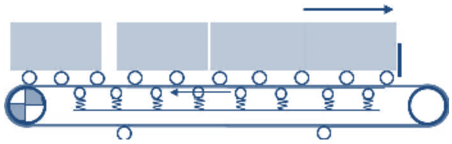
In todays material handling logistic live roller conveyor drives are essential. It is not only transport from A to B, also order picking or sorting processes are done on live conveyor roller drives.
The goods are transported on carrying rollers which are moved by a strong and narrow flat belt.
To transmit the power from flat belt to carrying roll pressure rolls in certain distances are necessary.

Continuous running system



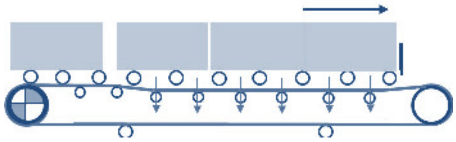
- Continuous running of carrying rollers
- No accumulation, no stops
- Pressure rollers can be fixed
- Flat belts with high friction rubber covers on top and bottom recommended

Low pressure accumulation



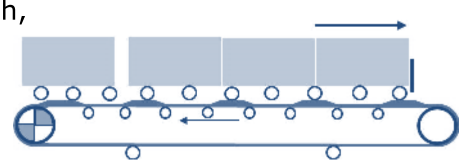
- Spring loaded pressure rollers can release while accumulating
- Belt continuous to run while accumulating
- Flat belts with high friction on drive pulley, low friction on carrying roller recommended

Zero pressure accumulation



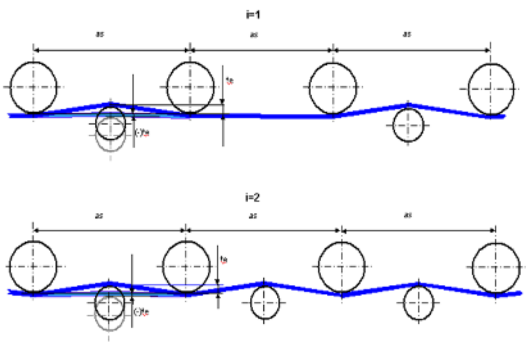
- Devices separate the pressure rollers from the carrying rollers during accumulation process
- Pressure roll lifting device can be mechanically, pneumatically or electromechanically operated
- Different sections of the roller conveyor can be independently engaged or disengaged
- Flat belts with high friction rubber covers on top and bottom recommended

Exciter/Activator belts

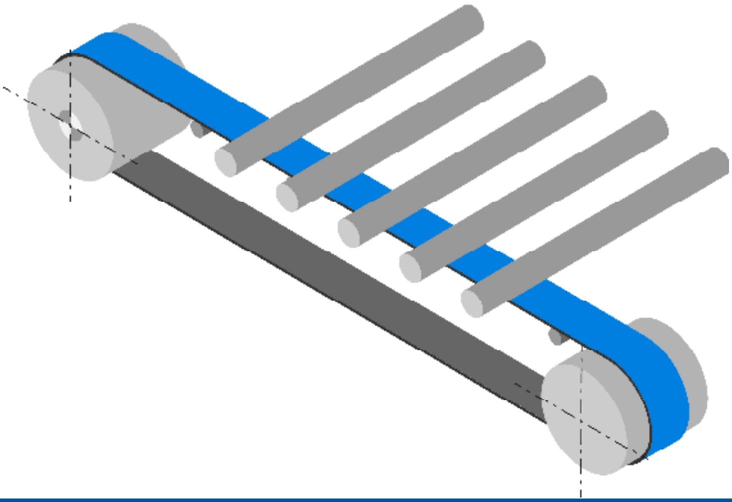


- Known as "ripple belt" pads, these pads can be made any length, thickness and width required.
- As the belt and pads travel underneath the carrier idlers, the pads contact the rollers and drive them, propelling a unit load forward.
- Spreader belt with PU-cover and PU cleats recommended

RappCalc



All sort of roller conveyor drives can be calculated by the sophisticated RappCalc: Diverters, Accumulations, Inclines.
RappCalc is calculating the correct insertion depth t_e considering belt thickness, friction factor and circumferential force F_u.

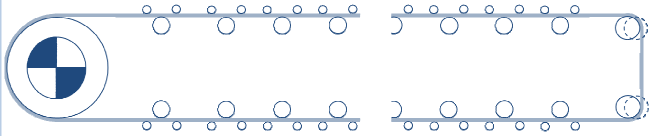


Ring spinning

Ring spinning is the most popular spinning operation. In ring spinning frames the roving will be stretched by the multiplier of 40-50 and at the same time twisted. The twist for the thread is given by a small runner which is moving on a circular course and winds the thread on a coil. For every twist in the yarn the coil makes a full rotation. The higher the speed of the coils the better the quality. The below mentioned drive systems are the most common ones but there are many more.

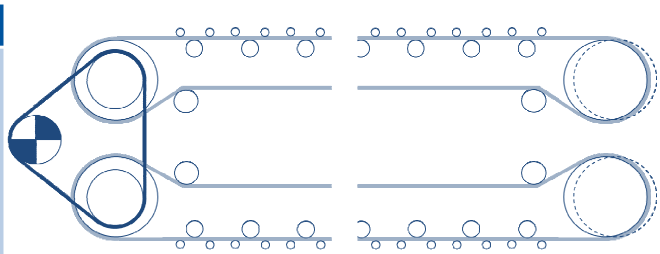
Single belt tangential drive system
The belt is driven on the inner side and drives hundreds of spindles on the outer side.

Pros	Cons
-Simple drive principle -Few flexing, no back flexing	-Strong belts needed -high shaft and bearing loads -Long take-up system -Significant spindle rev variation from first to last spindle -Demanding belt tracking



Dual belt tangential drive system
The main drive belt powers the two tangential belts located on each side of the spinning frame.

Pros	Cons
-Lower belt strength required -Lower shaft and bearing load -Few flexing and back flexing	-Different elongation and running conditions for each belt (pulled / pushed) -high shaft and bearing loads -Long take-up system -Different spindle revs between the belts because of creep on the main drive belt



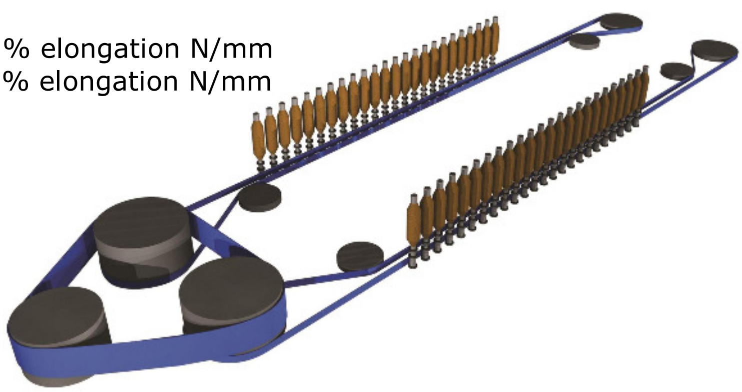
Belt requirements

- High and constant coefficient of friction
- Wear resistant covers, no glazing, peeling or cracking
- Long service life (years)
- High accuracy of thickness
- Perfect tracking
- Short take-up, no re-tensioning
- Energy saving

Replacement of existing belts
Existing belts are often replaced by belts with similar but not equal strength. In such case the tension of the belt must be adapted accordingly to get an equal shaft load.

$$\varepsilon_{new} = \frac{k1\%_{exist} \cdot \varepsilon_{exist}}{k1\%_{new}}$$

$k1\%_{exist}$ = Specific belt strength (dynamic) at 1% elongation N/mm
$k1\%_{new}$ = Specific belt strength (dynamic) at 1% elongation N/mm
ε_{exist} = Elongation existing belt (%)
ε_{new} = Elongation new belt (%)



RappCalc
All sort of spinning drive systems can be calculated by the sophisticated RappCalc.

Power Transmission

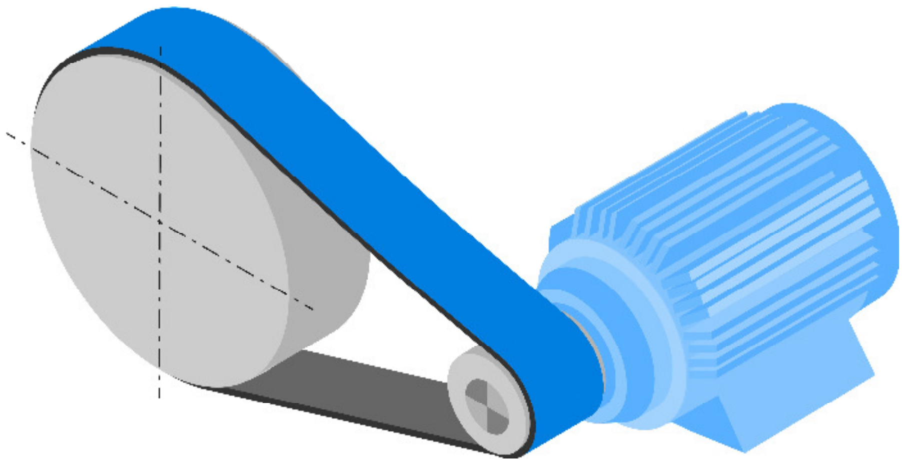
RAPPLON High Performance Flat Belts are very reliable and long lasting in Power Transmission appli-cations, provided the following requirements are provided:

- The belt should be specified according to its application and calculated by RappCalc
- Belt type, belt dimensions and initial elongation must be applied as calculated
- The actual operating conditions correspond with the initial specifications as calculated
- The fabrication and splice is made according to the RAPPLON® recommendations

RappCalc
RappCalc is the solution to calculate comprehensive Power Transmissions. By entering specific data you get a detailed and precise belt recommendation with all referring results such as shaft loads, forces, working tension and many more. Contact us for a calculation.

Overview tensile members
We offer a wide range of Power Transmission belts with different tensile members. This overview shows some indications for comparison reasons. Always use RappCalc to find the best solution.

Tensile Member	Polyamide foil	Polyester fabric
Description	Drive belts with Polyamide tensile member show excellent shock absorbing characteristics, as well as high lateral and edge stability	Drive belts with Polyester tensile member allow to transmit high peripheral force and permit smaller deflecting pulley diameters as well as short take up designs.
Heavy peak loads	Load factor c 1.4 — 1.5	
Medium peak loads	Load factor c 1.3 — 1.4	Load factor c 1.3 — 1.4
Even loads	Load factor c 1.0 — 1.2	Load factor c 1.0 — 1.2
Absorbing of overload impact	Very good	medium
Initial fitting elongation	1.8 % - 3.0 %	0.5 % - 2.0 %
Take up design	Long take up required	Short take up allowed
Elongation at break	20—30 %	7—12 %
Fabrication	Classic splice, skived and glued	QuickSplice



Power Transmission

Overview cover materials

We offer a wide range of Power Transmission belts with different cover materials. This overview shows some indications for comparison reasons. Always use RappCalc to find the best solution.

	Single side Power Transmission Double side Power Transmission	GT Sxx C GG Sxx C	GG Sxx LRC GG Sxx LRC (limited)	LT Sxx C LL Sxx C
Environment	**Clean**	+	+	0
	Dusty, Dirty, Oily	-	-	+
	Wet or very humid	-	+	+
Start-up characteristic	**Smooth start-up (frequency controlled)**	+	+	+
	Medium start-up (clutch, y-triangle)	0	+	+
	Jerking start-up (direct)	-	-	+
Drive characteristic	**Even loaded drive (load factor <1.2)**	+	+	+
	Medium peak loads (load factor <1.3)	0	+	+
	Heavy peak loads (load factor 1.3-1.5)	-	-	+
	High load changes — no slip allowed	0	+	-
	High load changes — slip allowed / required	-	-	+
Belt speed	**< 40 m/s**	+	+	+
	< 60 m/s	+	+	-
	Low speed, high force — high torque	-	0	+
	High speed, high force — low torque	+	0	-
Friction requirements	**Low friction**	-	-	0
	Medium friction	0	0	+
	High friction	+	+	-
Drive design	**Cone drive (shifting fork)**	-	0	+
	Crossed drive	0	0	+
Aero planning effect	**Reduced aero planning effect**	-	+	I

Aero planning effect

- Aero planning effects = Captured air between belt and pulley which has to escape laterally
- Air film can reduce contact pressure between belt and pulley
- High speed, wide width and long area of contact can create noise/whistle
- Aero planning effects can occur on GG / GT / LL / LT-style belts
- No aero planning effects with GG Sxx LRC belts as they are equipped with longitudinal grooves

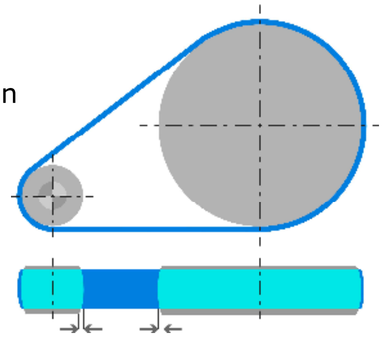
Noise/whistle

Check the following possible sources for noise creation:

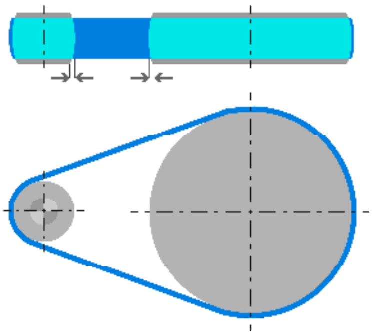
- Large contact area on the larger pulley
- High circumferential force $F_{u\ max}$
- High cover adhesion μ
- High belt speed v
- Incorrect pulley alignment

Drive layouts Power Transmission

Horizontal drive
Basically, the large pulley should be manufactured with a crown.
With horizontal shafts, the small pulley can be cylindrical if the transmission ratio exceeds 1:3.
The crowning height h1 and h2 should be taken from the table.



Vertical drive
With vertical shafts, both pulleys should always be crowned.
The crowning height h1 and h2 should be taken from the table.

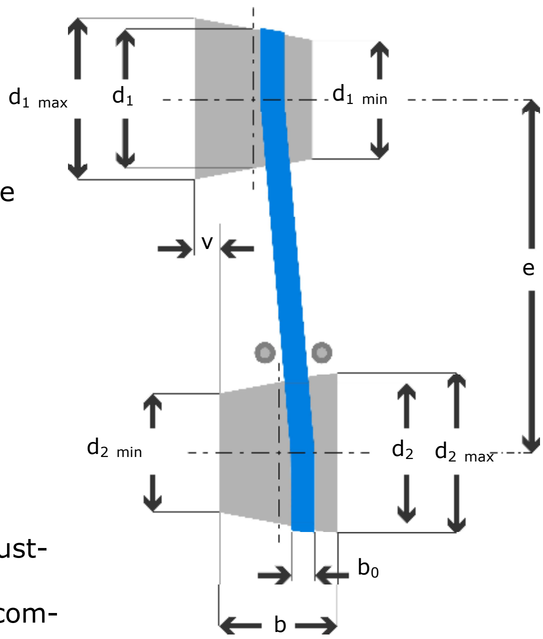


Cone drive
A belt as thick and narrow as possible should be selected.
Ease of movement is thereby assured, the distortion of the flat belt is lessened and, in addition, the range of adjustment is increased.
The conicity «K» should amount to max. 10%.
Both pulleys should have the same conicity.
When the power to transmit is low, as for example in the textile industry, then «K» can be increased to 15%.

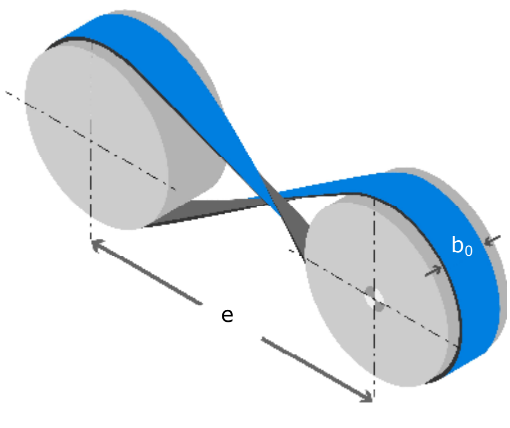
$$K = \frac{d_{max} - d_{min}}{b} \cdot 100\ (\%)$$

The transmission ratio «i» should be in the range between 1:1 to 1:1,2. The off-set «V» should not exceed V ≈ 0,5 · b0

Only idler pulleys with ball bearings should be used for the adjustment operation.
Leather covered belts or belts with longitudinal grooves are recommended.



Crossed drive
A narrow, thick flat belt should be used in order to keep the distortion at the point of intersection as low as possible.
With the correct selection of the pulley diameter, the transmission ratio and the pulley distance, only a light contact takes place at the point of intersection.

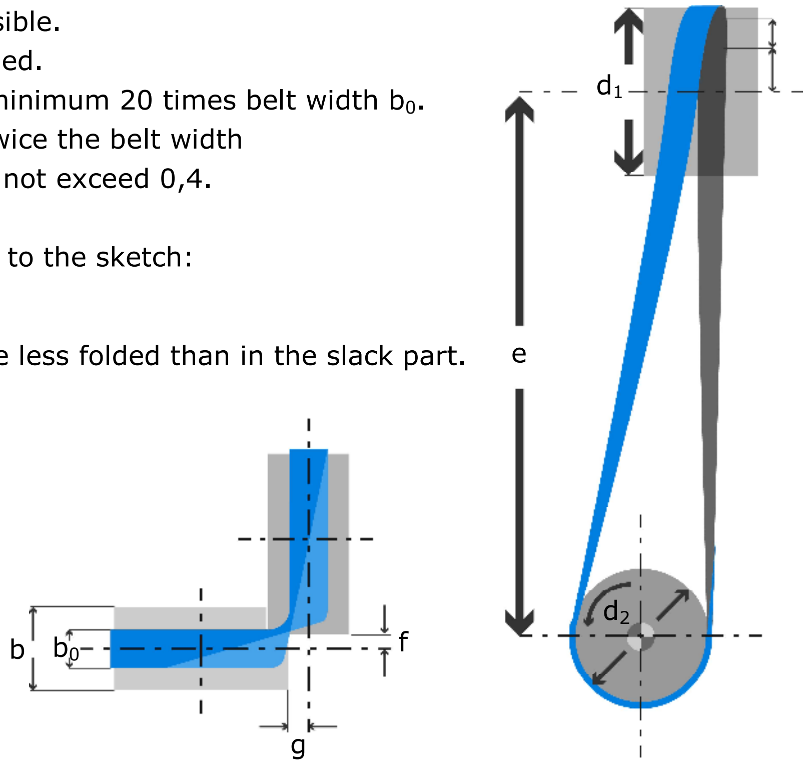


Drive layouts Power Transmission

Half crossed drive

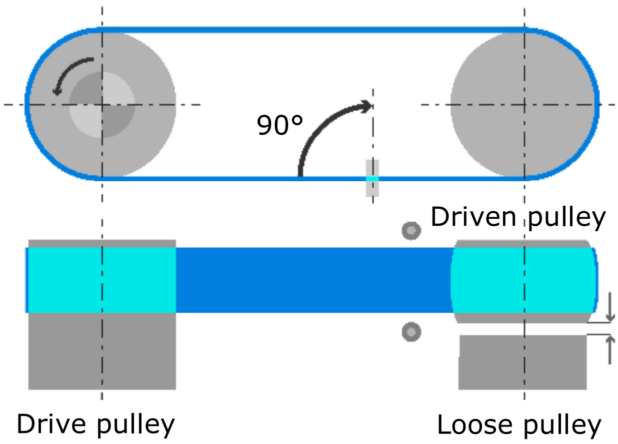
The half cross drive transmits power between two shafts which cross at an angle of 1° to 90°. The belt must run parallel onto the pulleys. A crossed flat belt is subject to high stress through distortion. One belt edge is exposed to additional tensile stress. For that reason it is an advantage to select the cross section of the belt as narrow and thick as possible.

- Keep pulley diameter as large as possible.
- Pulleys must be cylindrical, not crowned.
- Shaft distance as much as possible, minimum 20 times belt width b_0.
- Pulley face width should be at least twice the belt width
- Ratio from small to large pulley must not exceed 0,4.
- No reverse drive possible
- Pulleys must be misaligned according to the sketch:
  $g = 0{,}5 \times b_0$
  $f = 0{,}2 \times b_0$.
  In the pulling portion the belt must be less folded than in the slack part.



Shifter belt drive

Recommended is a flat belt which is as thick and narrow as possible, in order to achieve high cross sectional strength and low resistance to displacement.
In order to protect the edges of the flat belts, use rotary shifters with their axis at 90°. Set the shifters at the position where the belt enters the driven pulley.

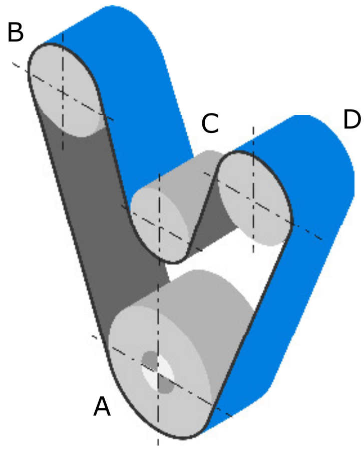


Tracking Power Transmission

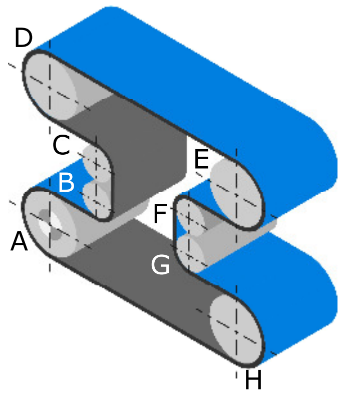
A belt reaching a pulley will get a deflection from the first contact between belt and pulley. As a consequence the belt is running to the direction where it is touching the turning pulley. Performance and efficiency of a drive system can only be guaranteed if the belt is properly tracked.
There are several recommendations to follow:

- Drive pulley should always be crowned
- Basically, only those pulleys should be crowned on which the same side of the belt is running

A, B and D can be manufactured with a crown. With short flat belts, a crown on the pulley A is sufficient. Do not crown pulleys running on opposite sides of the belt (e.g. C should never be crowned with A, B or D crowned).



A, D, E and H can be manufactured with a crown. With short flat belts, a crown of pulleys A and E is sufficient.
Recommendations:
In principle the pulleys and rollers must be adjustable.
For high belt speeds v > 2 m/s balance the pulleys.



Reasons for miss-tracking

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 not correctly tensioned. When the tension is too low, slippage occurs and the belt will go in every direction.

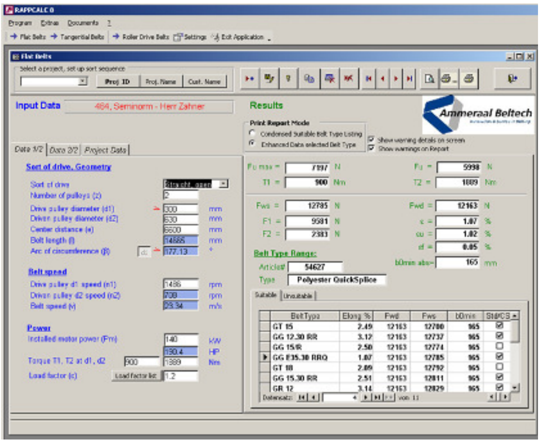
Pulleys
If pulleys are not parallel to each other and squarely on the belt the result is also mistracking.
Or the pulleys are not horizontal. Another reason is the rim shape or crowning of pulleys.

Transmitting power
In case the power is too high or the belt strength too low slippage and mistracking can occur. Always use our RappCalc software to calculate the correct belt strength, belt width and elongation and you are on the safe side. Do not replace a competitors belt without calculation.

Frame
The frame might not be stable.

Calculation Power Transmission

RappCalc
RappCalc is the solution to calculate comprehensive Power Transmissions. By entering specific data you get a detailed and precise belt recommendation with all referring results such as shaft loads, forces, working tension and many more. Contact us for a calculation.



Calculation assisted by charts
The calculation of the suitable belt for Power Transmission applications can also be done according to the following explanation. It can be of assistance as a guide line and to understand the relations between some parameters. Go through the following steps to calculate a suitable belt:

1. Belt speed v
2. Peripheral force Fu
3. Maximum peripheral force Fu max / Load factor
4. Arc of contact
5. Chart
6. Theoretical belt width b0
7. Initial elongation ε
8. Shaft loads stand still
9. Shaft loads running
10. Cover material choice
11. Belt length l

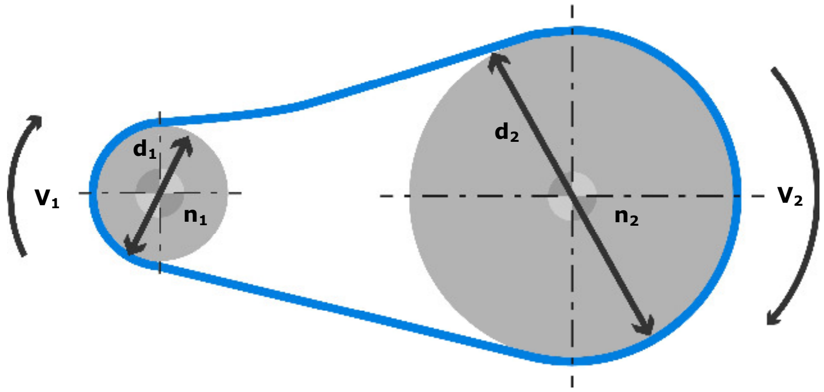
Abbreviation

Fw	= Shaft load	(N)
Fws	= Static shaft load	(N)
Fwd	= Dynamic shaft load	(N)
F_1	= Force in tight portion	(N)
F_2	= Force in slack portion	(N)
F_u	= Peripheral force	(N)
$F_{u\ max}$	= Maximum peripheral force	(N)
ε	= Total elongation	(%)
ε_u	= Basic elongation	(%)
ε_c	= Centrifugal elongation	(%)
V	= Belt speed	(m/s)
n_1	= Number of revolutions	(1/min)
n_2	= Number of revolutions	(1/min)
d_1	= Diameter of driving pulley	(m)
d_2	= Diameter of driven pulley	(m)
i	= Transmission ratio	
b_0	= Belt width	(mm)
l_g	= Geometrical belt length	(mm)
l_e	= Effective belt length	(mm)
PM	= Motor power	(kW)
d_l	= Diameter of large pulley	(mm)
d_s	= Diameter of small pulley	(mm)
c	= Centre distance	(mm)
k1%	= Specific belt strength (dynamic) at 1% elongation (N/mm)	
β	= Arc of contact on small pulley (°)	

Calculation Power Transmission

1. Belt speed v
The peripheral belt speed is equal on both pulleys (creep not considered)

$$V = \frac{d_1 \cdot \Pi \cdot n_1}{60}$$



Transmission ratio i

$$i = \frac{n_1}{n_2} = \frac{d_2}{d_1}$$

Number of revolutions of driven pulley

$$n_2 = n_1 \cdot = \frac{d_1}{d_2}$$

Note: The above listed formulas are theoretical as they do not consider the position of neutral layer nor the system inherent creep.

2. Peripheral force

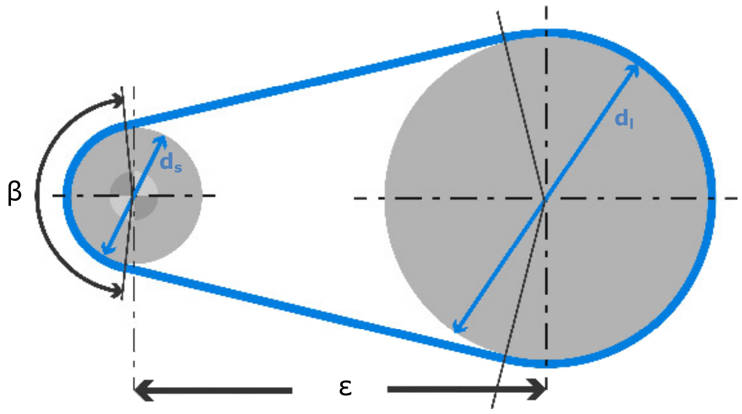
$$F_u = \frac{PM}{V}$$

3. Maximum peripheral force / Load factor
Please refer to the list of load factors according to your application

$$F_{u\ max} = F_u \cdot \text{Load factor}$$

4. Arc of contact
The arc of circumference of the smaller pulley limits the power transmission capacity.
In a two pulley drive system the sum of the arc of contacts of both pulleys is always 360°.

$$\beta = 180 - \frac{60 \cdot (d_l \cdot d_s)}{c}$$



The above formula is an approximate formula,
only suitable for β = 140° to 180°.
Otherwise a comprehensive trigonometric calculation would be necessary.

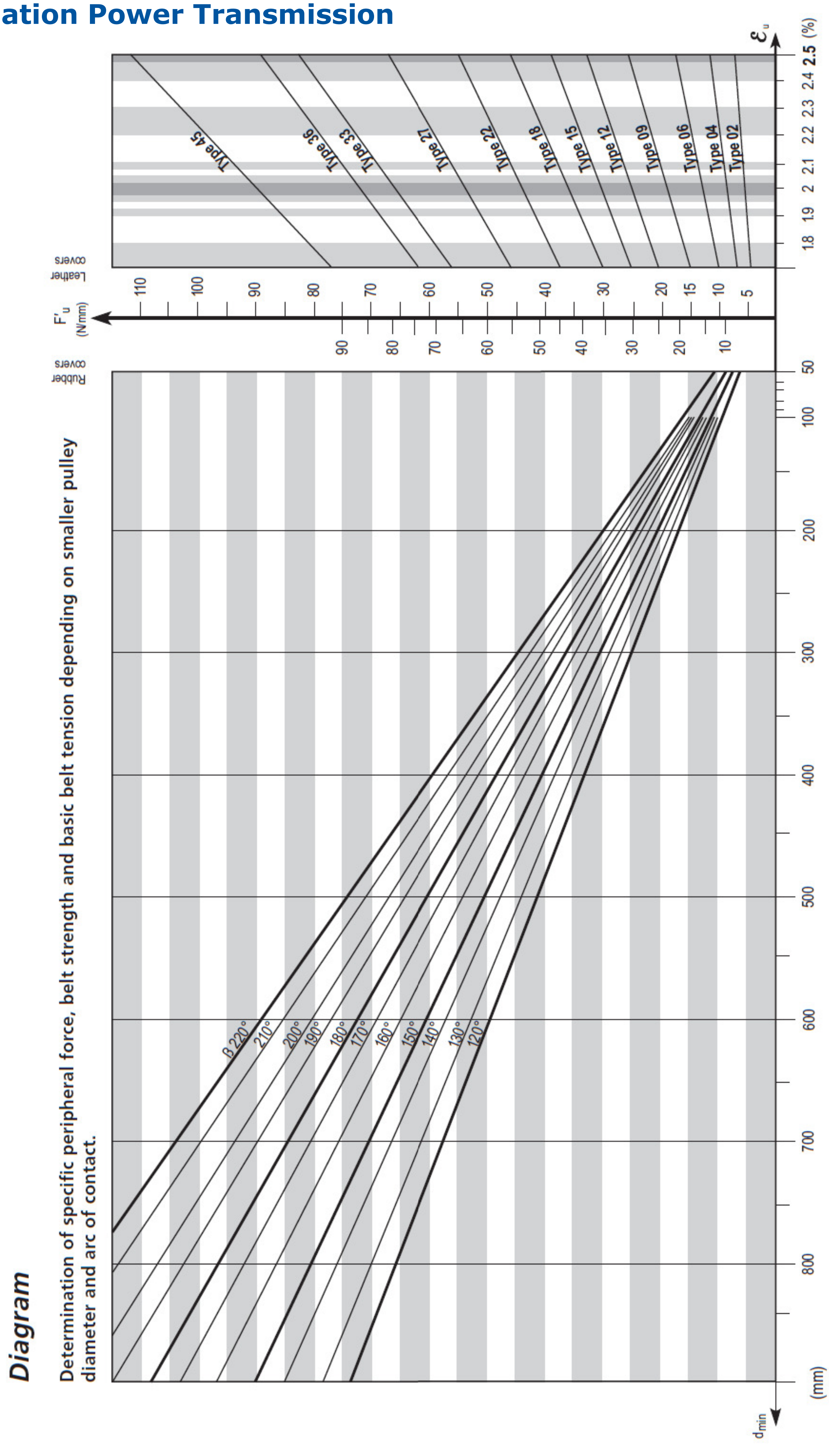
Calculation Power Transmission

Choose the load factor according your application:

Motor start-up characteristics	Smooth	Medium	Abrupt, jerking
Sort of start-up control	**Electric, frequency converter**	**Correct start-Y, mech. or hydrodyn. clutch**	**Direct, pole changing, slip-ring motors**
Applications			
band saw	1.1	1.1	1.4
blower	1.0	1.1	1.3
card (main drive)	1.2	1.2	1.3
Centrifuges / centrifugal pumps	1.2	1.2	1.4
chaser mill	1.5	1.5	1.5
centrifugal compressor	1.0	1.1	1.3
circular saws	1.1	1.1	1.4
compressor, piston (cyclic variation <1:80)	1.5	1.5	1.5
compressor, piston (cyclic variation >1:80)	1.3	1.3	1.5
crusher, stone	1.4	1.4	1.4
Decanter / seperator	1.1	1.2	1.3
drilling m/c (metal)	1.2	1.2	1.4
elevator, chain or bucket	1.1	1.1	1.4
fan / ventilator	1.1	1.2	1.4
generator	1.1	1.2	1.2
grinder, cylindrical	1.0	1.1	1.4
hammer mill	1.4	1.5	1.5
hydro plant generator	1.1	1.2	1.2
lathe	1.0	1.1	1.4
machine tool	1.2	1.2	1.4
mill, hammer / rolling	1.4	1.5	1.5
milling cutter (metal)	1.2	1.2	1.4
piston compressor (cyclic variation <1:80)	1.5	1.5	1.5
piston compressor (cyclic variation >1:80)	1.3	1.3	1.5
planer (metal)	1.2	1.2	1.4
press	1.2	1.2	1.4
pulper	1.1	1.1	1.4
pump, centrifugal, rotary	1.0	1.2	1.4
rotary compressor	1.1	1.2	1.4
saw, band or circular	1.1	1.1	1.4
saw, frame (1st belt, motor b., direct drive)	1.2	1.2	1.3
spinning m/c (main drive)	1.1	1.1	1.4
stamper, metal	1.2	1.3	1.4
stone crusher	1.5	1.5	1.5
stone, marble saw frame, (wet)	1.3	1.3	1.3
vibrator	1.5	1.5	1.5
wood chipper / wood chopper	1.3	1.4	1.5

Calculation Power Transmission

5. Chart



Calculation Power Transmission

6. Theoretical belt width
Determine the minimum (theoretical) belt width:

$$b_0 = \frac{F_{u\ max}}{F_u}$$

7. Initial elongation

$$\varepsilon = \varepsilon_u + \varepsilon_c$$

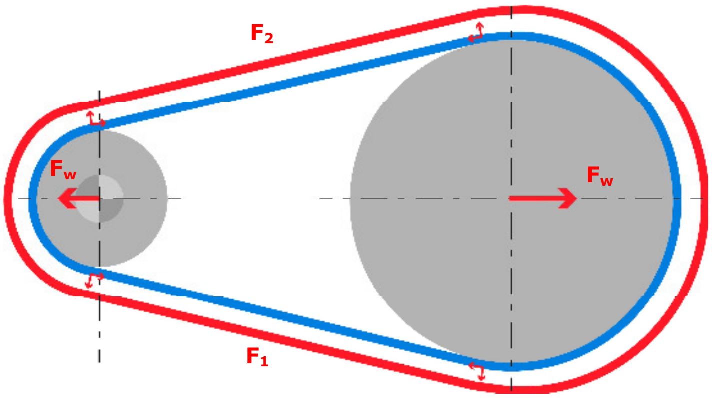
Chart for centrifugal elongation ε_c in % at v in m/s

Belt speed v im m/s Type	<20	20-29	30-39	40-49	50-60
02	0	0	0	0	0
04	0	0	0	0.1	0.2
06	0	0	0.1	0.2	0.3
09	0.1	0.1	0.1	0.3	0.4
11	0.1	0.1	0.2	0.3	0.5
15	0	0.1	0.2	0.4	0.6
18	0	0.1	0.3	0.5	0.7
27	0.1	0.2	0.4	0.7	1.1
36	0.1	0.3	0.6	1.0	1.4

8. Shaft load under stand still or idling condition

$$F_1 = F_2$$

$$F_{ws} = F_1 + F_2$$



Calculation Power Transmission

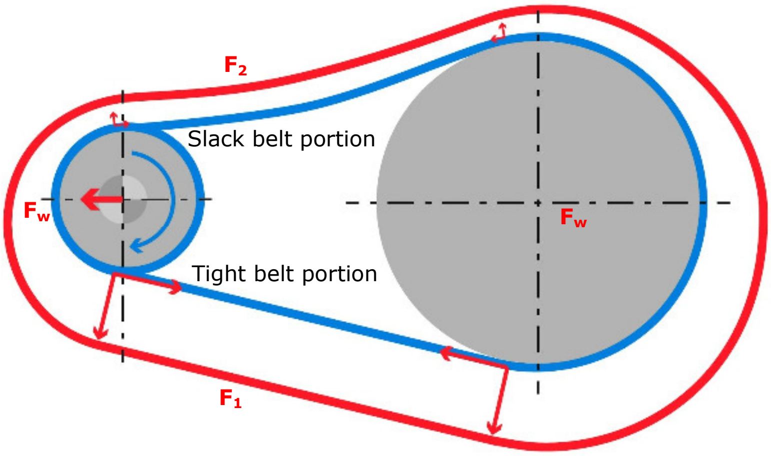
9. Shaft load under running condition
Under dynamic conditions the shaft load and forces increase due to the centrifugal force.

$F_1 > F_2$

$F_{wd} = F_1 - F_2$

$F_{wd} < F_{ws}$

$F_{wd} = \varepsilon \cdot k1\% \cdot b_0 \cdot 2$



10. Belt length
The geometric belt length is the inner circumference of an un-tensioned belt (steel tape length). Belt thickness and position of neutral layer are not considered.

$$l_g = 2c + \frac{\Pi}{2} \cdot (d_l + d_s) + \frac{(d_l - d_s)^2}{4c}$$

The above is an approximate formula valid for β = 140° to 180°
Otherwise a comprehensive trigonometric calculation would be necessary.

11. Cover material

Layout	Single side power transmission	Both sides power transmission
Standard drive system	GT Sxx RC	GG Sxx C
Dirty, dusty or oily conditions	LT Sxx C	LL Sxx C
Clean environment Hydro plants	GG Sxx LRC	

Notes

June 2014 TM

Local Contacts

Austria
T +43 171728 133
info@ammeraalbeltech.at
www.ammeraalbeltech.at

Belgium
T +32 2 466 0300
salesgb@ammeraalbeltech.be
www.ammeraalbeltech.be

Canada
T +1 905 890 1311
info@ammeraalbeltech.ca
www.ammeraalbeltech.ca

Chile
T +56 266 96975
info@ammeraalbeltech.cl
www.ammeraalbeltech.cl

China
T +86 512 8287 2709
info@ammeraalbeltech.com.cn
www.ammeraalbeltech.com.cn

Czech Republic
T +420 567 117 211
prodej@ammeraalbeltech.cz
www.ammeraalbeltech.cz

Denmark
T +45 75 72 31 00
admin@unichains.dk
www.unichains.com

Finland
T +358 207 911 400
info@ammeraalbeltech.fi
www.ammeraalbeltech.fi

France
T +33 3 20 90 36 00
client@ammeraalbeltech.fr
www.ammeraalbeltech.fr

Germany
T +49 4152 937-0
sales@ammeraal-beltech.de
www.ammeraalbeltech.de

Hungary
T +36 30 31 6099
info@ammeraalbeltech.hu
www.ammeraalbeltech.hu

India
T +91 44 265 34 244
info@ammeraalbeltech.net.in
www.ammeraalbeltech.com

Italy
T +39 051 660 60 06
info@ammeraalbeltech.it
www.ammeraalbeltech.it

Luxembourg
T +352 26 48 38 56
sales@ammeraal-beltech.lu
www.ammeraal-beltech.lu

Malaysia
T +60 3 806 188 49
sales.kl@ammeraalbeltech.my
www.ammeraalbeltech.com

Netherlands
T +31 72 57 51212
info@ammeraalbeltech.nl
www.ammeraalbeltech.nl

Poland
T +48 32 44 77 179
biuro@ammeraalbeltech.com
www.ammeraalbeltech.com

Portugal
T +351 22 947 94 40
geral@ammeraalbeltech.pt
www.ammeraalbeltech.pt

Singapore
T +65 62739767
sales@ammeraalbeltech.sg
www.ammeraalbeltech.com

Slovakia
T +421 2 55648541-2
predaj@ammeraalbeltech.sk
www.ammeraalbeltech.sk

South Korea
T +82 31 448 3613-7
amel@ammeraalbeltech.co.kr
www.ammeraalbeltech.co.kr

Spain
T +34 93 718 3054
ventas@ammeraalbeltech.es
www.ammeraalbeltech.es

Sweden
T +46 44 780 3010
info@ammeraalbeltech.se
www.ammeraalbeltech.se

Switzerland
T +41 55 2253 535
info@ammeraalbeltech.ch
www.ammeraalbeltech.ch

Thailand
T +66 2 902 2604-13
sales@ammeraalbeltech.th.com
www.ammeraalbeltech.com

United Kingdom
T +44 1992 500550
sales@ammeraalbeltech.co.uk
www.ammeraalbeltech.co.uk

United States
T +1 847 673 6720
info@ammeraalbeltechusa.com
www.ammeraalbeltechusa.com

Vietnam
T +84 8 376 562 05
dmh@ammeraalbeltech.com.vn
www.ammeraalbeltech.com.vn

International Head Office:

Ammeraal Beltech Holding B.V.
Handelsstraat 1
P.O. Box 38
1700 AA Heerhugowaard
The Netherlands

T +31 72 5751212
F +31 72 5716455
info@ammeraalbeltech.com
www.ammeraalbeltech.com

Solid advice
For all your belting needs
Local stock & service

... and 150 service contacts more on www.ammeraalbeltech.com