



Soliflex PRO

Positive Drive Belting

Table of Contents

1	Introduction	4
2	Material properties	4
3	Ordering belts, fabrication possibilities.....	6
4	Basic conveyor design	7
4.1	Drive lug configuration.....	8
4.2	Custom made configurations.....	9
4.3	Belt tensioning / take-up.....	9
4.4	Sprockets and support pulleys	10
4.5	Drum motors	13
4.6	Slider strips	14
4.7	Return part of the belt	19
4.8	Scrapers	19
4.9	Thermal expansion	20
4.10	Friction coefficients.....	21
5	Design guidelines for special conveyor types	22
5.1	Flexing and back flexing diameters	22
5.2	Inclined conveyors	22
5.3	Swan neck conveyors	23
5.4	Trough conveyors.....	24
5.5	Bi-directional conveyors – omega drives	24
6	Existing conveyor retrofit to Soliflex PRO (mini)	25
6.1	From modular belts	25
6.2	From synthetic belting and flat slider bed conveyor	25
7	Belt calculation	26
7.1	Belt properties – allowable load.....	26
7.2	Belt loads on horizontal conveyors.....	27
7.3	Belt loads on inclined conveyors.....	28
7.4	Belt loads on swan neck conveyors.....	28
7.5	Dimensioning of the motor and shaft	29
7.6	Definitions.....	29

8	Tables	30
8.1	Soliflex Specifications	30
8.2	Properties Sprocket	31
8.3	Thermal Expansion	34
8.4	Coefficient of Friction	34

1 Introduction

Soliflex and Soliflex PRO (mini) belts are homogeneous thermoplastic belts. Since these belts have no fabric inner layer, they are easy to clean and very hygienic. This makes them especially suitable for food applications; all materials comply with EC 1935/2004, EU 10/2011 (and amendments) and FDA food regulations.

Soliflex belts are friction driven, Soliflex 'PRO' belts are positive driven by drive lugs at the bottom side of the belt. The drive lugs are also used for guidance, making the Soliflex PRO (mini) belts inherently self-tracking. Soliflex and Soliflex PRO (mini) belts are available in various thicknesses and in two materials: TPU (polyurethane) and TPE (polyester).

This manual covers the selection of Soliflex PRO (mini) belts. It helps to select the right Soliflex PRO (mini) belt for the job and assists in the design and layout of conveyor systems. The selection of plain Soliflex belts is covered in a separate manual.

A calculation program is available to calculate the right configuration for your application. A technical data is available at the attachments.

If your question is not mentioned here, or if you need more detailed information about splicing, overview of accessories, technical drawings etc. please contact your local Ammeraal Beltech representative.

2 Material properties

Soliflex belts are extruded as homogeneous thermoplastic sheet. These sheets can simply be cut, welded and even recycled. Especially TPE material is very good recyclable. Soliflex sheets are produced according to strict specifications. The drive lugs and accessories are welded on in specialized workshops. Soliflex PRO belts are available in TPU or TPE material, each with specific advantages. See the table for benefits and limitations of both materials to assist in choosing the right material for the application. More information is provided Table 1

Soliflex PRO (mini) TPU 53D belts are very resistant to oils and fats. TPU 53D has a high abrasion resistance and will hardly show any wear. TPU 53D is very flexible and has a hardness of 53 Shore D. Compared with TPE belts TPU belts have a limited chemical resistance are sensitive to chlorine based cleaning agents (when in doubt, consult the Soliflex cleaning instructions). Due to the relatively high friction against steel slider strip, TPU belts are not the preferred solution for steel slider and may become brittle in applications below -5°C. Thicknesses are available in 1.5, 2, 3 and 4 mm; some types have special profiles. Soliflex PRO has a lug pitch of 51 mm and Soliflex PRO mini has a lug pitch of 25.5 mm.

Soliflex PRO TPE belts have a good chemical and low temperature resistance. In freezing applications to -20°C Soliflex TPE is the preferred solution. The material is strong and durable and can be used for longer conveyors. Both plastic and steel slider strips are possible. Thicknesses are 2 and 3 mm.

NOTICE

Although TPE is very easy to work with, it has a tendency to warp when welded. As a result the belt or splice will not be completely flat. Belts may have a slight waviness on the edges and the splice may stand up a little at the belt edges. The glossy surface of TPE is sensitive to scratches.

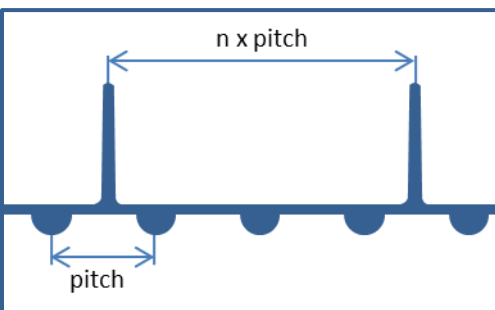


3 Ordering belts, fabrication possibilities

Endless Soliflex PRO belts can be supplied in widths up to 1800 mm. Endless Soliflex PRO mini belts can be supplied in widths up to 1200 mm. The practical minimum width for a Soliflex PRO (mini) belt is 50 mm.

For splicing on site up to widths of 1200 mm specially designed Soliflex splicing equipment is available. With this equipment it is possible to cut and splice the belt in a workshop or on site. For Soliflex PRO (mini) belts wider than 1200 mm contact your local Ammeraal Beltech representative for splicing instructions and information about the available splicing equipment.

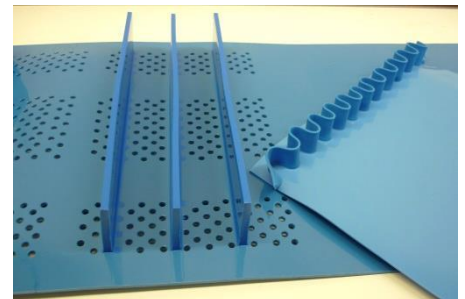
The length of a belt must always be a whole number times the pitch of the drive lugs (= 25.5 or 51 mm). Calculate the ordering length by measuring the belt length and round it to match a total length of $n \times 25.5$ or 51 mm (where $n = 1, 2, 3$, etc.).



The Soliflex PRO belts can be supplied spliced or open ended, with cleats, Bordoflex, punched holes, mechanical fasteners, guides and/or ropes. Notice that the distance between cleats should also match n times the pitch of 25.5 or 51 mm. The accessories program is continuously updated: contact your local Ammeraal Beltech representative for an overview of fabrication possibilities.

NOTICE

Be aware that accessories may have a different colour than the belt.

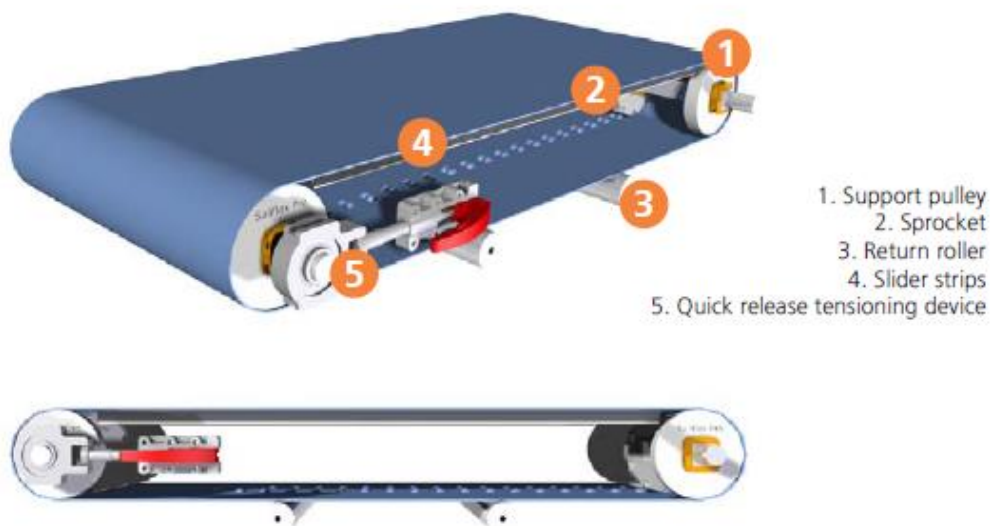


4 Basic conveyor design

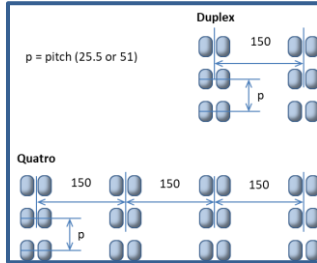
To get the full benefits of Soliflex PRO (mini) positive driven belts, special attention should be given to the conveyor design. This chapter gives guidelines and design considerations for the lay-out of scrapers, slider beds, tensioning devices, etc. Belt calculation is covered in chapter 7.

Soliflex PRO (mini) belts are tested at conveyor speeds up to 1 m/s, higher speeds are possible after consultation with your local Ammeraal Beltech representative.

A typical conveyor layout for a Soliflex PRO (mini) belt would look like this:



4.1 Drive lug configuration



Soliflex PRO (mini) Duplex - 2 rows of drive lugs

The advice for most applications is Soliflex PRO (mini) Duplex with 2 rows of drive lugs. Pitch of the Soliflex PRO lugs is 51 mm and for the Soliflex PRO mini 25.5 mm; center-to-center distance between the rows is 150 mm. Drive lugs are always positioned in the center of the belt. Other configurations are possible on request.

Soliflex PRO (mini) Quattro - 4 rows of drive lugs

This Soliflex PRO (mini) Quattro configuration is to be used for wider belts in combination with high loads. Using 4 rows spreads the transmitted force across the belt width, enabling a smooth operation.

4.2 Custom made configurations

For example in case of a retro-fit a standard configuration doesn't always fulfill the needs of the customer. In those cases it is needed to place the lugs at another center to center distance than 150 mm. This possibility to change the center to center distance is currently only possible on Soliflex PRO.

The center to center distance of the lug rows can be changed in steps of 25 mm while the minimum distance between two lugs rows is 50 mm. The maximum distance of the two lug rows in a Duplex configuration is 750 mm and the maximum belt width is 800 mm. The maximum distance between the two outer lug rows in a Quattro configuration is 1200 mm. The maximum belt width is the maximum available slab width (1800 mm for TPU).

The minimum distance from the edges of the belt and the center of the outer lug rows is 25 mm.



Figure 1 Example of custom made configuration

In all cases the configuration needs to be symmetrical over the belt width.

4.3 Belt tensioning / take-up

To operate an efficient Soliflex PRO (mini) conveyor optimal the tension should be $\leq 0.1\%$. A higher level of pretension will reduce the allowable loading of the belt. Higher levels of pretension might also induce creep in the material and reduce the service life of a belt.

The maximum allowable elongation at full load for a Soliflex PRO (mini) belt is 0.6% and in special cases up to 1.0%, at higher elongation the pitch of the drive lugs will no longer fit the sprockets. Your Ammeraal Beltech local representative can support you with the necessary design requirements. See also Table 2

A retractable pulley design is the preferred solution for quick removal and installation of the belt (e.g. for cleaning purposes). Another option is to use a quick release tensioning device. This enables easy belt removal for cleaning and/or maintenance.



4.3.1 How to tension the belt?

Apply 0.1% tension by measuring a 1000 mm mark on both sides of the belt and tension until these become 1001 mm. Let the belt run for a short while and recheck the elongation.



4.3.2 Layout of drive and tail shaft

For optimal performance both the drive and tail shaft should have *both* sprockets *and* pulleys. For the return shaft this ensures a rotating shaft at all times, therefore eliminating the chance of slippage and thus reducing wear on sprockets and belt.

Depending on the actual situation (width, usage of scrapers, products to be transported etc.) it might be beneficial to fill out the complete shaft with sprockets and support pulleys. The maximum center to center distance between sprockets and/or pulleys is 150 mm.

4.4 Sprockets and support pulleys

Soliflex sprockets and support pulleys are available for both round and square shafts. All sprockets and support rollers are made from solid food grade HDPE, with FDA and EU approvals.

- Round bore 20, 25, 30, 40 and 50 mm; all with DIN keyway.
- Square bore 40 mm; other types on request.
- Pilot bore PRO 15mm and PRO mini 6 mm; can be machined by customer

Soliflex sprockets and support rollers can be supplied in split versions (with a puzzle piece fit) for easy assembly on existing conveyors. Special sprockets versions are: self-cleaning or de-icing (where ice can be an issue). See also Table 6

Please note that Soliflex PRO sprockets and support rollers are 30 mm wide and the Soliflex PRO mini are 35mm wide. Also the lugs rows are 2 mm wider than the sprockets. See also the drawings below.

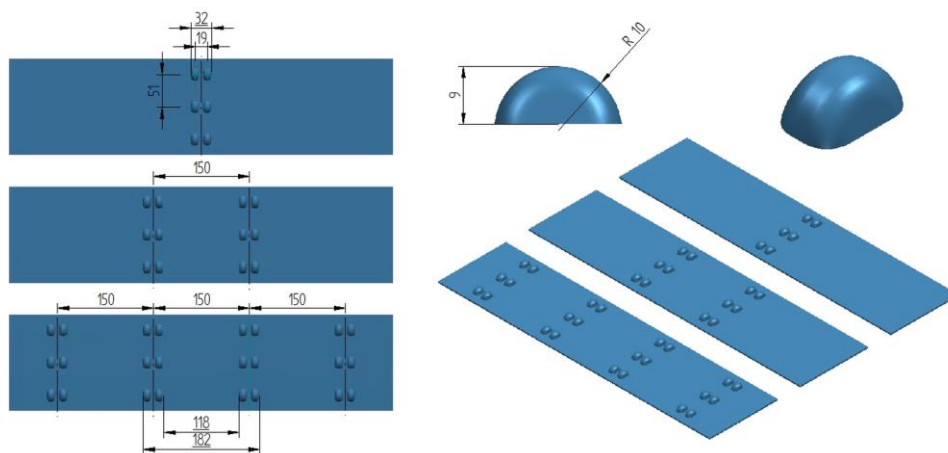


Figure 2 Soliflex PRO Lug Configurations and distances

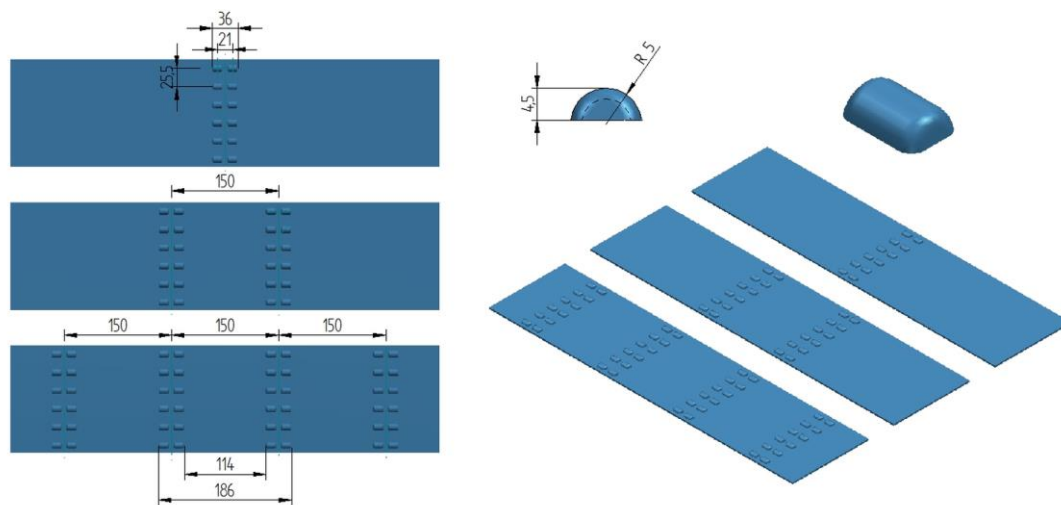


Figure 3 Soliflex PRO mini Configurations and distances

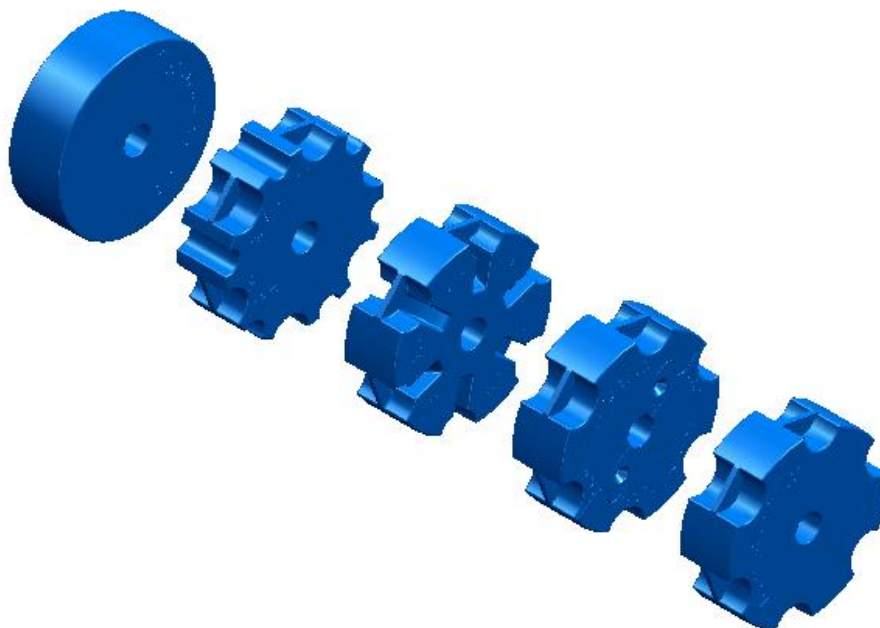


Figure 4 Soliflex PRO Sprockets Variations

4.4.1 Mounting sprockets and support rollers to the shaft

- Both square and round bore sprockets and support rollers can be fixed in axial direction with retainer rings.
- Fixate one sprocket axial and give the other sprockets on the shaft some 2 mm play in axial direction to compensate for thermal expansion.

© Ammeraal Beltech. Because of continuous development, the data is subject to alteration. This data replaces that included in previous publications. Ammeraal Beltech excludes any liability for the incorrect use of the given information.



- Round bore sprockets and support rollers can be fitted with DIN keyways.
- To align the sprockets make sure that the engraved logos are all pointing in the same direction.

The minimum sprocket diameters for a belt type are valid for a flat belt. For a belt with ropes, guides or Bordoflex the minimum allowable sprocket diameter should be increased; see the chapter 5 with design tips for special conveyors possibilities.

4.5 Drum motors

For drum motors, Interroll developed a special Soliflex PRO drum motor in 4 sizes:



Figure 5 Interroll Drum Motor with Soliflex Lagging

Interroll 80i with Soliflex PRO Z7 lagging TPU 88 shore D

Interroll 113i with Soliflex PRO Z9 lagging TPU 88 shore D

Interroll 138i with Soliflex PRO Z10 lagging TPU 88 shore D

Interroll 165i with Soliflex PRO Z12 lagging TPU 88 shore D

The hygienic design has been developed for ultimate cleaning

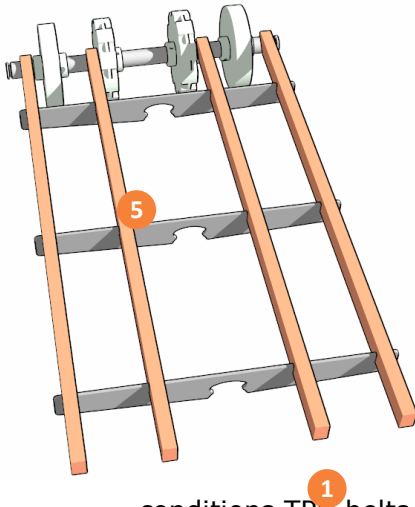
We advise to contact your local Interroll representative

For Soliflex PRO mini, there's not yet a special Soliflex drum motor, but a sprocket sleeves is available. This sleeve can be placed over the Interroll drum motor DM0080.

The sleeves have a Z14 profile and are 112.2 mm in diameter. The maximum width is 250 mm. For wider drum motors multiple sleeves can be combined.



Figure 6 Soliflex PRO mini Z14 sleeve for Interroll DM0080



4.6 Slider strips

The unique lug design in combination with the guide strips ensure superior and 100% trouble free tracking.

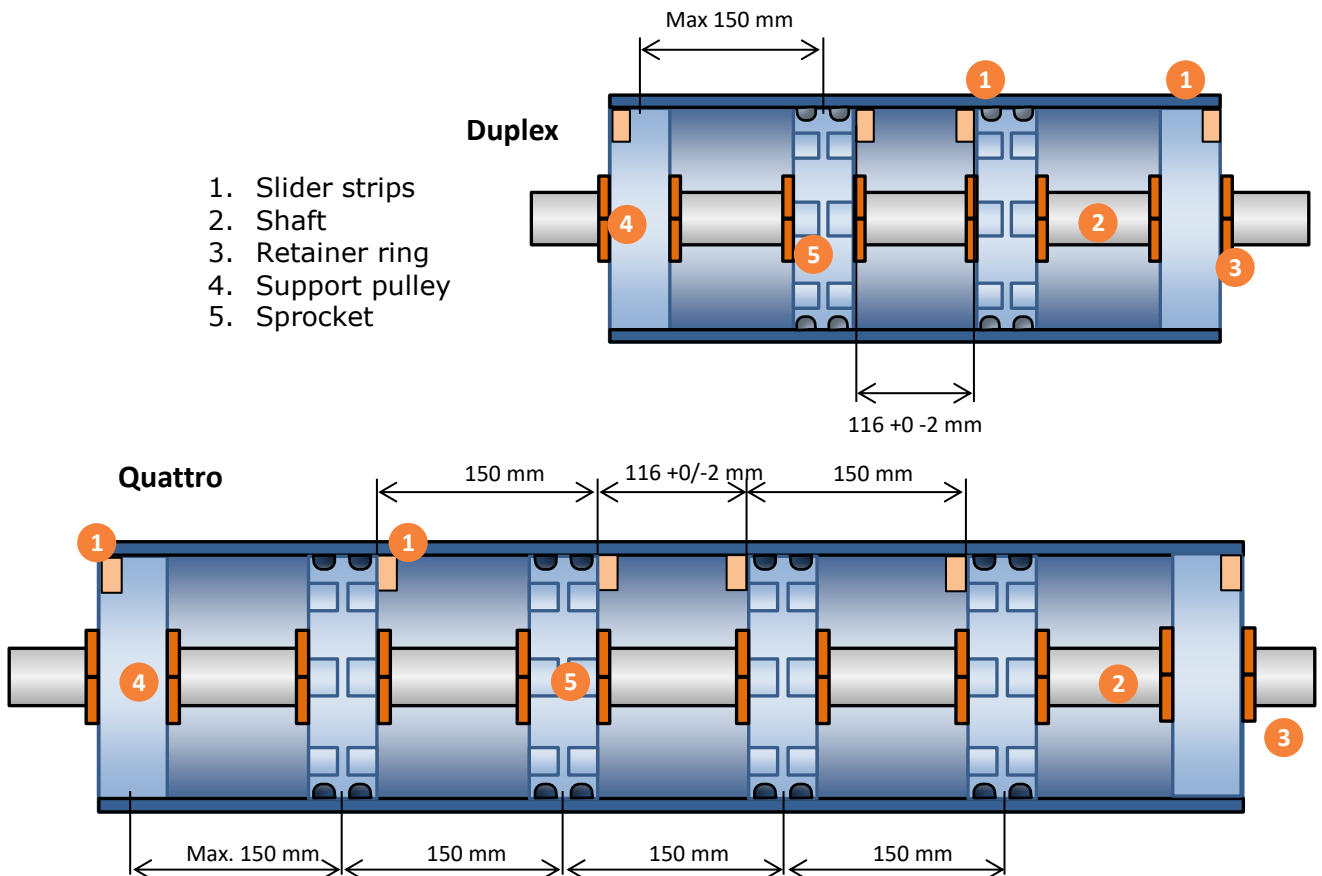
A conveyor with slider strips is the preferred solution for Soliflex PRO (mini). Use HDPE or UHMWPE slider strips to minimize the friction. The slider strips should be mounted close to the sprockets and pulleys. Allow some room to accommodate for possible thermal expansion (see page 20). Make sure that the height of the slider strips is not higher than the upper face of the pulleys. Stainless steel strips or round bars are possible; use the same configuration as for HDPE strips. Recommended stainless steel type is 316(L), stainless steel type 304 gives blackening on the belt. Make sure all edges are smooth. Be aware that in moist

conditions TPU belts may 'stick' to steel sliders, apply TPU with diamond profile or TPE in those cases.

4.6.1 Positioning of slider strips Soliflex PRO

How to calculate?

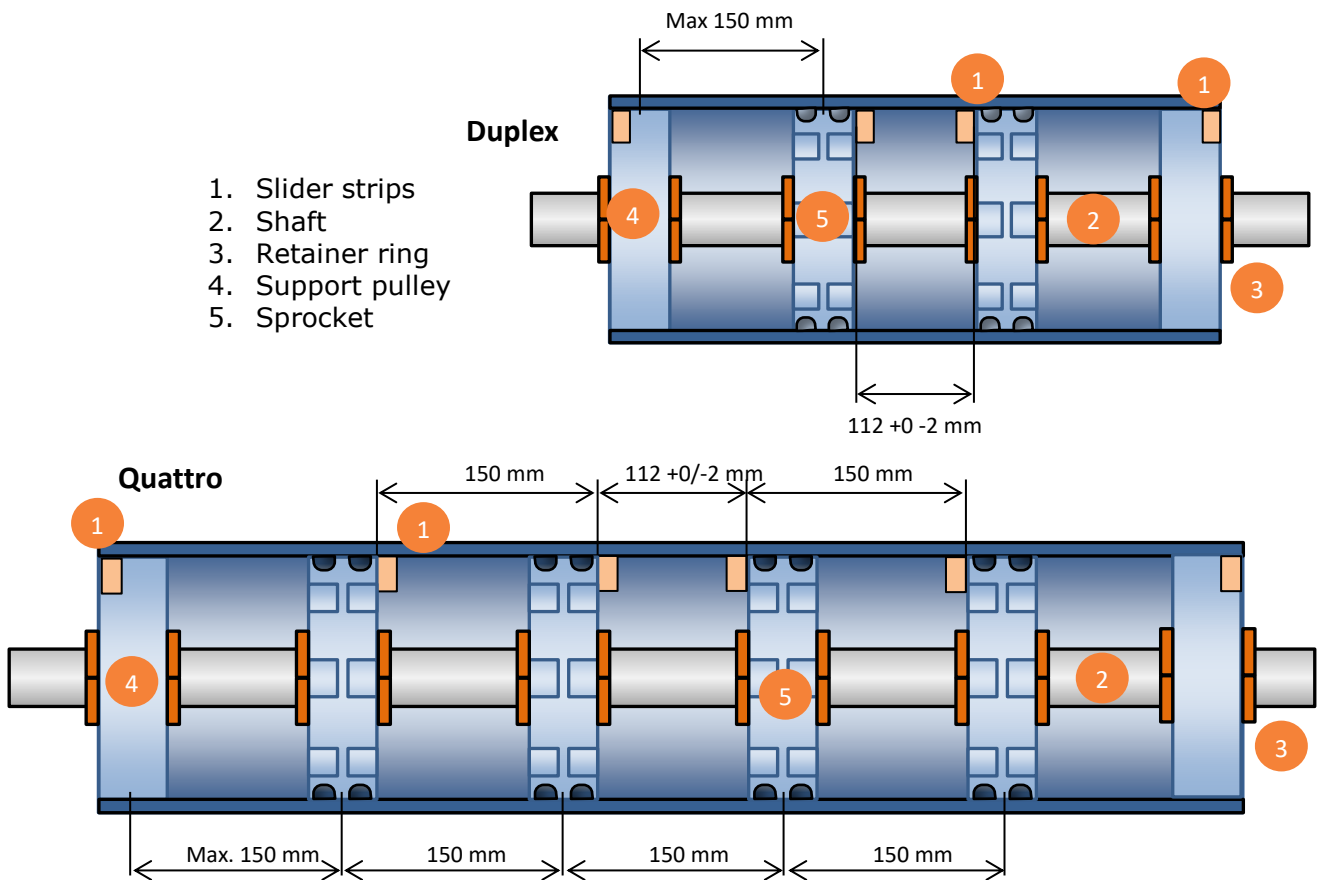
This is example of a standard configuration. Non-standard configurations can be calculated by the calculation program.



The slider strips should be used to guide/track the drive lugs in the running direction. Allow space between the slider strips and lugs.

Strip position	Distance between 2 strips
Outside lugs	185 mm +2 -0 mm
Inside lugs	116 mm +0 -2 mm

4.6.2 Positioning of slider strips Soliflex PRO mini

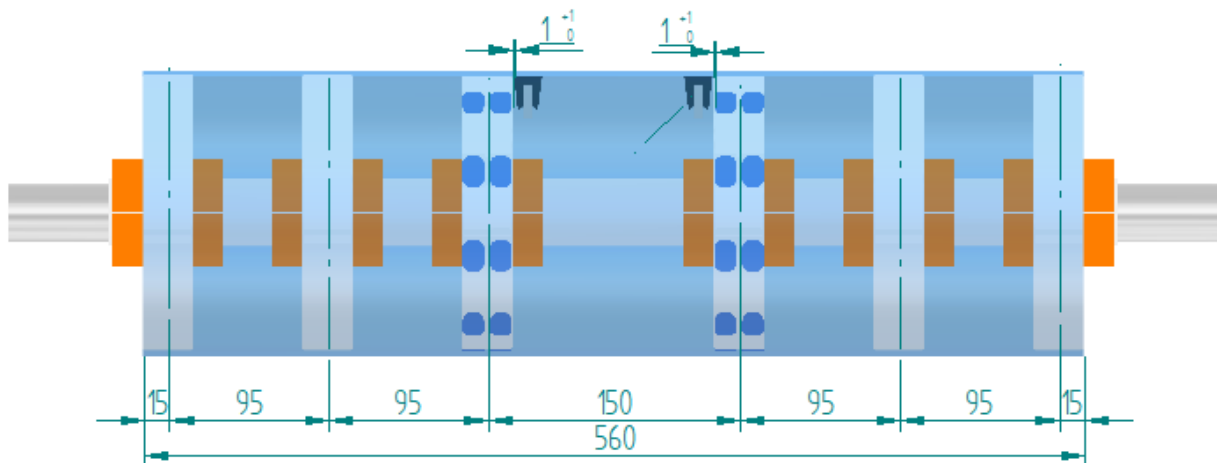


The slider strips should be used to guide/track the drive lugs in the running direction:

Strip position	Distance between 2 strips
Outside lugs	189 mm +2 -0 mm
Inside lugs	112 mm +0 -2 mm

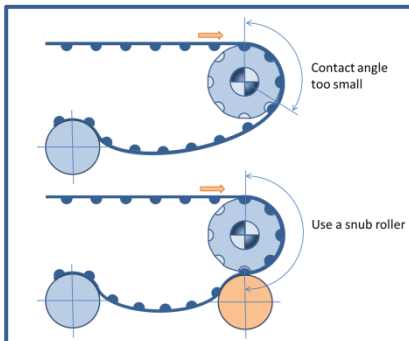
4.6.3 Example positioning.

In the example below of a Soliflex PRO belt of 560 mm wide. The sprockets are 150 mm center-to-center apart from each other. Two support rollers are at the edge of the belt. The center-to-center distance between the sprockets and the support rollers is now 190 mm. This is more than 150 mm and therefore extra support rollers are placed in the middle at a center-to-center distance of 95 mm ($1/2 \times 190$ mm).





4.7 Return part of the belt

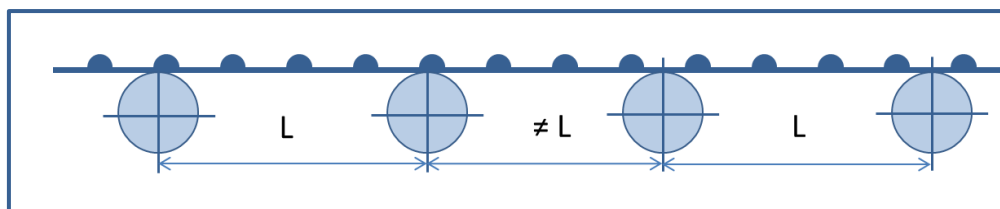


The belt in the return part will hardly have any stress. On a heavily loaded belt large catenary sag could form. In some cases this may become so big that the belt no longer has a sufficient wrapping angle on the drive sprocket. Use of pretension of 0.1% and a snub roller can be used just after the drive shaft. The snub roller must have the same width as the belt and a min. diameter of 50 mm. Position the snub roller just below or after the heart of the drive shaft and leave some room for the belt so that it is not pinched off.

Support pulleys or rollers in the return part should be positioned every 2 meters. To prevent resonance of the belt in the return part, this distance should be slightly varied as shown in the drawing. The diameter of these supports is minimum 50 mm.

Alternatively slider strips can be used to support the belt in the return part. This can be especially advantageous on inclined conveyors. Do not use these over the complete length of the conveyor; allow space for the catenary belt sag near the drive shaft. Slider strips can leave marks on the surface of the belt.

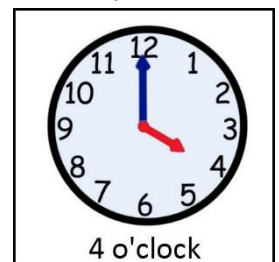
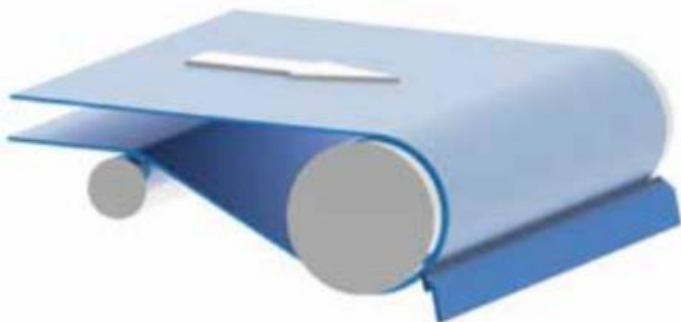
A belt with cleats is normally not supported on the cleats. However the cleats add lateral stability. When a belt with cleats is wider than 800 mm extra support is needed. This can be achieved by dividing the cleat into two sections and leaving an indent of minimum of 50 mm in the middle. A support roller has to be placed in this free section to support the belt.



4.8 Scrapers

Ultra-Scrapers can be used to ensure proper cleaning of the belt.

To release the product from the belt; Position the scraper on the sprocket at 2/3 of the wrap of the belt on the sprocket. (Four o'clock position).



For cleaning the belt the scraper has to be placed just after the wrap, so just after the 6 o'clock position. When a scraper is used 0.1% pretension has to be applied.

4.9 Thermal expansion

NOTICE

Be aware of the thermal expansion coefficient of the material.

4.9.1 Thermal expansion / contraction

In applications where operating temperatures are different from ambient temperatures (20°C), linear expansion of the belt length and width will occur. In lateral direction the absolute expansion or contraction is relatively small and no special actions are necessary. In longitudinal direction the following will occur:

*Operating temperatures higher than ambient temperatures: **Expansion***

- Belt tension will reduce and at a certain point the pitch of the belt will no longer match the pitch of the sprockets. This will happen at about 50°C belt temperature. For belts operating at 50°C or more special precautions should be taken (e.g. using sprockets with larger pitch). Contact your local Ammeraal Beltech representative for special solutions.
- Example: belt is installed, spliced and pre-tensioned at 22°C and is then moved to an environment operating at 62°C. Temperature difference = 40°C, the belt will elongate $40 \times 0.17 = 6.8 \text{ mm/m}$ or 0.68%. In this example the belt needs to be stretched before starting!

Each material is characterized by its own coefficient of linear thermal expansion. Changes in the belt length can be calculated as follows:

$\Delta L = L \times \alpha \times \Delta T$	α	=	linear thermal expansion coefficient
	L	=	belt length nominal in m
	ΔL	=	thermal expansion / contraction
	ΔT	=	temperature difference

4.10 Friction coefficients

Friction is a very important belt feature. In most cases a low friction between belt and slider bed/strips is preferred, this reduces the drag forces and thus the elongation in the belt and necessary power to drive it. The friction coefficients of Soliflex PRO (mini) belts to common slider materials in common conditions can be found in Table 9:

Values mentioned in this manual and used in our Soliflex PRO calculation program are based on clean environmental circumstances. Application circumstances can influence the friction both negative as positive. For example flour in bakeries cause higher friction and fluids in meat factories cause lower friction.

The friction between TPU and stainless steel is quite high and this is not the preferred combination. When using Soliflex PRO (mini) on existing installations with steel sliders the advice is to use a TPE belt or a TPU belt with diamond profile on the bottom side. This profile reduces the friction on steel significantly.

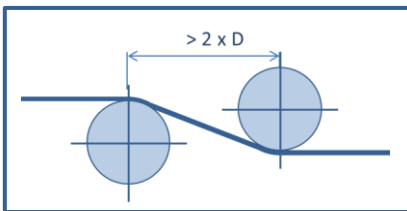
The low friction smooth topside of the belt improves hygiene but limits the angle of inclination ($\pm 15^\circ$). In case a higher angle of inclination is needed cleats can be applied.

5 Design guidelines for special conveyor types

In most applications a straight standard conveyor does the job, sometimes special designs are needed. This chapter gives some design guidelines for a number of special conveyor types.

5.1 Flexing and back flexing diameters

The allowed minimum flexing diameters for Soliflex PRO (mini) are depending on material and belt thickness. These values can be found in paragraph 8.1 and on the belt data sheet. If flex and back flex sprockets are close to each other, there should be at least a diameter distance in between. See also the chapter on omega drives.



Example: Scanner belt applications where flex and back flex rollers are close. The return part of the belt needs to be brought upward to accommodate for the relatively small opening through the scanner. Make sure that the centers of the rollers are at least two flex diameters apart.

Accessories are mainly used on Soliflex PRO belts. A limited number of accessories are possible on Soliflex PRO mini, an overview is shown in Table 7 for cleats and Table 8 for bordoflex

5.2 Inclined conveyors

Inclined conveyors are used to overcome height differences. The angle of inclination is limited by the friction between the transported goods and the belt. For most bulk goods the angle of inclination should be less than 15°, use cleats otherwise. The friction for piece goods should be tested.

Make sure that the drive drum is always on the topside of the conveyor. This is also important for declining conveyors.

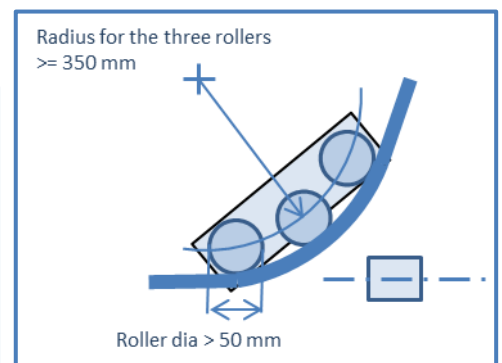
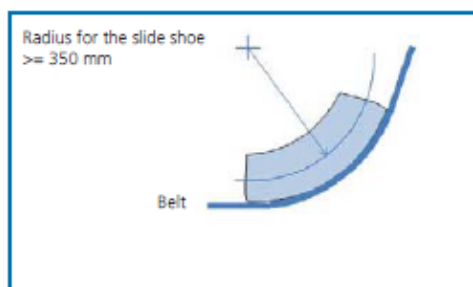
5.3 Swan neck conveyors

Swan neck conveyors are often used to transport bulk goods or small products coming from a hopper to a higher level. Swan neck conveyors only need a relatively small floor space. Inclination angles start at 30° and go up to 75°. In these conveyor types the belt width must be chosen carefully. Safe values normally recommended for homogeneous belts go up to a width of 500 mm. The special design of Soliflex PRO belts allows safe values up to 1000 mm. However even wider belts have been designed and are in use.

Design of the belt; the lug rows have to be placed as far as possible to the edge of the belt to lower the upward force in the middle of the bend area. Contact your local Ammeraal Beltech representative for detailed advice.

Give special attention to the design of the bends:

- The radius in these bends should be min. 350 mm. For slow moving conveyors (up to 0.2 m/s) slider shoes made from HDPE or UHMWPE can be used. A small outward pointing groove in the sole of the shoe can help to prevent dirt building up here.
- Use roller sets in the bends for conveyors running at higher speed. The effective width of shoes or rollers should be 50 mm. The space between shoe or roller and Bordoflex should be at least 10 mm.
- Looking from the width of the belt: The centerline of the shoe or rollers should be on the centerline of the outer lug rows.



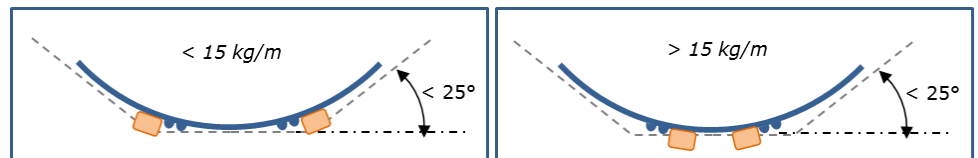
5.4 Trough conveyors

Soliflex PRO can be used for transport of bulk goods in troughed conveyors. Trough angles up to 25° are possible. Use stainless steel bars to support TPE belts and UHMWPE/HDPE slider strips for TPU belts.

For loads up to 15 kg/m the slider strips can be positioned on the outside of the drive lugs. Position the slider support in between the drive lugs for higher loads.



The transfer length from flat to trough as in-feed and out-feed should be equal to or larger than the belt width. A larger in-feed will increase the service life.

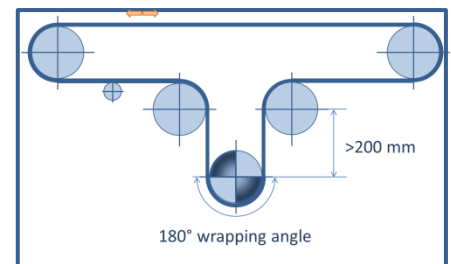


5.5 Bi-directional conveyors – omega drives

Some conveyors are designed to run bi-directionally. In those cases a special drive configuration, 'the omega drive' is recommended (see drawing). Note that the two upper (back flexing) pulleys are positioned in such a way that a wrapping angle of 180° on the driving sprockets is guaranteed.

Make sure that the upper pulleys are equal to or larger than the minimum allowed back flexing diameter for the belt.

Keep a distance of at least 200 mm between the center of the pulleys and the drive drum to prevent premature fatigue failure. The drive drum sprockets must have 4 teeth more than the standard minimal sprocket diameter (e.g. Z06 -> Z10)



Cleaning of the drive shaft is more difficult due to limited accessibility of the drive drum. This can be improved by using a drum motor.

Minimum pulley diameters are mentioned in Table 1.

6 Existing conveyor retrofit to Soliflex PRO (mini)

It is possible to exchange synthetic or modular belts for positive driven homogeneous belting such as Soliflex PRO (mini). Below are some tips for a Soliflex PRO (mini) retrofit on existing conveyors.

6.1 From modular belts

Sprockets and Rollers

Exchange the drive and tail pulleys for the appropriate sprockets and support rollers.

Slider strips/bed

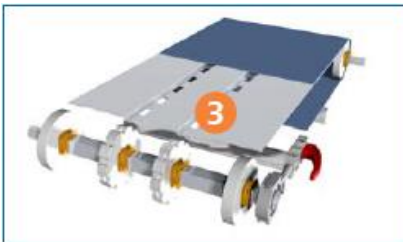


1. Flat slider bed
2. Slide strips

If the slider bed construction is made out of UHMWPE, HDPE or metal strips position them in such a way that they act as guides for the drive lugs (see also the chapter on slider strips).

Ensure that the slider bed height is slightly lower than or level with the upper face of the pulleys. A deviation of max. 5 mm will not negatively affect the operation of the positive drive.

6.2 From synthetic belting and flat slider bed conveyor



3. Bottom groove also acts as guide for lugs

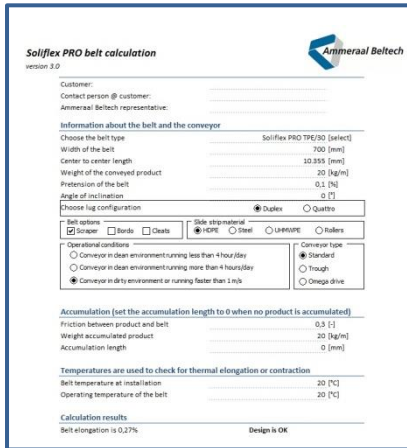
For a full slider bed: provide strips on top of the flat slider bed to ensure a smooth and efficient operation. Position these strips in such a way that they act as guides for the drive lugs.

Make sure that the height of the slider bed is not higher than the upper face of the pulleys. A tolerance of up to 5 mm is permitted and will not negatively affect the operation of the positive drive.

It is also possible to use a profiled slider bed. It is recommended to have drainage holes in the bottom grooves to prevent dirt build up.

The coefficient of friction of TPU to steel is relatively high so it is recommended to use TPE.

7 Belt calculation



For a Soliflex PRO (mini) belt the load on the belt needs to be compared to the allowable load for the selected belt type. The belt is subject to different loads: friction on the slider strips, the mass of the transported goods, mass of the belt (for inclined conveyors) and possible influences from scrapers etc. When accumulating products the load will also be higher and this needs to be taken into account.

This chapter covers the calculation of the allowable load for Soliflex PRO (mini) belts and calculation method for the determination of belt load for different types of conveyors. A dedicated tool is available; your local Ammeraal Beltech representative can support you with the necessary calculations.

The starting point for the calculations is that the belt is mounted without pretension.

7.1 Belt properties – allowable load

The allowable load for a belt depends on material and width and can be calculated as follows:

$$F_{\text{all allowable load}} = F_{\text{all}} = LF * b * FE * SF * 1000 \quad [1]$$

See the belt data sheet for the force elongation behavior of a belt (FE). The Load Factor (LF) is 0.6 with the standard sprocket and 1.0 with the Plus sprockets. The service factor (SF) depends on the operational conditions and on the conveyor type. See the table below for the service factor values.

The belt design is acceptable if the load in the belt is less than the allowable load:

$$F_B < F_{\text{all}} \quad [2]$$

factor (SF)	Horizontal conveyors	Inclined conveyors	Trough or swan neck ¹⁾
Conveyor in a <i>clean</i> environment running <i>less</i> than 8 hours/day with a speed <i>below</i> 1 m/s	1.0	0.9	0.8
Conveyor in a <i>clean</i> environment running <i>more</i> than 8 hours/day with a speed <i>below</i> 1 m/s	0.9	0.8	0.7

1) Or other conveyor types that have a combination of flat and inclined parts or back-flex rollers

7.2 Belt loads on horizontal conveyors

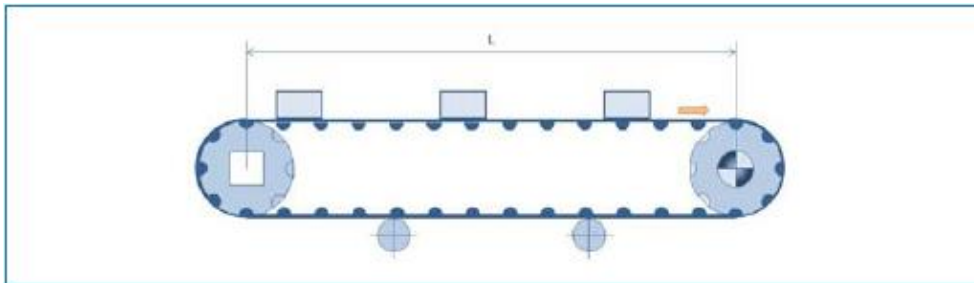
On a horizontal conveyor the main load comes from the friction on the slider strips. Also a scraper will create a load to the belt. Conveyors where products are accumulated encounter extra loads from the friction between products and belt. The friction coefficients between product and belt need to be determined. Notice that the weight per meter (m_A) will increase over the accumulation length.

$$F_1 \text{ friction load} \quad F_1 = \mu_1 * k * L * (m_b + m_p) * g \quad [3]$$

$$F_3 \text{ scraper load} \quad F_3 = 85 * b \quad [4]$$

$$F_4 \text{ accumulation load} \quad F_4 = \mu_2 * k * L_A * m_A * g \quad [5]$$

$$F_B \text{ total belt load} \quad F_B = F_1 + F_3 + F_4 \quad [6]$$



NOTICE

Coefficient of friction correction factor (k). *In dirty environments the coefficient of friction will be higher than stated in the belt datasheets. The Soliflex belt calculation program will add 25% on the coefficient of friction. Thus lowering the maximum load on the belt. In the formulas this is represented by the k . In clean environments $k = 1$ and dirty environments $k = 1.25$*

7.3 Belt loads on inclined conveyors

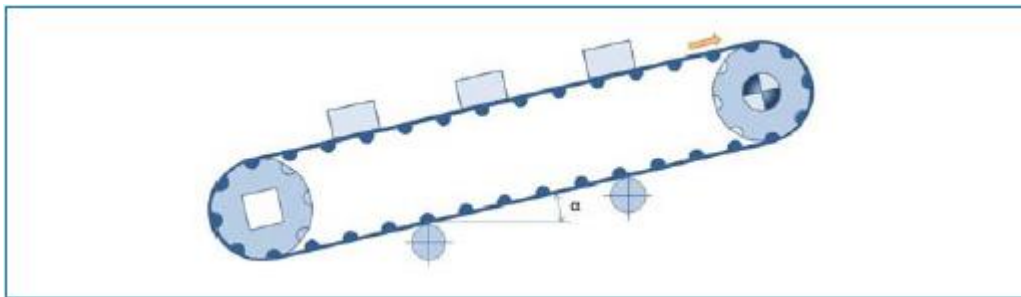
The product weight adds to the belt loads on an inclined conveyor, depending on the angle of inclination. Accumulation is not taken into account.

$$F_1 \text{ friction load} \quad F_1 = \mu_1 * k * L * (m_b + m_p) * g * \cos \alpha \quad [7]$$

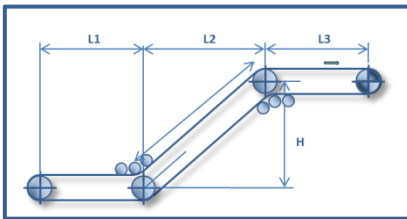
$$F_2 \text{ gravity load} \quad F_2 = L * (m_b + m_p) * g * \sin \alpha \quad [8]$$

$$F_3 \text{ scraper load} \quad F_3 = 85 * b \quad [9]$$

$$F_B \text{ total belt load} \quad F_B = F_1 + F_2 + F_3 \quad [10]$$



7.4 Belt loads on swan neck conveyors



The loads on swan neck conveyors and similar conveyors can be calculated by splitting the design up in separate horizontal and inclined conveyors. The total belt load is the sum of the belt loads for each part. Compare this total load to the allowable load for the given belt type, see formula [2]. The Soliflex PRO (mini) Calculation tool allows for an easy evaluation of swan neck conveyors.

7.5 Dimensioning of the motor and shaft

Calculate the required power for the motor from the speed and the total load in the belt. Also take the efficiency of the gear into account.

$$P \text{ required motor power } P = F_B \times v / 1000 \times \eta \quad [11]$$

For the calculations of the shaft we advise to use the CEMA guidelines.

7.6 Definitions

α	<i>inclination angle of the conveyor</i>[rad]
b	<i>belt width</i>[m]
F_1	<i>load in the belt caused by friction to the slider bed</i> [N]
F_2	<i>load in the belt caused by weight of the conveyed product</i> [N]
F_3	<i>load in the belt caused by a scraper</i> [N]
F_4	<i>load in the belt caused by friction to the slider bed</i> [N]
F_{all}	<i>allowable load for a belt type</i> [N]
F_B	<i>total load in the belt</i> [N]
FE	<i>force needed for 1% elongation (see belt data sheet)</i>[N/mm]
g	<i>gravitational acceleration; $g = 9.81$</i> [m/s ²]
k	<i>correction factor friction coefficient</i> [-]
L	<i>conveyor length c-c</i>[m]
L_A	<i>length where accumulation occurs</i>[m]
m_A	<i>weight of accumulated product per m length</i> [kg/m]
m_b	<i>weight of belt per m length</i> [kg/m]
m_p	<i>weight of conveyed product per m belt length</i> [kg/m]
η	<i>gear efficiency</i> [-]
P	<i>required motor power</i> [kW]
μ_1	<i>friction coefficient between belt and slider strips</i> [-]
μ_2	<i>friction coefficient between product and belt</i> [-]
v	<i>belt speed</i> [m/s]

8 Tables

8.1 Soliflex Specifications

Table 1 Soliflex Specifications

	TPU/15 53D PRO mini	TPU/20 53D PRO mini	TPU/20 53D PRO	TPU/30 53D PRO	TPU/40 53D PRO	TPE/20 PRO	TPE/30 PRO
Thickness (mm)	1.5	2.0	2.0	3.0	4.0	2.0	3.0
Hardness (Sh)	53D	53D	53D	53D	53D	55D	55D
Colour	Light blue						
Temperature min (°C)	-5					-20	
Temperature max (°C)	70					80	
Min Pulley Dia (mm)	47.0 (Z06)	63.3 (Z08)	94.7 (Z06)	127.3 (Z08)	176.1 (Z11)	127.3 (Z08)	159.8 (Z10)
Min Pulley Dia Backflexing (mm)	63.3 (Z08)	79.6 (Z10)	127.3 (Z08)	159.8 (Z10)	208.7 (Z13)	159.8 (Z10)	192.4 (Z12)
Min Pulley Dia Omega (mm)	79.6 (Z10)	95.9 (Z12)	159.8 (Z10)	192.4 (Z12)	241.2 (Z15)	192.4 (Z12)	225.0 (Z14)
Chemical resistance	+					++	
Cold resistance	+					++	
Scratch resistance	++					+	

Table 2 Pretension

Belt type	Advised pretension	Max. allowable elongation
Soliflex PRO (mini)	0 - 0.1%	0.6% standard
		1.0 % special

Table 3 Recommended minimum configurations Soliflex (based on default lug row pitch of 150 mm)

Duplex	Belt width	200 - 300 mm	300 - 500 mm	> 500 mm
Sprockets		2	2	2
Support Rollers		0	2	4

Quattro	Belt width	> 550 mm wide with high load
Sprockets		4
Support Rollers		every 150 mm belt width

8.2 Properties Sprocket

Table 4 Sprocket Dimensions

No. of teeth (Z)	diameter (mm)	
	PRO	PRO mini
6	94.7	47.0
7	111.0	
8	127.3	63.3
9	143.5	
10	159.8	79.6
11	176.1	
12	192.4	95.9
13	208.7	
14	225.0	112.2
<i>Other dimensions available on request</i>		

Table 5 Sprocket Bore dimensions

Pilot Bore (PB)	Square (SQ)	Round (RR)
6	40	20
15	50	25
		30
		40
		50
<i>Not all options are applicable on all sprocket type/sizes</i>		

Table 6 Sprocket Executions


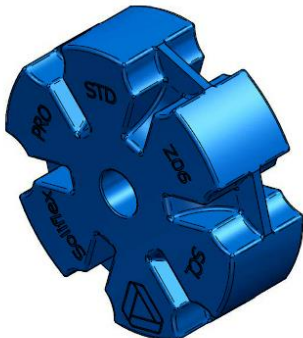


 <p>Standard Sprocket</p>	 <p>Self-Cleaning Sprocket</p>
 <p>De-Icing Sprocket</p>	 <p>Support Roller</p>

Table 7 Maximum Cleat type per sprocket type

PRO	PRO mini	Maximum standard belt cleat thickness (mm)	Maximum synthetic footless Ropanyl cleats	Maximum synthetic footless Amtel cleats
	Z06 47.0	Na	Na	Na
	Z08 63.3	Na	PN20	Na
	Z10 79.6	Na	PN35	Na
	Z12 95.9	Na	PN50	Na
Z06 94.7		3.0	PN50	Na
Z07 111.0		3.0	PN50	Na
Z08 127.3		4.0	PN50	PN35
Z09 143.5		4.0	PN75	PN35
Z10 159.8		4.0	PN75 / 100 x 6	PN50
Z11 176.1		4.0	PN75 / 100 x 6	PN50
Z12 192.4		4.0	PN75 / 100 x 6	PN75 / 100 x 6
Z13 208.7		4.0	PN75 / 100 x 6	PN75 / 100 x 6
Z14 225.0		4.0	PN75 / 100 x 6	PN75 / 100 x 6
Reducing PN-cleat height does not influence minimum sprocket diameter.				

Table 8 Maximum Bordoflex Height per sprocket type

PRO	PRO mini	Maximum height (mm)
	Z06 47.0	na
	Z08 63.3	20 mm
	Z10 79.6	25 mm
Z06 94.7	Z12 95.9	30 mm
Z07 111.0		35 mm
Z08 127.3		40 mm
Z09 143.5		45 mm
Z10 159.8		55 mm
Z11 176.1		60 mm
Z12 192.4		65 mm
Z13 208.7		70 mm
Z14 225.0		75 mm
For belts with Bordoflex the sprocket size must be chosen larger than the standard sizes. The minimum sprocket diameter must be higher than three times the Bordoflex height and also be bigger than the minimum sprocket diameter than the belt.		

8.3 Thermal Expansion

$\Delta L = L \times \alpha \times \Delta T$	α	=	linear thermal expansion coefficient
	L	=	belt length nominal in m
	ΔL	=	thermal expansion / contraction
	ΔT	=	temperature difference

	Material	α [mm/m/°C]
Soliflex and Soliflex PRO (mini)	TPU	0.17
	TPE	0.17
Slider strip materials	HDPE	0.14
	UHMWPE	0.14
	(Stainless) steel	0.01

8.4 Coefficient of Friction

Table 9 Coefficient of Friction

Slider material	TPE smooth	TPU smooth	TPU diamond profile
HDPE	0.29	0.24	0.23
Stainless steel	0.27	0.58	0.29