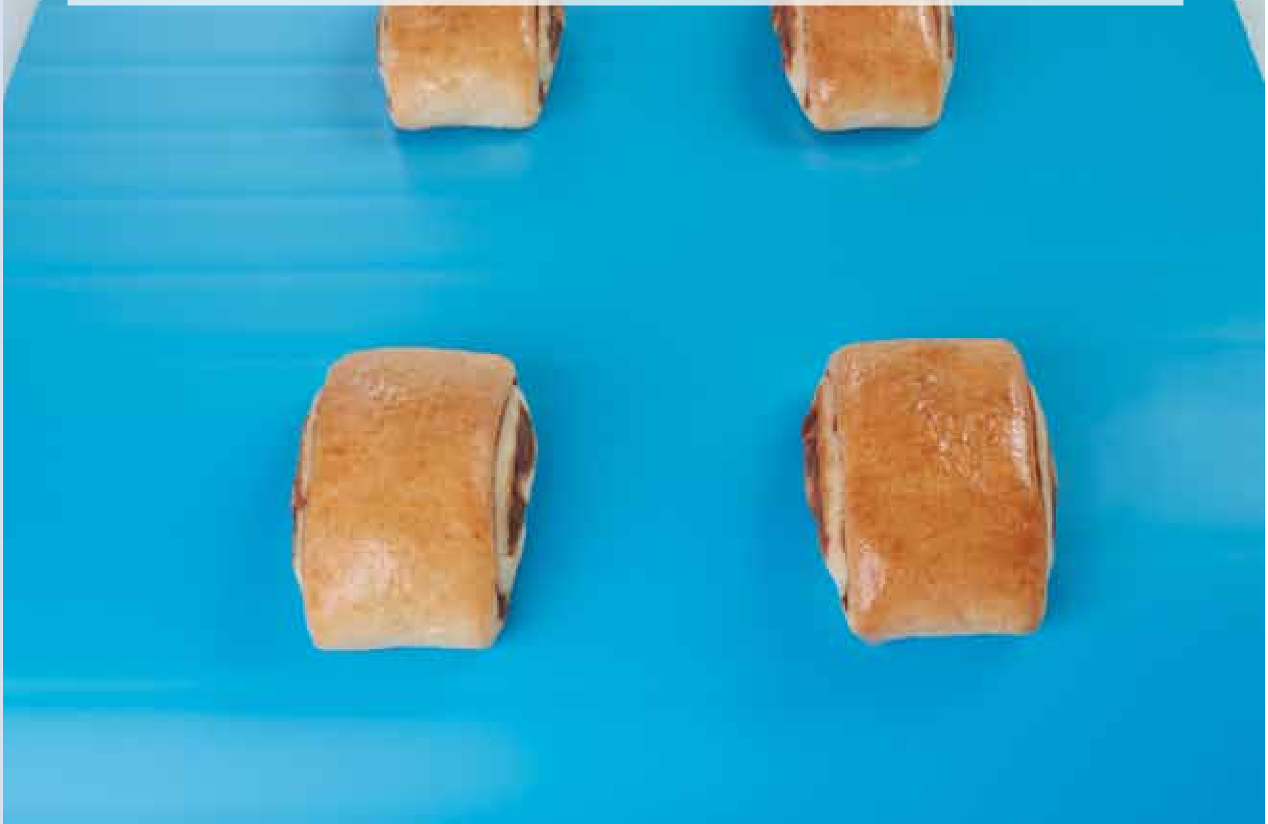
siegling fullsan
homogeneous belts

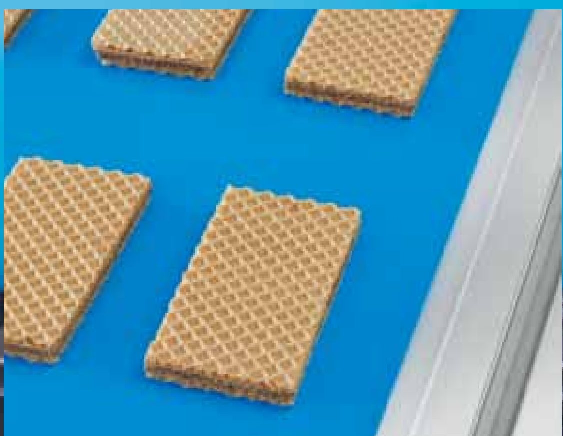
ENGINEERING MANUAL FULLSAN FLAT

Siegling – total belting solutions

MOVEMENT SYSTEMS

Siegling Fullsan compliments the Forbo Movement Systems conveyor belt range with homogeneous belts made from high-grade polyurethane. Our extensive experience in light materials handling is your guarantee not only of outstanding product quality, but also of competent advice, rapid availability and practice-oriented service.

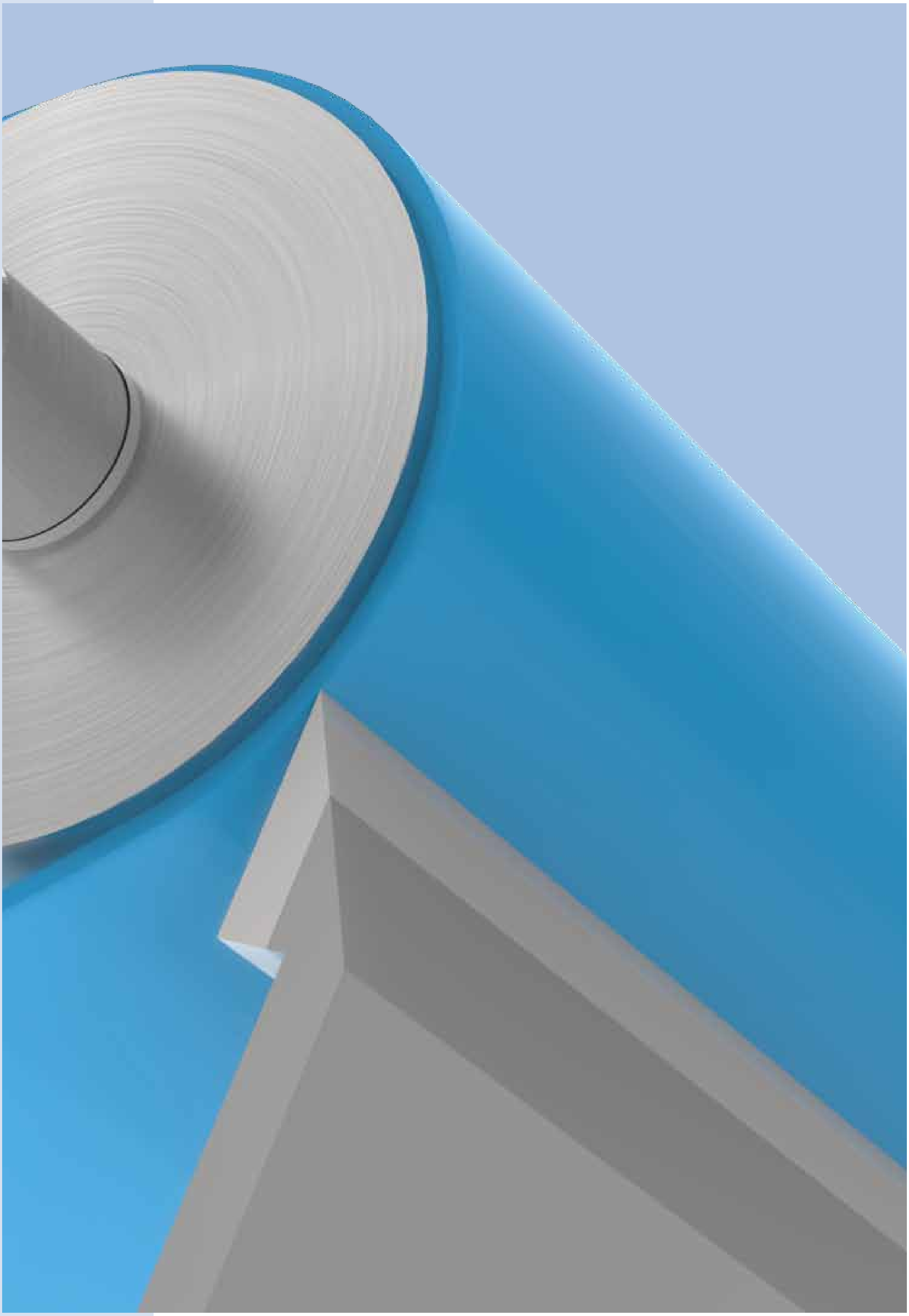




BETTER HYGIENE WITH SIEGLING FULLSAN

Siegling Fullsan is virtually resistant to contamination of oil, grease, moisture and bacteria. Siegling Fullsan is very easy to clean, and is exceptionally well suited to use in especially hygiene-critical applications (dairy products, dough processing, meat and poultry processing, as well as other food processing applications).

INDEX



1 BASICS

1.1 TECHNICAL DATA

Fullsan Flat

Belt types	Article number	Total thickness approx. [mm (in)] ± 0.15 (0.006)	Effective pull at 1% elongation (k_1% relaxed) [N/mm width]	Min pulley ø without counter bending [mm (in)]	Min pulley ø with counter bending [mm (in)]	Permissible operating temperature [°C]	Permissible operating temperature [°F]
FLT+ U30 GL/GL-NA HACCP BL FDA	640019	3 (0.12)	9.0	40 (1.57)	40 (1.57)	– 10/+70	14/158
FLT+ U30 GL/MT-NA-HACCP BL FDA	640020	3 (0.12)	9.0	40 (1.57)	40 (1.57)	– 10/+70	14/158
FLT+ U30 GL/NP-NA HACCP BL FDA	640021	3 (0.12)	9.0	40 (1.57)	40 (1.57)	– 10/+70	14/158
FLT+ U30 MT/GL-NA-HACCP BL FDA	640022	3 (0.12)	9.0	40 (1.57)	40 (1.57)	– 10/+70	14/158
FLT+ U30 MT/NP-NA-HACCP BL FDA	640023	3 (0.12)	9.0	40 (1.57)	40 (1.57)	– 10/+70	14/158
FLT+ U30 NP/GL-NA HACCP BL FDA	640024	3 (0.12)	9.0	40 (1.57)	40 (1.57)	– 10/+70	14/158
FLT+ U30 NP/MT-NA-HACCP BL FDA	640025	3 (0.12)	9.0	40 (1.57)	40 (1.57)	– 10/+70	14/158

Blue (RAL 5015)

Type key (all Siegling Fullsan series)

Type designation for Siegling Fullsan belts

FLT U 30 MT / GL - NA - HACCP BL FDA

FLT + U 30 NP / GL - NA - HACCP BL FDA

- Fullsan series
- Pitch
- Reinforced
- Belt material
- Belt thickness (FLT) / Deck height (CD/PD) in 1/10 mm
- Surface finish underside
- Surface finish top face
- Belt property
- Belt property
- Color
- Belt property

FLT	=	Flat top
+	=	Reinforced (Pro) version
U	=	Polyurethane
GL	=	Smooth
MT	=	Matte
NP	=	Inverted pyramid
NA	=	Non-antistatic
HACCP	=	Supports the HACCP concept
FDA	=	Food safe in compliance with EC/FDA
BL	=	Blue

1.2 BELT FABRICATION

Splice types

When choosing the type of endless splicing, take into account:

– Hygienic aspects

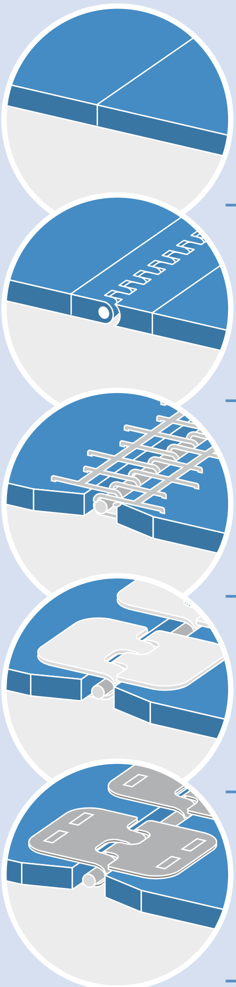
– Material being conveyed

– Tensile forces in the belt

– Conveyor design/application environment (can endless splicing be carried out on the conveyor?)

– Cleaning method · Cleaning-in-place (CIP), Cleaning-off-place (COP)

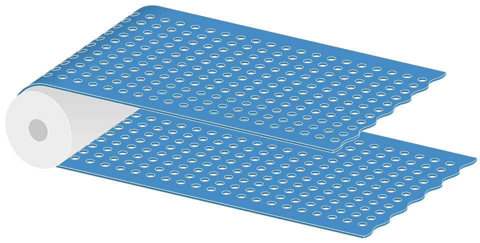
All belts are also available as open roll material or with prepared ends.



	Splice type possible with **Fullsan Flat**
Butt splice (standard)	●
Hinged lace (only for 3 mm belt thickness)	●
Hook fastener	●
Plastic rivet	●
Clamp fastener (metal)	●

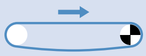
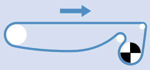
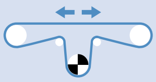
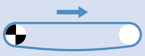
Belt features

Perforations
Belt perforations available for all belt types. Available in various hole diameters and patterns. Contact customer service for examples of row perforations and additional information.



1.3 BELT SELECTION AND SIZING

Drive types

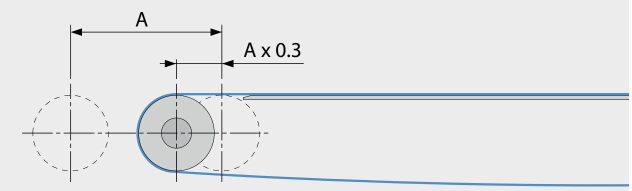
		Drive type possible with **Fullsan Flat**
	Head drive	●
	Lower head drive	●
	Center drive (e.g. Omega drive)	●
	Tail drive	●

Pre-tension

Depending on the type and application, Siegling Fullsan belts work with different pre-tensions.

Even with low pre-tension, which could be generated by the belt sagging on the return side, it is often advantageous to use a take-up or quick tensioning release take-up (see section 2.2). This makes the belt easy to fit, and provides good control over the belt sag. In addition, it enables fast and convenient cleaning of the belt and conveyor.

The tensioning range (A) should be calculated so that with the take-up extended 30%, no pre-tension is generated, and at least the desired pre-tension can be achieved with the remainder of the travel (fig. 1).



1

Calculating the required belt length

The required belt length can be determined using the following calculation process (fig. 2):

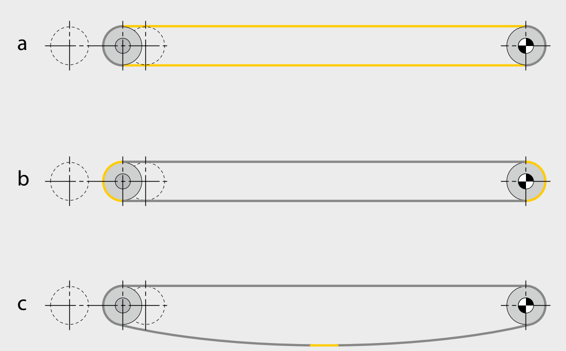
– Find the total of the individual span lengths in the stretched state. Assume that position-dependent take-ups are extended 30% (a).

– Find the total of the individual arc lengths at all deflection points (b).

– Find the additional required belt length resulting from the desired catenary sag (c) (see section 2.4).

– Add these values.

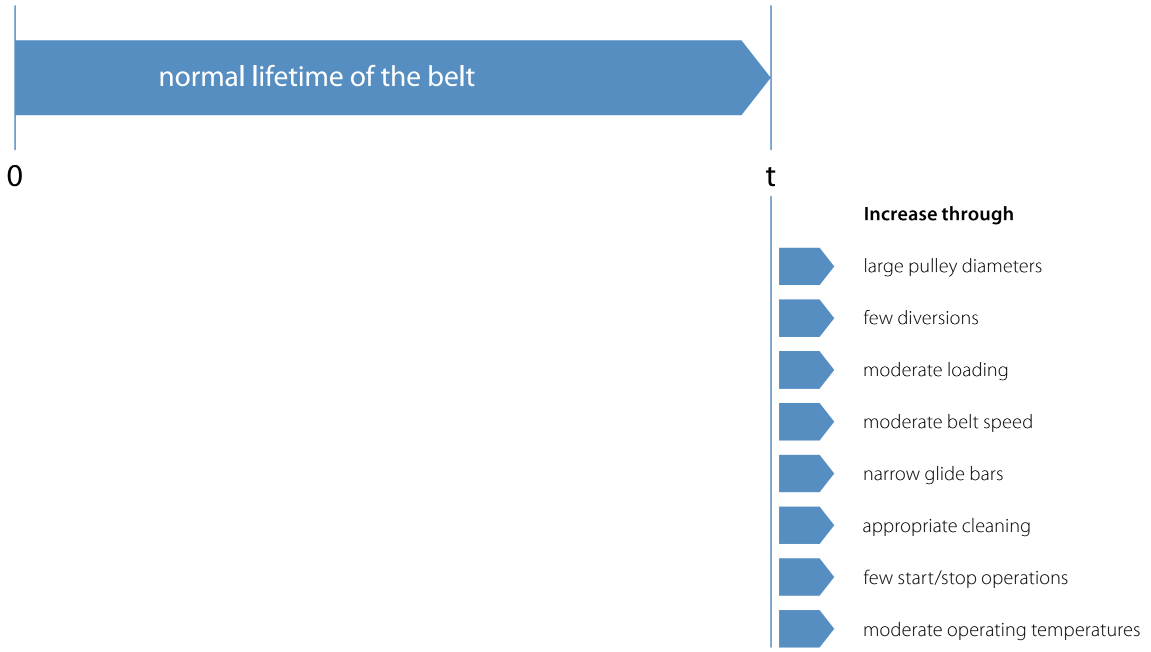
– Correct the result if necessary taking expected load states into account (belt length and width change depending on the loading).



2

1.4 FACTORS INFLUENCING BELT LIFE

The following diagram shows the basic effects of various influencing factors on the service life of a Siegling Fullsan belt.



1.5 CLEANING

To achieve optimum cleaning results, coordinate the cleaning process in detail with your cleaning agent supplier and your contact at Forbo Movement Systems.

Follow the steps below to clean:

1 Make sure all large particles and residues are removed using scrapers or brushes.

2 Rinse with hot water (55 – 60 °C / 130 – 140 °F). Do not use boiling water or extremely high pressure as this will reduce belt life.

3 Apply an alkaline cleaning agent to the belt surfaces that has been approved by your plant sanitarian, sanitary operation procedures, or cleaning chemical supplier.

4 Rinse the belt with hot water (55 – 60 °C / 130 – 140 °F). Do not use boiling water or extremely high pressure as this will reduce belt life.

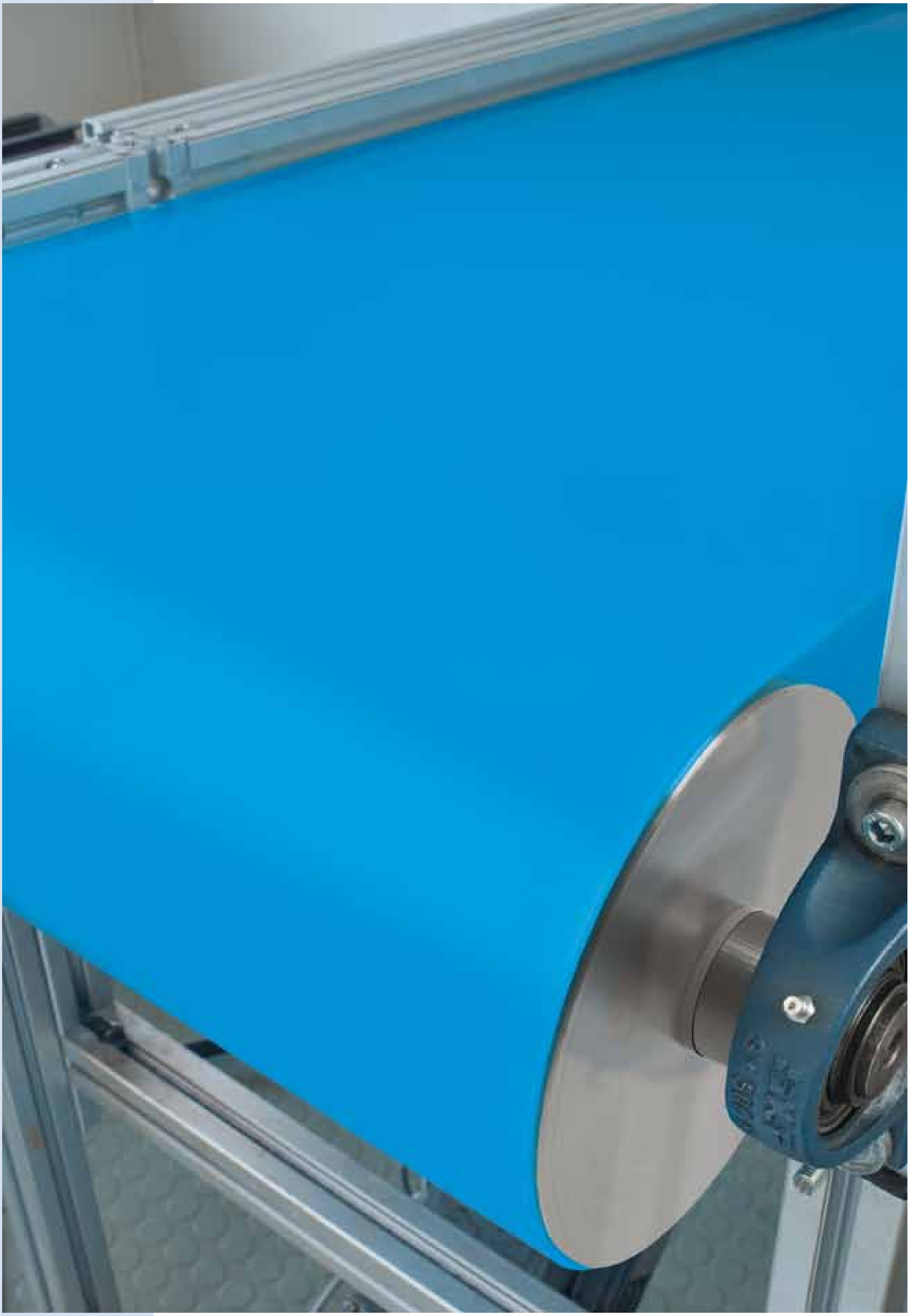
5 Disinfect with a disinfectant that has been approved by your plant sanitarian, sanitary operation procedures, or cleaning chemical supplier.

6 Rinse the belt with hot water (55 – 60 °C / 130 – 140 °F). Do not use boiling water or extremely high pressure as this will reduce belt life.

Notes:

- Water pressure should not exceed 17 bar (250 psi), to avoid aerosol contamination.
- Maintain a safe distance between belt and water nozzle.
- Water temperature should not exceed 65 °C (150 °F), to avoid proteins sticking to the belt surface, as well as for safety reasons.
- Do not exceed the specified concentration or temperature for the cleaning agent. Please refer to your plant sanitarian, sanitary operation procedures, or cleaning chemical supplier for proper use of and recommended chemicals for your specific needs.

Our TecInfo 09 also offers you a detailed description. Please inquire.

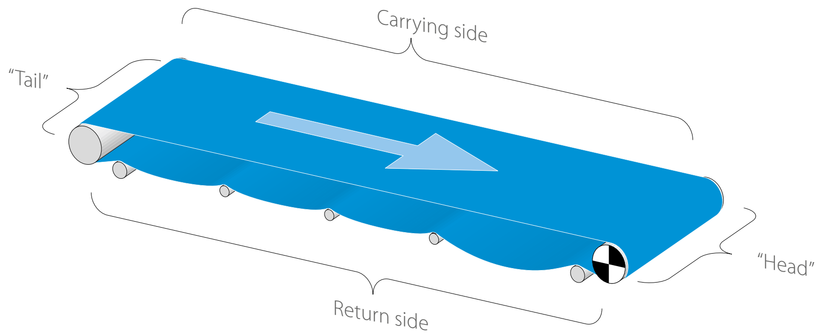


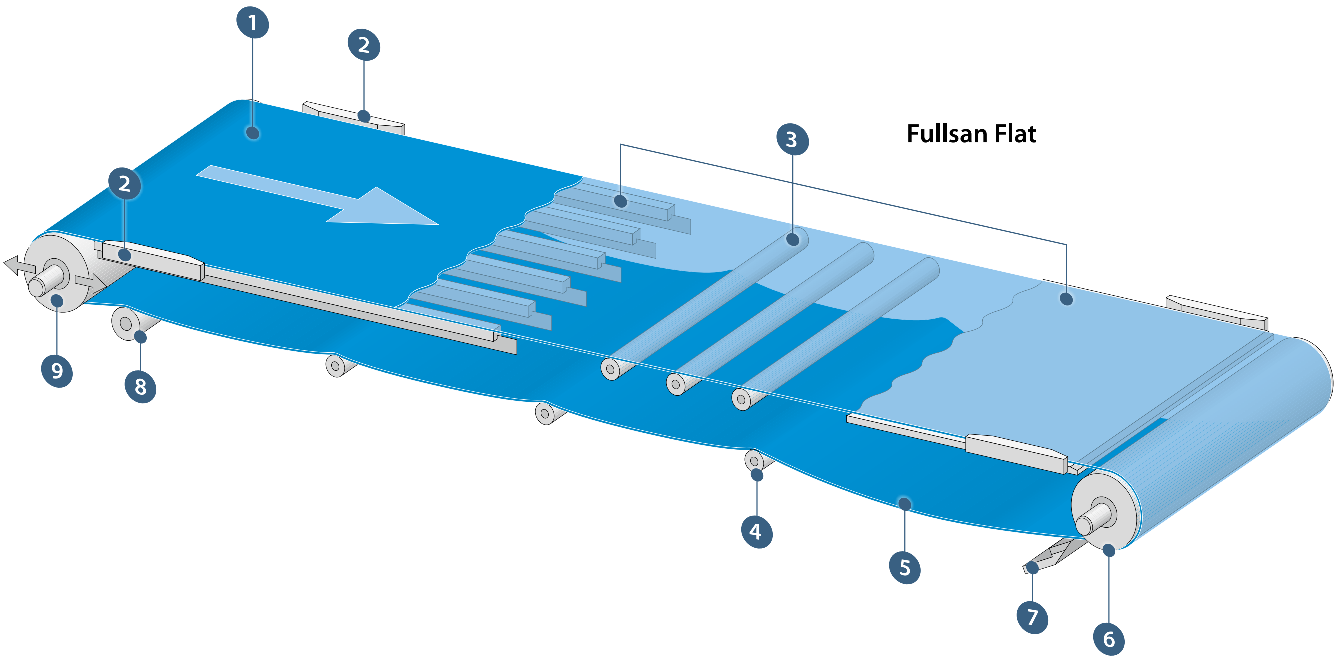
2 CONVEYOR DESIGN

2.1 GENERAL

Conveyor components

Conveyors may differ considerably from the diagram shown here due to different drive types and layouts.





❶ **Siegling Fullsan homogeneous belts**

Conveyor carrying side

❷ Guide rails to guide the belt at the sides
❸ Different types of belt supports

Conveyor return side

❹ Return rollers (if necessary with flanged pulleys to guide the sides of the belt)
❺ Belt sag

"Head" of the conveyor (outfeed)

❻ Drive shaft/drum (at the "head" of the conveyor)
❼ Scraper
❽ Snub roller

"Tail" of the conveyor (infeed)

❾ Idler shaft/drum (at the "tail" of the conveyor, optionally designed as a take-up)

2.1 GENERAL

Hygienic design

Siegling Fullsan belts are very often used in applications where high hygiene standards have to be maintained. The system as a whole can only meet these standards in conjunction with an adequate conveyor design.

Where high hygiene standards are required, conveyor systems and conveyors have to be constructed according to design principles that avoid relevant design weaknesses. Dirt must not build up; materials, surfaces and components should be easy to clean.

Therefore, in these cases, bear the following principles in mind:

- Keep the overall design as simple as possible to avoid dirt traps.
- Use as many supports as structurally necessary.
- Avoid using mechanical belt splices whenever possible.
- Avoid using tubes that are not completely sealed. Instead use solid bars wherever possible.
- L and U sections as well as surfaces should be positioned so that liquids reliably run off them.
- For the joining technology, give preference to clean welded joints (welded seams in contact with food should be ground/cut flat).
- If bolted connections are unavoidable, do not leave any thread sections exposed; do not use star washers as clamping elements and do not use Allen screws. All joint areas should be easy to clean.
- Never design inner radii that are smaller than 3 mm.
- Never drill into completely sealed tube sections, not even to create internal threads, e.g. for adjustable feet.
- Design for easy tool-free installation and removal of accessory parts, e.g. belt guides.
- Finish all surfaces that are in direct contact with food in accordance with relevant food hygiene regulations (grind, polish, passivate, …)
- Use only materials that are easy to clean and resistant to frequent cleaning, and are food safe where applicable. Note the materials table on the next page.

Detailed information about hygienic design requirements and hygienic operation can be found in the publications of the European Hygienic Engineering & Design Group (EHEDG) | www.ehedg.org

In addition to the requirements listed here, the further sections on conveyor design should also be taken into account whenever Siegling Fullsan is used.

Materials

All materials used in the conveyor must satisfy hygienic and mechanical requirements, withstand the corresponding operating conditions, and where applicable be correct friction partners in interaction with the conveyor belt.

Therefore, for the selection and type of materials, it is essential to observe the recommendations in the following table. During use, also note the expansion/contraction of the respective materials due to temperature (see section 2.2).

Conveyor components	Materials
Frame	Aluminium Steel Stainless steel
Sliding support	Polyamide (PA) Polyethylene (PE) Ultra-high-molecular-weight Polyethylene (UHMW-PE) Polytetrafluoroethylene (PTFE) Stainless steel
Drum	Steel Stainless steel
Scraper	Polyurethane (PU)
Side strips	Ultra-high-molecular-weight Polyethylene (UHMW-PE)
Side skirts	Polyurethane, solid (PUR)

Please contact our customer service team if you have any questions.

2.2 NOTES ON CONVEYOR CONSTRUCTION

Frame and supports

The following aspects should be taken into account in the design:

– For cleaning, maintenance and repair purposes, all parts of the conveyor must be easily accessible. Use simple structures that allow the belt to be lifted up and/or drive/idler rollers to be easily removed (e.g. swing open designs).

– For easy belt installation as well as quick and convenient cleaning, take-ups and/or quick-tensioning devices may also be useful even if the belt is operated without pre-tension.

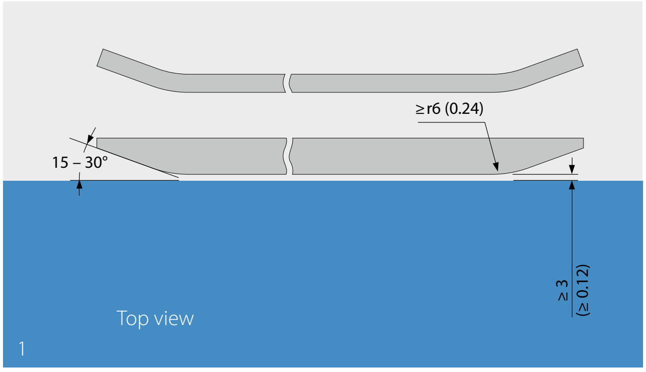
– Match the conveyor design to the selected belt type. All pulley diameters, transitions etc. should have at least the allowed d_{min} of the belt (for wrap angles ≤ 15° also $d_{min}/2$). Also pay attention to counter-bending and the space requirements e.g. of profiles (flights, sidewalls) etc. Profiles (flights, sidewalls) may require a greater drum diameter than the belt type on its own (see "Technical information 2", ref. no. 318 and "Siegling Fullsan · Lower cleaning costs, better hygiene", ref. no. 259).

– If the design makes it difficult to fit preassembled belts, then it has to be possible to make the belts endless on the conveyor. Alternatively, mechanical belt fasteners can be used if the application permits.

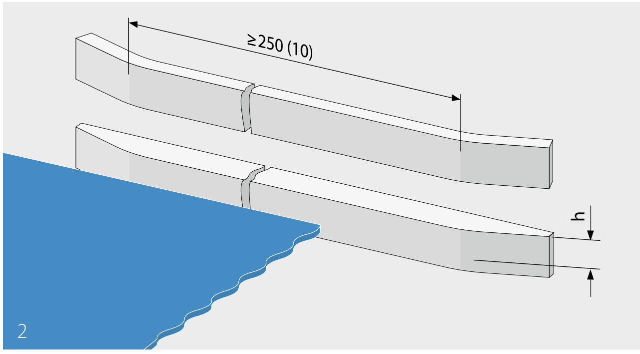
– The spatial conditions at the installation site must allow all planned conveyor functions.

– For all conveyor dimensions, note the belt elongation and shrinkage that can occur during operation. Low temperatures must not result in excessive shaft loads (due to shrinkage) and at high temperatures lengthening must be accounted for to ensure appropriate transmission of drive power (see materials table in section 2.1).

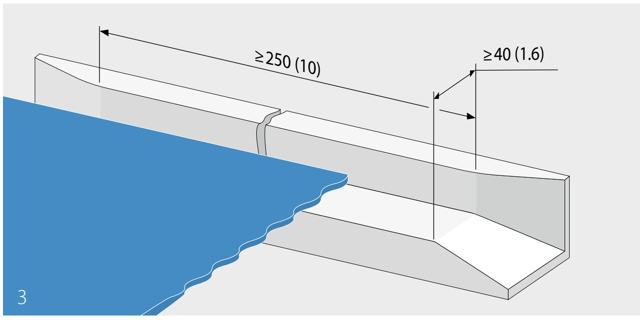
– When designing the belt support in the bottom run, take into account the weight, length and position of the belt sagging that can occur depending on temperature. It is important that e.g. fastening elements, cables and collection trays do not touch the belt in any operating state.



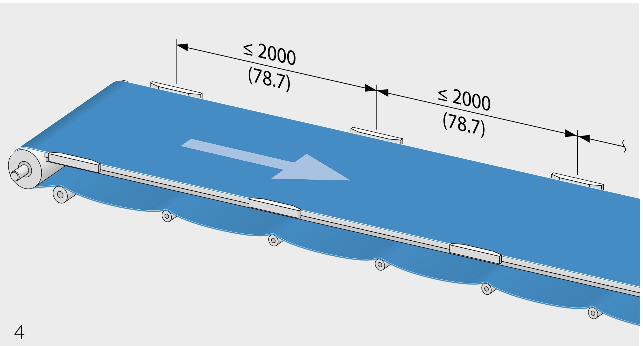
1



2



3



4

Belt side guides

If required, Siegling Fullsan belts can be guided at the belt edges. Do not use these belt guides to compensate for poor belt tracking (if necessary, correct the belt tracking as described in section 2.5).

– Use only the materials specified in section 2.1 with the corresponding surface finish to minimise abrasion and drag where applicable to meet hygienic requirements.
– At the greatest width that the belt reaches under the given operating conditions, the gap at the side from guide components must be at least 3 mm (0.12 in) (fig. 1, top view).
– Use either guide blocks or flange rollers (main dimensions see figures 1–4). Place the first guide components close to the end pulley; the next ones at intervals of no more than 2000 mm (78.7 in) towards the drive. Use long side guides or L-shaped supports in the area of infeeds and outfeeds.
– During installation, make sure fastening elements do not rub against the belt (use countersunk headscrews) and that hygiene requirements are observed. All guide surfaces should be accurately aligned in the conveyor direction and perpendicular to the conveyor path.

Support on the underside of the belt is provided by wearstrips, flat supports or rollers. See section 2.4.

2.2 NOTES ON CONVEYOR CONSTRUCTION

Conveyor speed

We recommend a soft start and soft stop for the motor for speeds of more than 20 m/min (65 ft/min), or for loads greater than 70% of the max. load.

Conveyor length

The maximum conveyor length is generally limited by the belt's maximum tensile strength, but it can also be limited by the effects of elastic oscillation, which should in principle be avoided. This can occur when the belt stretches under load and causes a slip-stick effect. The slip-stick-effect describes the effect of the belt alternating between sliding over and sticking to the slider bed.

The determining factors to avoid the slip-stick effect are belt length, belt speed, loading, and friction. In general, the higher the speed and the shorter the conveyor, the lower the risk of slip-stick.

Expansion/contraction due to temperature

Plastics can expand or contract significantly with variations in temperature.

- Make allowances for possible changes in the belt length and width that occur when the operating temperature deviates from the original ambient temperature. This applies both to the belt sag on the return side and lateral clearance on the conveyor frame.
- Components such as guide rails and wearstrips also change size depending on the temperature. Take this into account for assembly (e.g. by providing elongated holes, fixing at only one point, placing slotted parts on sheet metal edges, etc.) Easy to clean gaps should be allowed between adjacent parts.
- Remember that components and the belt expand at the same time, so gaps between them may become smaller from both sides due to temperature changes.

Materials tested and recommended by Forbo Movement Systems for various conveyor components are listed in the materials table in section 2.1.

Take-ups

The belt contact pressure on the drive drum that Fullsan Flat requires to transmit the circumferential force is generated by a take-up that tensions the belt (fig. 1).
Even if no pre-tensioning is required, it can be helpful to use a take-up, because:

- it can make it easier to fit and remove the belt
- it simplifies and speeds up cleaning processes
- it can compensate for temperature and load-dependent belt lengthening, and if necessary control belt sag

Usually position-dependent take-ups are used. In this case, a pulley is fitted that is adjustable in the conveyor direction (e.g. by screws). It can be moved parallel to the axis to apply the desired pre-tension or generate the desired belt sag.

The tensioning range should be calculated so that with the tensioning travel extended 30%, no pre-tension is generated, and at least the desired pre-tension can be achieved by extending the take-up system out further.

Force-dependent tensioning can be achieved e.g. by means of a weight load acting via a cable. Alternatively, pneumatic, hydraulic or spring-loaded take-ups can be used.

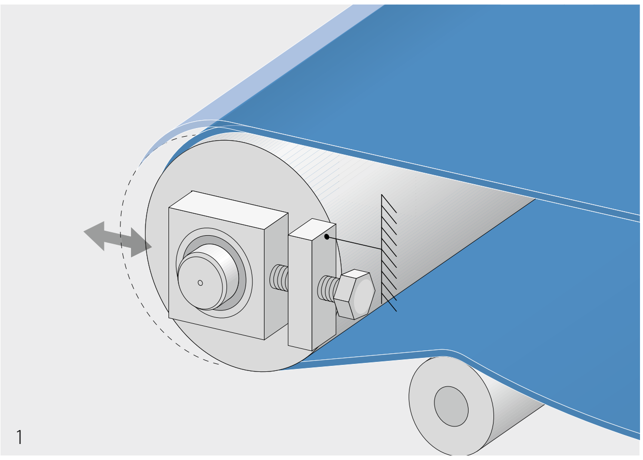
Quick release tensioning devices

Unlike adjustable take-ups, pure quick-action tensioning devices do not allow precise adjustment of the tension and belt sag (fig. 2).

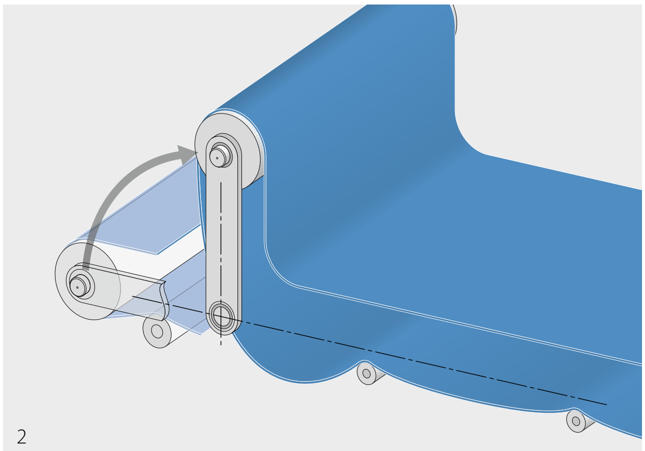
Locking swing-open designs are common here. One end of the conveyor frame (including the pulley) is designed to swing up via an axis-parallel pivot axis. Swinging the device up completely slackens the belt and forms a large sag. This makes it much easier and faster to clean the belt and conveyor.

Once closed, the belt is correctly tensioned and in the right position again.

Of course it is possible and often useful to combine this with a take-up.



1



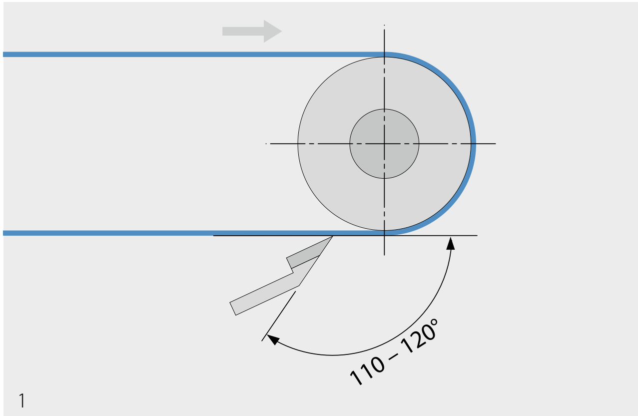
2

2.2 NOTES ON CONVEYOR CONSTRUCTION

Scrapers

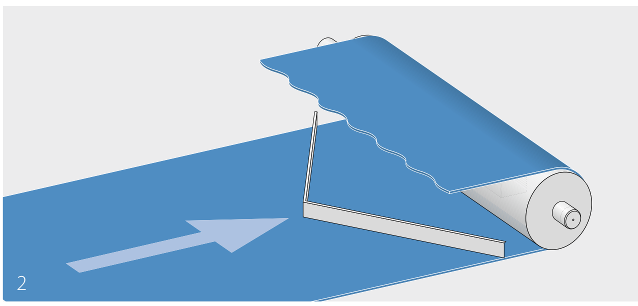
Often one or more scrapers are sufficient to clean adhering transported material from the belt during operation. To ensure trouble-free operation, calculations should include an extra allowance for drive power.

- The scraper material should be well matched to the belt and transported material to prevent unnecessary wear on the belt surface and achieve effective cleaning performance.
- The best results are normally achieved with co-extruded scrapers that have a relatively soft scraper lip and rigid main body. They are recommended for hygiene reasons due to their homogeneous structure.
- Scraper to be mounted on cross rigid structure (minimizing bending/deflections) supported by the conveyor frame.
- Scraper should be installed as shown with light contact to the belt. (fig. 1).
- Set the angle of the scraper according to the drawing (do not fit at 90° to the belt).
- Provide adjustment devices to compensate for wear in the scraper strip.
- Readjust or replace worn scrapers. Damaged scrapers should also be replaced to prevent belt damage.
- Make sure that the belt is flat in the transverse direction at the scraper position (e.g. check the small clearance between the roller and the scraper at the relevant axis) and does not change its position due to changes in belt sag.



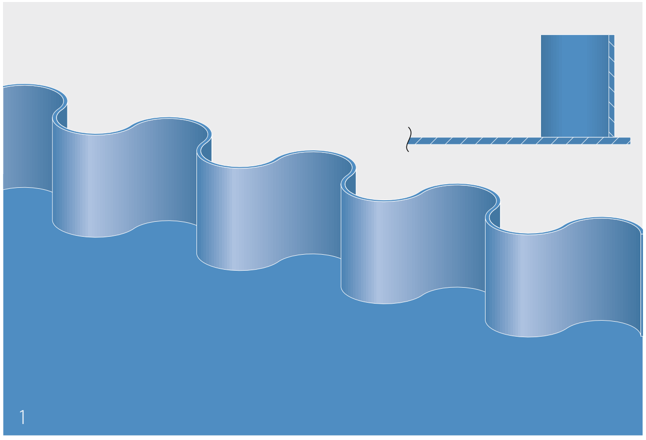
1

- On the bottom run, so-called plough deflectors are often used before the end deflector to prevent falling transported material coming between the belt and drum. They should only lightly touch the belt (fig. 2).
- Smooth drums without a lagging can be kept clean by steel scrapers. These scrapers can be positioned close against the drum surface and modified for the ring shape (e.g. trapezoid shape).


2

All Siegling Fullsan Series

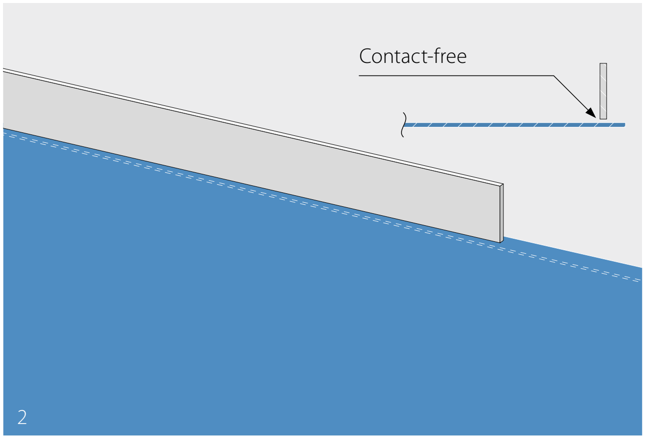
Side limits


1

Sidewalls
Encapsulating the product on the sides can be achieved with sidewalls (fig. 1).

– Provide sufficient clearance from other conveyor components to avoid contact.
– Note that in the concave curve (on angle conveyors), the waves are compressed at the top edge and become wider across the conveyor direction.

Available sidewalls are listed in the Forbo Siegling brochure "Siegling Fullsan · Lower cleaning costs, better hygiene", ref. no. 259.

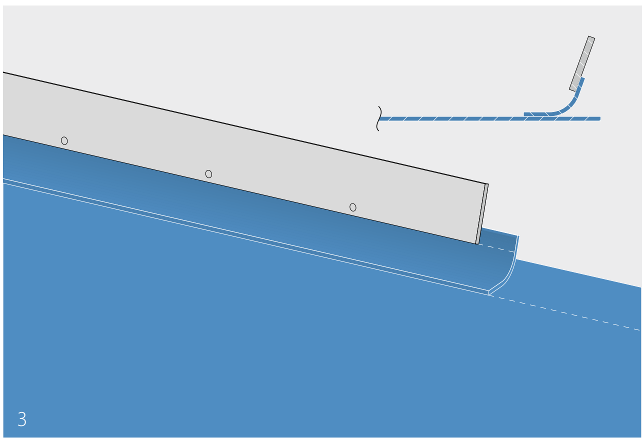


2

Side strips
Side strips are lateral guides for the transported material (fig. 2). They should open in the direction of belt travel (towards the outfeed end) to prevent transported material getting trapped between the sealing guide (strip) and belt.

– Fit sealing guides at right angles to the belt and only as close to the belt as the transported material requires.

For material recommendations see the materials table in section 2.1.


3

Side skirts
Side skirts drag on the belt and can be used for lightweight transported material (fig. 3).
This can cause increased wear on the carrying side of the belt. Profiles (flights) may need to be moved inwards to make room for them.

For material recommendations see the materials table in section 2.1 or consult your Forbo Movement Systems sales representative for side skirt material solutions.

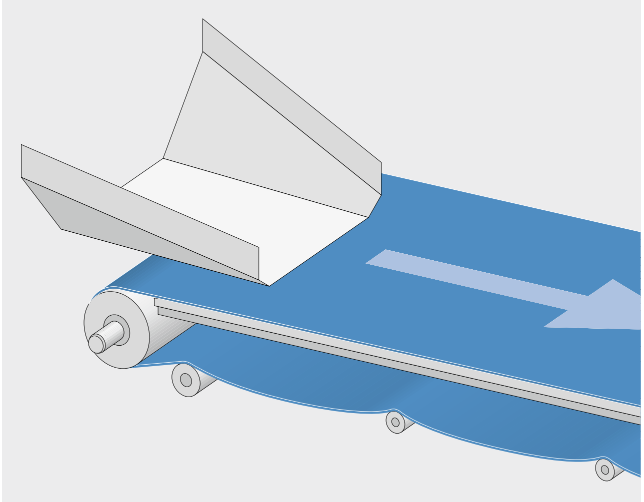
All Siegling Fullsan Series

2.2 NOTES ON CONVEYOR CONSTRUCTION

Feeding the transported material

During loading, the conveyor belt is stressed in the vertical (impact) and tangential directions.

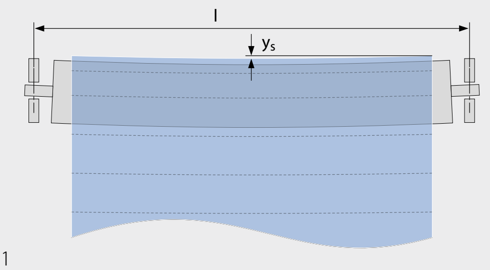
You should therefore provide devices that deliver the transported material to the conveyor belt with low impact energy and a speed component in the belt running direction (ideally at the same speed) (fig. 1). Loading should take place centrally to prevent deflection of the belt (material fed e.g. by chutes, guide plates, hoppers, feed silos).



1

Deflection of shafts, axes, drums, and rollers (fig. 1)
The belt pull acting on axes and shafts causes deflection.
Large bearing distances and small diameters amplify this effect.

- Keep deflection as small as possible to minimize material fatigue and ensure a small, uniform transfer gap (we recommend keeping the deflection value ≤ 2 mm).
- If the belt pull causes greater deflection (> 2 mm), change the dimensioning accordingly or use an intermediate bearing.



1

The deflection can be calculated using the following formulas:

$$y_s = \frac{5 \cdot Fs \cdot l_b^3}{384 \cdot E \cdot I} \quad [mm, in]$$

with:

y_s	=	shaft deflection	[mm, in]
F_s	=	shaft load	[N, lb]
l_b	=	bearing center distance	[mm, in]
E	=	modulus of elasticity	[MPa, psi]
I	=	area moment of inertia	[mm^4, in^4]
W_s	=	edge length of square shaft	[mm, in]
d_s, d_{in}, d_{out}	=	diameter of shaft	[mm, in]
t_s	=	wall thickness of shaft	[mm, in]

Material	**E in** $\left[MPa = \frac{N}{mm^2}\right]$	**E in** [10^6 psi]
Steel	200000	29.01
Stainless steel	180000	26.11
Aluminum	700000	10.15

Shaft type	I
Round	$\frac{\pi \cdot d_s^4}{64}$
Hollow round	$\pi \cdot \frac{d_{out}^4 - d_{in}^4}{64}$
Square	$\frac{W_S^4}{12}$
Hollow square	$\pi \cdot \frac{W_S^4 - (W_S - 2 \cdot t_s)^4}{12}$

All Siegling Fullsan Series

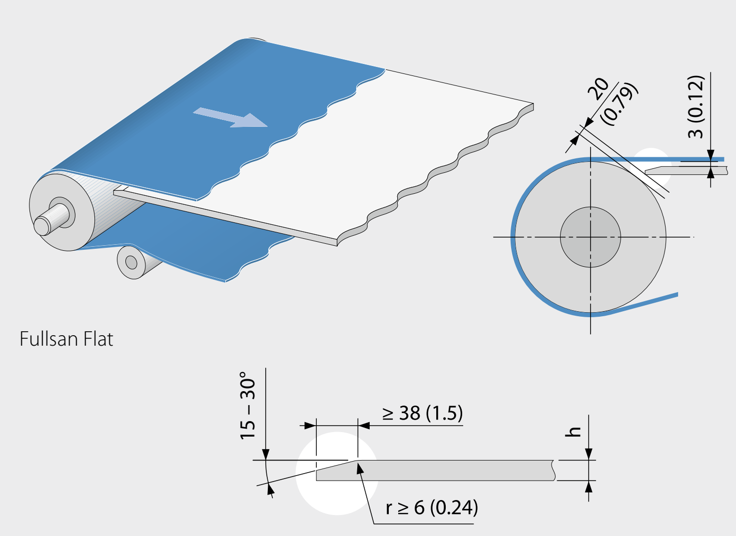
2.3 BELT SUPPORT ON THE CARRYING SIDE

General

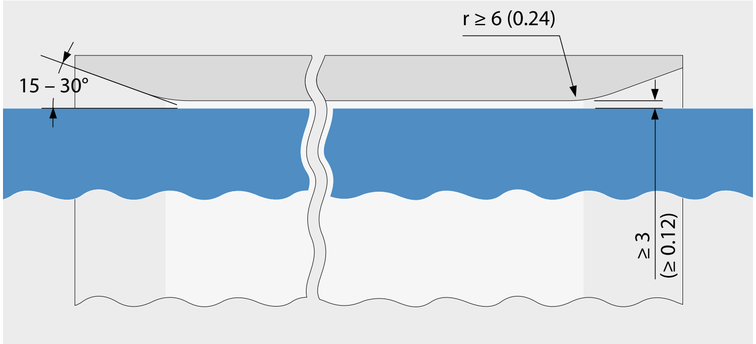
When designing the belt support, also note the general information in section 1.1 and, where applicable, the notes on hygienic design in section 2.1.

- Always precisely align the slide supports, as these have a very strong guiding effect on the belt.
- Position the slide supports as shown in the drawings.
- For the slide support, use only the materials listed in section 1.1. These materials produce favorable friction characteristics.
- Thoroughly clean the slide supports before putting the conveyor into service. Otherwise residues of protective paints or other contamination could cause significant problems (e.g. tracking issues, belt damage, increased friction on the running side).
- Consult your contact person at Forbo Movement Systems if particularly heavy materials are to be transported and high point loads occur.

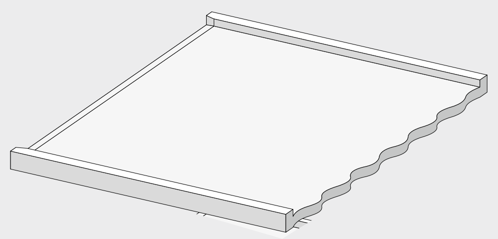
Supporting the belt with flat (table) supports



1



2 In slider bed integrated belt guides, top view



3

Full-surface table supports are recommended for systems with heavy loads (fig. 1).

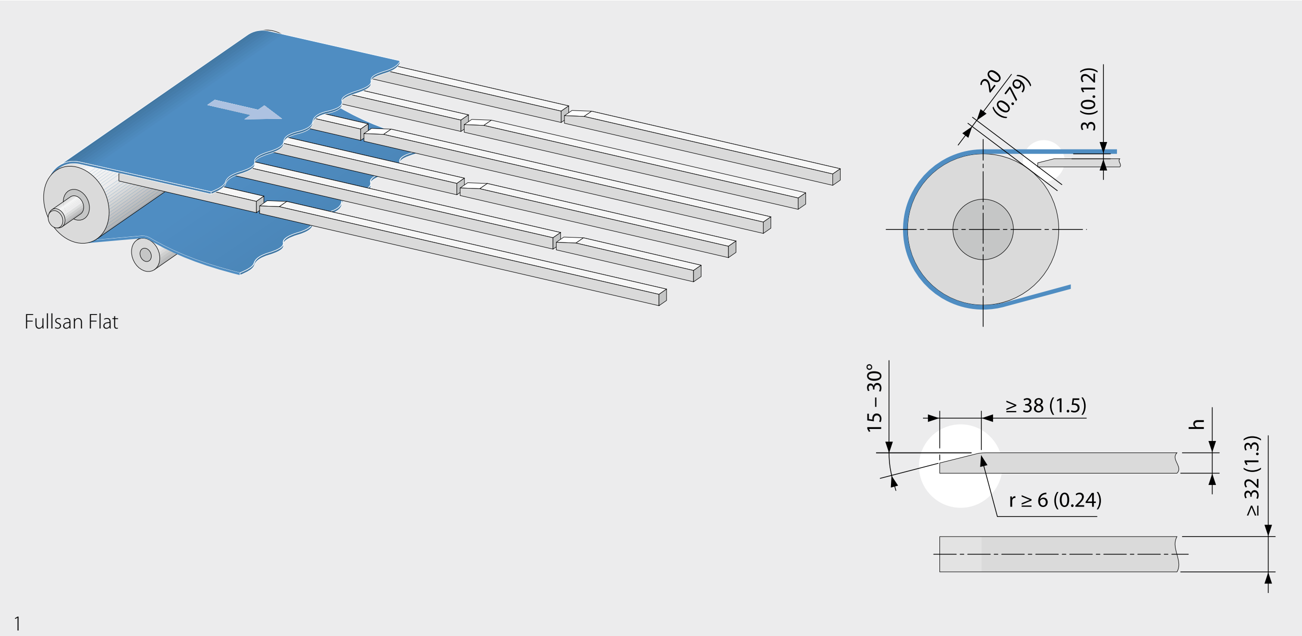
- Use only materials according to the specifications in the materials table in section 2.1.
- Carefully round off edges and slightly chamfer sliding surfaces in the conveyor direction.
- The thickness "h" should be at least large enough to allow fastening elements such as screw heads to be completely countersunk, and so that the chamfer in the conveyor direction can be formed.
  In addition, the thickness is determined by the static requirements.
- Fastening elements must not make contact with the belt.

The design is dependent on the belt type used and the conveying task. For better hygiene the slider bed and side guides can be designed out of one piece (figs. 2/3).

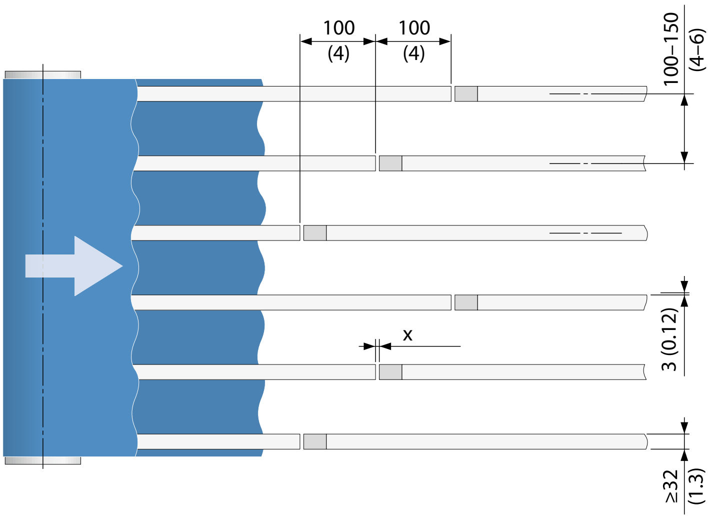
When designing the drive and idler pulley area, observe the notes for Siegling Fullsan Flat (section 2.5).

2.3 BELT SUPPORT ON THE CARRYING SIDE

Supporting the belt with parallel wearstrips



1



2

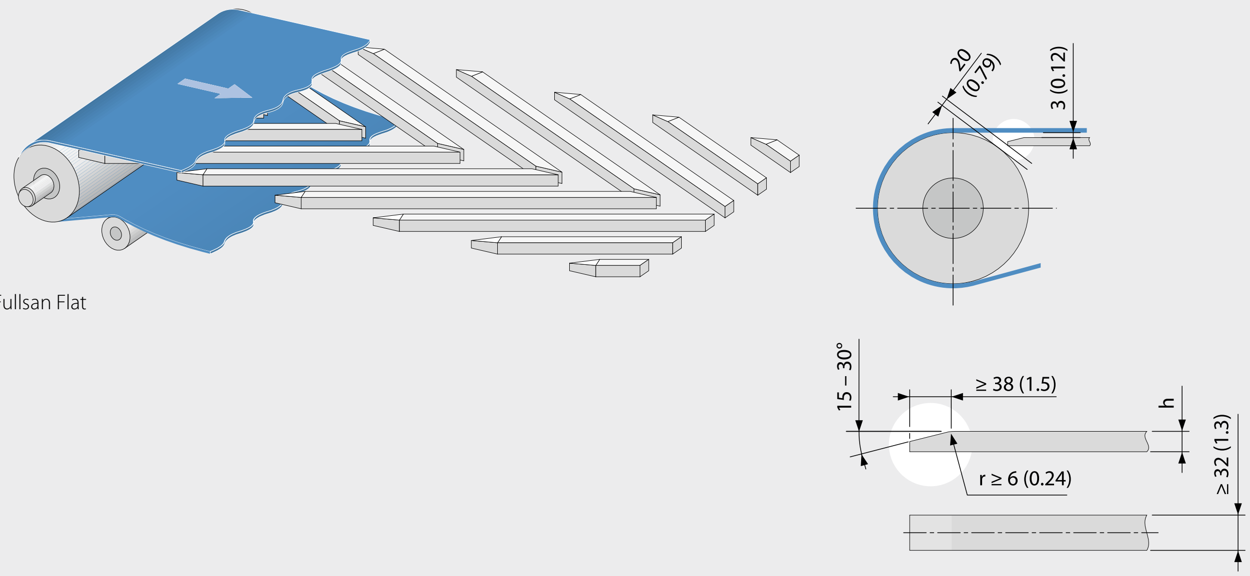
For applications with light loads, parallel wearstrips can be used (fig. 1, left page). Note in this case that the underside of the belt is subject to increased wear in the area of the wearstrips.

- Use only materials according to the specifications in the materials table in section 2.1.
- See the figures 1 and 2 for the main dimensions of wearstrips and their positioning.
- The thickness "h" should be at least large enough to allow fastening elements such as screw heads to be completely countersunk, and so that the chamfer in the conveyor direction can be formed. (Specifications for plastic material.)
  In addition, the thickness is determined by the static requirements.
- The sliding surface must be flat and aligned in two directions with the belt run.
- Carefully round off edges and slightly chamfer sliding surfaces in the conveyor direction.
- Fastening elements must not make contact with the belt.
- Stagger the joints of the wearstrip sections in the conveyor direction. A gap must be provided between the individual sections in the conveyor direction (dimension "x") that can accommodate length changes due to temperature fluctuations and be cleaned easily.
- Check whether sections with flat (full surface) support are appropriate in the transported material infeed area.

When designing the drive and idler pulley area, observe the notes for Siegling Fullsan Flat (section 2.5).

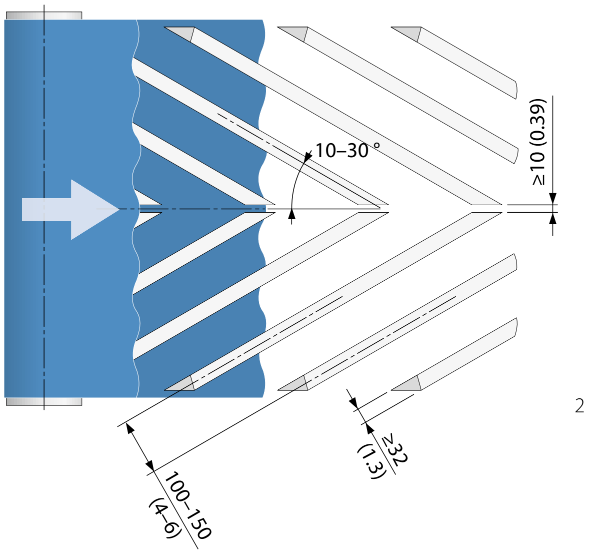
2.3 BELT SUPPORT ON THE CARRYING SIDE

Supporting the belt with a V-shaped arrangement of wearstrips



Fullsan Flat

1



With a V-shaped arrangement of wearstrips, the belt is supported across its full width (fig. 1, left page). This results in even wear across the belt width, which means that heavier loads are possible. At the same time, contaminating particles can be wiped off the belt underside.

– Use only materials according to the specifications in the materials table in section 2.1.
– Select the angle and spacing so that the individual V-shapes reach into one another and support the belt across the full width.
– See the figures 1 and 2 for the main dimensions of wearstrips and their positioning.
– The thickness "h" should be at least large enough to allow fastening elements such as screw heads to be completely countersunk, and so that the chamfer in the conveyor direction can be formed. (Specifications for plastic material.)
  In addition, the thickness is determined by the static requirements.
– Carefully round off edges and slightly chamfer sliding surfaces in the conveyor direction.
– Fastening elements must not make contact with the belt.

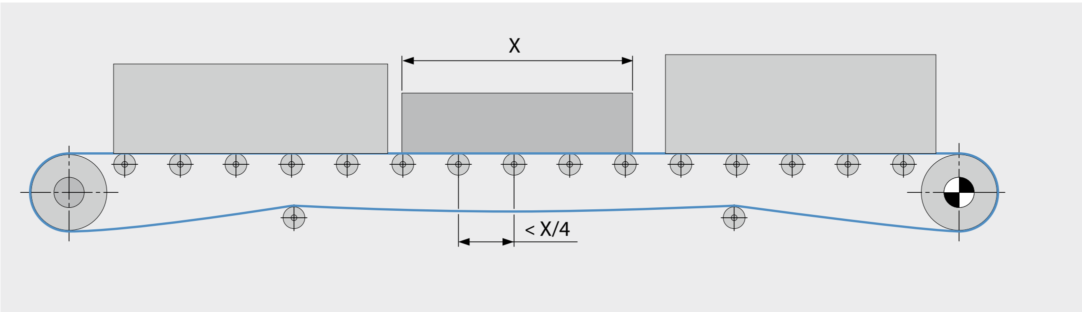
When designing the drive and idler pulley area, observe the notes for Siegling Fullsan Flat (section 2.5).

2.3 BELT SUPPORT ON THE CARRYING SIDE

Supporting the belt with rollers

Forbo Movement Systems recommends roller supports only for Fullsan Flat.
Troughed conveyors are an exception (see section 3).

For conveying unit goods, the support roller spacings are determined by the edge length of the unit goods being transported (25% of the length of the transported goods).



All Siegling Fullsan Series

2.4 BELT SUPPORT ON THE RETURN SIDE

General

The correct design of the return side is very important for the trouble-free operation of the conveyor. It is the only way to ensure the desired (almost) tensionless operation of the belt.

When designing the belt support for the return side, also note the general information in section 1.1 and, where applicable, the notes on hygienic design in section 2.1.

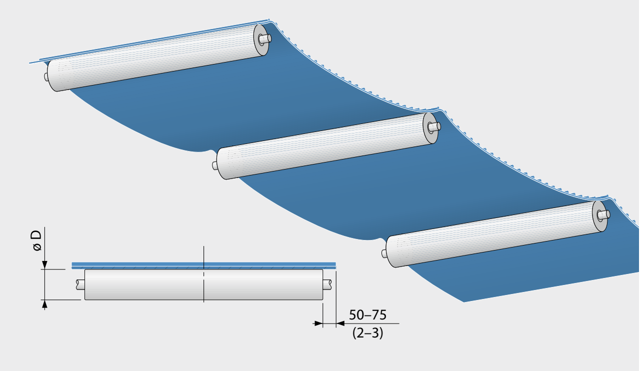
- Determine the values for changes in the belt length and width at lowest/highest operating temperature, and take these into account in the design (see materials table in section 2.1).
- Include the design of the return side in all considerations concerning accessibility for maintenance and repairs, ease of cleaning the conveyor, belt changes, etc.
- For belts wider than 610 mm (24 in), flights have to be sectioned so that a support can be provided in the return side (see next page, fig. 3).
- Use only materials according to the specifications in the materials table in section 2.1.

2.4 BELT SUPPORT ON THE RETURN SIDE

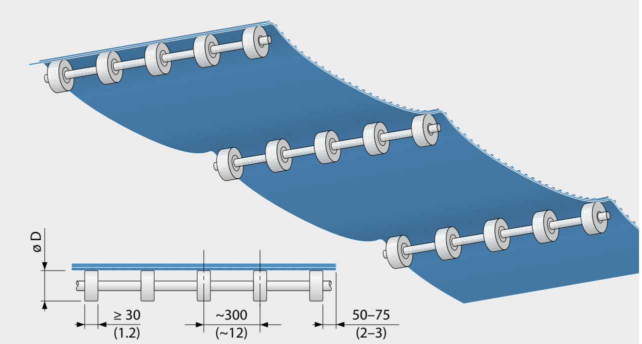
Supporting the belt with rollers

Forbo Movement Systems recommends the use of support rollers to support the belt on the return side. Support rollers can support either the full belt width (fig. 1) or sections of it (fig. 2/3).

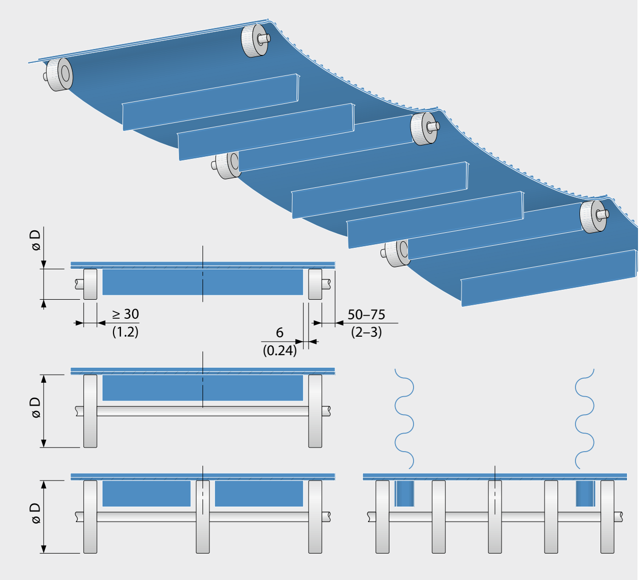
- Preferably use support rollers that support the belt across its full width.
- Parallel to the conveyor direction, support is provided at intervals of 500 – 1800 mm (19.7 – 70.9 in).
- The roller diameter "D" must not be smaller than the permissible counter bending diameter of the belt.
- For belts with flights and/or sidewalls, only narrow support rollers can be used. If a continuous shaft is used, a suitable large roller diameter should be chosen.



1



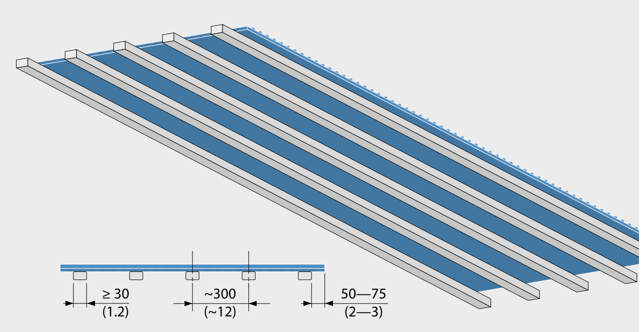
2



3

Sliding belt supports

Sliding belt supports in the return side, in the form of fixed wearstrips, slide shoes or slide shafts are often found in practice (fig. 4). Forbo Movement Systems recommends the use of support rollers to support the belt on the return side.



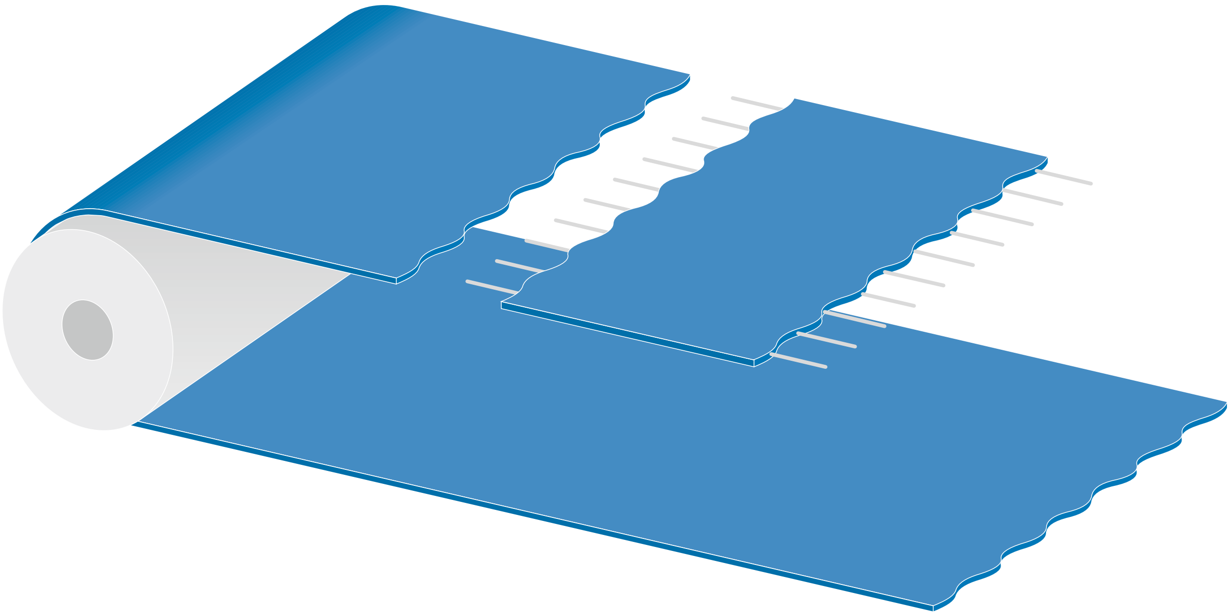
4

2.5 **FULLSAN FLAT**
DRIVE | PULLEYS | TRACKING

General

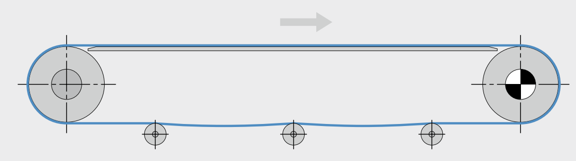
This section contains design information that applies specifically to Fullsan Flat.

For important information applicable to all Siegling Fullsan series, see sections 2.1 to 2.4.



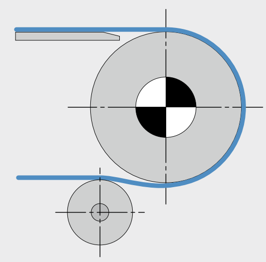
Drive types

Head drive
This drive type is used for most conveyor functions. The drive shaft is located at the head of the conveyor (outfeed side) and pulls the belt (fig. 1).



1

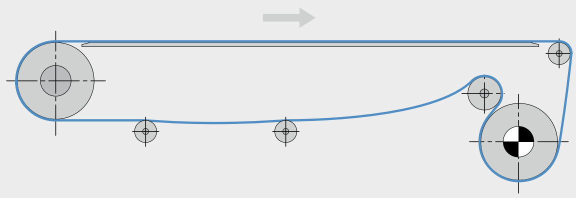
Snub rollers
Use snub rollers if necessary in the return side to increase the wrap angle at the drive/idler pulley and/or to minimize the distance between the carrying and return sides (fig. 2). The diameter of snub rollers can be up to 1/2 d_{min} as long as the wrap angle does not exceed 15°.



2

Lower head drive

This is a variant of the head drive where the drive shaft/drum is arranged in a lower position. It means that the smallest possible pulley diameter can be used at the transfer point to minimize the transfer gap (fig. 1).


1

Center drive (e.g. Ω-drive)

Due to limitations in top side support on the return way caused by sidewalls and lateral profiles these are not suitable for center drive applications.
Center drive (e.g. Ω-drive) is typically used when:

- the smallest possible pulley diameters are required at the infeed and outfeed sides to minimize the transfer gap, and/or
- reversing operation is required.

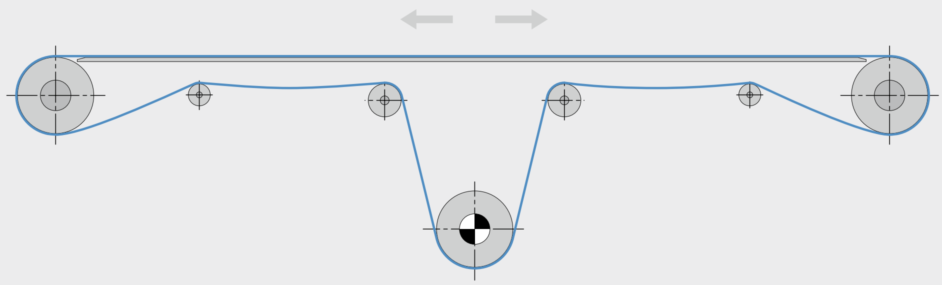
Reverse operation is more complex to belt tracking and is not recommended by Forbo.

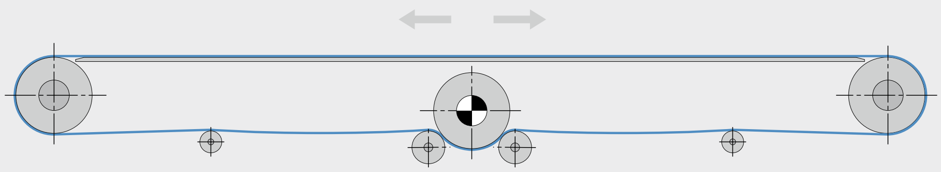
A large wrap angle on the drive produces optimal conditions for reliable power transmission in both running directions (fig. 2).

With a lighter belt load, the wrap angle can be made smaller, which also gives the conveyor a flatter shape (fig. 3).

In both cases, the axes/shafts at the ends of the conveyor system are under higher loads because the belt pull is present as belt tension on both the tight and slack sides of the belt.

- Arrange the drive shaft in the middle if possible.
- The belt length between the snub roller and drive should be shorter than between the snub roller and the next support roller. Otherwise weight rollers are required in the desired sag area.

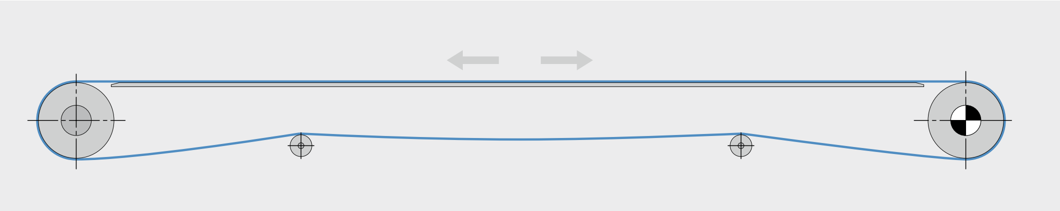

2


3

2.5 **FULLSAN FLAT** DRIVE | PULLEYS | TRACKING

Tail drive (pusher configuration) and alternating tail-head drive
If a head drive reverses direction, it becomes a tail drive (fig. 1).
This means that the drive unit has to push the loaded belt. In this case, if the return side tension is not greater than the carrying side tension, the belt may slip on the drive drum.

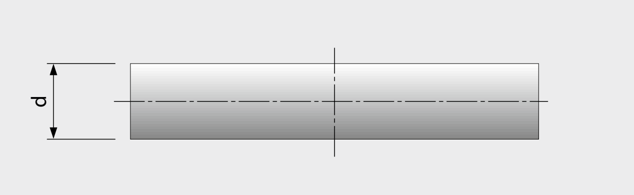
Rear drives and alternating head/tail drives may require higher pre-tension.



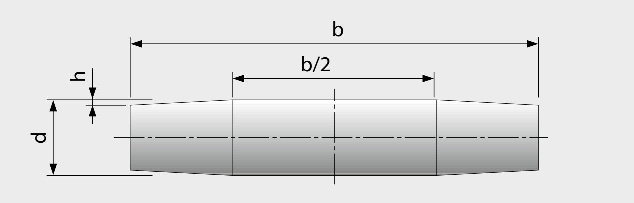
1

Drive and idler drums

Shaft design
For dimensioning the shafts, see the corresponding paragraphs in section 2.2. As an alternative to a conventionally drive shaft, a drum motor can be used.



2



3

Drum dia. [mm (in)]	< 200 (7.87)	200 (7.87) – 500 (19.68)	> 500 (19.68)
Conicity "h" [mm (in)]	0.5 (0.02)	0.8 (0.03)	1.0 (0.04)

Geometry of drive and idler drums
If the diameter is too small, it will lead to unacceptable deflection of the drums, particularly on wide systems. This will cause undesired wrinkling of the belt and poor tracking.

Please do a check calculation. Drum diameters should always be as large as possible.
The smallest permissible diameter is determined by

- the circumferential force to be transferred
- the bending characteristics of the belt type used
- the bending characteristics of the welded-on lateral flights and longitudinal profiles (see "Technical information 2", ref. no. 318) and "Siegling Fullsan · Lower cleaning costs, better hygiene", ref. no. 259).

Drive and idler drums can be cylindrical (fig. 2) or conical-cylindrical (fig. 3).

Conical-cylindrical drums are particularly useful for short belts due to their higher tracking effect. Should the belt width be significantly smaller than the drum length, the belt width is decisive for the division of the drive drum.

Fullsan Flat

Smooth running surfaces

The running surfaces of all drums should be smoothly finished.
Excessive grooves will produce an undesired guiding effect.
Roughness $R_Z \leq 25$ (DIN EN ISO 4287), (roughness depth $\leq 25\ \mu m$)

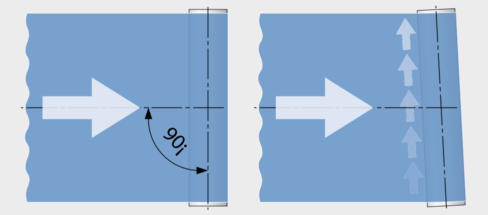
Use only drums whose surface was machined in two turning processes from the middle outwards (or from the edges to the middle). Half of the resulting turning grooves will then have a right-hand "thread" and half a left-hand "thread"; their steering effects will cancel each other out.

2.5 **FULLSAN FLAT** DRIVE | PULLEYS | TRACKING

Belt tracking

Conveyor design and condition

The conveyor frame should be as rigid as possible. It must not be distorted by the forces exerted by the belt. If the axes are not arranged at right angles to the belt conveyor direction, the belt will run off track (fig. 1).



1

All rollers, drums and shafts in the system as well as supports and guide elements should be:

- clean and in a good condition,
- aligned axially parallel and at right angles to the conveyor direction,
- aligned laterally in relationship to one another.

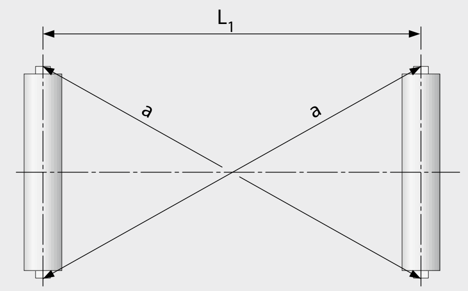
Effect of temperature

Strong asymmetrical heating and loading on a properly adjusted belt can cause uneven changes in the belt's inner tension.

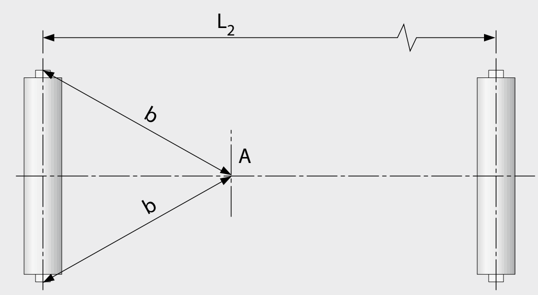
This creates steering forces which could cause the belt to run off track. In these cases, an automatic belt tracking system is recommended.

Alignment at a 90° angle

- Align the conveyor torsion-free and adjust all axes and shafts so that they are horizontal (measured across the conveyor direction).
- Measure the diagonal distance "a" between the ends as shown in the drawing. If the distances are equal, the alignment is correct. Make sure that the distances in the conveyor direction are correct after alignment (fig. 2).
- If the shafts are too far apart or obstacles are in the way, you can measure the distance "b" between ends and a point "A" on the center line of the conveyor (fig. 3).



2



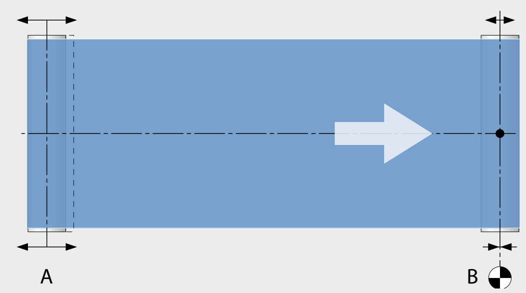
3

Fullsan Flat

Belt tracking at the pulleys

Drums, rollers and shafts should be arranged adjustably to compensate for manufacturing tolerances in the system and belt (fig. 1). If satisfactory belt tracking cannot be achieved in this way, options include using slanting rollers or automatic belt tracking systems.

For so-called “undersquare” systems (axis distance ~ belt width) or an even worse length/width ratio, the belt can no longer be adjusted via conical-cylindrical or crowned drums.



1

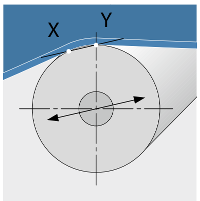
Adjustment

- Fit the belt, align pulleys A + B axially parallel, and create the desired sag in the return side.
- Correct the belt tracking by increasing or reducing the tension on one side of the drive shaft B. The belt will move towards the less tensioned side.
- It may be necessary to use a belt tracking system near the end drum (e.g. for wide, short belts).

Belt tracking with snub rollers

A very effective way to track the belt is to use snub rollers C, D (fig. 2).

The greatest tracking effect is always exerted by the snub roller where the return side meets the end pulley.
if the belt runs in direction 1, snub roller C.
if the belt runs in direction 2, snub roller D.



The snub rollers should be adjustable only in direction X Y (belt run-on and run-off point). That way, the belt edges are hardly affected at all. Highly effective automatic belt tracking control can be implemented with the aid of motorized adjustable snub rollers.

2

Adjustment

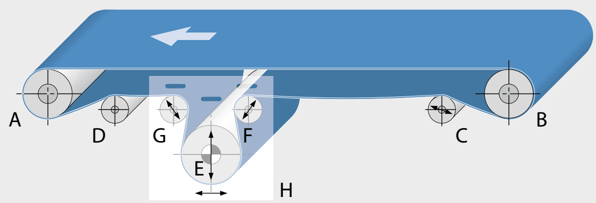
- Set axes and shafts axially parallel as a basic setting.
- Fit the belt with the correct sag in the return side.
- Correct the belt tracking via drum C or D. A belt tracking system using drum C or D as the control drum may be required.

Fullsan Flat

Belt tracking with center drive/Ω-drive
Snub pulleys G and F as well as the drive shaft E are adjustable in the direction of the arrow (fig. 1).

As a simple design solution, the mounts for G, F and E can be installed on a plate H which is moveable along the returnway.

For the arrangement, design and control characteristics of drums A, B, C and D, see the previous and next pages.

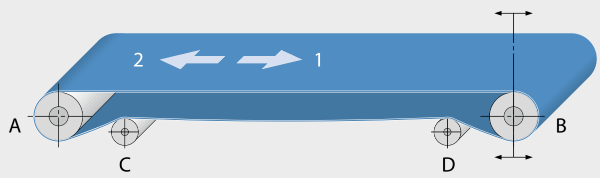


1

Adjustment
– Set axes and shafts axially parallel as a basic setting.
– Fit the belt with the correct sag in the return side.
– Correct belt tracking via the snub roller C and if necessary via the bend pulleys G and F or plate H. A belt tracking system may be required here too.

Belt tracking with reversing systems
The precision with which the system and belt are manufactured is important for trouble-free belt tracking in reversing operation.

It is not easy to adjust the belts correctly in reversing operation. Once the conveyor belt is adjusted correctly in one conveyor direction, it often runs off track in the other conveyor direction. It takes some time to adjust the drums correctly (fig. 2).



2

Adjustment
– Set axes and shafts axially parallel as a basic setting.
– Fit the belt with the correct sag in the return side.
– In reversing operation, the belt tracking should be adjusted not at the snub rollers but at the end pulleys.

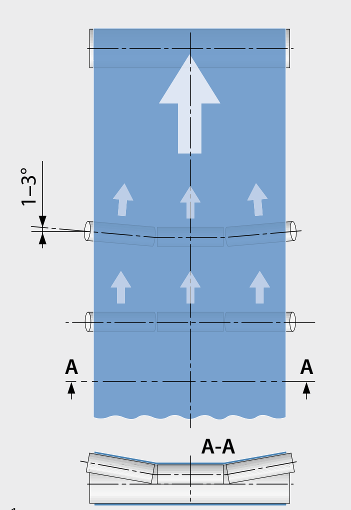
Fullsan Flat

Effect of support rollers

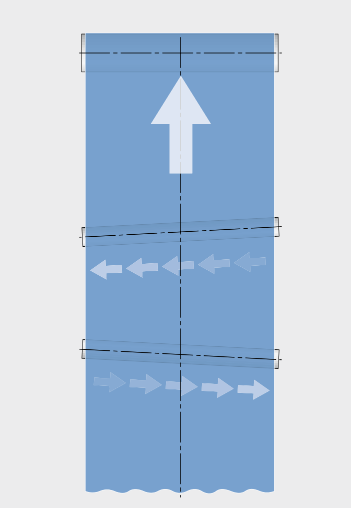
For troughed belts, tracking can be improved by rotating the side rollers at some roller stations forwards by up to approx. 3° in the direction of belt travel, depending on the belt speed (fig. 1).

You can often control non-troughed belts adequately by installing some horizontally adjustable support rollers, then pivot them forwards by about 2 – 4° (fig. 2).

The effect of supporting rollers can mainly be used with long belts.



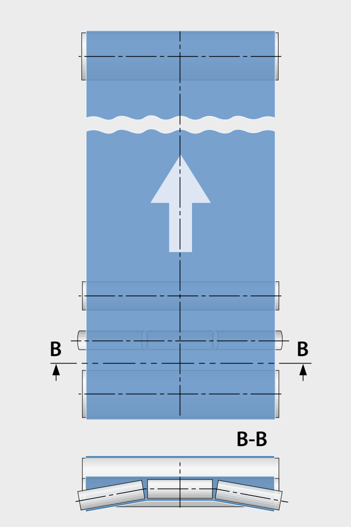
1



2

Effect of negatively troughed roller sets

A negatively troughed roller set in the return side is very effective at centring the belt, if it is positioned close to the tail drum (fig. 3).



3

Belt edge sensors

Different types of belt edge sensors are available, e.g. mechanical, hydraulic, electrical, optical and pneumatic. They activate the the belt tracking system when the belt edge position changes.

Automatic belt tracking

Automatic belt tracking systems are often used with tilting snub rollers. They are usually adjusted by means of electrically operated threaded spindles or pneumatic cylinders according to the current belt edge values detected by the belt edge sensors.

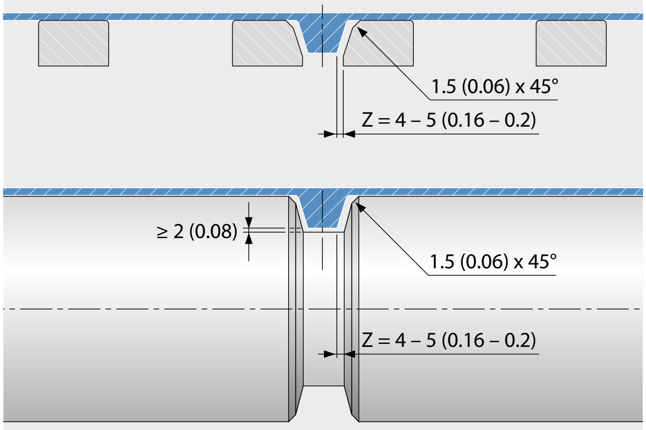
Purely mechanical solutions without auxiliary energy are also possible on small systems.

Absorbing lateral forces with longitudinal profiles

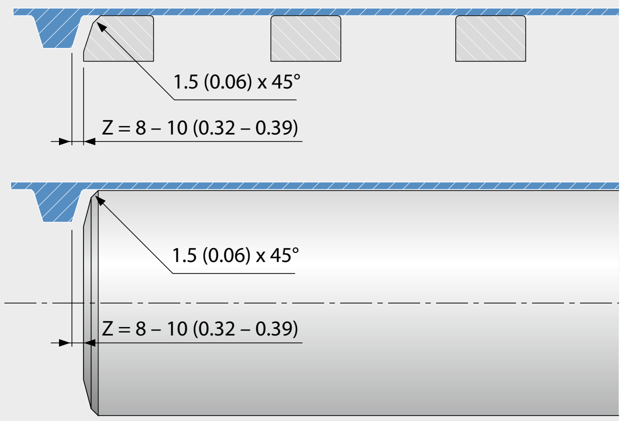
Lateral forces arising e.g. due to transported material entering or exiting from the side can be absorbed by welded-on longitudinal profiles in the conveyor path support area.

- For systems with a length/width ratio of less than 2, the belt can be guided by grooves in drums/taper rollers. If the ratio is greater than 2, it should be guided by grooves in the table or between wearstrips so that the profile does not climb up the edge of the groove and destroy the belt (fig. 1/2).
- The grooves for longitudinal profiles should be at least 8 – 10 mm wider and 2 mm deeper than the profile. The large amount of play enables adjustment of the belt without it immediately rubbing at the sides.
- If heavy soiling is anticipated, increase the groove depth.
- For minimum belt lengths and details of profile dimensions, types and minimum drum diameters, see “Technical information 2”, ref. no. 318.
- For large lateral forces, provide an automatic tracking device.

Do not fix guide strips until the belt is running properly. A minimum play as specified in section 2.2 must remain to allow for tolerances.



1 Guiding by central guide profile



2 Guiding by laterally mounted guide profiles

Fullsan Flat

3 CONVEYOR LAYOUTS

3.1 HORIZONTAL CONVEYORS

General

In conveyors that are aligned horizontally, the conveyor belt runs around two end pulleys, one of which is a drive pulley. The idler can be used as a take-up.

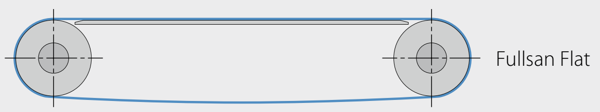
Preferably the drive is located at the outfeed side of the conveyor. In this case it is called head-end.
With this arrangement, the transmission forces are applied more efficiently than with a tail drive.

Conveyor layouts

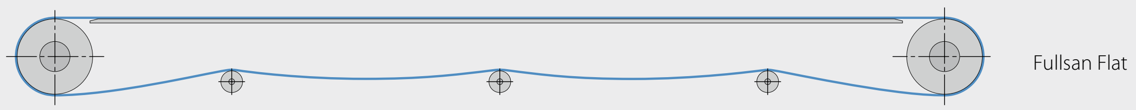
Up to length of 2000 mm, horizontal conveyors can be designed without belt supports in the return side (fig. 1). With axis intervals > 2000 mm, belt supports (preferably return rollers) should be fitted in the return side (fig. 2). This prevents excessive sagging due to the belt's own weight.

– Use the belt sag to compensate for belt length changes due to temperature and load fluctuations. Specifically plan the longest unsupported section as a buffer zone for belt expansion.

See section 2 "Conveyor design" for all design details.



1 Shown without optional snub roller/pressure roller



2 Shown without optional snub roller/pressure roller

3.2 INCLINE/DECLINE CONVEYORS

General

In straight incline/decline conveyors (without a change of angle), the conveyor belt runs around two end pulleys, one of which is a drive pulley. The idler can be used as a take-up.

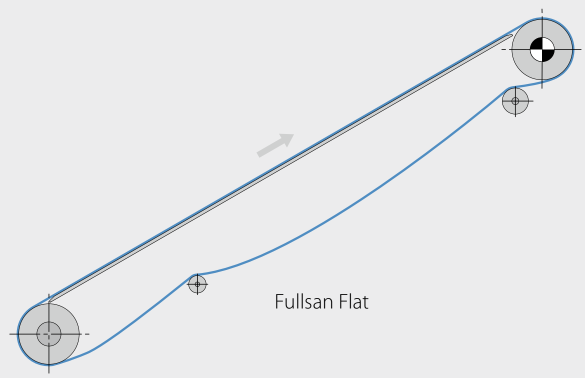
The design of the drive depends on the conveyor direction (incline or decline). Conduct your own experiments to determine the conveyor angle that can be realized for your conveying task, and consider the use of sidewalls and/or flights, if necessary.

Incline conveyor (fig. 1)

Generally we recommend the following:

- Use only a head drive (i.e. use the upper shaft as the drive shaft).
- Ensure there is always a screw tension take-up system or force-dependent take-up on the tail, since the belt tension (generated by the belt sag) decreases with an increasing conveyor angle.
- If the belt width is wider than 600 mm, we recommend providing additional supports on the belt surface or between the flights in the return side.

See section 2 "Conveyor design" for all design details.



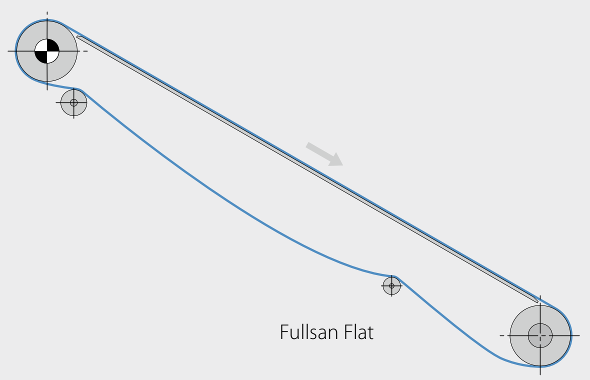
1

Decline conveyor (fig. 2)

Generally we recommend the following:

- Drive type head drive
- Ensure there is always a screw tension take-up system or force-dependent take-up on the tail, since the belt tension (generated by the belt sag) decreases with rising gradient.
- If the belt width is wider than 600 mm, we recommend providing additional supports on the belt surface or between the flights in the return side.
- In case of heavy load a tail drive configuration can be recommended.

See section 2 "Conveyor design" for all design details.



2

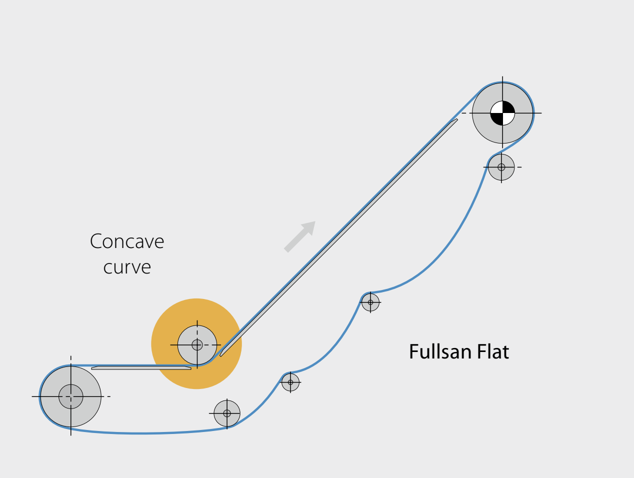
3.3 HOCKEY-STICK AND SWAN-NECK CONVEYORS

General

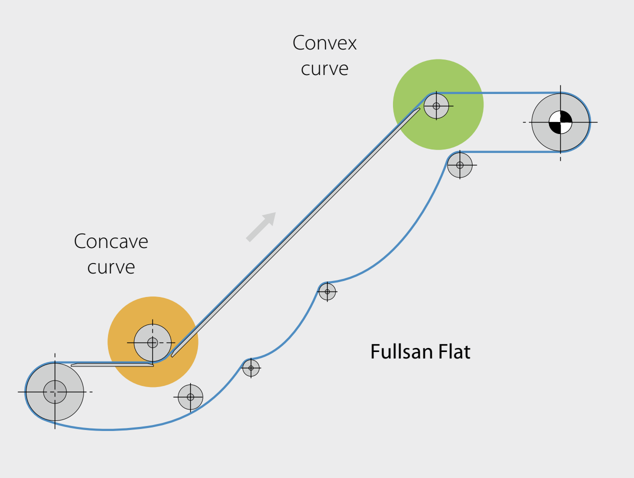
A **hockey-stick conveyor** (L-conveyor) has a horizontal conveyor section in the lower part of the conveyor, and a conveyor section with a gradient angle (fig. 1). The conveyor direction is usually upwards. A head drive is usual. If there is limited space around the head drum, a tail drive can work but is generally not recommended.
The belt undergoes at least one counter bend due to contact with guide elements on the carrying side.

A **swan-neck conveyor** (Z-conveyor) has a horizontal conveyor section at the bottom of the conveyor, a conveyor section with a gradient angle, and a horizontal section at the top of the conveyor (fig. 2). The conveyor direction is usually upwards. If there is limited space around the head drum, a tail drive can be used. In this case, the tensile forces in the belt can only be small, since the concave bending in the return side is critical.

The belt undergoes at least two counter bends due to contact with guide elements on the carrying side. With this arrangement, the transmission forces are applied more efficiently than with a tail drive.



1



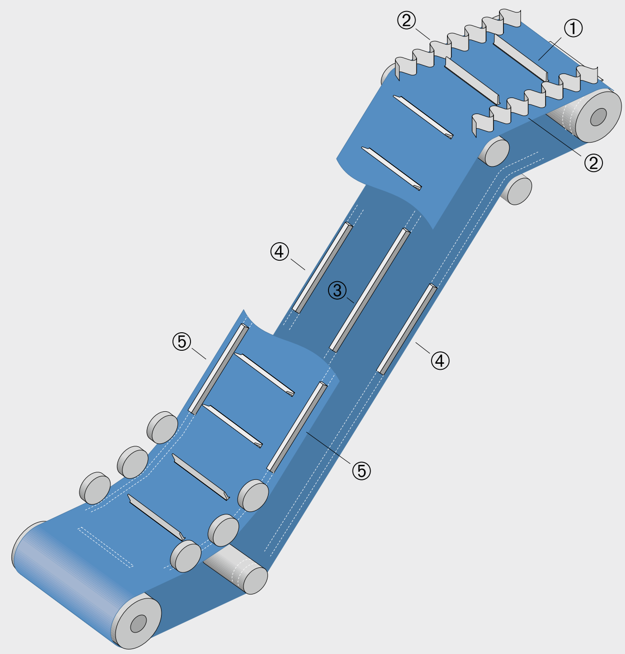
2

Use of profiles (flights, sidewalls) and bending/counter-bending radii

For incline conveying, it is often useful to equip conveyor belts with profiles (flights, sidewalls) (fig. 1).

- **Lateral flights** (1) ensure that the transported material is carried on the belt
- **Sidewalls** (2) enclose the belt's conveying area at the sides
- **Longitudinal profiles positioned centrally on the running side** (3) ensure central tracking of the belt
- **Longitudinal profiles at the edges of the belt on the running side** (4) or on the carrying side (5) are required for guidance and to ensure a constant width if the transverse rigidity of the belt including any welded-on sidewalls is not sufficient to keep the belt laterally stable in the concave curve.

In these cases, the minimum bending/counter-bending radii are dependent not only on the belt type but also on the profiles (flights, sidewalls) that are used.



1

Drive

Hockey-stick and swan-neck conveyors almost exclusively use head drives. The upper drum is used as the drive drum, and is provided with a friction coating (Fullsan Flat). The motor should be designed for low accelerations, as otherwise many system components can be placed under excessive loads.

- Ensure there is always a screw tension take-up system or force-dependent take-up on the tail, since the belt tension (generated by the belt sag) decreases with an increasing conveyor angle.

3.3 HOCKEY-STICK AND SWAN-NECK CONVEYORS

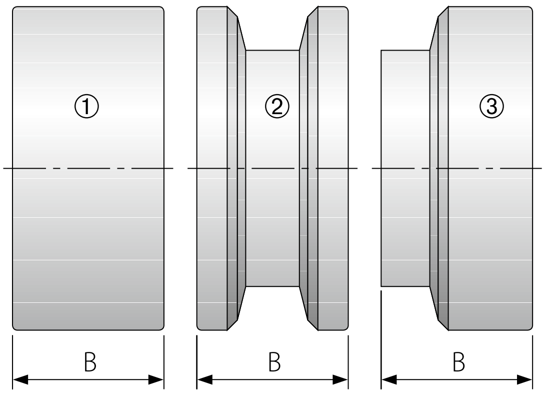
Belt guidance in the concave curve (top side of belt)

Forbo Movement Systems recommends roller support on any counter-bending/transition section of the conveyor.

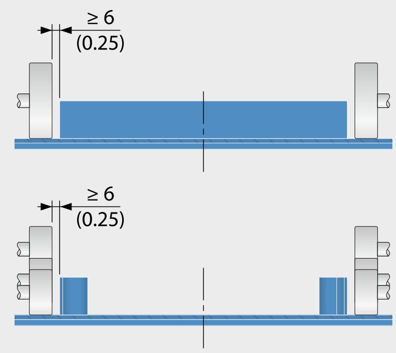
- Use hold down rollers (fig. 1) having the permissible d_{min} to hold down the belt edge (minimum width "B" in each case 30 mm (1.2 in);
  > cylindrical rollers (1) for belts without longitudinal profiles on the carrying side,
  > V-pulleys or guide rollers (2/3) for belts with longitudinal profiles on the carrying side (guide profiles).
- Forbo Movement Systems does not recommend the use of skids or wearstrips.
- When using sidewalls and/or lateral profiles, the smallest permissible deflection diameter increases if the d_{min} of the sidewall/profile is larger than the d_{min} of the belt on its own (for values see "Siegling Fullsan · Lower cleaning costs, better hygiene", ref. no. 259).
- When using V-shaped profiles, the smallest permissible deflection diameter increases if the d_{min} of the profile is larger than the d_{min} of the belt on its own (for values see "Siegling Transilon · Technical information 2", ref. no. 318).
- Between the belt supports and profiles/sidewalls, allow a gap at the side of at least 6 mm (0.25 in) (fig. 2).
- For belt widths exceeding 600mm, additional support rollers are recommended on the return side. In these cases, gapped flights are required.

For low and unchanging gradient angles, it is sufficient to use one pressure roller (4) on each side of the belt (counter bending radius see above) (fig. 3).

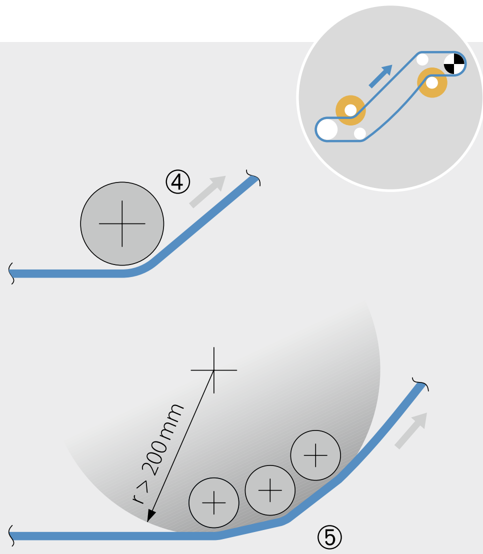
For larger and changing gradient angles, multiple pressure rollers (5) can be used at each side of the belt (at least three). Their diameter can be smaller than when using a single roller per side. An overall deflection radius of > 200 mm must be maintained, however, since the arcs of contact at the local deflection points could cause breaks in the spliced area of the belt (fig. 3).



1



2

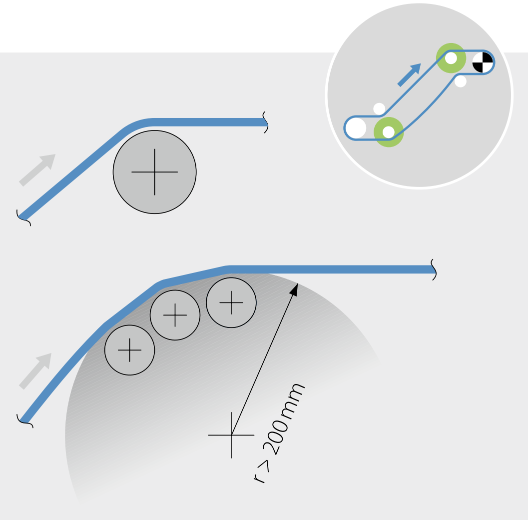


3

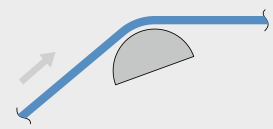
Belt guidance in the convex curve (underside of belt)

Especially if the belt is operated dry without lubrication, high friction resistance occurs at this bending point.

- Preferably (depending on the belt type) use rollers as an end pulley that meet the permissible d_{min} across the full width of the belt (fig. 1).
- Forbo Movement Systems does not recommend the use of skids or wearstrips (fig. 2).



1


2

3.4 TROUGHED CONVEYORS

General

For transporting bulk solids, conveyors with troughed belts are frequently used. These can operate horizontally or at a gradient. Design the trough cross-section according to the belt type used and the conveyor width/task. The idler can be used as take-up.

Preferably the drive is located at the outfeed side of the conveyor, in this case called the head-end.
With this arrangement, the transmission forces are applied more efficiently than with a tail drive.

Transitional area between end pulley and trough

Where the troughed belt transitions from the drum onto the supporting rollers (and vice versa), the edges are subjected to increased elongation (fig. 1).

Therefore please observe the guide values listed in the table for the transition length l_s.

l_s = belt width b_0 · factor c_7 [mm]

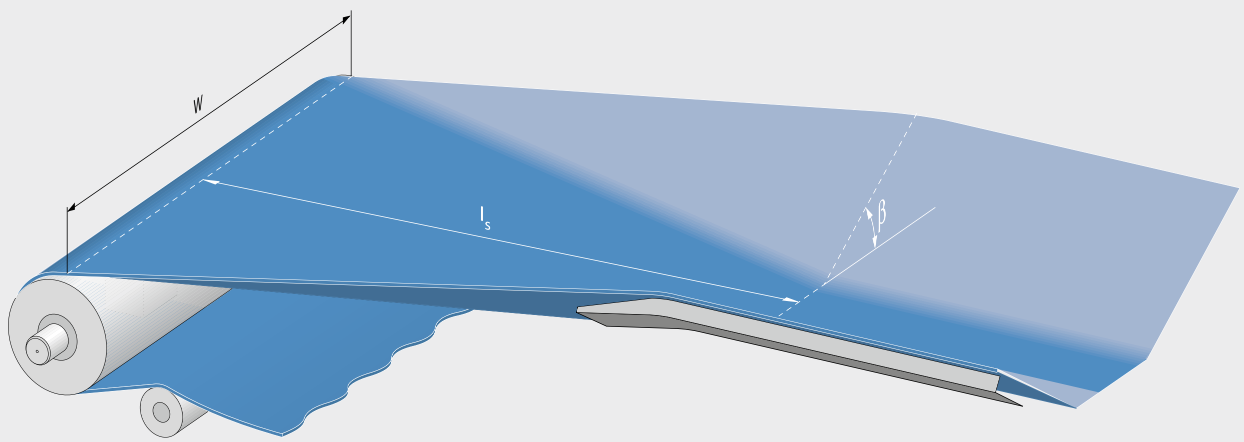
Trough angle	15°	20°	30°	40°
c_7	0.7	0.9	1.5	2

Trough angle

Possible trough angles depend on the belt width:

Belt width < 300 mm	trough conveying not recommended
Belt width 300 – 500 mm	trough angle up to 30°
Belt width > 500 mm	trough angle up to 45°

Depending on the Siegling Fullsan type used, different trough shapes can be realized (see following pages).



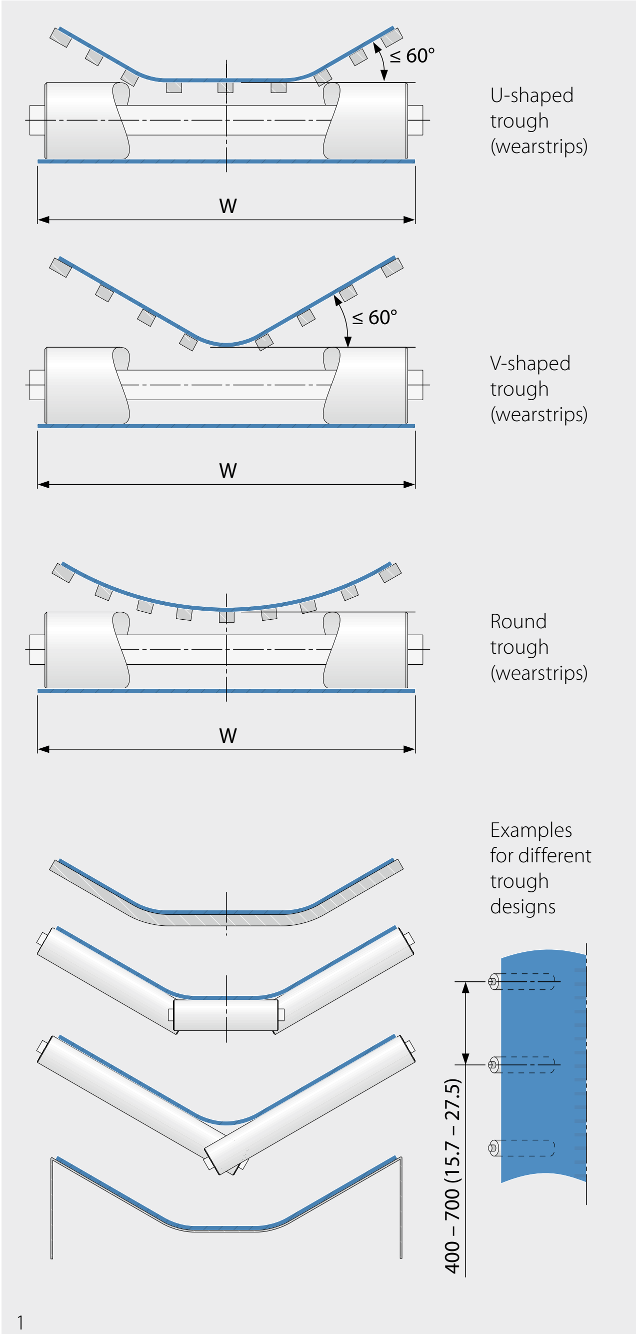
1

Siegling Fullsan series and trough shape

The possible trough shape and belt support design depend on the conveying task and the Siegling Fullsan type used.

Belt support for Fullsan Flat (fig. 1)

- The belt can be supported by wearstrips, full-surface and by rollers (U-shaped, V-shaped or round).
- Use only materials according to the specifications in the materials table in section 2.1.
- For all types of belt support, observe the main dimensions in the drawings opposite and in section 2.3.
- Rollers should extend outwards at least to the edge of the belt. The spacing in the conveyor direction is normally between 400 mm and 700 mm (15.7 and 27.5 in).
- Integrate side guides if necessary.
- Make sure that the transitions in the regions at the beginning and end of the trough are well rounded.
- The top edges of the head and tail pulleys and the middle trough plane must lie in one plane. If the trough bottom is not supported by a wearstrip, a maximum sag of 30 mm (1.2 in) is permissible.



Principle diagrams for different trough designs

LEGAL NOTES

Forbo Siegling GmbH ("Forbo") provides this Engineering Manual for information purposes only. While Forbo endeavors that its recommendations, operating instructions, details and information on suitability and use of our products are as accurate and complete as possible, Forbo does not make any representation or warranty of any kind whatsoever, neither expressed nor implied, with respect to any information contained in this Engineering Manual unless otherwise expressly set forth in writing by duly authorized representatives of Forbo. It is your sole responsibility to perform appropriate testing of our products and their merchantability and fitness for a particular purpose, and Forbo does not accept any liability for any damages, including but not limited to property damages and personal injury, in connection with your reliance on any information contained in this Engineering Manual or any technical and/or other support which Forbo may have provided to you.

This Engineering Manual is Forbo property. Any reproduction, transmission or other use of this Engineering Manual or part(s) thereof is only permissible with Forbo's written consent.

Forbo reserves the right to modify the content of this Engineering Manual at any time and without prior notice to you. The latest version of this Engineering Manual can be downloaded from our website.

Siegling – total belting solutions

Committed staff, quality oriented organization and production processes ensure the constantly high standards of our products and services.

Forbo Movement Systems complies with total quality management principles. Our quality management system has ISO 9001 certification at all production and fabrication sites. What's more, many sites have ISO 14001 environmental management certification.

Ref. no. 443-2
02/23 · Reproduction of text or parts thereof only with our approval. Subject to change.

Our service – anytime, anywhere

Forbo Movement Systems employs around 2,500 people in its group of companies. Our products are manufactured in ten production facilities across the world.
You can find companies and agencies with warehouses and workshops in over 80 countries.
Service points are located in more than 300 places worldwide.

Forbo Siegling GmbH
Lilienthalstrasse 6/8, D-30179 Hannover
Phone +49 511 6704 0
www.forbo-siegling.com, siegling@forbo.com

forbo
MOVEMENT SYSTEMS