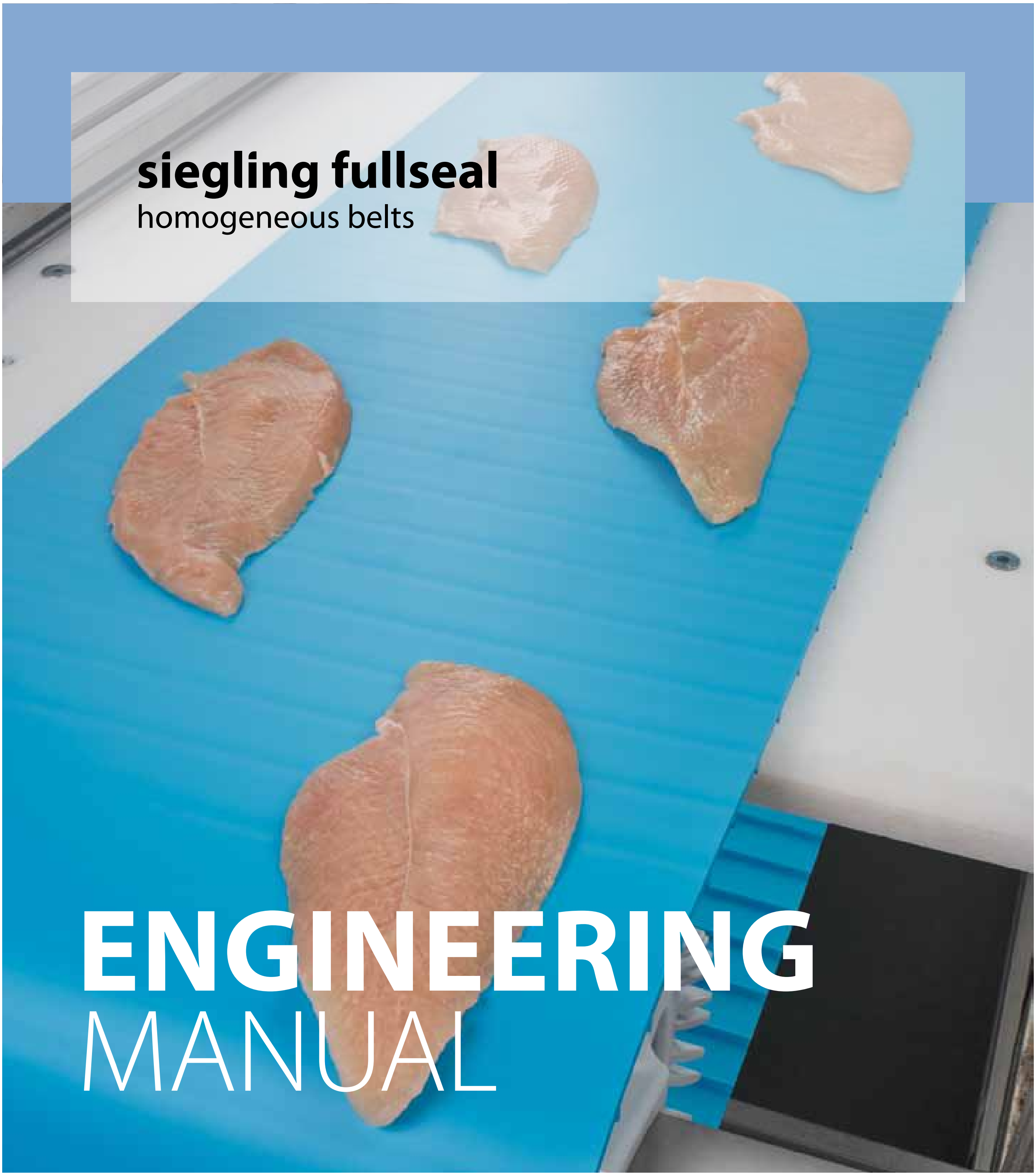


siegling fullseal

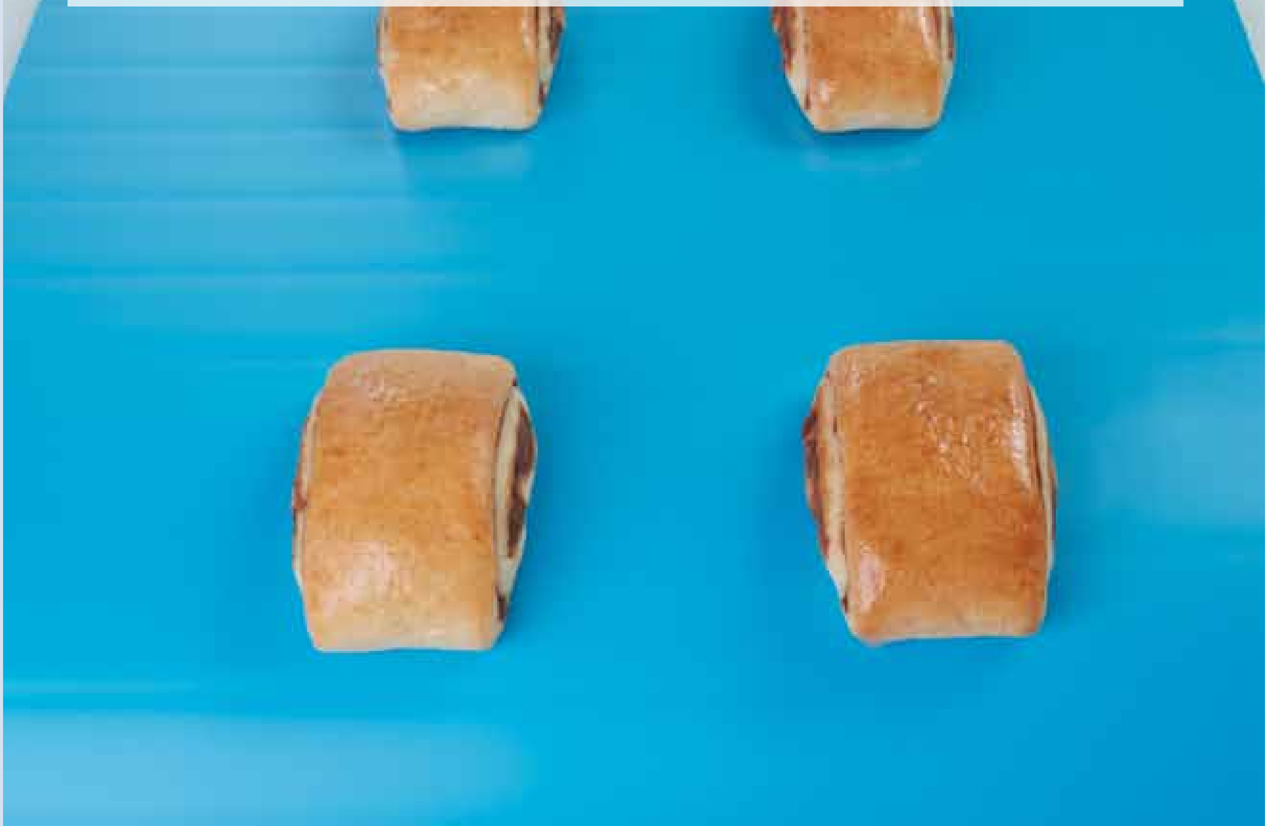
homogeneous belts

ENGINEERING MANUAL

Siegling – total belting solutions

forbo
MOVEMENT SYSTEMS

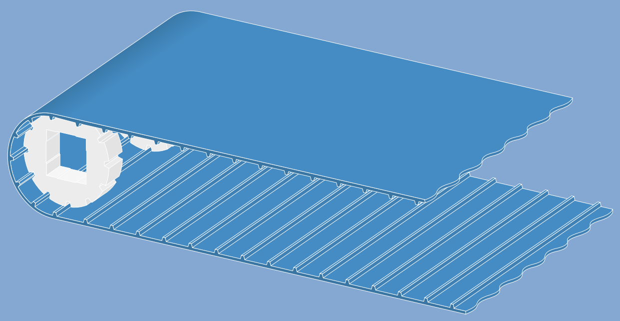
Siegling Fullseal compliments the Forbo Movement Systems conveyor belt range with homogeneous belts made from high-grade polyurethane. Our extensive experience in light materials handling is your guarantee not only of outstanding product quality, but also of competent advice, rapid availability and practice-oriented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



BETTER HYGIENE WITH SIEGLING FULLSEAL

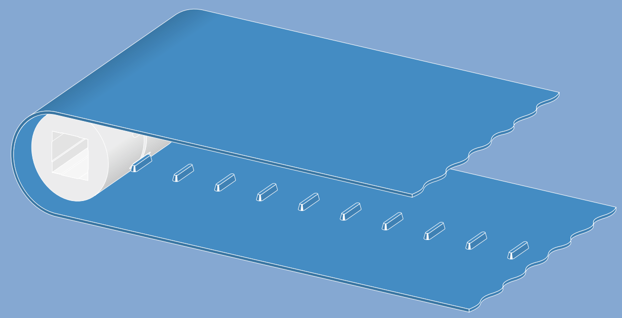
Fullseal is virtually resistant to contamination of oil, grease, moisture and bacteria. Fullseal is very easy to clean, and is exceptionally well suited to use in especially hygiene-critical applications (dairy products, dough processing, meat and poultry processing, as well as other food processing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

Siegling Fullseal is manufactured in three versions. With optional profiles and sidewalls, they can be adapted to countless conveying tasks.



Siegling Fullseal Positive Drive

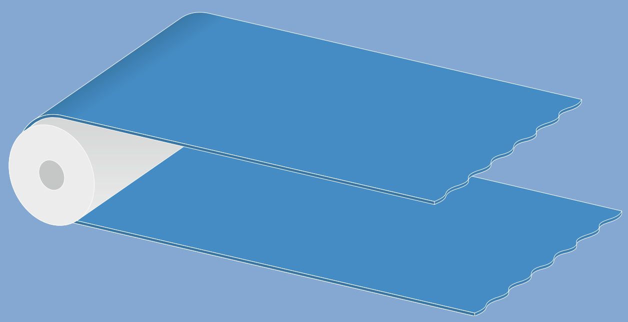
Polyurethane belt with homogeneous belt body. Form-fit (positively driven) power transmission via sprockets. Full width drive bars on the underside of the belt.



Siegling Fullseal Center Drive

Polyurethane belt with homogeneous belt body. Form-fit (positively driven) power transmission via sprocket drums. With one centric or two parallel rows of teeth.

In addition to their hygiene benefits, Fullseal belts with Center Drive (CD) or Positive Drive (PD) offer other application engineering advantages: the form-fit sprocket drive means the belts are slip-free and enables accurate positioning.



Siegling Fullseal Flat

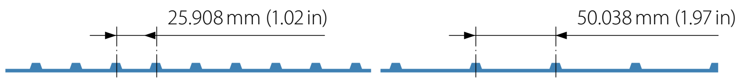
Polyurethane belt with homogeneous belt body. For tension driven applications.

INDEX

1 BASICS

1.1 TECHNICAL DATA

Fullseal Positive Drive

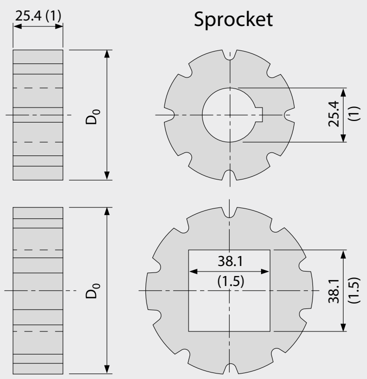


Belt types	Article number	Total thickness approx. [mm (in)]	Pitch [mm (in)]	Min. pulley ø with counter bending [mm (in)]	Min. pulley ø without counter bending [mm (in)]	Permissible operating temperature [°C]	Permissible operating temperature [°F]	Standard widths supplied [mm (in)]
Fullseal Positive Drive								
PD1 U30 MT-NA-HACCP blue FDA	500478	3.05 (0.12)	25.908 (1.02)	83 (3.27)	51 (2)	-9/+71	+15/+160	1524 (60)
PD1 U30 MT-NA-HACCP beige FDA	500479	3.05 (0.12)	25.908 (1.02)	83 (3.27)	51 (2)	-9/+71	+15/+160	1524 (60)
PD1 U48 ST-NA-HACCP blue FDA	500541	4.80 (0.19)	25.908 (1.02)	83 (3.27)	51 (2)	-9/+71	+15/+160	1524 (60)
PD2 U34 MT-NA-HACCP blue FDA	500480	3.43 (0.14)	50.038 (1.97)	98 (3.86)	80 (3.15)	-9/+71	+15/+160	1524 (60)
PD2 U34 MT-NA-HACCP beige FDA	500481	3.43 (0.14)	50.038 (1.97)	98 (3.86)	80 (3.15)	-9/+71	+15/+160	1524 (60)
PD2 U34 NP-NA-HACCP blue FDA	500524	3.40 (0.13)	50.038 (1.97)	98 (3.86)	80 (3.15)	-9/+71	+15/+160	1524 (60)

Fullseal Positive Drive Pitch 25.908 mm (1.02 in)

Outside dia. D_0 [mm (in)]	No. of teeth	Material	Bore [mm (in)]	Color
47.8 (1.88)	6	UHMW*	25.4 (1) RD	white
64.3 (2.53)	8	UHMW	25.4 (1) RD	white
80.8 (3.18)	10	UHMW	38.1 (1.5) SQ	white
97.2 (3.83)	12	UHMW	38.1 (1.5) SQ	white
163.3 (6.43)	20	UHMW	38.1 (1.5) SQ	white

Sprocket

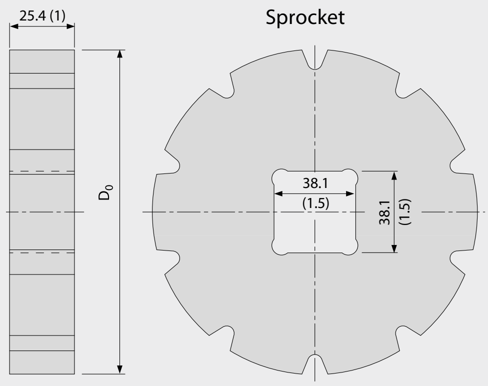


***** UHMW-PE · Ultra-High-Molecular-Weight Polyethylene

Fullseal Positive Drive Pitch 50.038 mm (1.97 in)

Outside dia. D_0 [mm (in)]	No. of teeth	Material	Bore [mm (in)]	Color
93.7 (3.69)	6	UHMW*	38.1 (1.5) SQ	white
125.7 (4.95)	8	UHMW	38.1 (1.5) SQ	white
157.5 (6.20)	10	UHMW	38.1 (1.5) SQ	white
189.5 (7.46)	12	UHMW	38.1 (1.5) SQ	white
253.2 (9.97)	16	UHMW	38.1 (1.5) SQ	white

Sprocket

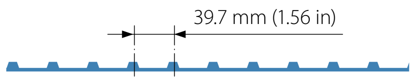


***** UHMW-PE · Ultra-High-Molecular-Weight Polyethylene

Blue (RAL 5015)

Beige (RAL 1013)

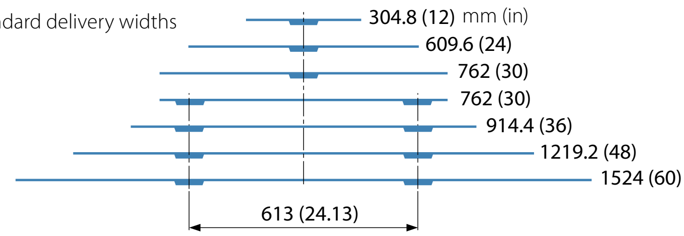
Fullseal Center Drive



Belt types	Article number	Total thickness approx. [mm (in)]	Pitch [mm (in)]	Min. pulley ø with counter bending [mm (in)]	Min. pulley ø without counter bending [mm (in)]	Permissible operating temperature [°C]	Permissible operating temperature [°F]	Standard widths supplied [mm (in)]
Fullseal Center Drive								
CD40 U34 MT-NA-HACCP beige FDA	500475	3.4 (0.13)	39.7 (1.56)	98 (3.88)	80 (3.15)	-9/+71	+15/+160	see below*
CD40 U34 MT-NA-HACCP blue FDA	500509	3.4 (0.13)	39.7 (1.56)	98 (3.88)	80 (3.15)	-9/+71	+15/+160	see below*
CD40 U34 PRS-NA-HACCP blue FDA	500528	3.4 (0.13)	39.7 (1.56)	98 (3.88)	80 (3.15)	-9/+71	+15/+160	see below*

* Customized widths possible. Please contact your technical representative for more details.

Standard delivery widths

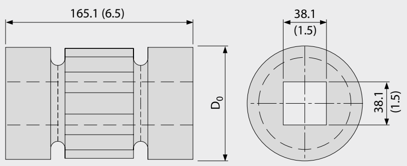


Sprocket drums

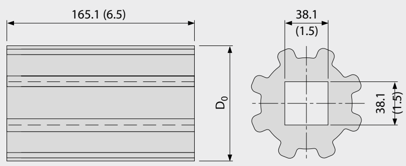
Outside dia. D_0 [mm (in)]	No. of teeth	Material	Color
101.6 (4)	8	UHMW*	white
152.4 (6)	12	UHMW	white
203.2 (8)	16	UHMW	white

***** UHMW-PE · Ultra-High-Molecular-Weight Polyethylene

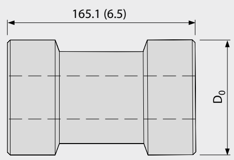
Sprocket selftracking



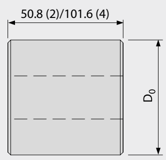
Sprocket open ended (PU material)



Tail roller



Support roller



Blue (RAL 5015)

Beige (RAL 1013)

1.1 TECHNICAL DATA

Fullseal Flat

Belt types	Article number	Total thickness approx. [mm (in)]	Effective pull at 1% elongation (k1% relaxed) [N/mm width]	Min. pulley ø with counter bending [mm (in)]	Min. pulley ø without counter bending [mm (in)]	Permissible operating temperature [°C]	Permissible operating temperature [°F]	Standard widths supplied [mm (in)]
Fullseal Flat								
FLT U20 GL/GL-NA-HACCP blue FDA	500458	2 (0.08)	1.0	30 (1.18)	30 (1.18)	-9/+71	+15/+160	1524 (60)
FLT U20 NP/GL-NA-HACCP blue FDA	500457	2 (0.08)	1.0	30 (1.18)	30 (1.18)	-9/+71	+15/+160	1524 (60)
FLT U30 GL/GL-NA-HACCP beige FDA	500472	3 (0.12)	1.5	40 (1.57)	40 (1.57)	-9/+71	+15/+160	1524 (60)
FLT U30 GL/GL-NA-HACCP blue FDA	500468	3 (0.12)	1.5	40 (1.57)	40 (1.57)	-9/+71	+15/+160	1524 (60)
FLT U30 NP/GL-NA-HACCP beige FDA	500473	3 (0.12)	1.5	40 (1.57)	45 (1.77)	-9/+71	+15/+160	1524 (60)
FLT U30 NP/GL-NA-HACCP blue FDA	500469	3 (0.12)	1.5	40 (1.57)	45 (1.77)	-9/+71	+15/+160	1524 (60)
FLT U30 PRS/NP-NA-HACCP blue FDA	500531	3.4 (0.135)	1.5	40 (1.57)	40 (1.57)	-9/+71	+15/+160	1524 (60)
FLT U50 GL/GL-NA-HACCP blue FDA	500523	5 (0.20)	2.5	67 (2.64)	67 (2.64)	-9/+71	+15/+160	1524 (60)

Blue (RAL 5015)

Beige (RAL 1013)

Type key (all Fullseal series)

Type designation for Fullseal belts

FLT	U	30	NP /	GL-	NA-	HACCP	blue	FDA
PD1	U	30		MT-	NA-	HACCP	beige	FDA
Fullseal series	Belt material	Belt thickness in 1/10 mm	Surface finish underside	Surface finish top face	Belt property	Belt property	Color	Belt property

FLT	=	Flat Top
CD	=	Center Drive
PD1	=	Positive Drive · Pitch 25.908 mm (1.02 in)
PD2	=	Positive Drive · Pitch 50.038 mm (1.97 in)
U	=	Polyurethane
NP	=	Inverted pyramid
GL	=	Smooth
MT	=	Matt
PRS	=	Positive release structure
ST	=	Saw tooth
NA	=	Non-antistatic
HACCP	=	Supports the HACCP concept
FDA	=	Food safe in compliance with EC/FDA (see data sheet)

1.2 BELT SELECTION AND SIZING

Which Fullseal type for which application?

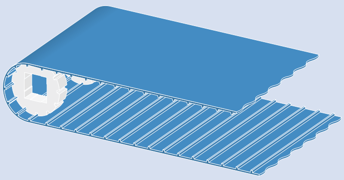
Forbo Movement Systems offers various Fullseal versions. They can be supplied with profiles, sidewalls and other custom configurations to suit various applications. This variability gives you the greatest application engineering benefits.

When selecting a belt, take all relevant factors into account:

- Nature of the transported material (grip, consistency, weight, shape, temperature etc.)
- Process parameters if applicable, e.g. for drying, washing and draining (temperature, pressure, necessary permeability etc.)
- Basic conveyor layout (direction, length, width)
- Drive position and type (form-fitting/friction)
- Belt speed and operating modes (e.g. stop & go, cycling, positioning)
- Spatial conditions at the installation site
- Ambient conditions during operation (temperature, humidity, chemical and mechanical loads)
- Hygiene/cleaning requirements

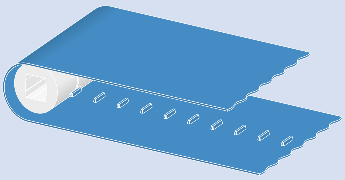
Belt dimensions may change in operation due to loading and the operating temperature. Take this into account when determining your order data.

Siegling Fullseal Positive Drive
Polyurethane belt with homogeneous belt body. Form-fit power transmission via sprockets. Full width drive bars on the underside of the belt.



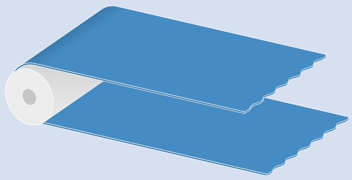
Advantages
- Easy to clean
- High-quality raw material and surface finishing for better hygienic properties
- Hydrolysis- and chemical-resistant
- Food-safe: FDA, EU and USDA compliant
- Blue color to provide a contrast to foodstuff
- Smooth running
- Retrofitting of plastic modular belts

Siegling Fullseal Center Drive
Polyurethane belt with homogeneous belt body. Form-fit power transmission via sprocket drums. With one centric or two parallel rows of teeth.



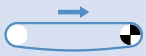
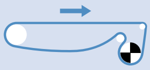
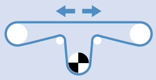
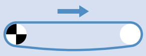
Advantages
- Easy to clean
- High-quality raw material and surface finishing for better hygienic properties
- Hydrolysis- and chemical-resistant
- Food-safe: FDA, EU and USDA compliant
- Blue color to provide a contrast to foodstuff
- Self tracking
- Trough conveying on request

Siegling Fullseal Flat
Polyurethane belt with homogeneous belt body. Friction power transmission via a drive drum.



Advantages
- Easy to clean
- High-quality raw material and surface finishing for better hygienic properties
- Hydrolysis- and chemical-resistant
- Food-safe: FDA and EU compliant
- Blue color to provide a contrast to foodstuff
- Trough conveying possible
- Easy tracking properties

Drive types

		Drive type possible with		
		Fullseal PD	Fullseal CD	Fullseal Flat
	Head drive	●	●	●
	Lower head drive	◐	◐	●
	Center drive (e.g. Omega drive)	●	●	●
	Tail drive	❍	❍	●

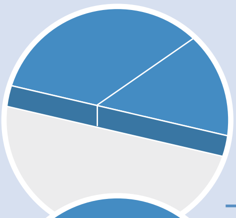
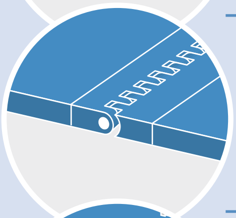
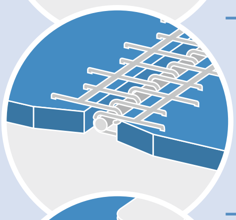
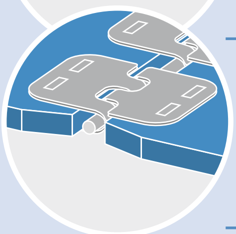
● recommendend
◐ not recommended
❍ not suitable

1.2 BELT SELECTION AND SIZING

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 (CIP/COP)

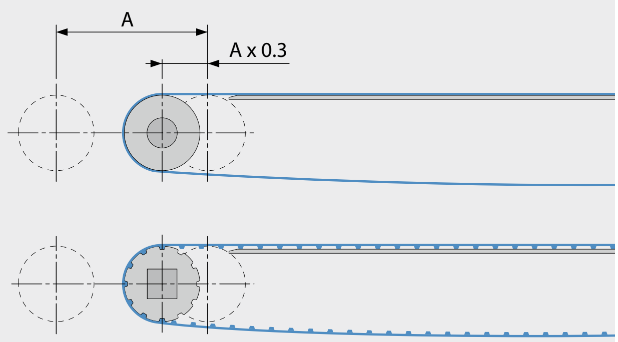
		Splice type possible with		
		Fullseal PD	**Fullseal CD**	**Fullseal Flat**
	Butt splice (standard)	●	●	●
	Hinged lace (only for 3 mm belt thickness)	● For PD2 only	●	●
	Hook fastener fastener	●	●	●
	Plastic rivet	●	●	●
	Clamp fastener (metal)	●	●	●

Pre-tension

Depending on the type and application, Siegling Fullseal 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. 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

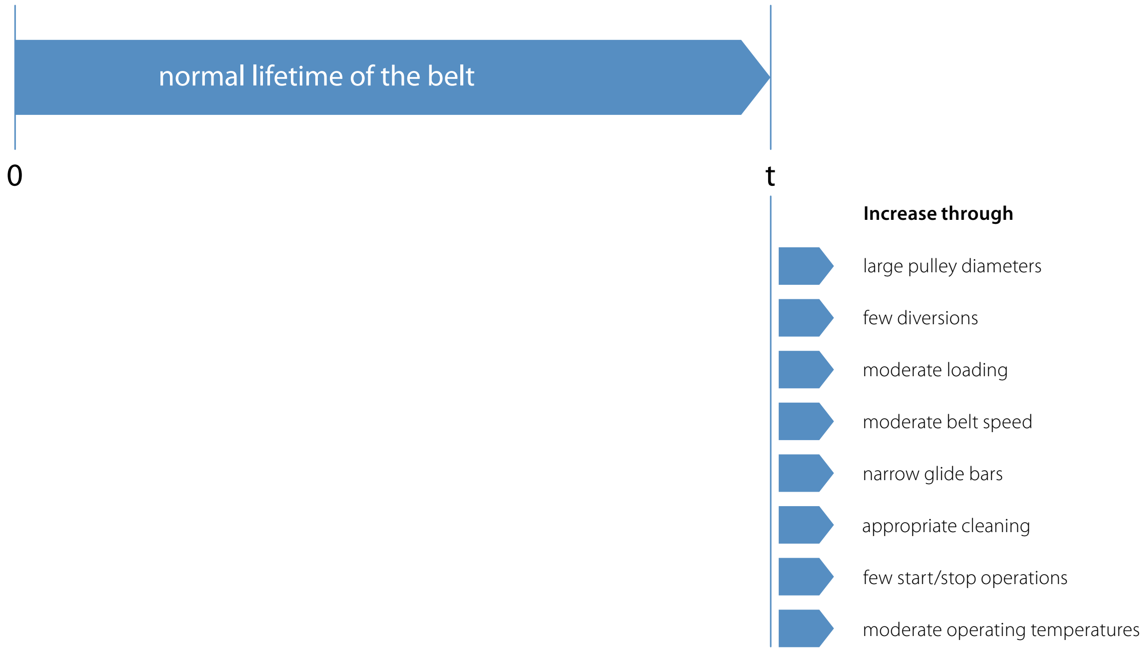
The required belt length can be determined using the following calculation process (fig. 2):

- 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 4.2).
- Add these values and round them if necessary up to a multiple of the tooth pitch.
- Correct the result if necessary taking expected load states into account (belt length and width change depending on the loading).

2

1.3 FACTORS INFLUENCING BELT LIFE

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



1.4 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.

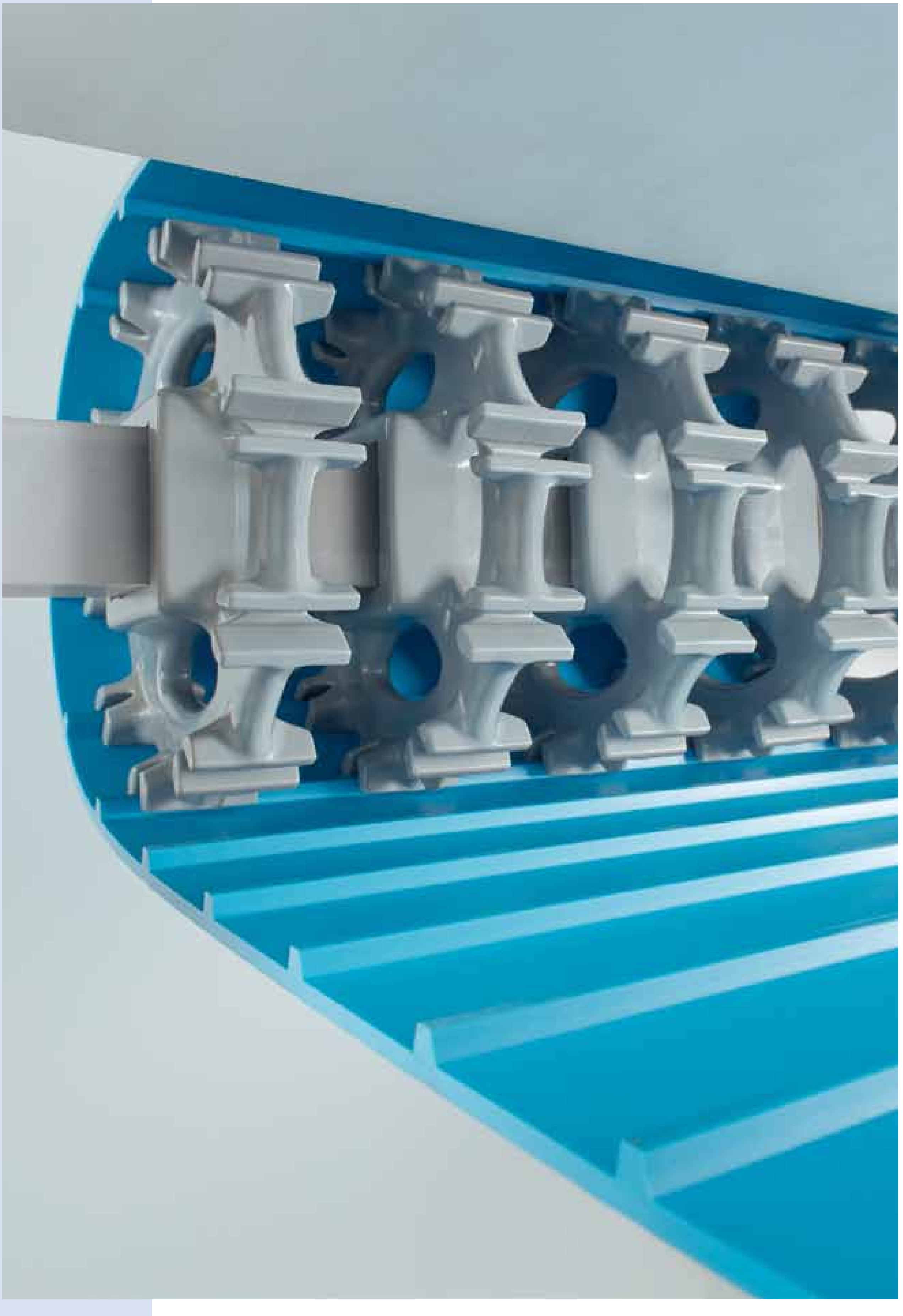
5 Disinfect with a disinfectant that has been approved by your plant sanitarian, sanitary operation procedures, or cleaning chemical supplier.

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 he 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.



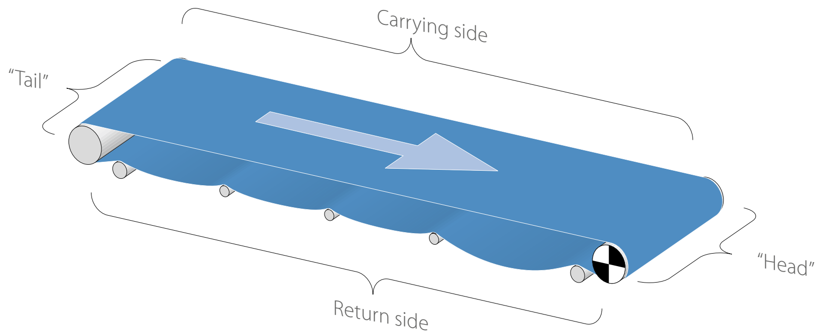
2 CONVEYOR DESIGN

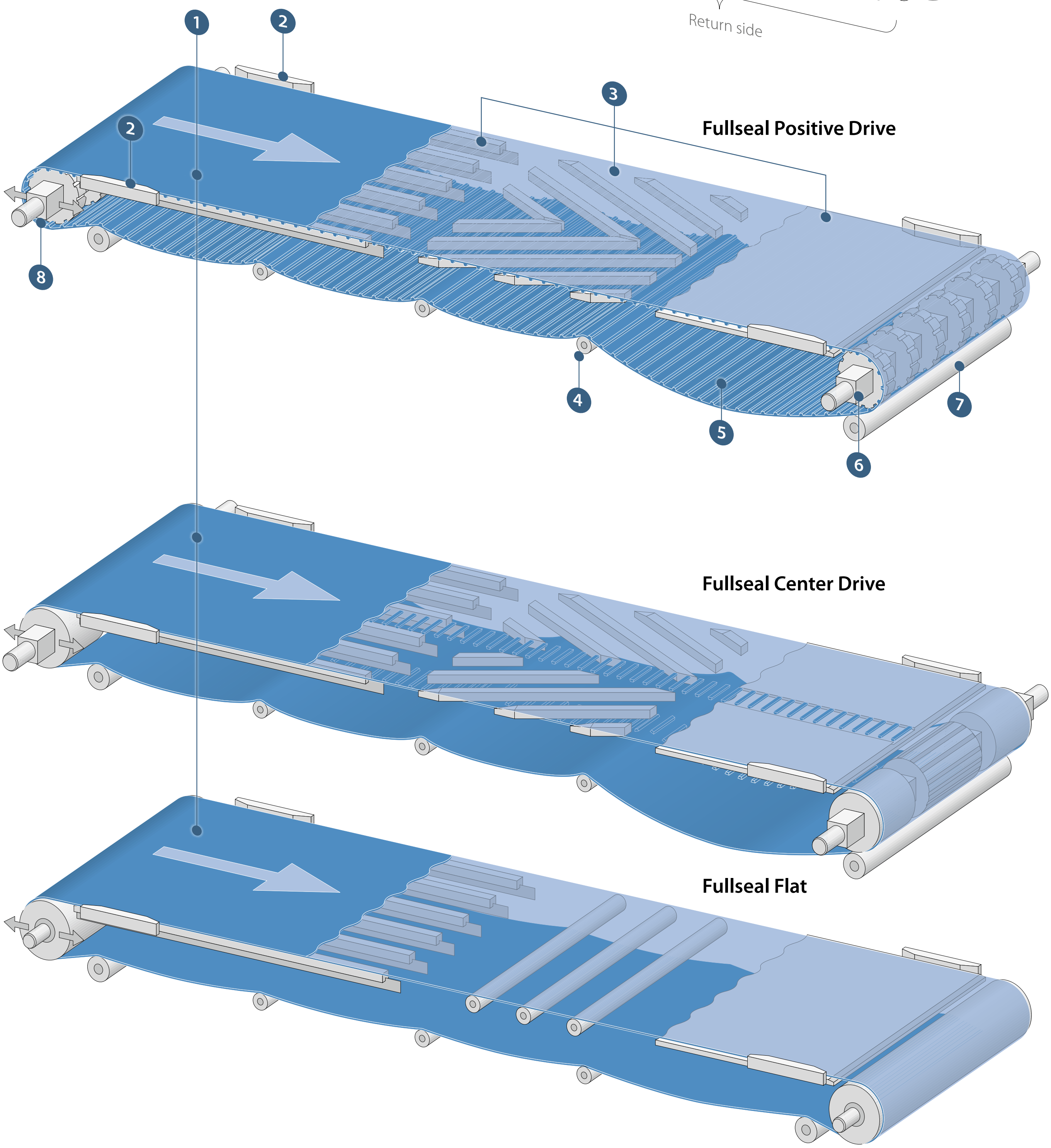
Many conveyor design principles are identical for all Fullseal series, and are therefore dealt with together.
But drives, pulleys and belt tracking systems differ from each other in many respects, so they are described separately for each Fullseal series.

2.1 GENERAL

Conveyor components

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





❶ **Siegling Fullseal homogeneous belts (PD, CD, Flat series)**

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 Snub roller/Pressure roller

"Tail" of the conveyor (infeed)

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

2.1 GENERAL

Hygienic design

Fullseal 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 (flat welded seams in contact with food should be ground 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 Fullseal 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) Polyacetal (POM) Stainless steel
Drum	Steel Stainless steel
Scraper	Polyurethane (PU)
Side strips	Polyacetal (POM) Ultra-high-molecular-weight Polyethylene (UHMW-PE)
Side skirts	Polyurethane, solid (PUR)

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

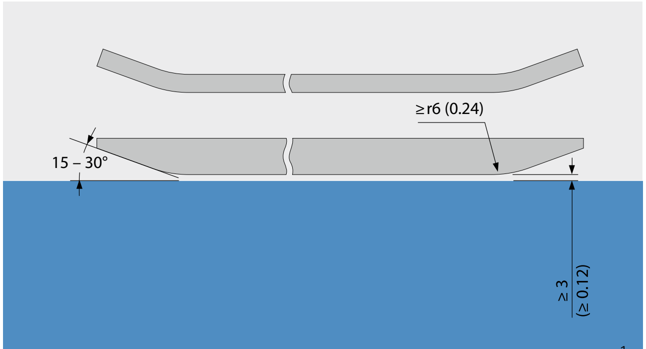
2.2 NOTES ON CONVEYOR CONSTRUCTION

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, sidewalls etc. Profiles and sidewalls may require a greater drum diameter than the belt type on its own (see "Technical information 2", ref. no. 318 and "Fullseal · Lower cleaning costs, better hygiene", ref. no. 248).
- 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.
- A sag in the bottom run should normally be provided for. It can only be omitted with relatively short belts that are fitted with a pre-tension of not more than 0.3%.
- 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.

Belt side guides



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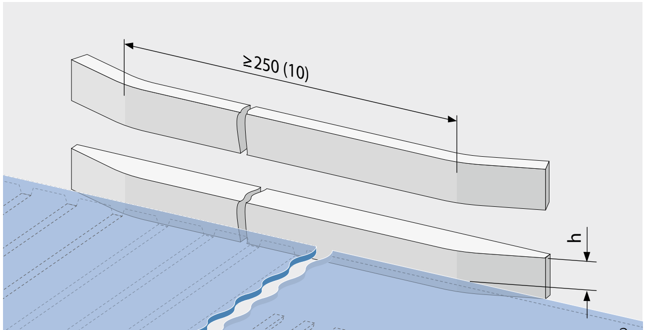

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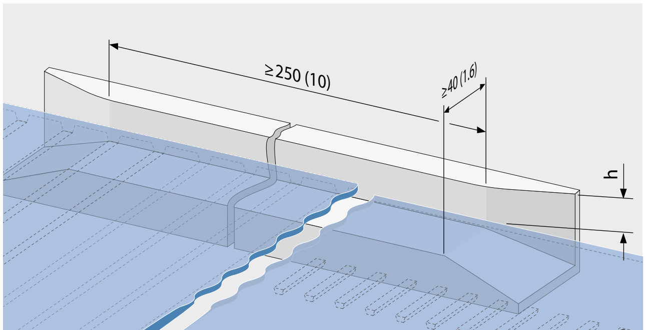

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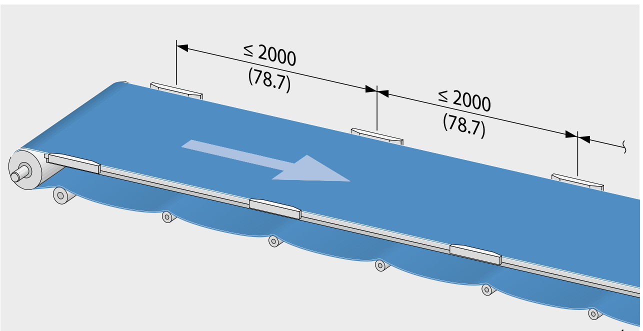


4

If required, Fullseal belts can be guided at the belt edges. With the Fullseal Center Drive type, one or more rows of profiles ensure perfect tracking. Do not use these belt guides to compensate for poor belt tracking (if necessary, correct the belt tracking as described in sections 2.5/2.6/2.7.

– Use only the materials specified in section 2.1 with the corresponding surface finish to minimise abrasion and 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).
– 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 not 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, 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 and loading. 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 Fullseal 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 (normally with Fullseal Positive Drive and Fullseal Center Drive), 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. 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

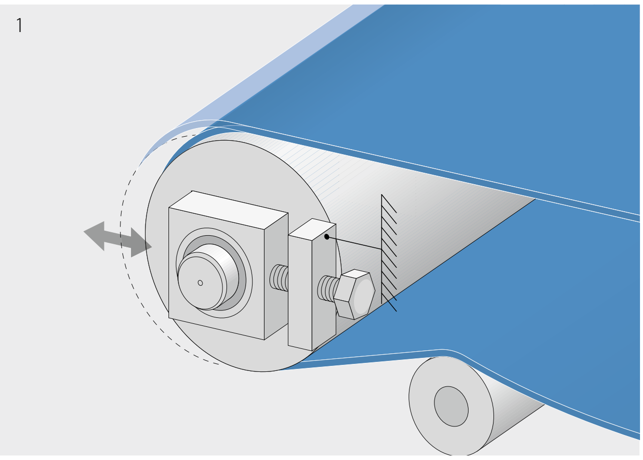
Unlike adjustable take-ups, pure quick-action tensioning devices do not allow precise adjustment of the tension and belt sag (fig. 2).

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



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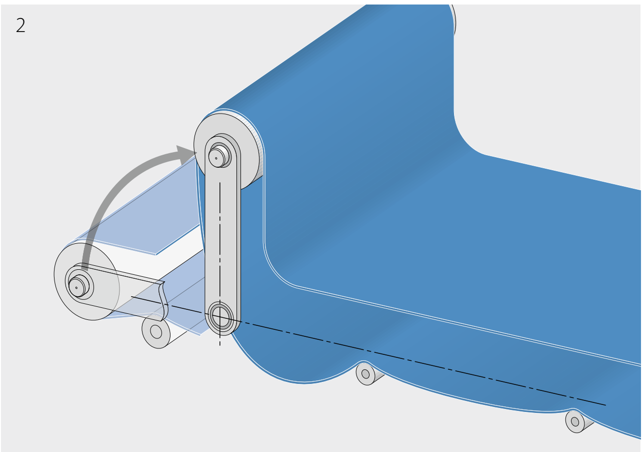


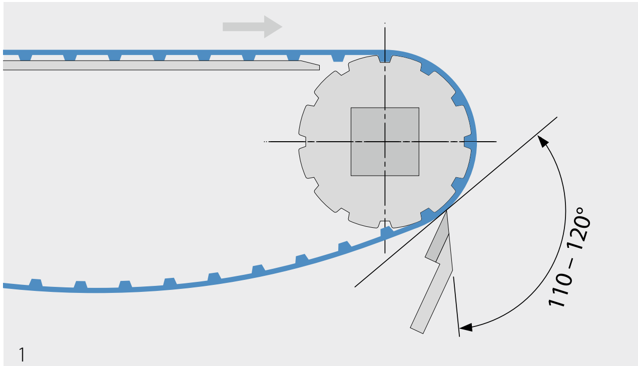
All Fullseal Series

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. If necessary, observe the position of the gearwheel during assembly. The sprocket must be turned so that the belt is supported by a raised area of the sprocket (figs. 1/2).
- 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 sprocket/roller and the scraper at the relevant axis) and does not change its position due to changes in belt sag.



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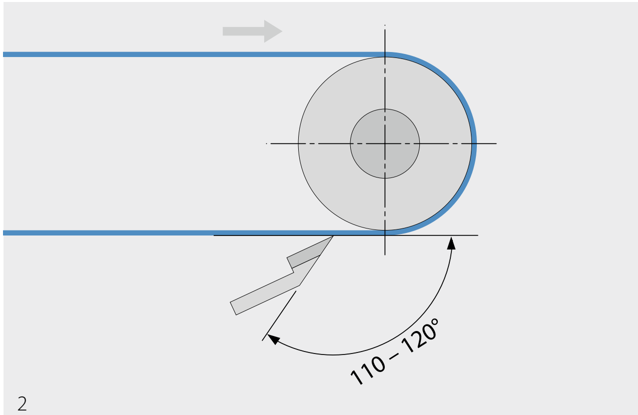
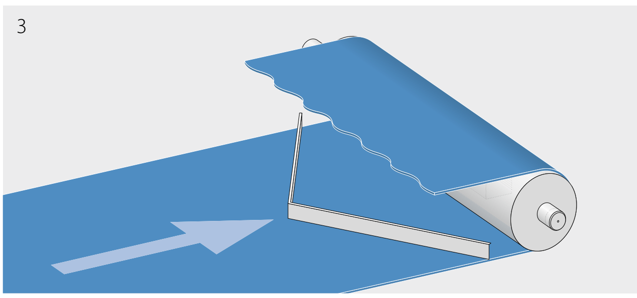


2

Only for Fullseal Flat:

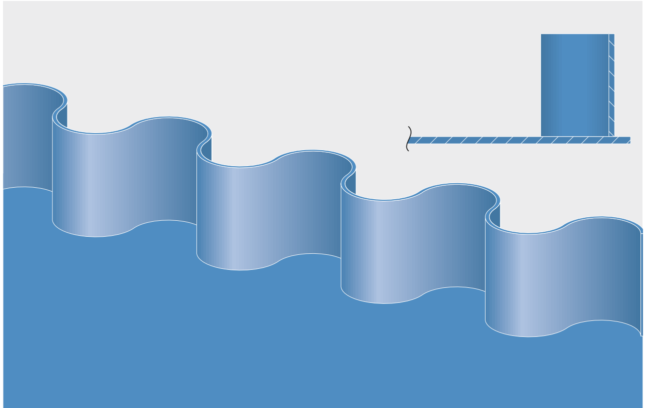
- On the bottom run, so-called plough deflectors are often used before the end deflector to prevent falling transported material coming between the belt and drum. They should only lightly touch the belt (fig. 3).
- Smooth drums without a lagging can be kept clean by steel scrapers. These scrapers can be positioned close against the drum surface and modified for the ring shape (e.g. trapezoid shape).

3



All Fullseal Series

Side limits



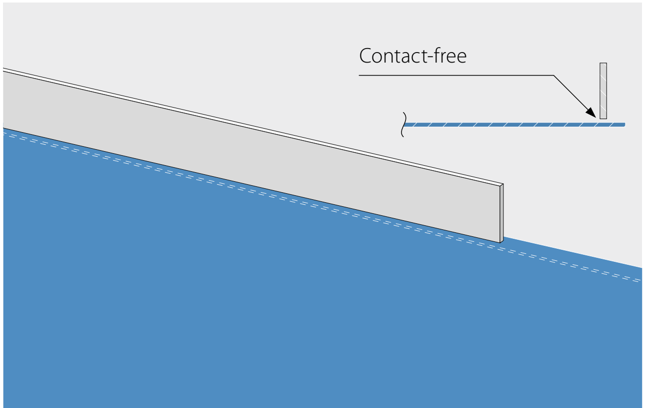
1

Sidewalls

Complete sealing of 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 "Fullseal · Lower cleaning costs, better hygiene", ref. no. 248.



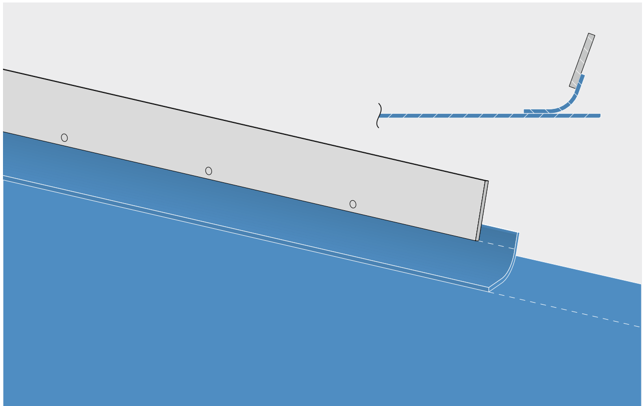
2

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 may need to be moved inwards to make room for them.

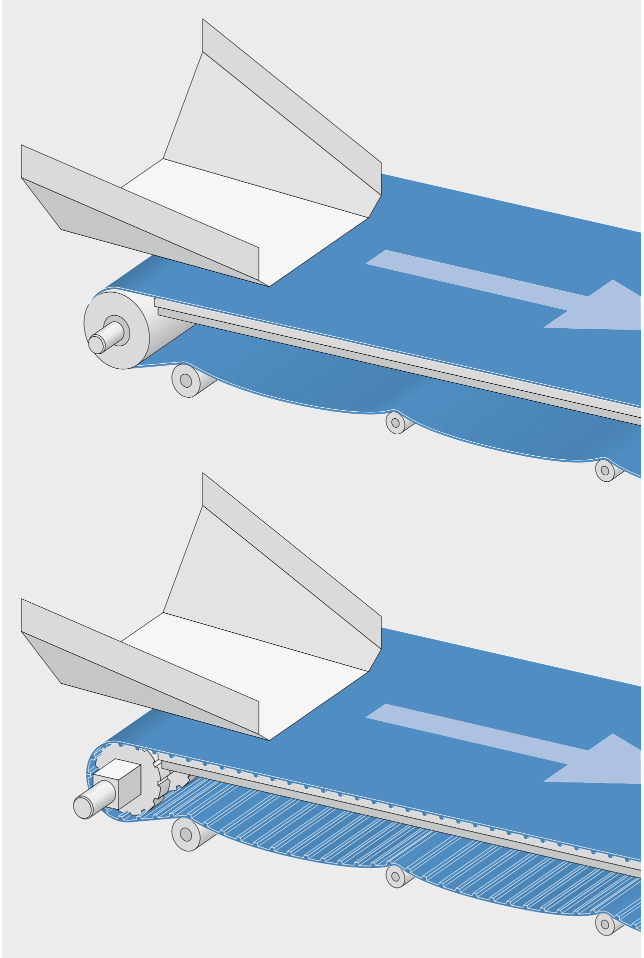
For material recommendations see the materials table in section 2.1.

2.2 NOTES ON CONVEYOR CONSTRUCTION

Feeding the transported material

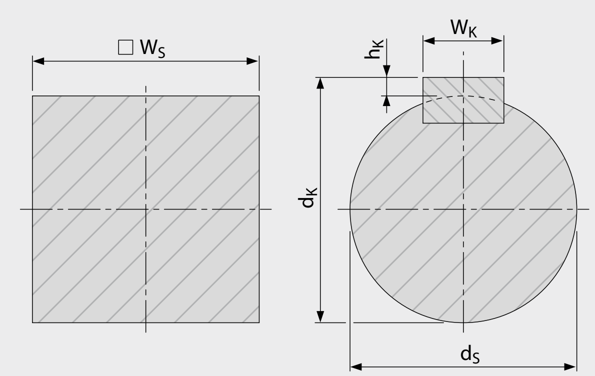
During loading, the conveyor belt is stressed in the vertical (impact) and tangential directions.

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

Designing axes and shafts

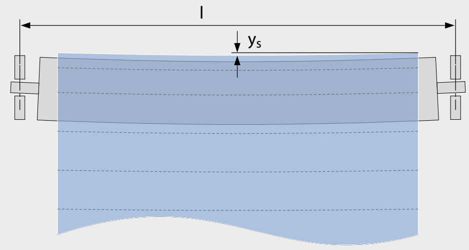
Shaft profiles
For form-fit drive with Fullseal PD and Fullseal CD, we recommend using square shafts. They have the advantage that positive drive and tracking are possible without keys and keyways. This can save on manufacturing costs. Occasionally round shafts with feather keys are used for narrow belts with light loads. Specially designed sprockets with bore and keyway are also available (fig. 2).



2

Deflection of shafts, axes, drums, and rollers (fig. 1/2)
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 value ≤ 2 mm).
- If the belt pull causes greater deflection (> 2 mm), change the dimensioning accordingly or use an intermediate bearing.



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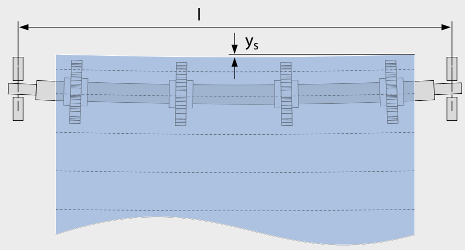


2

The deflection can be calculated using the following formulas:

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

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

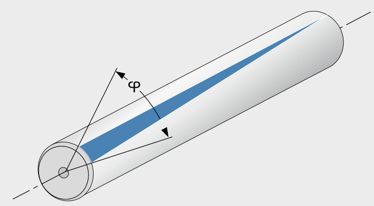
Shaft type	I
Round	$\frac{\pi \cdot d_s^4}{64}$
Hollow round	$\pi \cdot \frac{d_{out}^4 - d_{in}^4}{64}$
Square	$\frac{W_S^4}{12}$
Hollow square	$\pi \cdot \frac{W_S^4 - (W_S - 2 \cdot t_s)^4}{12}$

2.2 NOTES ON CONVEYOR CONSTRUCTION

All Fullseal Series

Shaft torsion (fig. 1)
Because of the belt pull, shafts twist when transmitting torque, from the drive end to the sprocket farthest away. Long and thin shafts as well as high tensile forces and large sprockets amplify this effect.

If the shaft twists too much, the teeth will not engage correctly. We recommend keeping a torsion angle φ (phi) of < 0.5 ‰ per metre of shaft length.



1

The shaft torsion can be calculated using the following formulas:

$$\varphi = \frac{90 \cdot F_{adj} \cdot D_0 \cdot l_s}{\pi \cdot G \cdot I_T}$$

with:

φ	=	torsion angle in drive shaft	[°]
F_{adj}	=	adjusted belt pull	[N, lb]
D_0	=	pitch diameter	[mm, in]
l_s	=	shaft length	[mm, in]
G	=	modulus in shear strength	[MPa, psi]
I_T	=	torsional inertial force	[mm^4, in^4]

Material	**G in** $\left[\text{MPa} = \frac{\text{N}}{\text{mm}^2}\right]$	**G in** [10^6 psi]
Carbon steel	80000	11.6
Stainless steel	75000	10.88
Aluminum	27000	3.92

Shaft type	I_T **[mm⁴]**
Round	$\pi \cdot \frac{d_s^4}{32}$
Hollow round	$\pi \cdot \frac{d_{out}^4 \cdot d_{in}^4}{32}$
Square	$0.141 \cdot W_S^4$
Hollow square	$0.127 \cdot (W_S^4 - 2 \cdot t_s)^4$
Hexagon	$1.847 \cdot \left(\frac{W_S}{2}\right)^4$

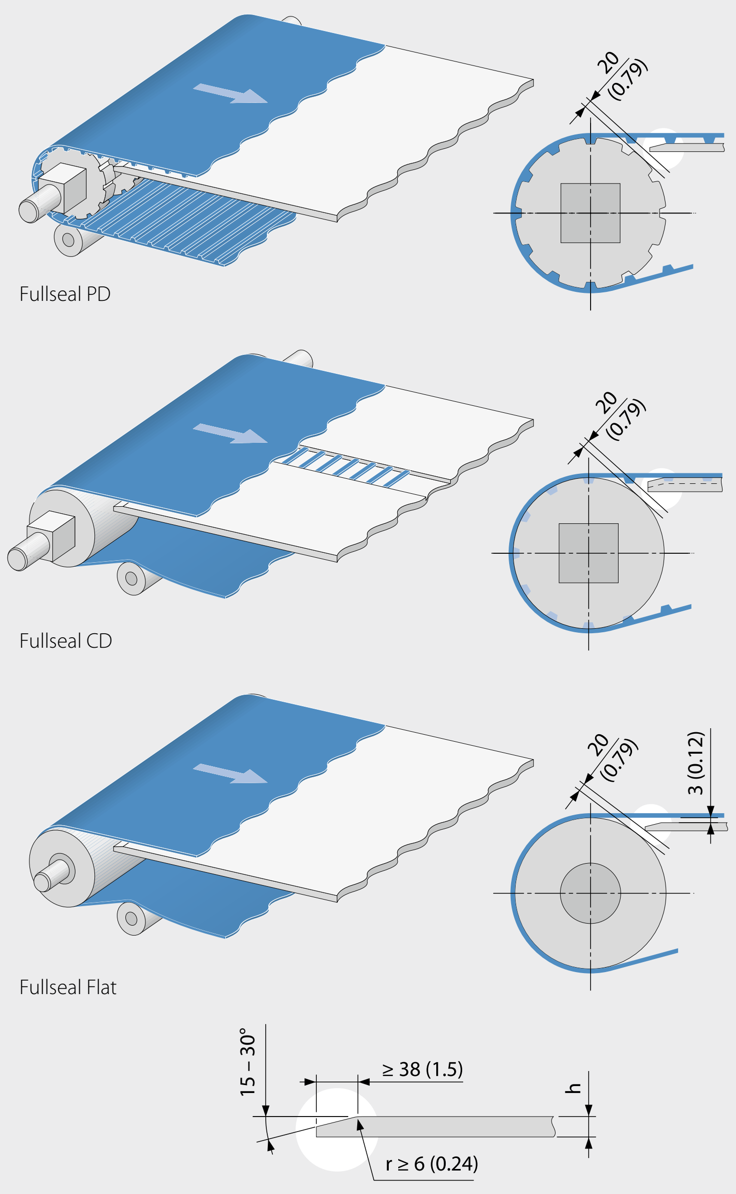
2.3 BELT SUPPORT ON THE CARRYING SIDE

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 together with the low-friction running side of Siegling Fullseal belts produce favourable 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



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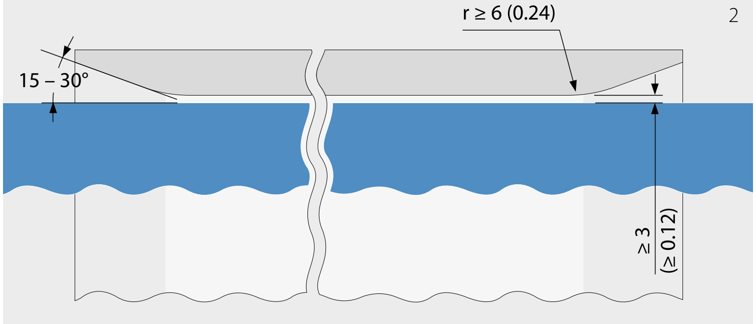


2

In slider bed integrated belt guides, top view

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

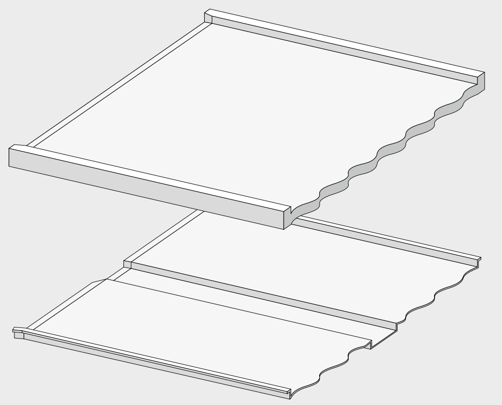
- Use only materials according to the specifications in the materials table in section 2.1.
- Carefully round off edges and slightly chamfer sliding surfaces in the conveyor direction.
- The thickness "h" should be at least large enough to allow fastening elements such as screw heads to be completely countersunk, and so that the chamfer in the conveyor direction can be formed. The smallest angle for the chamfer (15°) produces a value "h" of approx. 12.5 mm (½ in).

  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).

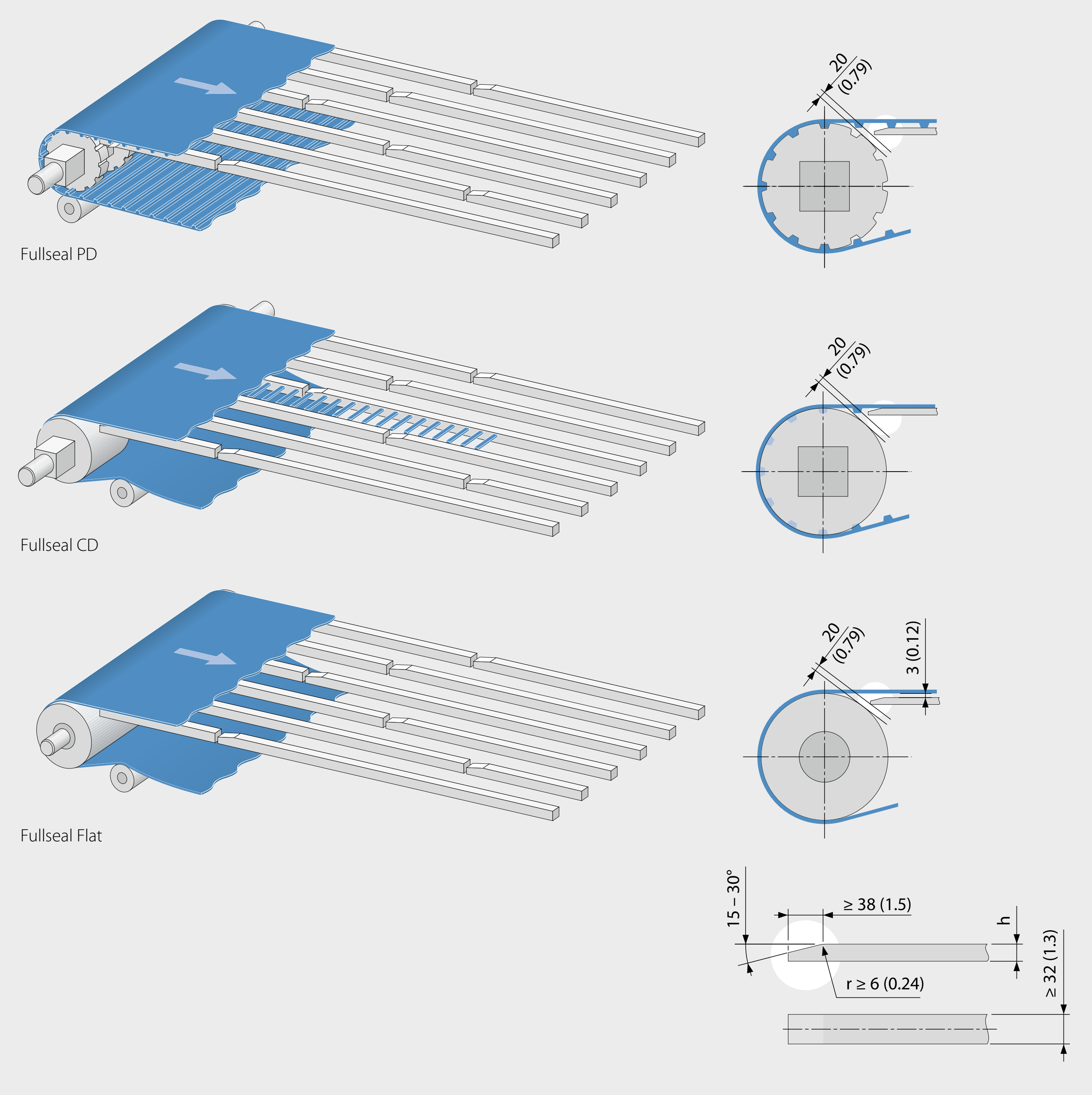
When designing the drive and idler pulley area, observe the notes for the Fullseal series used (section 2.5, 2.6 or 2.7).

3



2.3 BELT SUPPORT ON THE CARRYING SIDE

Supporting the belt with parallel wearstrips



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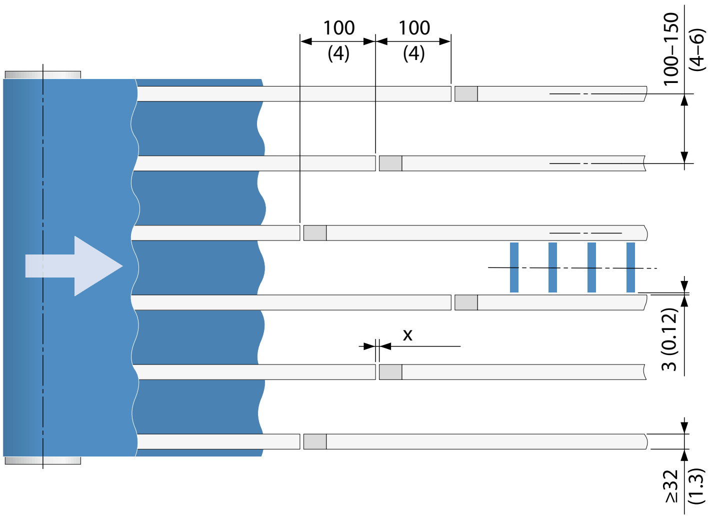

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For applications with light loads, parallel wearstrips can be used (fig. 1, left page). Note in this case that the underside of the belt is subject to increased wear in the area of the wearstrips.

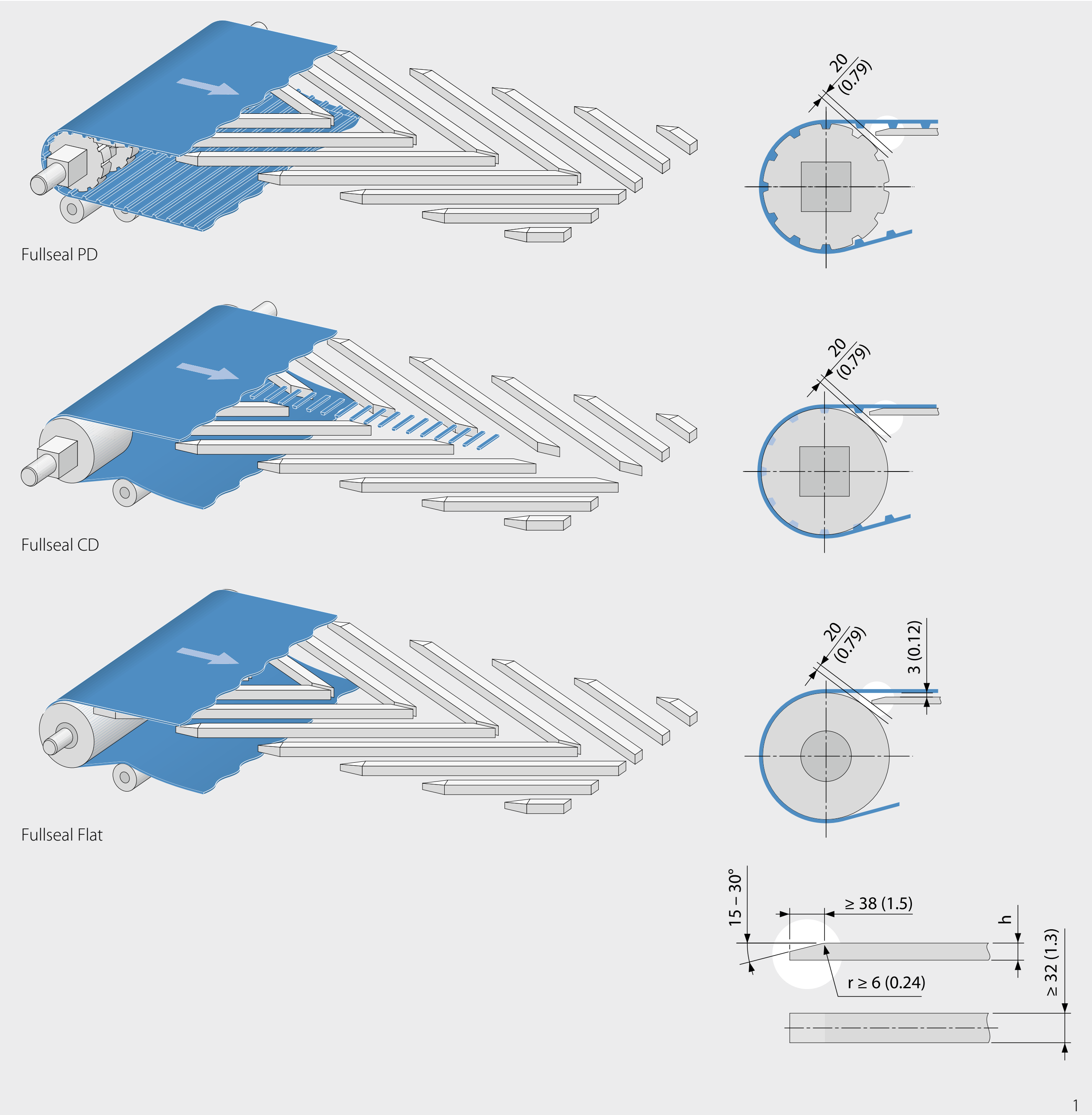
- Use only materials according to the specifications in the materials table in section 2.1.
- See the figures 1 and 2 for the main dimensions of wearstrips and their positioning.
- The thickness “h” should be at least large enough to allow fastening elements such as screw heads to be completely countersunk, and so that the chamfer in the conveyor direction can be formed. The smallest angle for the chamfer (15°) produces a value “h” of approx. 12.5 mm (½ in).

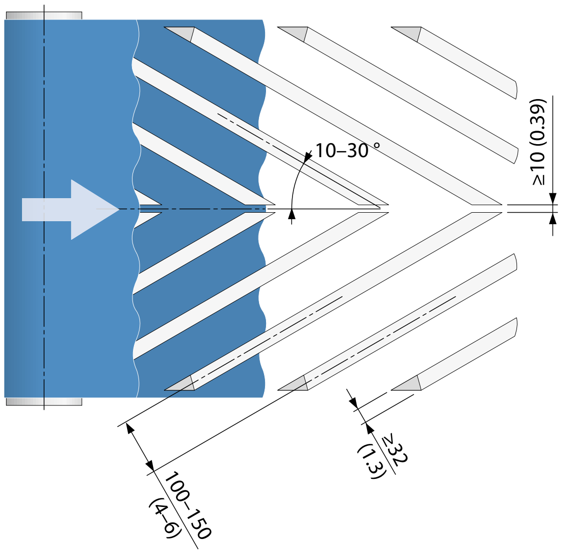
  In addition, the thickness is determined by the static requirements.
- The sliding surface must be flat and aligned in two directions with the belt run.
- Carefully round off edges and slightly chamfer sliding surfaces in the conveyor direction.
- Fastening elements must not make contact with the belt.
- 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.
- Fullseal Center Drive belts can be guided at the sides by pairs of wearstrips.

When designing the drive and idler pulley area, observe the notes for the Fullseal series used (section 2.5, 2.6 or 2.7).

2.3 BELT SUPPORT ON THE CARRYING SIDE

Supporting the belt with a V-shaped arrangement of wearstrips





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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. The smallest angle for the chamfer (15°) produces a value "h" of approx. 12.5 mm (½ in).
  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.
– Fullseal Center Drive belts can be guided at the sides by pairs of wearstrips.

When designing the drive and idler pulley area, observe the notes for the Fullseal series used (section 2.5, 2.6 or 2.7).

2.3 BELT SUPPORT ON THE CARRYING SIDE

Supporting the belt with rollers

Forbo Movement Systems only recommends roller supports for Fullseal 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).

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.

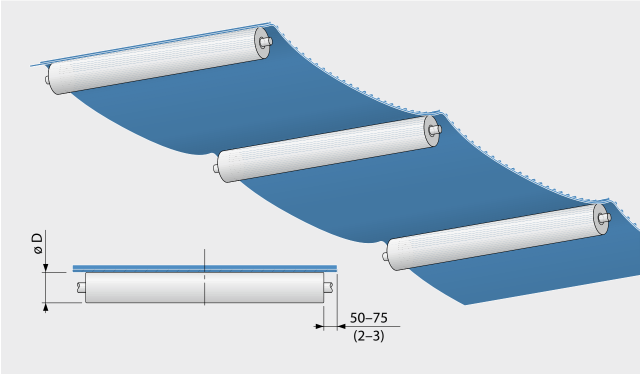
- Determine the values for changes in the belt length and width at lowest/highest operating temperature, and take these into account in the design (see materials table in section 2.1).
- Include the design of the return side in all considerations concerning accessibility for maintenance and repairs,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

2.4 BELT SUPPORT ON THE RETURN SIDE

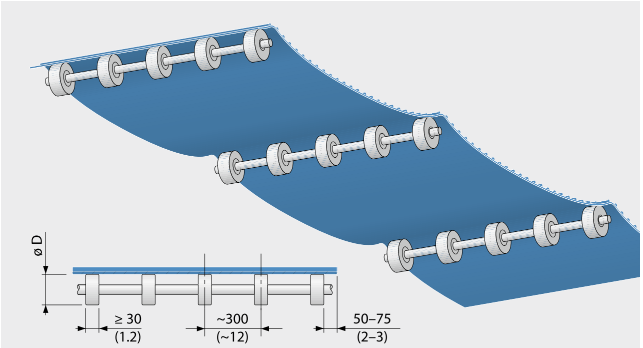
Supporting the belt with rollers

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 profiles 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



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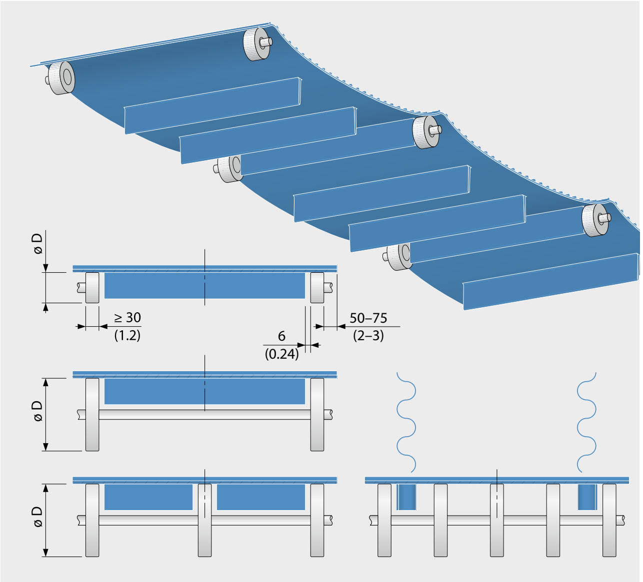


3

Illustrations using the example of Fullseal Positive Drive

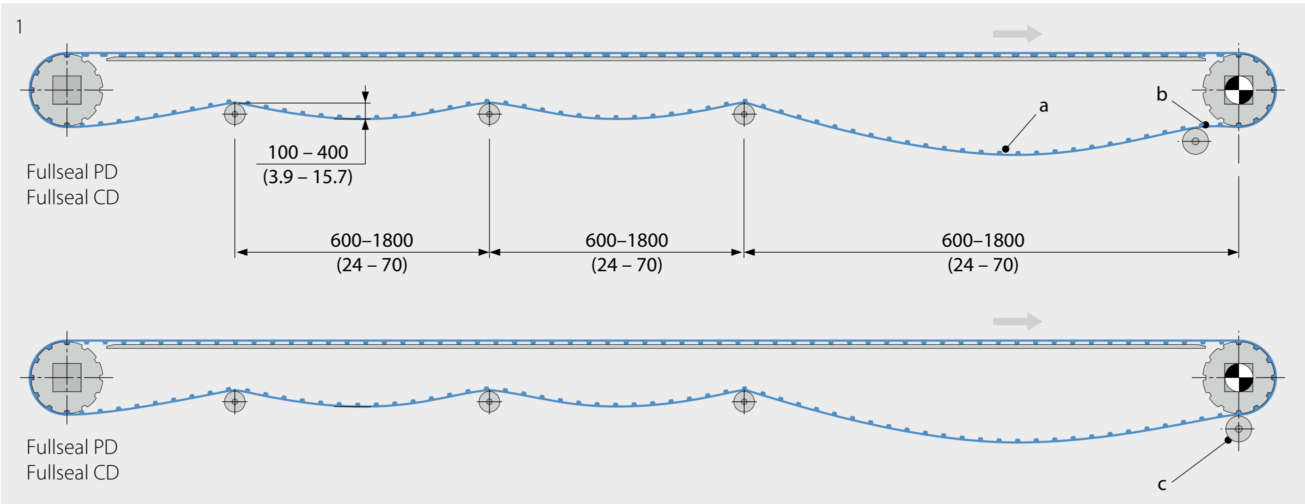
Sliding belt supports

Sliding belt supports in the return side, in the form of fixed wearstrips, slide shoes or slide shafts are often found in practice.
Forbo Movement Systems does not recommend them.

Belt sag (Positive and Center Drive only)

In sections on the return side that are not supported the belt material hangs loose (fig. 1). The height of the sag results from the belt length at the current operating temperature, the load state, and the distance between supports. The largest sag always occurs in the longest section without support.

- For the trouble-free operation of longer conveyors, plan the belt sag. Usually each of these sections is 600 – 1900 mm (24 – 75 in) long and has a sag height of between 100 – 400 mm (4 – 15.7 in).
- Specifically plan the longest unsupported section (a) as a buffer zone for belt expansion. The sagging belt loop must never rub against other parts, even in extreme cases.
- For the short sections, plan different lengths to prevent the occurrence of vibrations.
- Note that the mass of the belt in the sag affects the belt tension.
- For conveyors up to a length of 2000 mm (79 in), a belt support in the return side is not required.
- To ensure proper belt wrap position the first belt support roller/row of rollers (b) behind the drive shaft so that the belt sags as little as possible.
- Use pressure rollers (c) if necessary.



All Fullseal Series

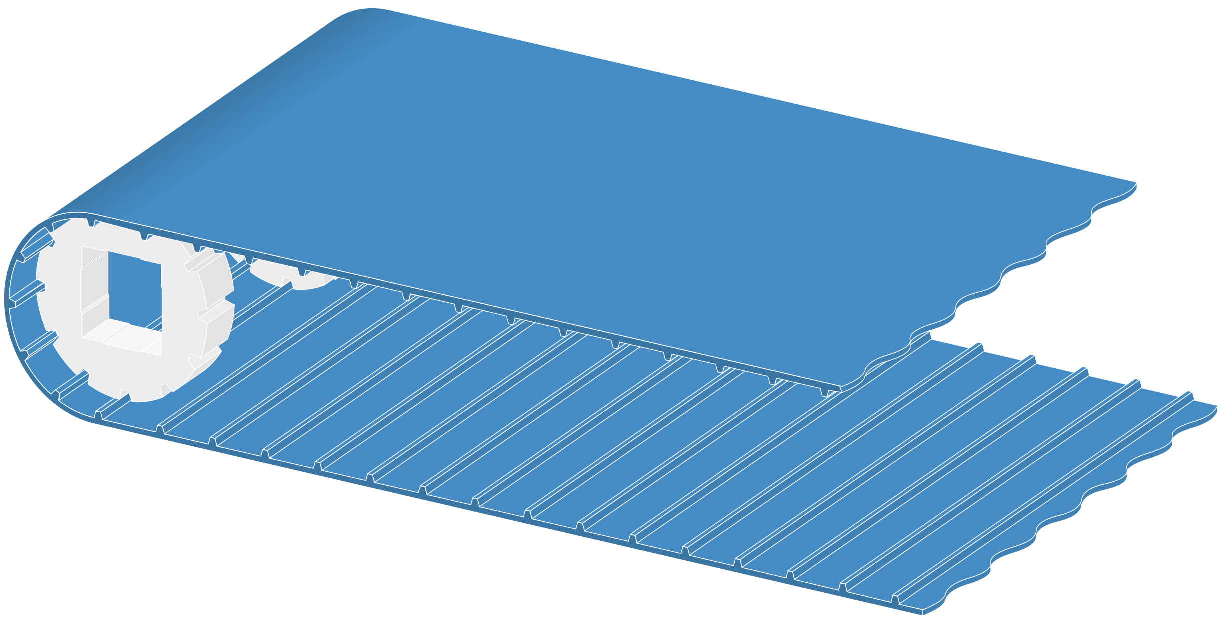
2.5 **FULLSEAL POSITIVE DRIVE** DRIVE | PULLEYS | TRACKING

General

Fullseal Positive Drive is a flat polyurethane belt with drive bars across the full belt width for form-fit power transmission. As a result, the belts are slip-free and enable accurate positioning. Sprockets can be arranged almost as close together as desired, and therefore transmit relatively high forces.

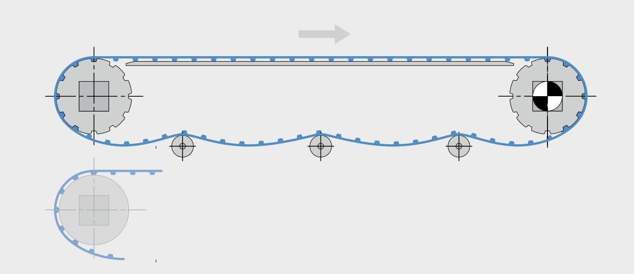
This section contains design information that applies specifically to Fullseal Positive Drive.

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



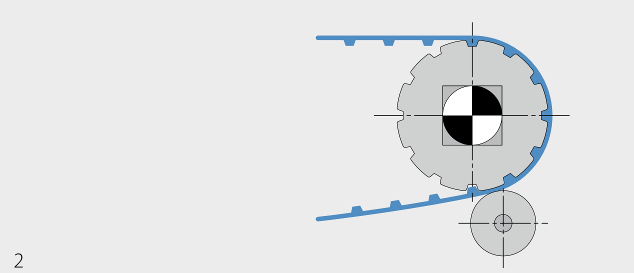
Drive types

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). For the end pulleys, either sprockets (recommended by Forbo) or cylindrical rollers can be used. For sprockets, pressure rollers can be provided if required (fig. 2).



1

Pressure rollers
Use pressure 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).



2

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.

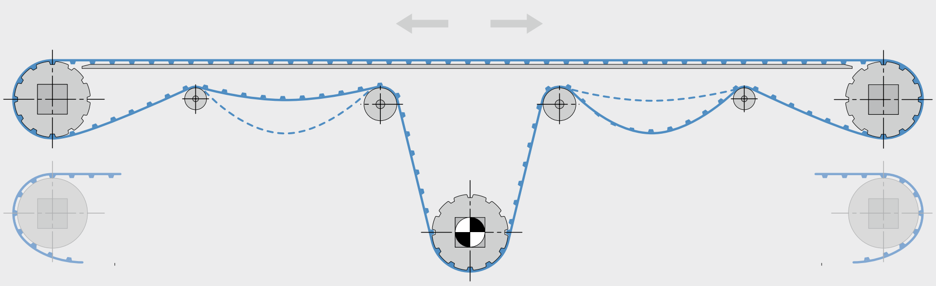
Reverse operation is more complex to belt tracking and is not recommended by Forbo.

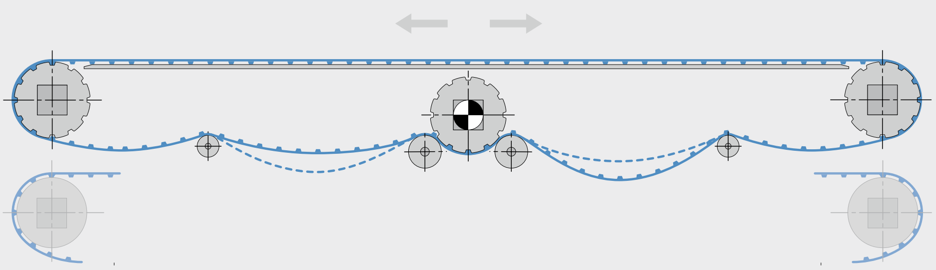
A large wrap angle on the drive produces optimal tooth engagement conditions for reliable power transmission in both running directions (fig. 1).

With a lighter belt load, the wrap angle can be made smaller, which also gives the conveyor a flatter shape (fig. 2).

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.
- On the right and left of the drive unit, provide sections in which the belt sags. This sag is required for the necessary belt tension.
- The belt length between the snub roller and drive should be shorter than between the snub roller and the next support roller. Otherwise gravity take-ups are required in the desired sag area.
- For the end pulleys, either sprockets (recommended by Forbo Movement Systems) or cylindrical rollers can be used. For sprockets, pressure rollers can be provided if required (see "head drive").


1


2

Drive and idler shaft

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

Sprocket diameter
Sprocket diameters should always be as large as possible. The smallest permissible diameter is determined by

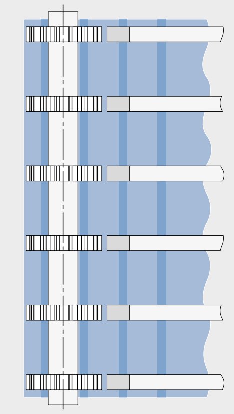
- the circumferential force to be transmitted according to your calculation
- the bending characteristics of the belt type used
- the bending characteristics of the welded-on lateral and longitudinal profiles (see "Technical information 2", ref. no. 318) and "Fullseal · Lower cleaning costs, better hygiene", ref. no. 248).
- If necessary, use pressure rollers to increase the wrap angle.

Attaching the sprockets
The middle and outer sprockets should be mounted on the shaft with slight play of max. 1 mm (0.04 in) in the axial direction (figs. 3/4).

- Use one of the assembly methods shown opposite.
- Spacers can be used to fill the gaps between the sprockets.

Positioning wearstrips
If parallel wearstrips are used, we recommend arranging them in line with the sprockets (fig. 1).
For heavy loads, the wearstrips can be arranged between the sprockets. This makes the gap smaller, and the belt is supported until the next sprocket (fig. 2).

1



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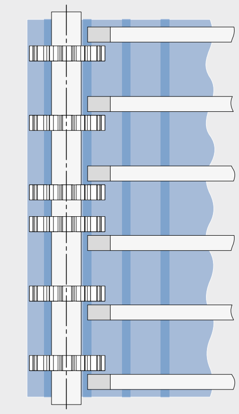
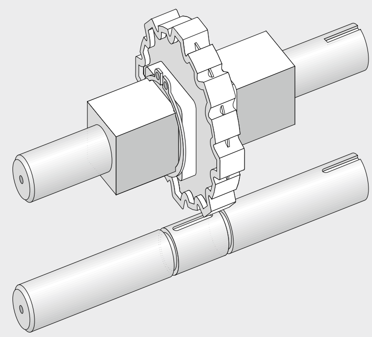
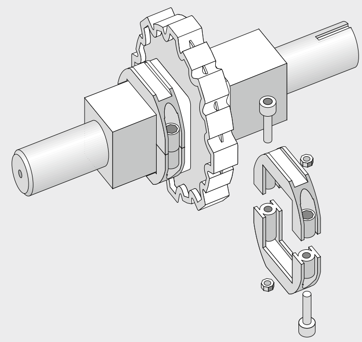


3



Fastened with retaining rings in accordance with DIN 471 (Seeger circlip ring)

4



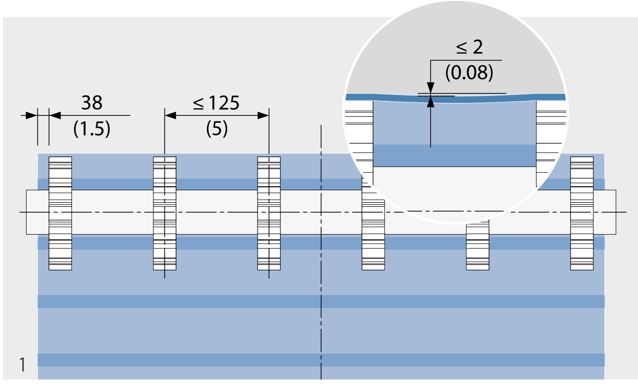
Fastened with clamp rings

Sprocket positions on the drive (fig. 1)
The distances between the sprockets should be no greater than 125 mm (4.9 in).

- Divide the belt width by 125 mm (4.9 in), round up the result and add 1. This gives you the required minimum number of sprockets.
- If the result is an even number, we recommend adding one more sprocket. Narrow belts with a width < 300 mm (11.8 in) are an exception to this rule. In this case, two sprockets are sufficient.
- Never fit a belt on only one sprocket.
- Move the outer sprockets inwards by approx. 38 mm (1.5 in) and spread out the remaining sprockets evenly between them.

The number of sprockets may need to be increased depending on the load. This is calculated using the ratio between the specific and the maximum permissible belt pull.

- During operation, the belt must not dip more than 2 mm (0.08 in) between the sprockets in the drive shaft region. Add sprockets if necessary.
- For heavy loads (or if scraping needs to be particularly effective), place sprockets close together. Ensure that the design meets hygienic requirements, where necessary.



Capacity utilisation $\left[\frac{F_{adj}}{F_{adm}}\right]$	**Max. distance between drive sprockets**
≤ 20%	125 mm (4.9 in)
≤ 40%	60 mm (2.4 in)
≤ 50%	50 mm (2 in)
> 50%	On request

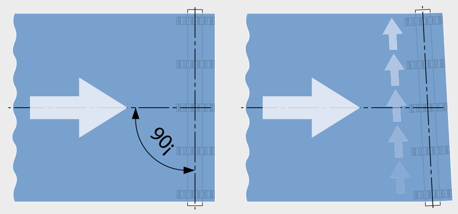
F_{adj} = Adjusted belt pull
F_{adm} = Admissible belt pull

Sprocket position on the idler pulley
The idler shaft is usually fitted with sprockets in the same way as the drive shaft. If scrapers are used, it may be useful to increase the number of sprockets to achieve a better scraping result.

Belt tracking

Conveyor design and state of repair

The conveyor frame should be as rigid as possible. It must not be distorted by the forces exerted by the belt. If the axes of sprocket shafts 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

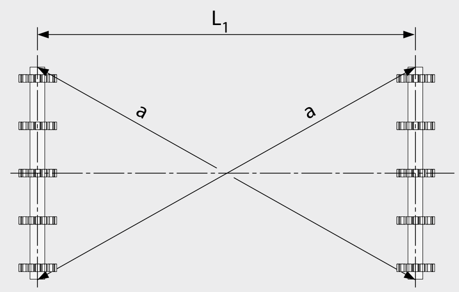
– clean and in a good state of repair,
– aligned axially parallel and at right angles to the conveyor direction,
– correctly laterally oriented in relationship to one another.

Effect of temperature

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

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).



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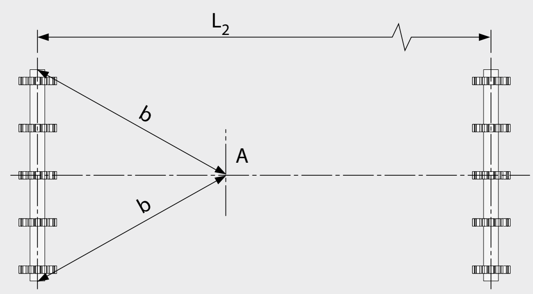


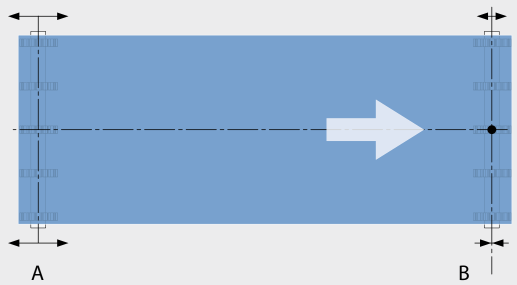
3

Belt tracking at the pulleys

Sprocket axes and shafts should be arranged adjustable to compensate for manufacturing tolerances in the system and belt (fig. 1).

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

Flanged rolllers can be used for additional belt tracking.



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).

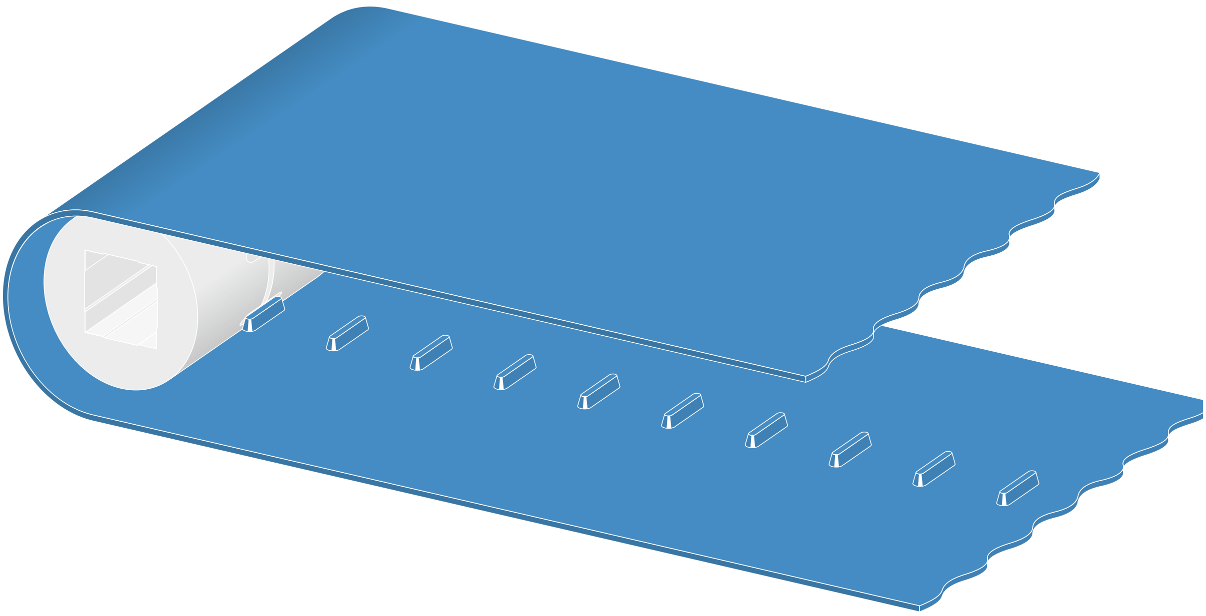
2.6 **FULLSEAL CENTER DRIVE**
DRIVE | PULLEYS | TRACKING

General

Fullseal Center Drive is a flat polyurethane belt that has one or two rows of profiles for form-fit power transmission. As a result, the belts are slip-free and enable accurate positioning.

This section contains design information that applies specifically to Fullseal Center Drive.

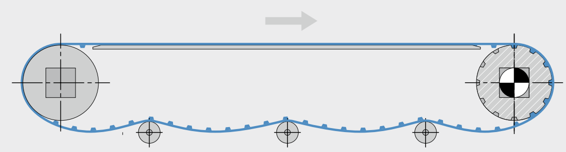
For important information applicable to all Fullseal series, see sections 2.1 to 2.4.



Drive types

Head drive

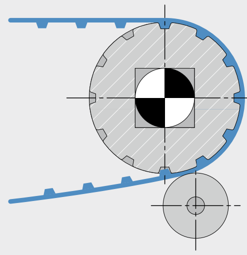
This drive type is used for most conveyor functions. The drive shaft is located at the head of the conveyor (outfeed side) and pulls the belt (fig. 1). Pressure rollers can be provided if required (fig. 2).



1

Pressure rollers

Use pressure rollers if necessary 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 pressure rollers can be up to 1/2 d_{min} as long as the wrap angle does not exceed 15°.



2

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.

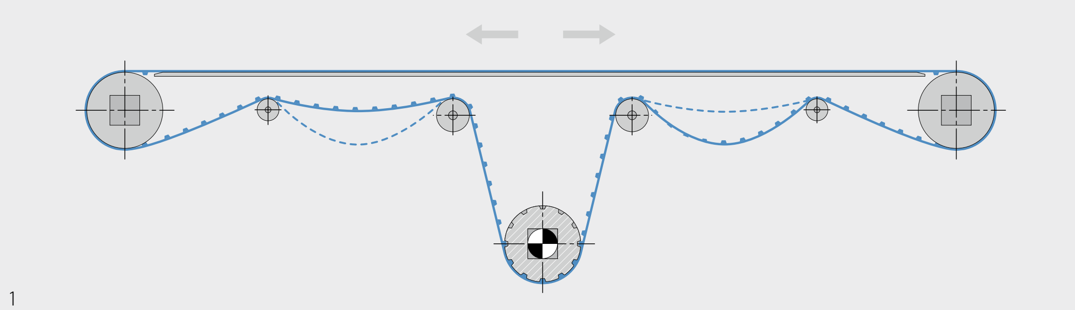
Reverse operation is more complex to belt tracking and is not recommended by Forbo.

A large wrap angle on the drive produces optimal tooth engagement conditions for reliable power transmission in both running directions (fig. 1).

With a lighter belt load, the wrap angle can be made smaller, which also gives the conveyor a flatter shape (fig. 2).

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.
– On the right and left of the drive unit, provide sections in which the belt sags. This sag is required for the necessary belt tension.
– The belt length between the snub roller and drive should be shorter than between the snub roller and the next support roller. Otherwise gravity take-ups are required in the desired sag area.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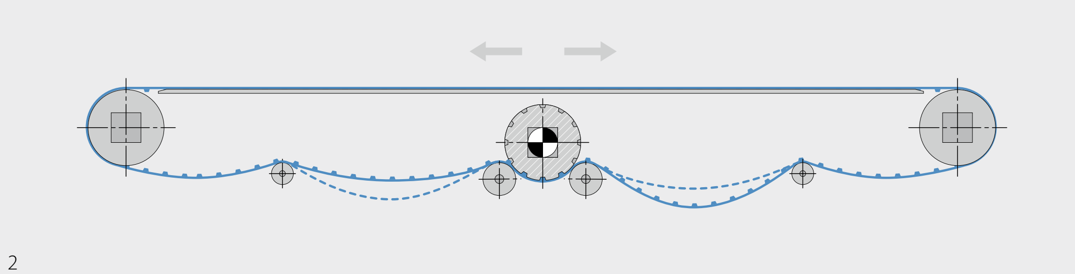

2

Drive and idler shafts

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

Sprocket drum diameter
Sprocket drum diameters should always be as large as possible. The smallest permissible diameter is determined by

- the effective pull to be transmitted
- the bending characteristics (d_{min}) of the belt type used
- the bending characteristics (d_{min}) of the welded-on lateral and longitudinal profiles (see "Technical information 2", ref. no. 318) and "Fullseal · Lower cleaning costs, better hygiene", ref. no. 248).

If necessary, use pressure rollers to increase the wrap angle.

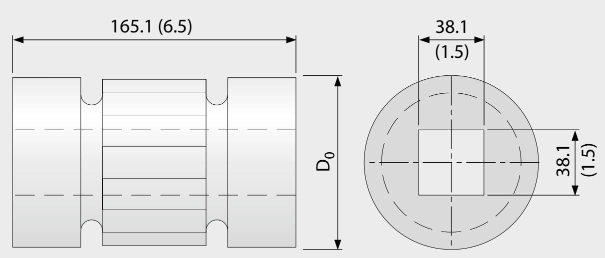
Sprocket drum type
Fullseal Center Drive can be driven by one of the two following sprocket drum types:

- sprocket with guide (fig. 1)
- open sprocket (fig. 2)

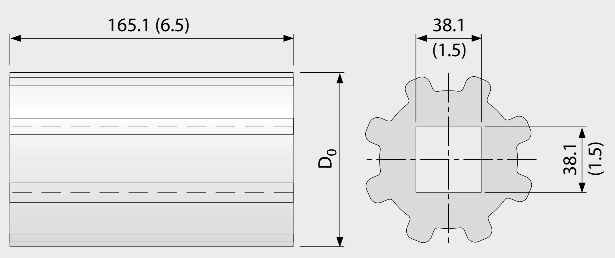
Attaching sprocket drum and idler pulleys
All sprocket drums and idler pulleys have to be fitted to the shaft with slight play in the axial direction.

- Use one of the attachment methods described in the previous section (Fullseal Positive Drive).
- Spacers can be used to fill the gaps between the sprockets.

1



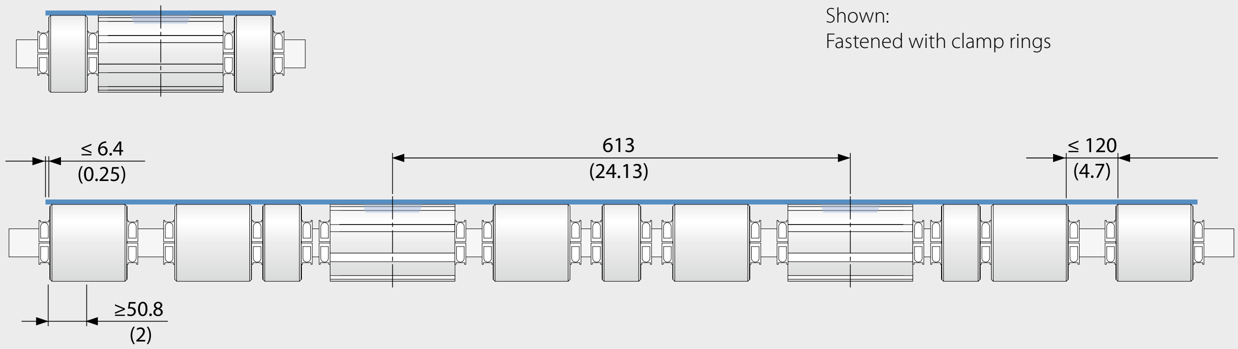
2



Sprocket drum position on the drive (fig. 1)
Fullseal Center Drive types have one or two rows of profiles on the underside of the belt.

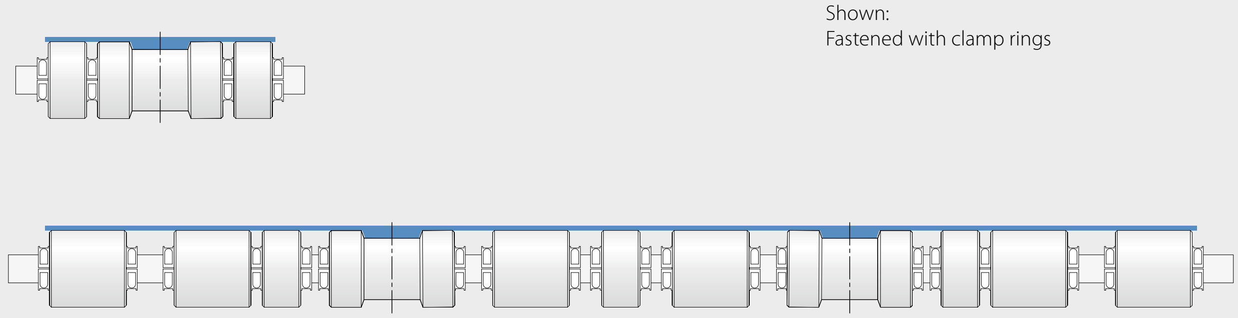
– Provide one sprocket for each row of profiles.
– Position the sprockets centrally to the rows of profiles on your Center Drive type.
– Position end rollers on the drive shaft as shown in the examples below.

1



Sprocket drum positions on the idler shaft (fig. 2)
Fit components to the idler shaft to match the drive shaft; but instead of sprockets use tail rollers, which have a smaller diameter in the area of the profile rows.

2

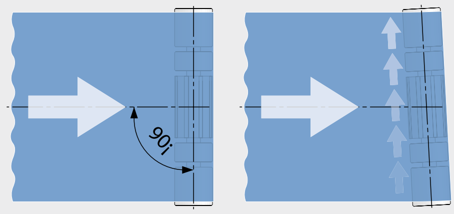


Fullseal Center Drive

2.6 **FULLSEAL CENTER DRIVE**
DRIVE | PULLEYS | TRACKING

Belt tracking

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



1

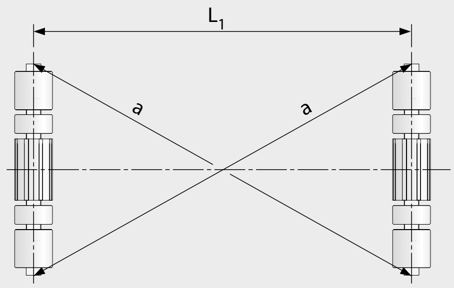
All rollers, drums and shafts in the system as well as supports and guide elements should be

– clean and in a good state of repair,
– aligned axially parallel and at right angles to the conveyor direction,
– correctly laterally oriented in relationship to one another.

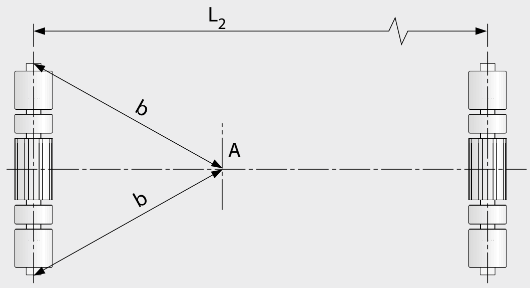
Effect of temperature
Strong asymmetrical heating and loading on a properly adjusted belt can cause uneven changes in the belt's inner tension.

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. 1).
- 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. 2).



1

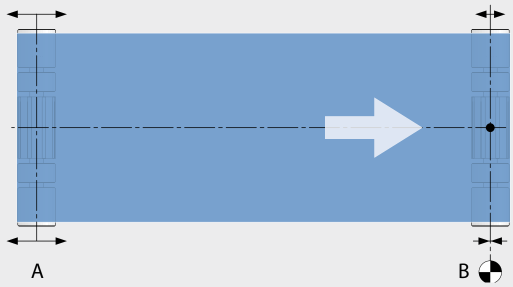


2

Belt tracking at the pulleys

Sprocket axes and shafts should be arranged adjustably to compensate for manufacturing tolerances in the system and belt (fig. 3).

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



3

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).

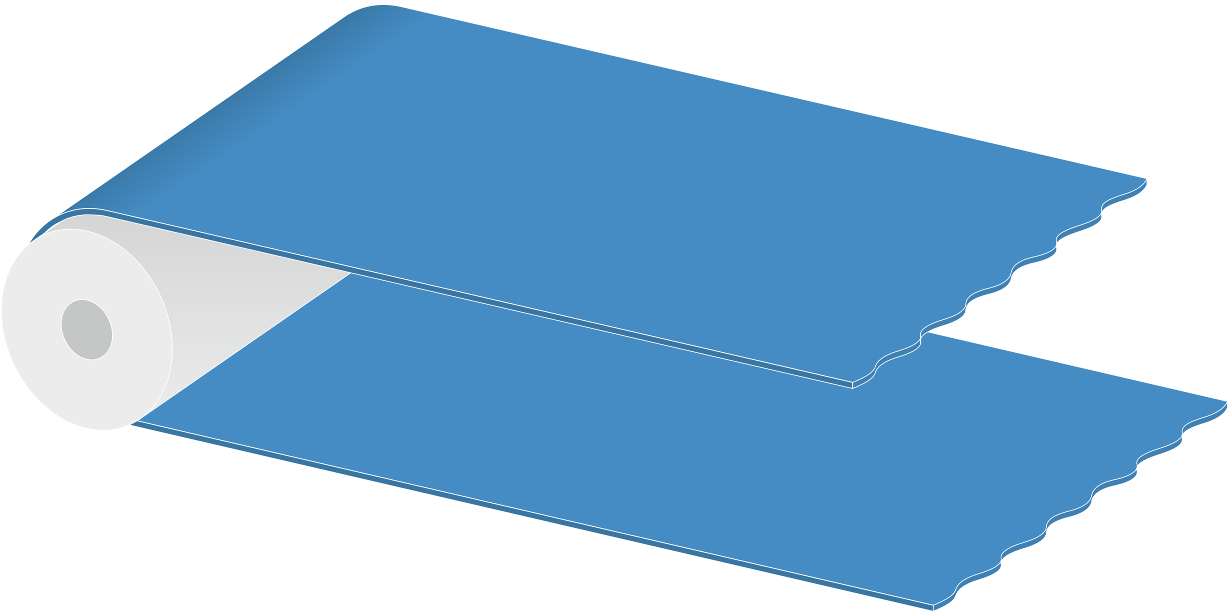
2.7 **FULLSEAL FLAT** DRIVE | PULLEYS | TRACKING

General

Fullseal Flat is a belt with a homogeneous belt body. As a flat polyurethane belt, it is friction-driven by a drive drum.

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

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

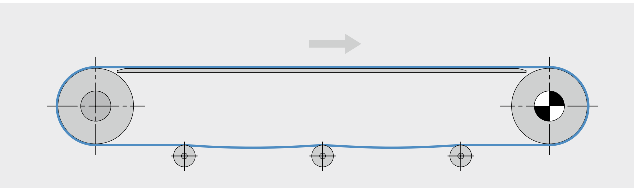


Fullseal Flat

Drive types

Head drive

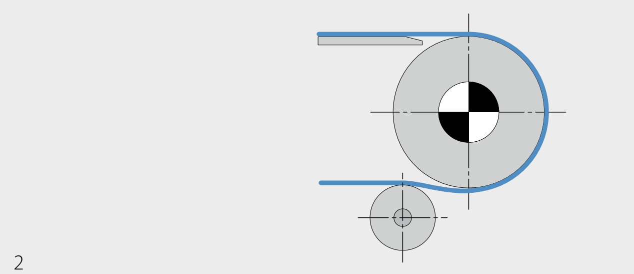
This drive type is used for most conveyor functions. The drive shaft is located at the head of the conveyor (outfeed side) and pulls the belt (fig. 1).



1

Snub rollers

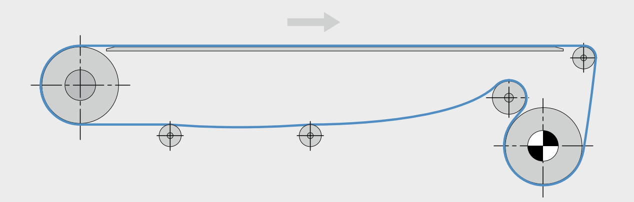
Use snub rollers if necessary in the return side to increase the wrap angle at the drive/idler pulley and/or to minimize the distance between the carrying and return sides (fig. 2). The diameter of snub rollers can be up to 1/2 d_{min} as long as the wrap angle does not exceed 15°.



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 (roller or sprocket) 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.

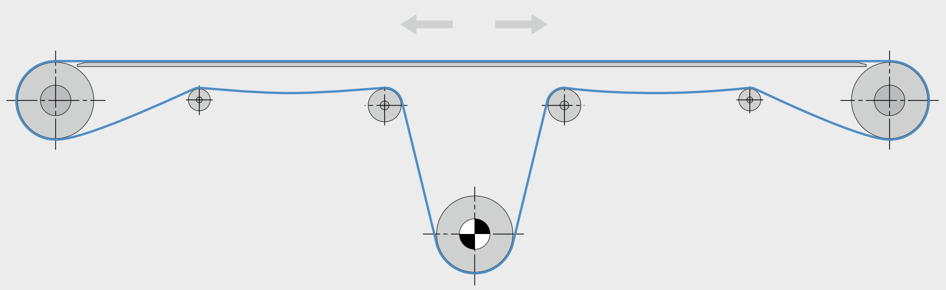
Reverse operation is more complex to belt tracking and is not recommended by Forbo.

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.



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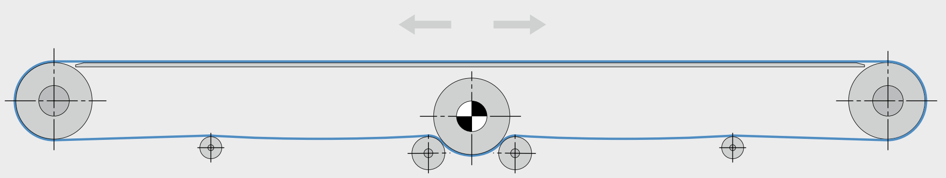


3

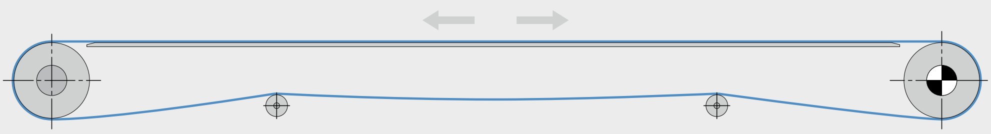
Fullseal Flat

2.7 **FULLSEAL 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.

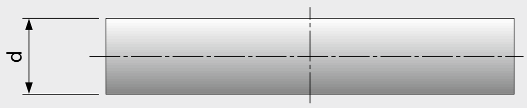


1

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

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 and longitudinal profiles (see “Technical information 2”, ref. no. 318) and “Fullseal · Lower cleaning costs, better hygiene”, ref. no. 248).

Drive and idler drums are usually cylindrical (fig. 2).

Fullseal Flat

Smooth running surfaces

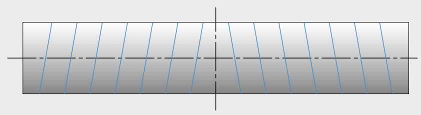
The running surfaces of all drums should be smoothly finished.
Excessive grooves will produce an undesired guiding effect.
Roughness $R_Z \leq 25$ (DIN EN ISO 4287), (roughness depth ≤ 25 µm)

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.

Lagged running surfaces

To improve friction characteristics on the drive drum, drum lagging can be used (fig. 1). Plastic coverings should have a hardness of not less than 85 Shore A at 20 °C to prevent excessive wear. Rubber coatings should have a hardness > 56 Shore A and be made from wear-resistant rubber material. In both cases, the materials must be food safe where necessary.

Use only drums whose lagging is wrapped from the center to the outside (or from the edges to the middle). Then the steering effects of the left-hand and right-hand winding will cancel each other out.

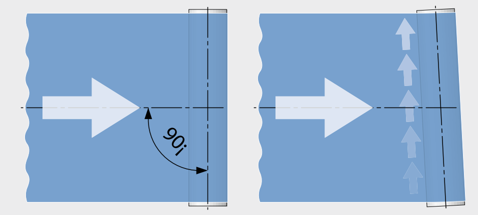


1

2.7 **FULLSEAL FLAT**
DRIVE | PULLEYS | TRACKING

Belt tracking

Conveyor design and state of repair
The conveyor frame should be as rigid as possible. It must not be distorted by the forces exerted by the belt. If the axes of sprocket shafts 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 state of repair,
– aligned axially parallel and at right angles to the conveyor direction,
– aligned laterally in relationship to one another.

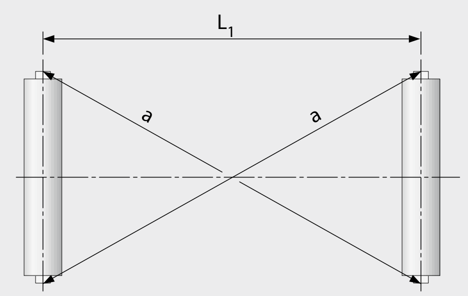
Effect of temperature
Strong asymmetrical heating and loading on a properly adjusted belt can cause uneven changes in the belt's inner tension.

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

Fullseal Flat

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).



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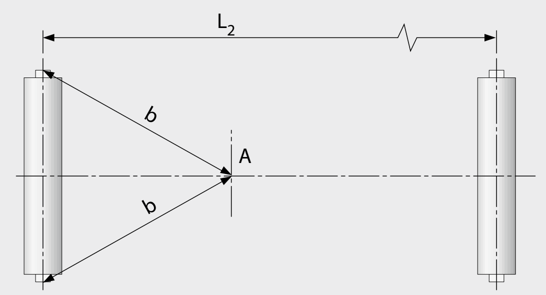
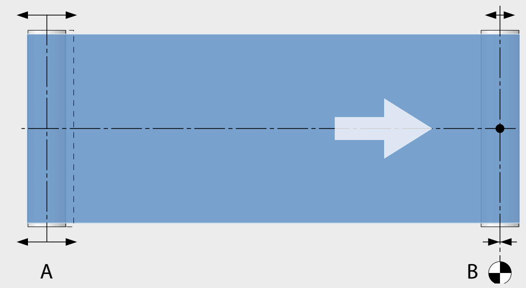


3

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 "square" systems (axis distance ~ belt width) or an even worse length/width ratio, the belt can no longer be adjusted via conical-cylindrical drums.



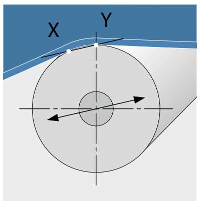
1

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: by snub roller D with the belt running in direction 1, and by snub roller C with the belt running in direction 2.



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.

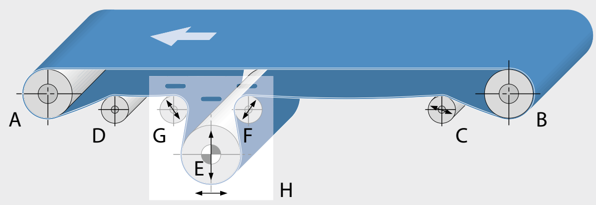
Fullseal Flat

2.7 **FULLSEAL FLAT** DRIVE | PULLEYS | TRACKING

Belt tracking with center 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 adjustable in the arrow direction.

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

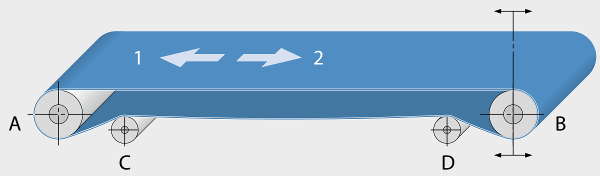


1

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

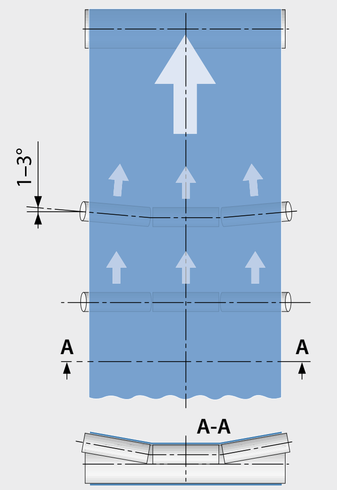
Adjustment
- Set axes and shafts axially parallel as a basic setting.
- Fit the belt with the correct sag in the return side.
- In reversing operation, the belt tracking should be adjusted not at the snub rollers but at the end pulleys.

Effect of support rollers

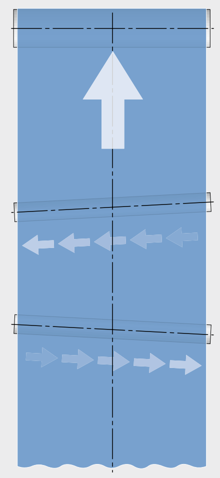
For troughed belts, tracking can be improved by rotating the side rollers at some roller stations forwards by up to approx. 3° in the direction of belt travel, depending on the belt speed (fig. 1).

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.



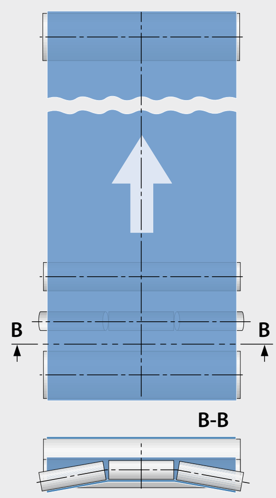
1



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.

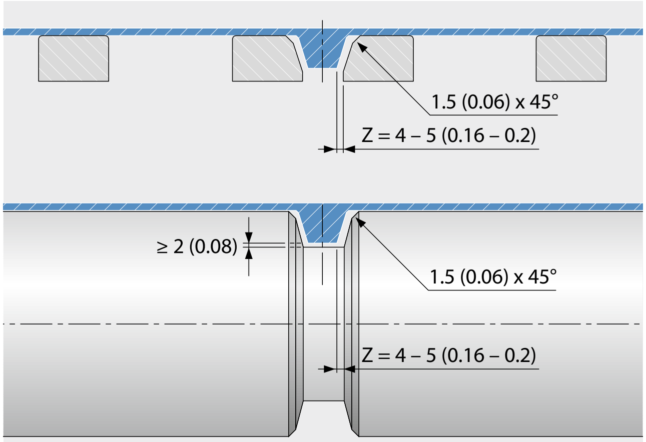
2.7 **FULLSEAL FLAT**
DRIVE | PULLEYS | TRACKING

Absorbing lateral forces with longitudinal profiles

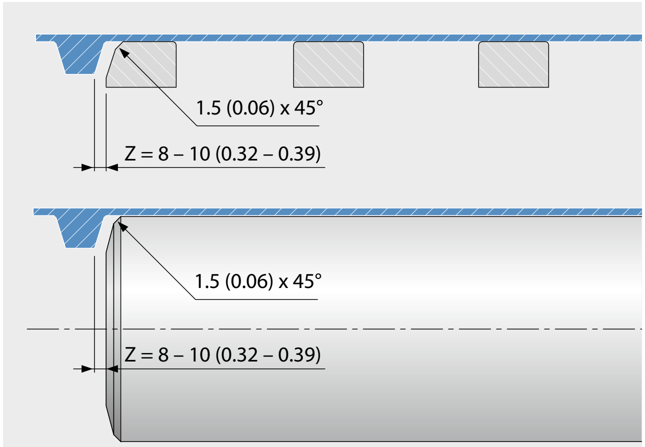
Lateral forces arising e.g. due to transported material entering or exiting from the side can be absorbed by welded-on longitudinal profiles in the conveyor path support area.

- 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

Fullseal Flat

3 CONVEYOR LAYOUTS

3.1 HORIZONTAL CONVEYORS

General

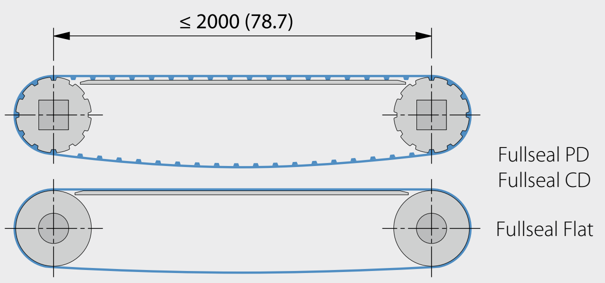
In conveyors that are aligned horizontally, the conveyor belt runs around two end pulleys, one of which is a drive pulley. The idler can be used as a take-up.

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.

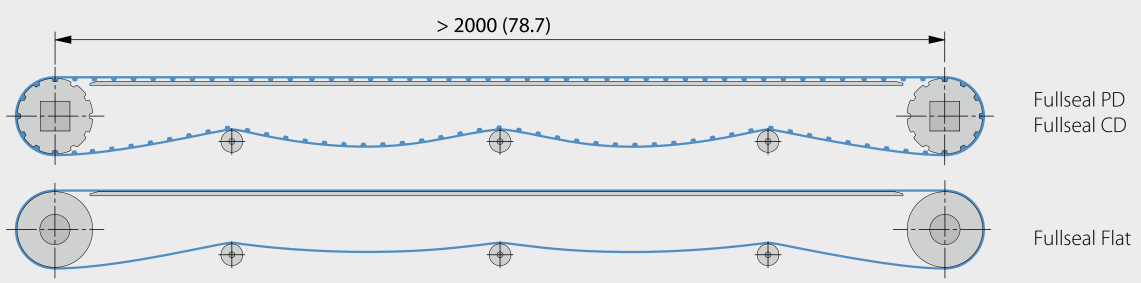
Conveyor layouts

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

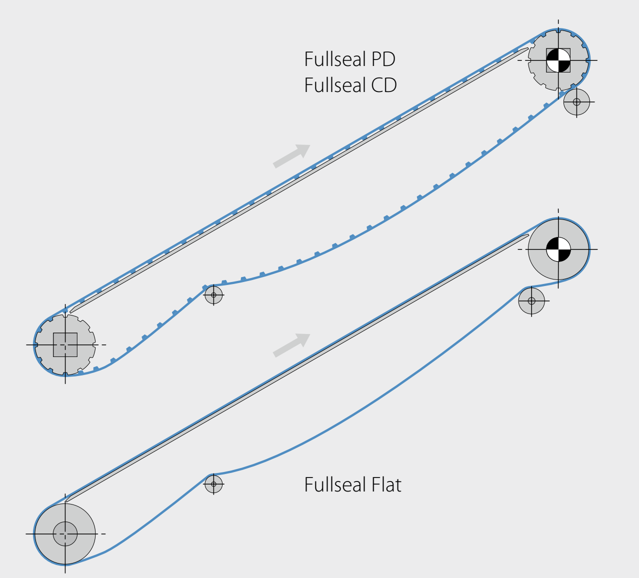
In straight incline/decline conveyors (without a change of angle), the conveyor belt runs around two end pulleys, one of which is a drive pulley. The idler can be used as a take-up.

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 top side profiles, 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 profiles in the return side
– See section 2 "Conveyor design" for all design details.

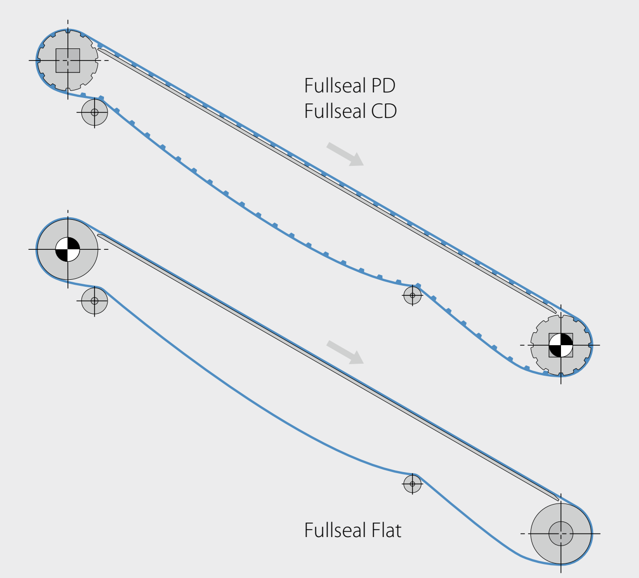


1

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 profiles in the return side
– See section 2 "Conveyor design" for all design details.



2

3.3 HOCKEY-STICK AND SWAN-NECK CONVEYORS

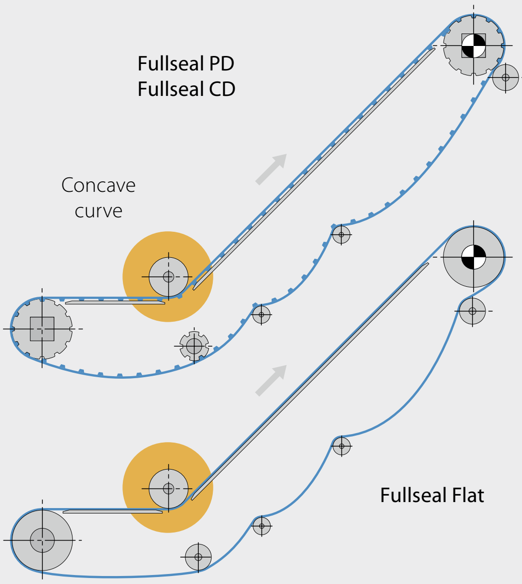
General

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 deflection 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



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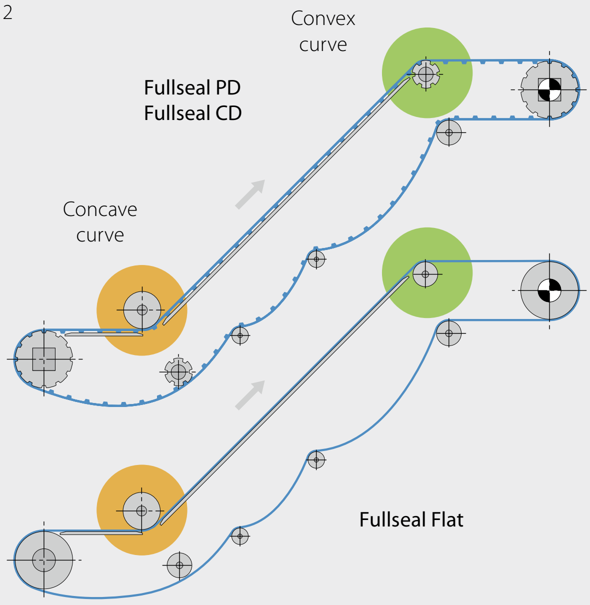
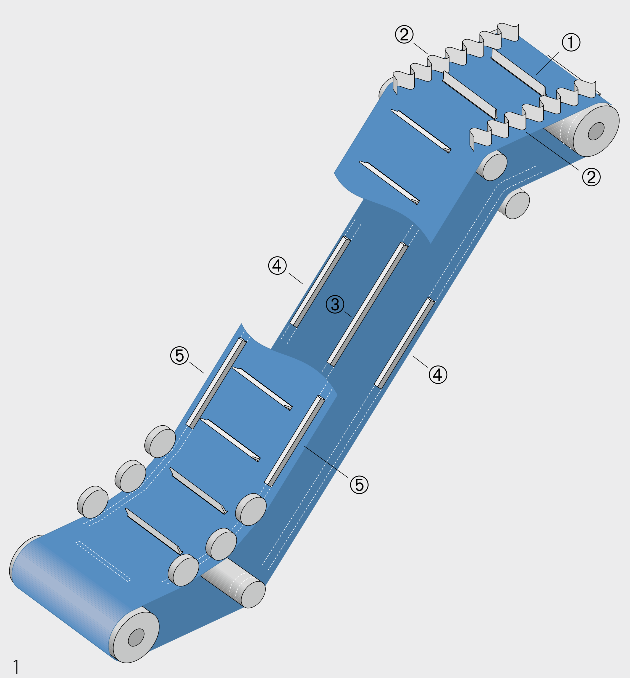


Use of profiles and deflection radii

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

- **Lateral profiles** (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 radii of the deflections and counter bends (curves) are dependent not only on the belt type but also on the profiles and 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 (Fullseal Flat) or sprockets. 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

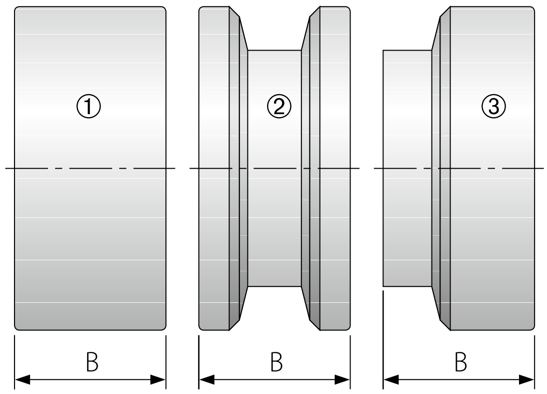
Belt guidance in the concave curve (top side of belt)

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

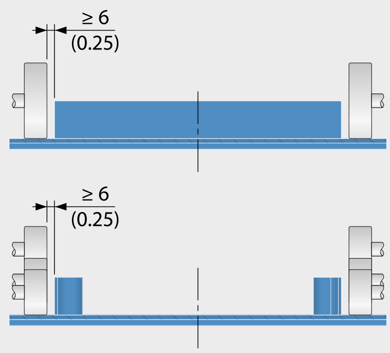
– Use pressure rollers (fig. 1) having the permissible d_{min} to hold down the belt edge (minimum width "B" in each case 30 mm (1.2 in);
  > cylindrical rollers (1) for belts without longitudinal profiles on the carrying side,
  > V-pulleys or guide rollers (2/3) for belts with longitudinal profiles 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 "Fullseal · Lower cleaning costs, better hygiene", ref. no. 248).
– 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).
– If the belt width is wider than 600 mm, we recommend providing additional supports on the belt surface or between the profiles in the return side.

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).

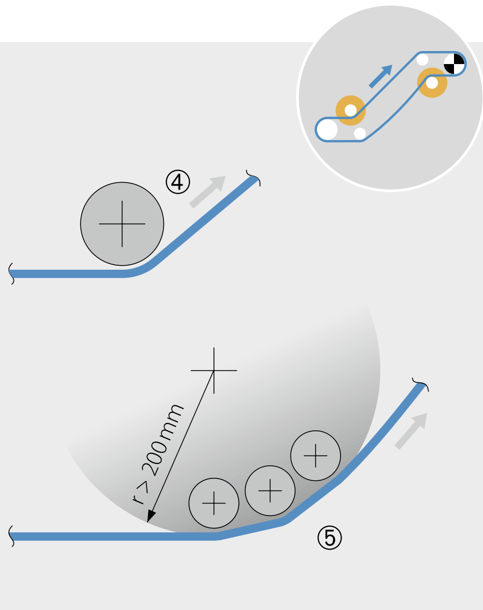
For larger and changing gradient angles, multiple pressure rollers (5) can be used at each side of the belt (at least three). Their diameter can be smaller than when using a single roller per side. An overall deflection radius of > 200 mm must be maintained, however, since the arcs of contact at the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



1



2 Belt shown without drive bars



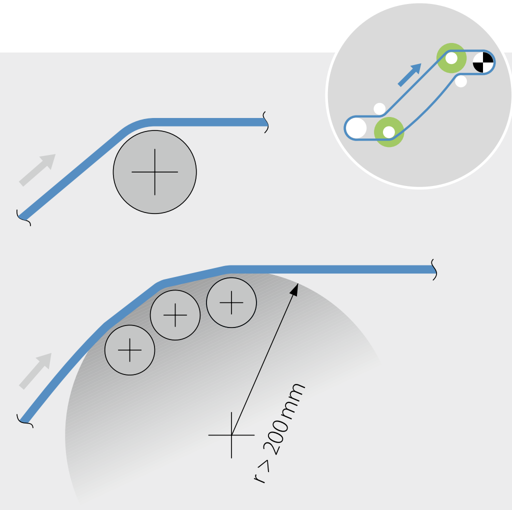
3 Belt shown without drive bars

Belt guidance in the convex curve (underside of belt)

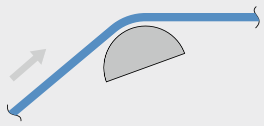
Especially if the belt is operated dry without lubrication, high friction resistance occurs at this bending point.

– Preferably (depending on the belt type) use rollers or sprockets 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.

In contrast to other applications, Fullseal Flat is provided with a preload of 0.5%.

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 $b_0 \cdot$ factor c_7 [mm]

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

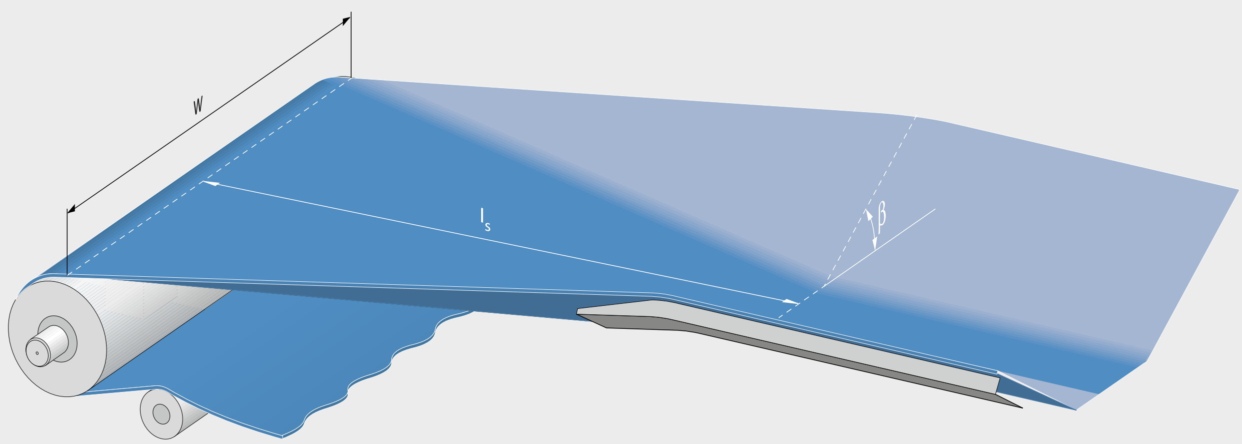
Trough angle

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 Fullseal type used, different trough shapes can be realized (see following pages).

1

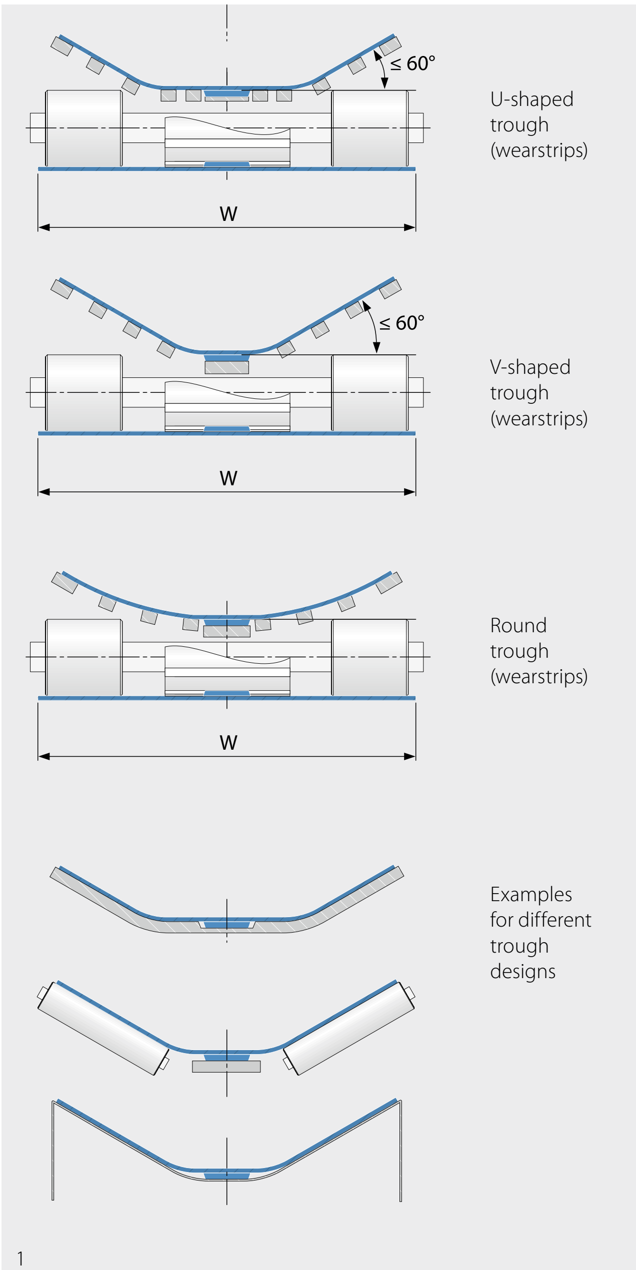


Fullseal series and trough shape

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

Belt support for Fullseal CD (fig. 1)

- The belt can be supported by wearstrips, full-surface and by rollers (U-shaped, V-shaped or round).
- The profile rows in Fullseal Center Drive must lie at the bottom of the trough and not be part of the cupped/ angled section of the belt.
- 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 lateral belt 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.

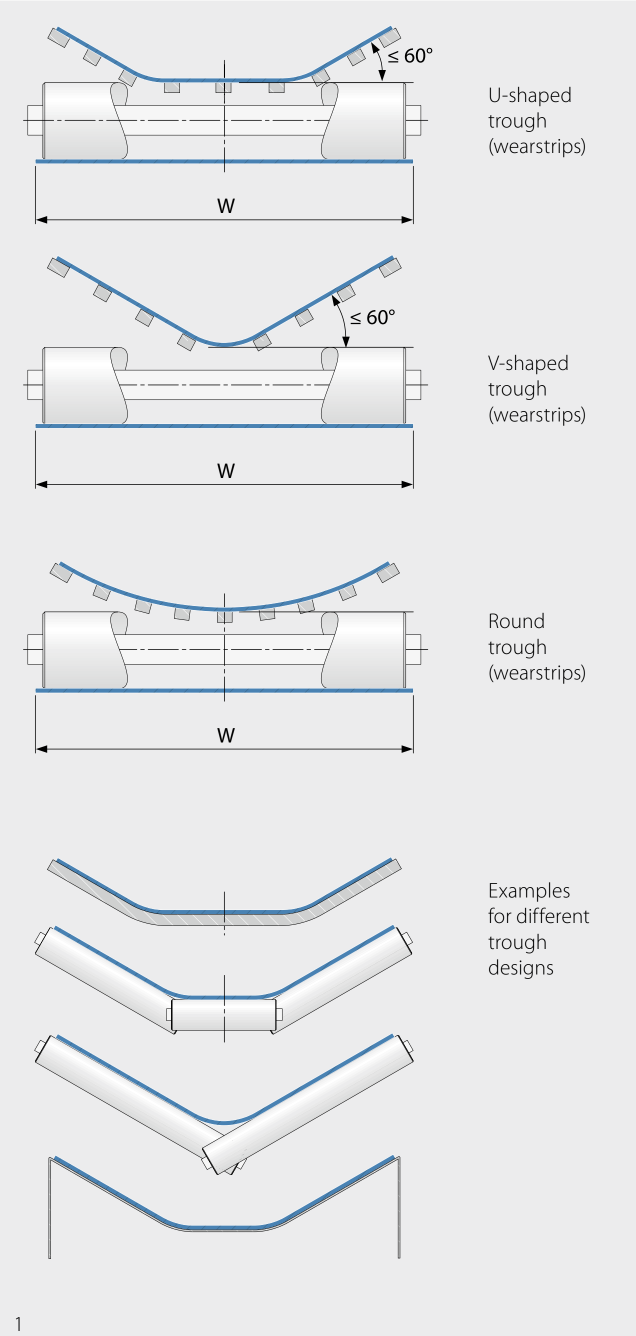


Principle diagrams for different trough designs

3.4 TROUGHED CONVEYORS

Belt support for Fullseal 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 lateral belt 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

4.1 LEGAL NOTES

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 at www.forbo.com/movement/en-gl/.

Committed staff, quality oriented organization and production processes ensure the constantly high standards of our products and services. The Forbo Siegling Quality Management System is certified in accordance with ISO 9001.

In addition to product quality, environmental protection is an important corporate goal. Early on we also introduced an environmental management system, certified in accordance with ISO 14001.

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The Forbo Siegling Group employs more than 2,500 people. 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. Forbo Siegling service points are located in more than 300 places worldwide.

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