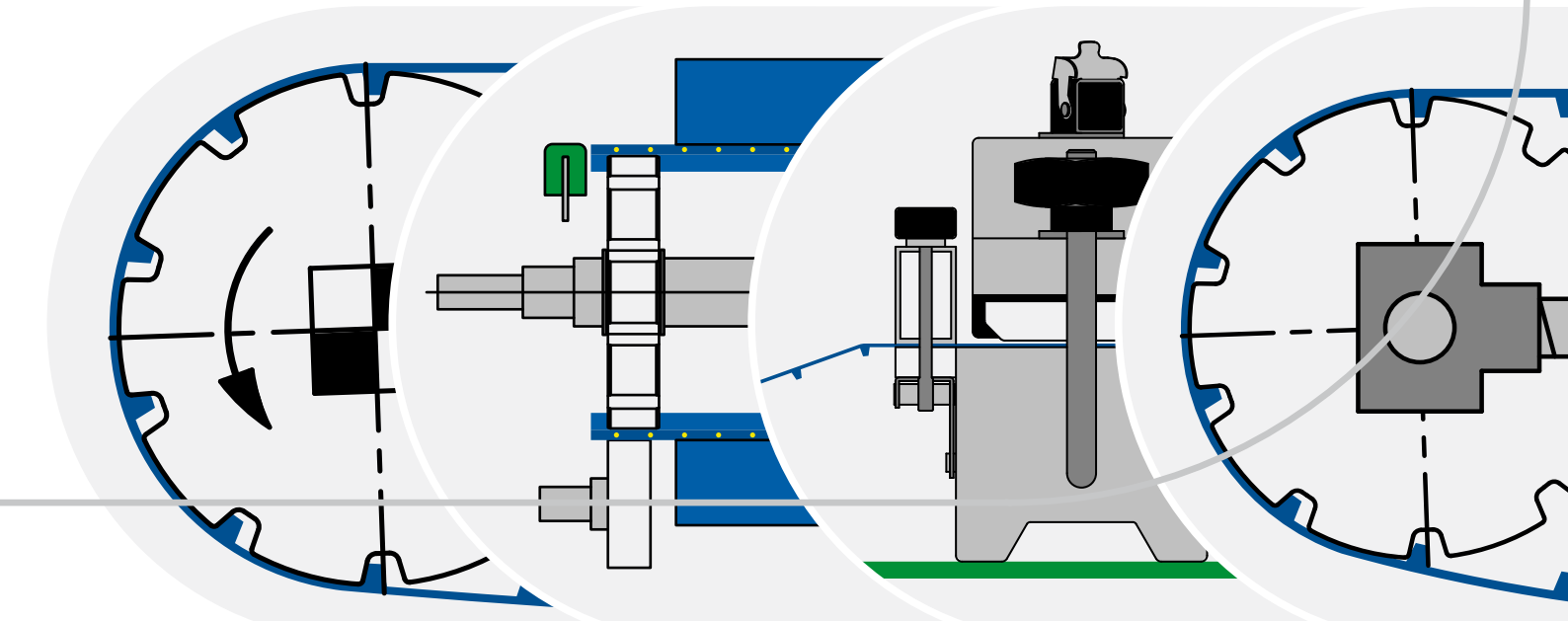
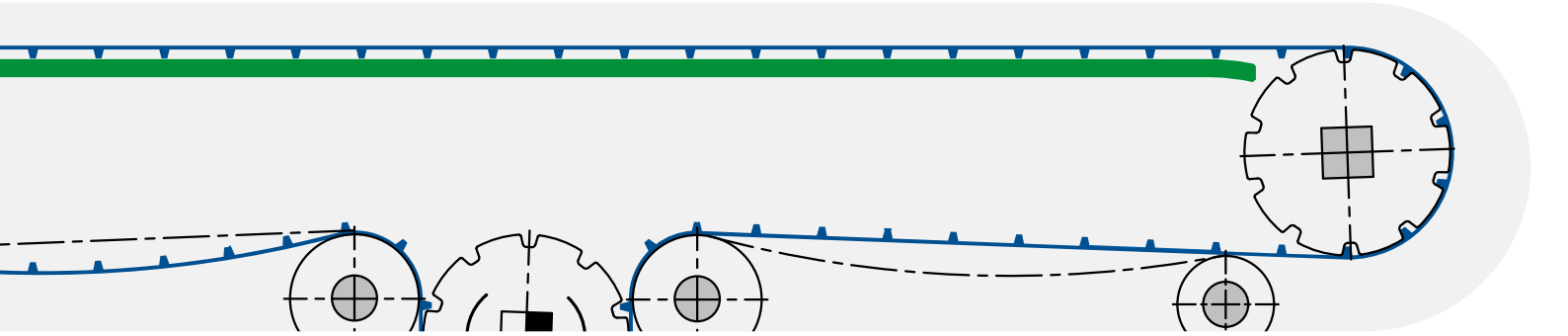
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# Habasit Cleandrive™ Monolithic belts

## Engineering Guide

Habasit – Solutions in motion





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# Introduction
# Habasit Cleandrive™ features

Habasit Cleandrive™ aramid reinforced monolithic TPU conveyor belts have been on the market for many years and are recognized for their safe and hygienic food processing performance.

Supporting a wide range of applications, Habasit Cleandrive™ belts are manufactured in two versions:
- sprocket driven "positive drive"
- pulley driven "friction drive"

The fully extruded monolithic belt design produced by our advanced manufacturing technology meets our customers' most stringent hygiene requirements, while also delivering exceptional performance and cost-efficiency.



**Fig. 1** Superior abrasion resistance and hydrolysis resistance

### Aramid reinforced belt design for performance

Habasit Cleandrive™ belt design includes aramid cord reinforcement for dimensional stability. This permits continuous and reliable sprocket engagement, which results in reduced belt wear, maintenance and downtime.

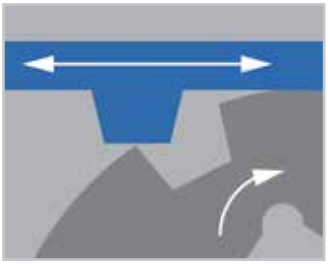


**Fig. 2** Conventional cordless monolithic positive drive

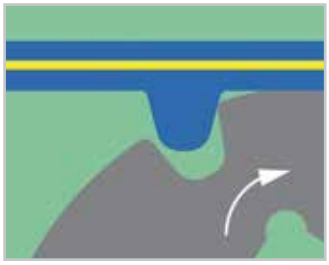


**Fig. 3** Habasit Cleandrive™ aramid reinforced positive drive

### Premium TPU belt material for food safety

Habasit Cleandrive™ belts are manufactured using premium TPU, which features superior abrasion resistance and hydrolysis resistance, and is inherently resistant to microbiological attack. The belts are designed to withstand the most aggressive cleaning protocols and chemical agents, and to operate in a wide temperature spectrum: from low-temperature freezer in-feeds to high-temperature fryer out-feeds.

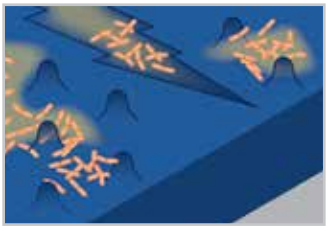


**Fig. 4** Conventional monolithic belt materials



**Fig. 5** Habasit Cleandrive™ materials made of premium TPU

### Monolithic belt design for hygiene

The fully extruded monolithic belt design of Habasit Cleandrive™ belts is completely free of fabric members that could fray during use and pose a food safety risk. The solid yet flexible belt design is also free of the cavities, joining rods and crevices normally found in hinged belts, making Habasit Cleandrive™ very easy to clean.



**Fig. 6** Frayed fabric belt edges



**Fig. 7** Habasit Cleandrive™ monolithic belt design

These benefits make the Habasit Cleandrive™ conveyor belt the safe choice for hygiene-sensitive food processing applications.

# Introduction
# Habasit Cleandrive™ features

### Food safety
Habasit Cleandrive™ belts meet the currently relevant EU and US food contact regulations and are certified by the Japan Food Research Laboratories (JFRL). For details, please contact your Habasit representative or check our websites for the respective food certificates: Declarations of Compliance – DoC.

USDA M&P/Dairy approvals are available on some belt versions; please contact your Habasit representative.

### Low noise
Compared with hinged plastic belts, Habasit Cleandrive™ belts produce significantly less noise. When solid and hard conveyor elements like sprockets and wear strips engage with the softer material of the belts, the amount of noise is reduced, creating less environmental disturbance.

### Accessories
Habasit Cleandrive™ belts can be accessorized with a full array of scoops, cleats, side walls and V-guides to support numerous applications, including incline/decline, guidance and separation.

### Hygienic welding of accessories
Our hygienic welding technology guarantees solid attachment of accessories, with an easy-to-clean bonding area using hygienic, rounded corners.

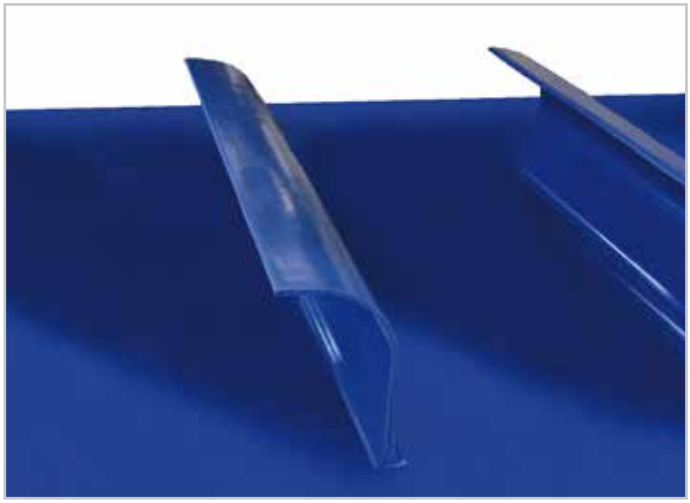


**Fig. 8** Habasit Cleandrive™ scoop profile



**Fig. 9** Conventional welding

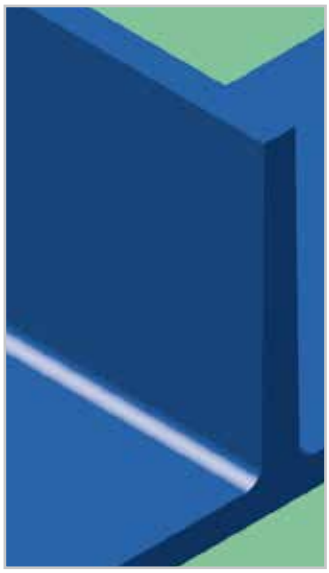


**Fig. 10** Habasit Cleandrive™ with hygienic welding

### Hygienic endless belt joining

Our newly developed Quickmelt joining technology produces a continuous and smooth joining area that is free of crevices and cracks. A belt can be fitted quickly on-site with high belt strength and an easy-to-clean joint.



**Fig. 11** Hot-pressing device PQ-603

Belts can be joined endless or combined with our mechanical lace for easy opening of the belt during cleaning.



**Fig. 12** Mechanical joining

### Habasit Cleandrive™ HyCLEAN sprockets

Habasit Cleandrive™ HyCLEAN sprockets provide reliable belt engagement and easy cleaning. The smooth rounded surfaces are free of hidden areas, ensuring perfect cleaning and disinfecting results.

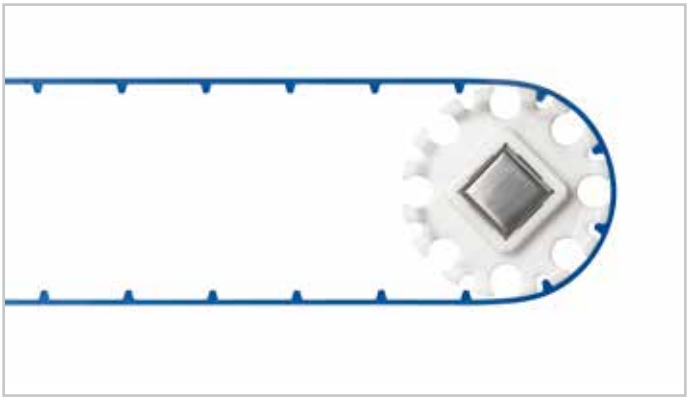


**Fig. 13** HyCLEAN sprocket

HyCLEAN series sprockets are designed for standalone performance but can be ideally combined with our HyCLEAN CIP automated cleaning system.

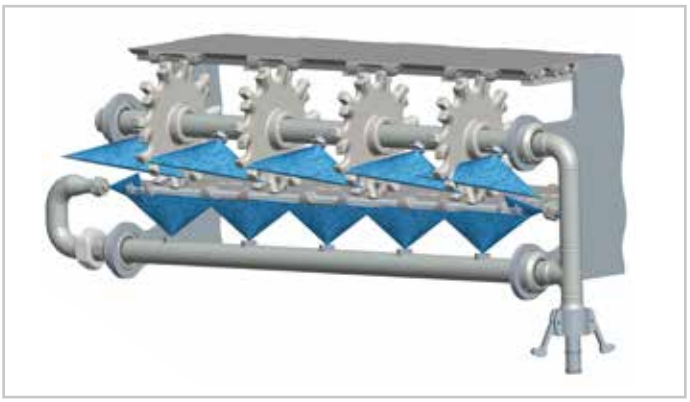


**Fig. 14** HyCLEAN CIP system

# Introduction
# Materials for belts and sprockets

## Material for belts

| Material | Code | Property | Food approval | Density g/cm³ *lb/in³* | Temperature range | Habasit colors |
|---|---|---|---|---|---|---|
| Thermoplastic polyurethane | TPU | Thermoplastic material with good chemical and hydrolysis resistance. Hardness: 95 Shore A | EU FDA | 1.15 *0.042* | -30 °C to +80 °C *-22 °F to +176 °F* | Blue White |

## Materials for sprockets

| Standard materials | Code | Property | Food approval | Density g/cm³ *lb/in³* | Temperature range | Habasit colors |
|---|---|---|---|---|---|---|
| Polyoxymethylene (Acetal) | POM (AC) | Thermoplastic material specially designed for sprockets, with high strength and good abrasion resistance. Good chemical resistance to oil and alkalines, but not suitable for long-term contact with high concentrations of acids and chlorine. | EU FDA | 1.42 *0.051* | Wet conditions: -40 °C to +60 °C *-40 °F to +140 °F*<br><br>Dry conditions: -40 °C to +90 °C *-40 °F to +200 °F* | White |
| Polyamide | PA | Thermoplastic material with high strength and very good abrasion resistance. Suitable for heavy duty applications in dry conditions and at elevated temperatures. The material is specially modified to keep its properties stable over a long time at elevated temperatures. | EU FDA | 1.14 *0.042* | Wet conditions: not recommended<br><br>Dry conditions: -46 °C to +130 °C (short-term +160 °C) *-50 °F to +266 °F (short-term +320 °F)* | White |
| **Special materials – only available on request** | **Code** | **Property** | **Food approval** | **Density g/cm³ *lb/in³*** | **Temperature range** | **Habasit colors** |
| Polyethylene | PE | UHMW Ultra-high molecular weight material for machined sprockets. Very good chemical resistance. | EU FDA | 0.94 *0.034* | -70 °C to +50 °C *+94 °F to +120 °F* | Natural |
| Polypropylene | PP | Thermoplastic material with excellent chemical resistance to acids, alkalines and hot water. Abrasion resistance not as good as of POM. | EU FDA | 0.90 *0.033* | +5 °C to +105 °C *+40 °F to +220 °F* | White |



**Fig. 15** CD.M50.S-UA.WB
Pitch 50.4 mm *(1.984")*, TPU elastomer material

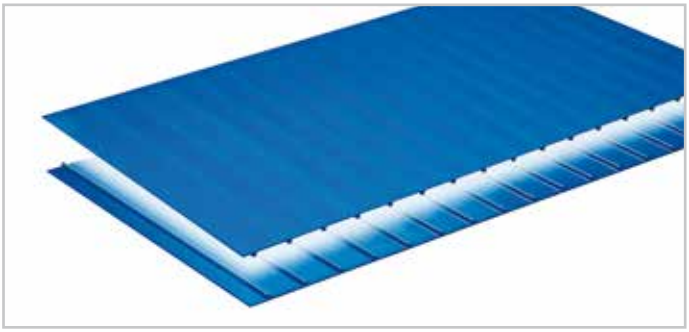


**Fig. 16** CD.M50.S-UA.CB
Pitch 50.4 mm *(1.984")*, TPU elastomer material



**Fig. 17** CD.M25.S-UA.WB
Pitch 26.8 mm *(1.055")*, TPU elastomer material

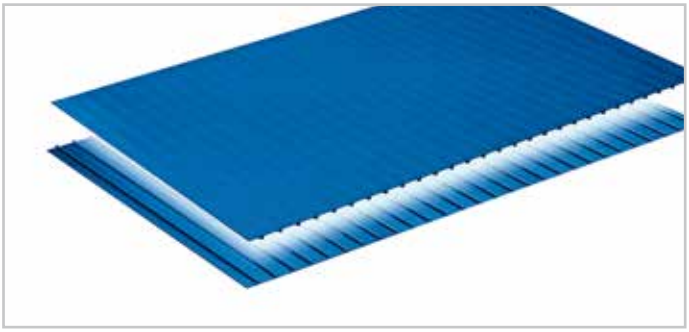


**Fig. 18** CD.M25.S-UA.CB
Pitch 26.8 mm *(1.055")*, TPU elastomer material

# Introduction
# Habasit Cleandrive™ positive drive conveyor belts

**The Habasit Cleandrive™ positive drive aramid reinforced monolithic conveyor belt delivers significant advantages for wet applications in the food processing industry.**

**The advanced technology and design of the Habasit Cleandrive™ belt meet customers' most stringent hygiene requirements while delivering exceptional performance, reliability and cost-efficiency.**

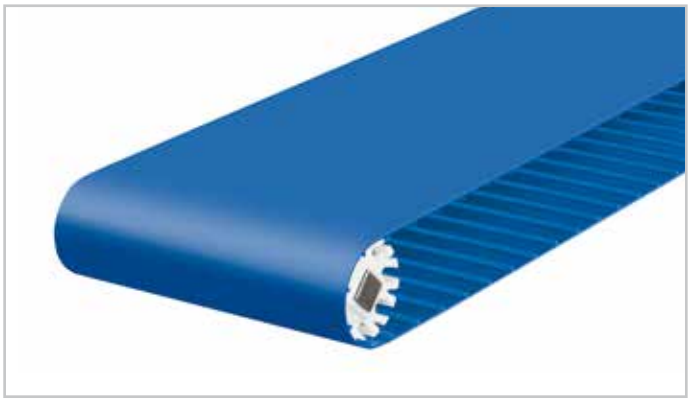


**Fig. 19** Positive drive belt CD.M50.S-UA.CB

## Reliable performance

The Habasit Cleandrive™ belt design includes aramid cord reinforcement for dimensional stability. This permits continuous and reliable sprocket engagement, which results in reduced belt wear, maintenance and downtime.

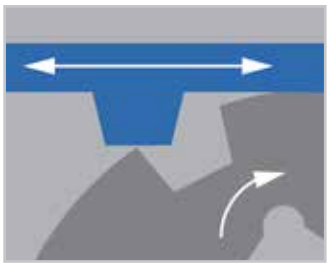


**Fig. 20** Conventional monolithic belt elongates during service life

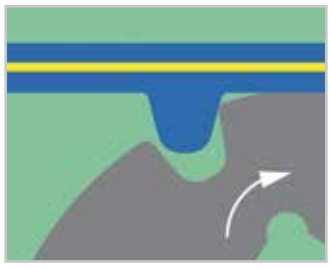


**Fig. 21** Habasit Cleandrive™ has a continuous fit

## Easy conveyor construction, installation, and retrofit

Habasit Cleandrive™ belts reduce the amount of design work needed when building a conveyor. The zero-tension belt design eliminates the need for special active sprocket engagement, which reduces complexity and cost, and extends the belt lifetime due to less abrasion.

Zero tension means that no extra forces (tensioning or pressing) are required other than the tension coming from the belt's tare weight to keep the drive bars properly engaged within the sprockets.

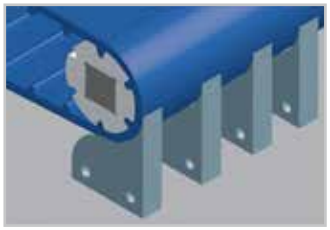


**Fig. 22** Conventional monolithic belt – active sprocket engagement

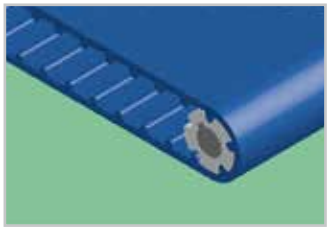


**Fig. 23** Habasit Cleandrive™ – strong and flexible

## Scraper friendly

Our proprietary manufacturing process allows us to produce Habasit Cleandrive™ belts completely free of sink marks. This facilitates increased scraper efficiency as residual products on the belt surface can be safely removed by the scraper, thereby reducing the risk of cross-contamination of foodstuffs.

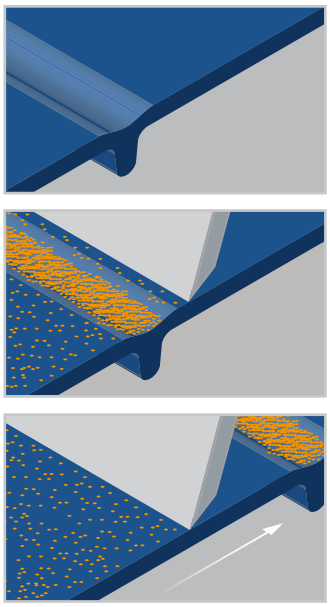


**Fig. 24** Conventional monolithic belt – with sink marks

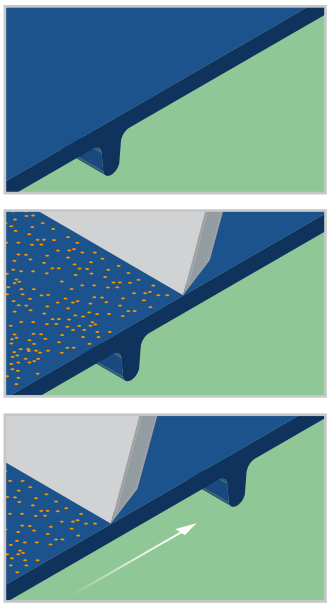


**Fig. 25** Habasit Cleandrive™ with scraper-friendly surface

# Introduction
# Habasit Cleandrive™ positive drive conveyor belts

### Hygienic design
Hygienic design plays an increasingly important role in food-safe production. Smooth, rounded shapes make it easy to remove foodstuff residues – even on the backside of the belt.

### Narrow transfers
Flexible and strong construction permits the smallest possible pulley diameters, thus minimizing product damage and loss in transfer situations.

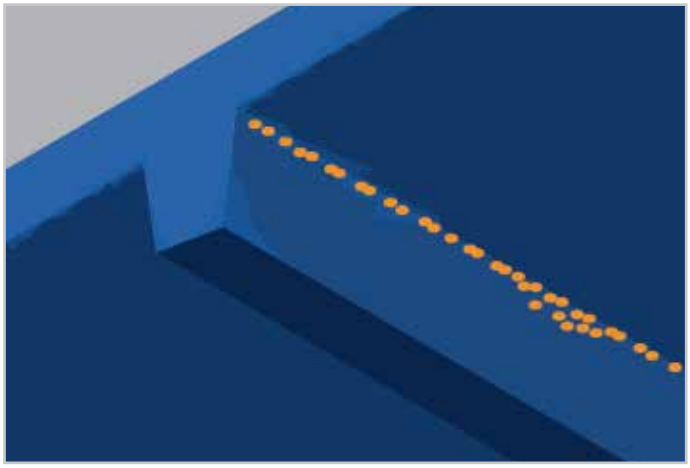


Fig. 26 Conventional monolithic belt with hard-angled corners

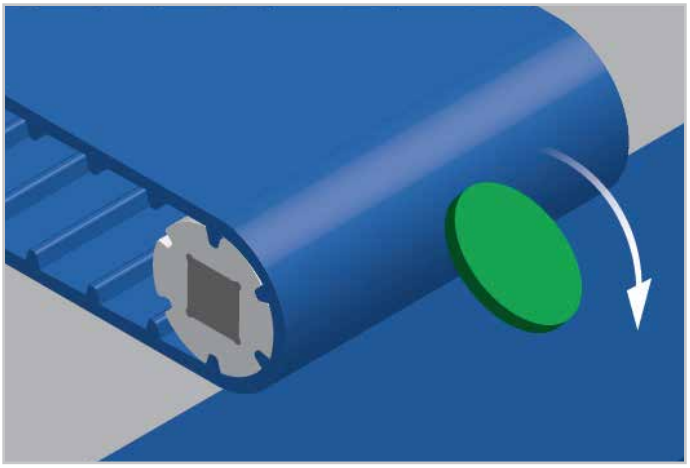


Fig. 28 Conventional monolithic belt – hard shore materials

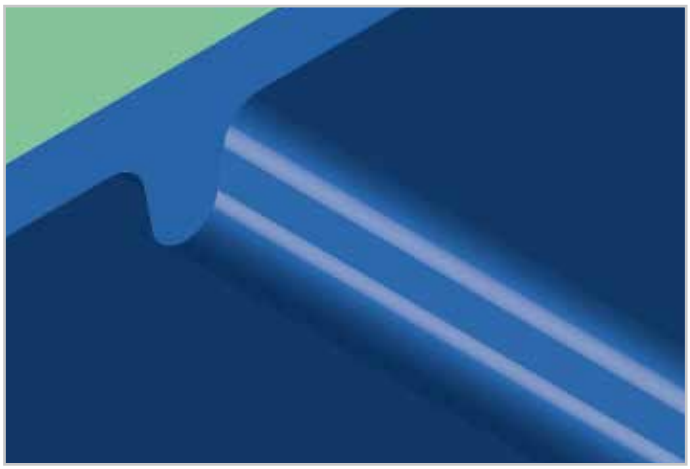


Fig. 27 Habasit Cleandrive™ with hygienic rounded corners

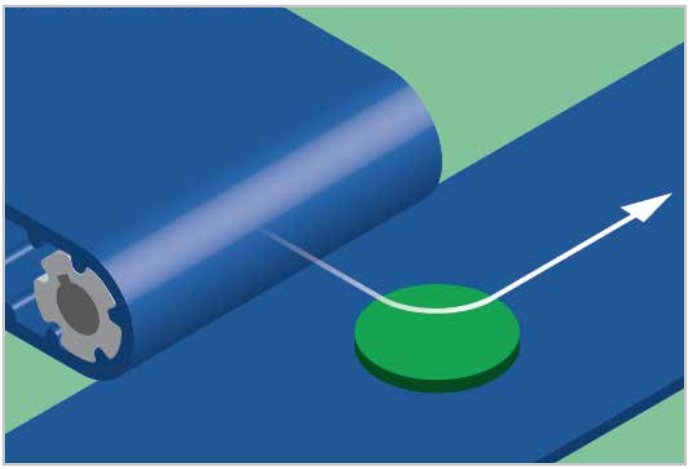


Fig. 29 Habasit Cleandrive™ – strong and flexible

# Introduction
# Habasit Cleandrive™ positive drive conveyor belts

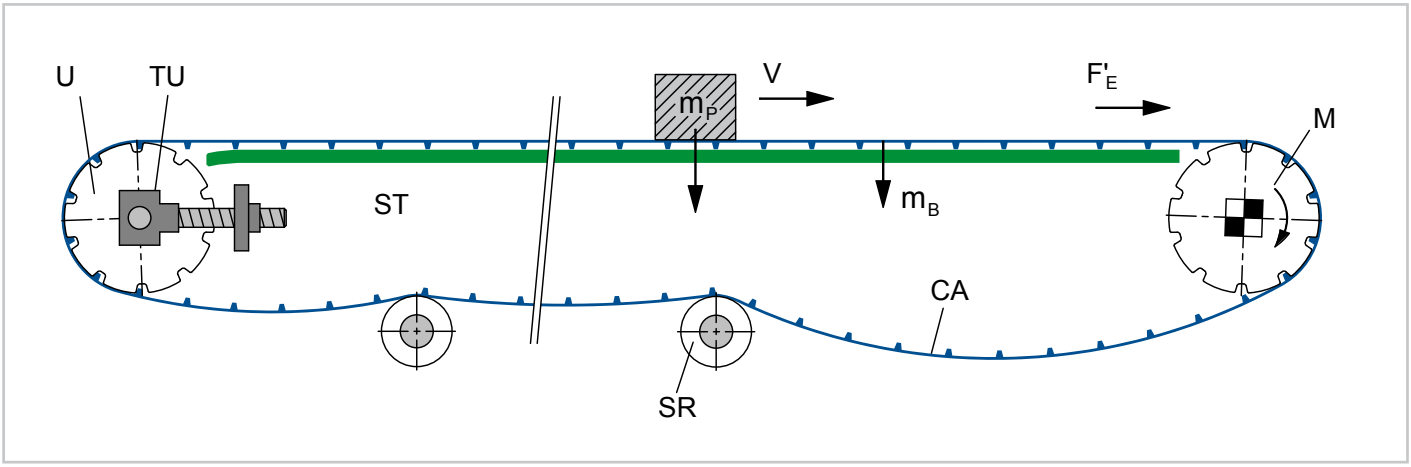



Fig. 30 Standard configuration of conveyor design layout

U **Idling shafts**, usually equipped with sprockets.

TU **Take-up device:** for example, a screw, gravity or pneumatic type is used to apply slight belt pre-tension if required, and to adjust a catenary sag.

ST **Slider supports on the transport side** with parallel or chevron (V-shape arranged) wear strips carry the moving belt and load.

$m_P$ **Conveyed product weight** expected to be distributed over the belt surface; calculated average load per $m^2$ (*$ft^2$*).

v **Belt speed**: Applications exceeding 50 m/min *(150 ft/min)* negatively affect the life expectancy of the belt. For speeds above 50 m/min always consult a Habasit specialist.

SR **Belt support on the return way** can be equipped with rollers (preferred) or longitudinal wear strips (slider support). If static charge-up is an issue, steel rollers may be an alternative.

$m_B$ **Belt mass (weight)** is added to the product mass for calculation of the friction force between the belt and the slider frame.

CA **Catenary sag** is an unsupported length of belt that provides a small tension for drive sprockets to ensure engagement. It is a buffer for absorbing length variations due to thermal expansion and load changes.

$F'_E$ **Effective tensile force (belt pull)** is calculated near the driving sprocket, where in most cases it reaches its maximum value during operation. It depends on the friction forces between the belt and the supports (ST) (SR).

M **Driving shafts** can be square or round. Square shafts allow higher transmission of torque. The sprockets are usually fixed on the shaft.

SN **Snub roller**: This is shown on page 14, Design guide – drive concepts. Snub rollers are used in a bi-directional center drive configuration as belt back-bending rollers and if a gravity take-up is used. They have a larger diameter than the belt support rollers, in order for the belt to bend easily 90° to 180° around them.

Habasit Cleandrive™ belts are joined endless using the Quickmelt preferred method. Alternative joining methods such as butt-end and Flexproof are possible, although they will reduce the performance of some parameters. For fast installation and de-installation, belts can be equipped with a mechanical joint, but in this case, reduced admissible tensile strength must be considered. Please consult the product data sheet.

For a glossary of terms, see the tables in the Appendix.

# Design guide – positive drive belts
# Horizontal conveyors – basic design

**When using Quickmelt endless joining**
Habasit Cleandrive™ positive drive conveyor belts are designed with driving bars and are positively driven by sprockets. To ensure proper sprocket engagement the belt usually has at least a 1.2 m long catenary sag (Fig. 31) just after the drive section. Belts joined by the Quickmelt method must be allowed to have a catenary sag (CA).

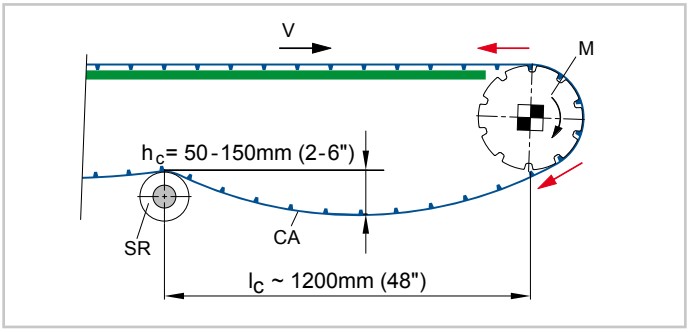



**Fig. 31** Catenary sag endless

**Take-up unit** (Fig. 32)
A screw-type take-up unit (TU), usually placed at the idle shaft, can be used to set the correct catenary sag.

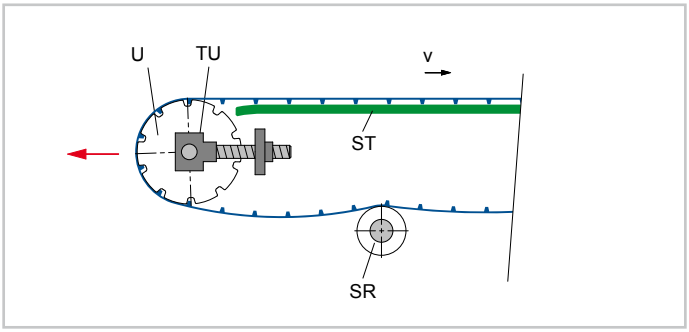



**Fig. 32** Take-up unit endless

**Gravity take-up** (Fig. 33)
If there is no room for a catenary sag, a gravity take-up (G) is a very good way to simulate a CA.

| Belt type | Tensioner weight G per m *(ft)* belt width |
|---|---|
| CD M25 + CD M50 | 10 kg/m *(7 lb/ft)* |

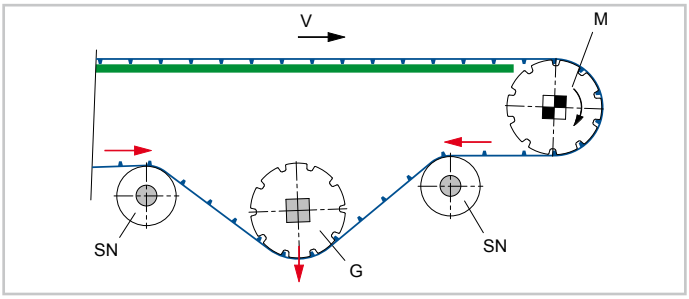



**Fig. 33** Gravity take-up

**Short conveyors** (L0 ≤ 1.5 m (*5 ft*))
In this case belt support on the return side can be omitted. Note the parallel alignment of the shafts. (Fig. 34)

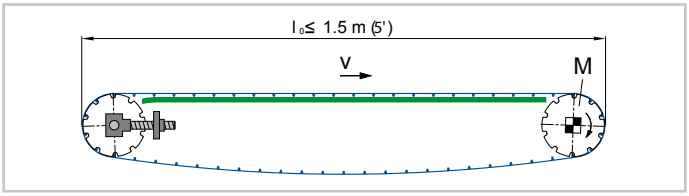



**Fig. 34** Design without support rollers

**Longer conveyors** (L0 > 1.5 m (*5 ft*))
A common design has the belt on the return side supported by rollers or discs (if flights are applied). Wear strips can also be used, but friction will be higher. In the case of multiple catenary sags, vary the support roller spacing, e.g. 1800/1200/1800/… to prevent belt speed variations due to oscillation. (Fig. 35)

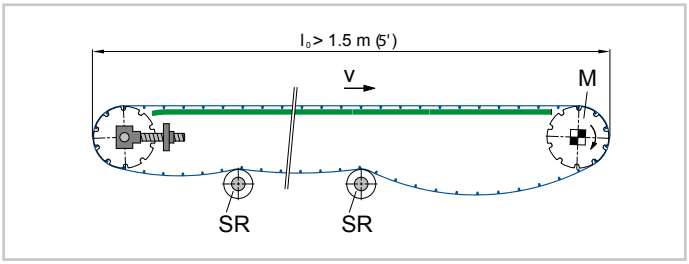



**Fig. 35** Long conveyor with support rollers

# Design guide – positive drive belts
# Horizontal conveyors – basic design

### When using a mechanical lace

Habasit Cleandrive™ positive drive conveyor belts are designed with driving bars and are positively driven by sprockets. To ensure proper sprocket engagement, the belt usually has a small catenary sag (CA) just after the drive section. (Fig. 36)

Belts equipped with a mechanical joint must have a small initial tension that can be applied by a take-up unit TU. (Fig. 37)

Depending on the type of belt connection the admissible tensile strength $F_{adm}$ varies.

### POM rod connection

CD.M25: M0F02125M5
CD.M50: MGPA3090M5
$F_{adm}$ = 30% of $F_{nom}$

### SS floater connection

CD.M25: CD25MLR00SS
CD.M50: CD50MLR00SS
$F_{adm}$ = 50% of $F_{nom}$

### Take-up unit (Fig. 37)

A screw-type take-up unit (TU), usually placed at the idle shaft, can be used to apply a slight initial tension of approx. 0.1% to 0.2% (measure the distance over the joint) to the belt if small sprockets (5 or 6 teeth) or a mechanical joint are used.

### Gravity take-up (Fig. 38)

For conveyors with a fixed shaft distance, a gravity take-up (G), i.e. a shaft with sprockets, can be an adequate solution. A vertical screw-type take-up unit (TU) could also be used.

| Belt type | Tensioner weight G per m *(ft)* belt width |
|---|---|
| CD M25 + CD M50 | 10 kg/m *(7 lb/ft)* |

In cases where a horizontal TU is not possible due to a fixed center shaft position, a vertical TU can be used. (Fig. 39)

### Recommended roller diameters

| Belt type | CD M25 *(1")* | | CD M50 *(2")* | |
|---|---|---|---|---|
| | mm | *inch* | mm | *inch* |
| SR roller | 50 | *2* | 75 | *3* |
| SN roller | 75 | *3* | 100 | *4* |
| G for gravity sprocket pitch diameter | 102.7 | *4* | 129.1 | *6* |

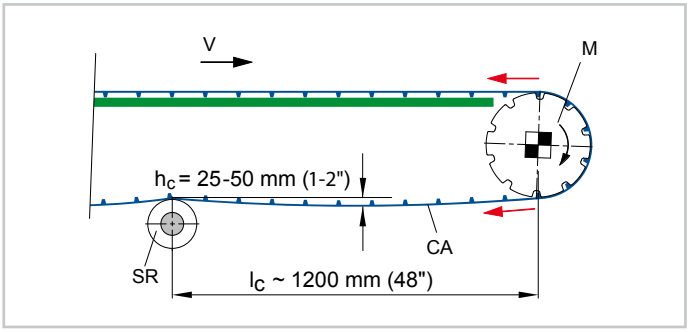



**Fig. 36** Catenary sag mechanical lace

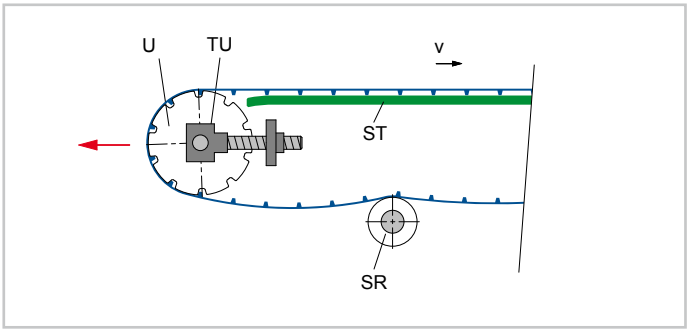



**Fig. 37** Take-up unit mechanical lace

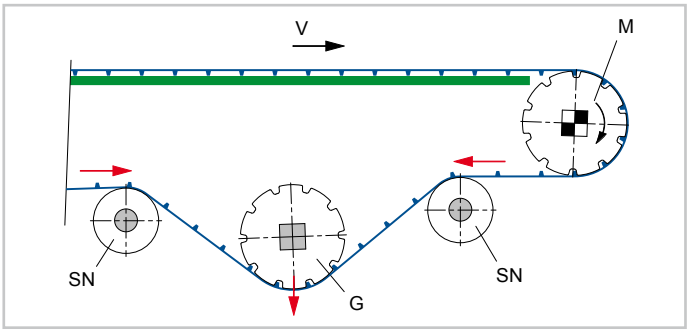



**Fig. 38** Gravity take-up

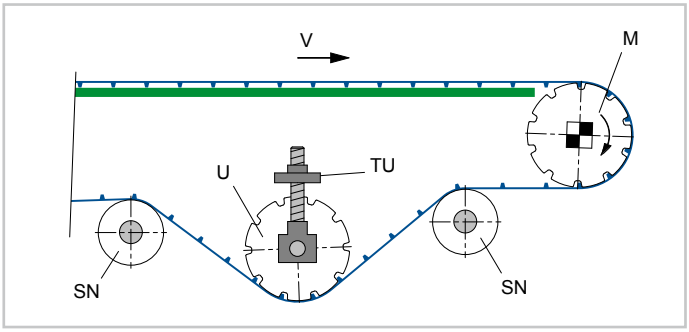



**Fig. 39** Vertical take-up unit

# Design guide – positive drive belts
# Horizontal conveyors – drive concepts

**Standard head drive**
Uni-directional: one motor at the conveyor end in pull operation drives the sprockets and the belt. Maintain approx. 180° belt wrap on the sprockets. (Fig. 40)

**Double head drive** (two motors)
Bi-directional: one motor at each end, but only one pulls the belt. The other remains disengaged by a clutch. (Fig. 41)

**Center drive**
One drive shaft is usually placed in the middle of the belt return path. Drive sprockets with minimum 10 teeth and two snub rollers (SN) ensure an arc of contact of approx. 180° (belt wrap).

**Uni-directional:** the belt needs a small catenary sag (CA) just after the drive section. (Fig. 42)

**Bi-directional:** a take-up unit is used to apply a slight initial tension of approx. 0.1% to 0.2% to ensure smooth running direction inversion. This is also important where small (5 or 6 teeth) transfer sprockets or a mechanical joint are used. (Fig. 43)

Note: Since the driving force is applied on the return way of the belt, the shaft load FW will be twice the calculated belt pull.

**Push-pull drive concept** (Fig. 44)
This drive concept requires belt pre-tension and is only recommended for light-loaded and short (up to 2 m max.) conveyors. A tensioning device must keep the tension at 110% of the effective belt force. The shaft load will increase to:

**Push drive**

$F_W = 2.2 \times F'_E$ (see also Calculation guide)

**Pull drive**

$F_W = 3.2 \times F'_E$ (see also Calculation guide)

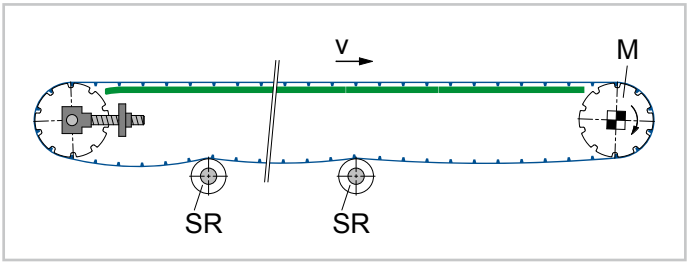



Fig. 40 Standard head drive

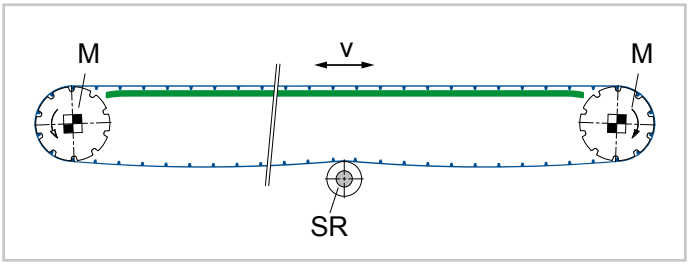



Fig. 41 Double head drive

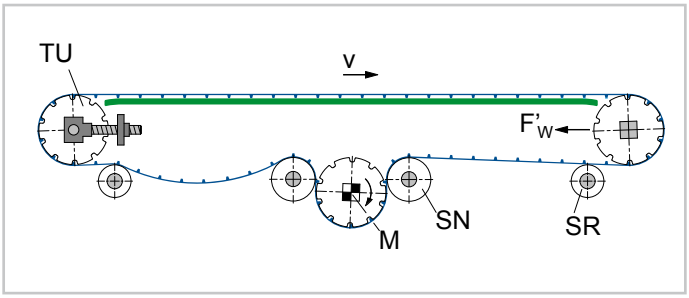



Fig. 42 Uni-directional center drive

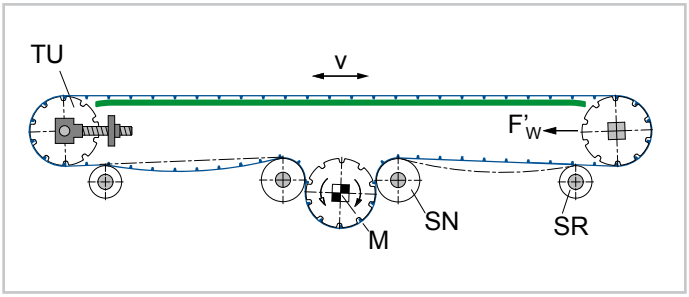



Fig. 43 Bi-directional center drive

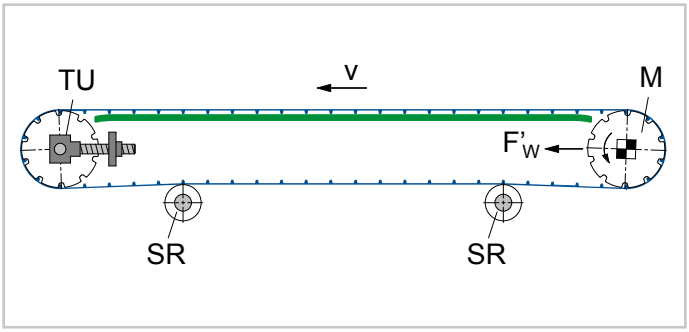



Fig. 44 Push-pull drive

# Design guide – positive drive belts
# Clearance between drive sprocket and snub rollers

**Clearance between the drive sprocket and snub rollers**
For trouble-free belt movement with center drives, maintain clearance C between the drive sprocket and the snub rollers of 2 to 3 mm plus the respective belt thickness to ensure forced engagement.

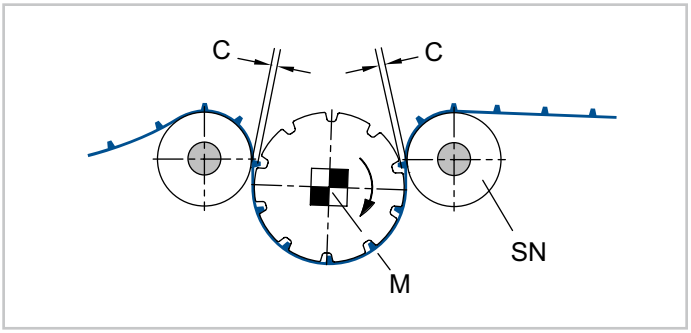



**Fig. 45** Clearance at the drive sprocket with snub rollers

Depending on the sprocket size, the positioning of the snub rollers must ensure that the arc of contact (belt wrap) and the number of teeth engaged meet the minimum requirements given by Habasit's online belt calculation program SeleCalc.

# Design guide – positive drive belts
# Inclined conveyors – basic design

For the design of **inclined conveyors**, the following basic rules have to be followed:

For Z conveyors (Fig. 48) use a CD M50 belt type only.

M **The driving shaft** must be located at the top end of the conveyor. (Figs. 46 and 47)

ST **Slider supports** on the transport side with parallel, serpentine or chevron wear strips or slider bed.

SR **Roller supports** are preferred for the belt return way. Belts equipped with flights can be supported at free-edge (indent) sections by roller discs (specifically for Z conveyors) or static shoes. Outer sprockets must be aligned with discs or shoes (Fig. 47). If static charge-up is an issue, steel rollers may be an alternative.

CA **Catenary sag**
$l_C$ = 900 mm to 1200 mm *(35" to 48")*. This follows the same working principle as for horizontal belts, but in most cases it is positioned at the lower end of the belt. (Fig. 46)

TU To avoid a large and concentrated catenary sag (CA) at the idle shaft, we recommend installing a **screw-type take-up** unit (TU) to adjust the conveyor length to the given belt length. Do not put the belt on high tension.

U To reduce the friction at belt bending, we recommend idle sprockets.

SH Use hold-down shoes for belt back-bending if the application is wet. Use rollers for dry situations. The belt radius must be approx. 200 mm *(8")*

I Belt indent **minimum** 50 mm *(2")*

$m_p$ For maximum belt load prior to belt back-bending, see table below.

| Belt width | Max. belt load prior to back-bending |
|---|---|
| 609 mm/*(24")* | approx. 25 kg *(55 lb)* |
| 508 mm/*(20")* | approx. 50 kg *(110 lb)* |

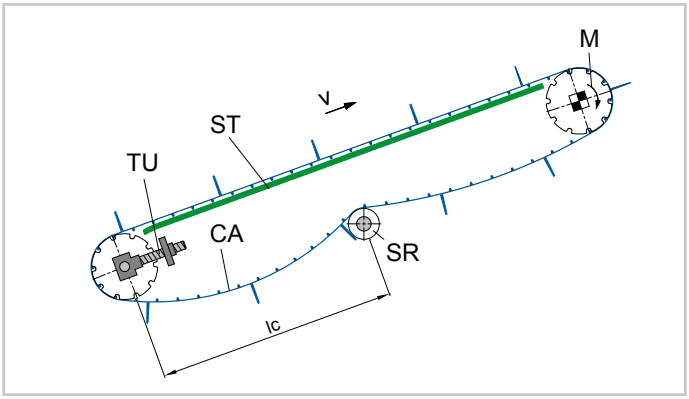



Fig. 46 Inclined head drive

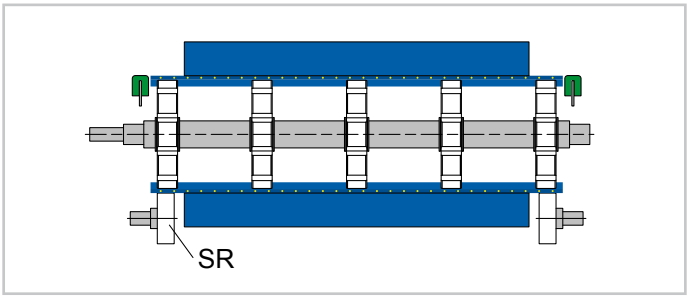



Fig. 47 Cross-section of inclined conveyor

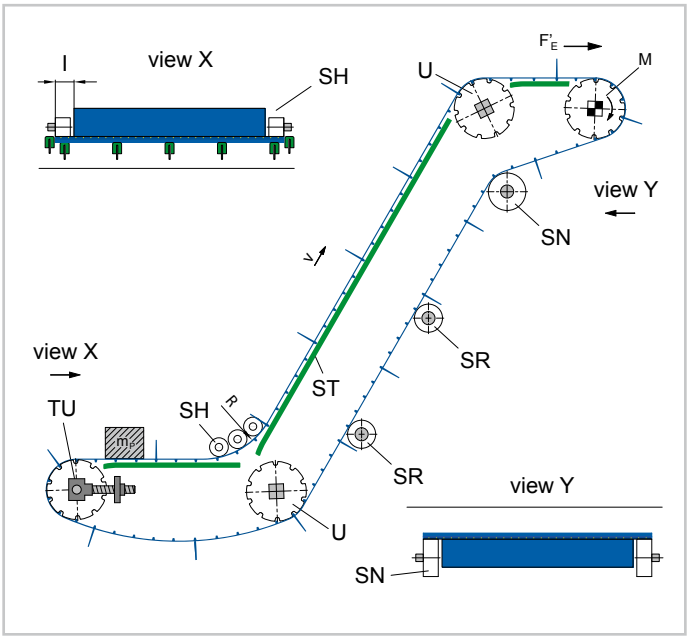



Fig. 48 Z conveyor layout design

# Design guide – positive drive belts
# Trough-shaped conveyors – basic design

With trough-shaped belts, the edges will be subjected to increased elongation forces as the belt moves from the trough-shaped support to the sprockets on the shafts. It is therefore important to ensure that the translation length l' selected is not too small. (Fig. 49)

Recommended translation length:

| $l' = c \times b_0$ | | | |
|---|---|---|---|
| Trough angle | 10° | 20° | 30° |
| Factor c | 1.0 | 1.5 | 2 |

Use the larger number of sprockets recommended per shaft.

Due to the drive bars the belt support is usually designed with wear strips or a slider bed. The belt return way can be supported by rollers. Although trough-shaped belts do have a certain self-guiding effect, we recommend applying some tracking guides at the belt edges with sufficient clearance. (Fig. 50)

For trough-shaped applications increase the drive shaft position $A_1$ to belt base of +5 mm *(0.2")*. (Fig. 51)
See also page 18 and 19, Sprocket evaluation.

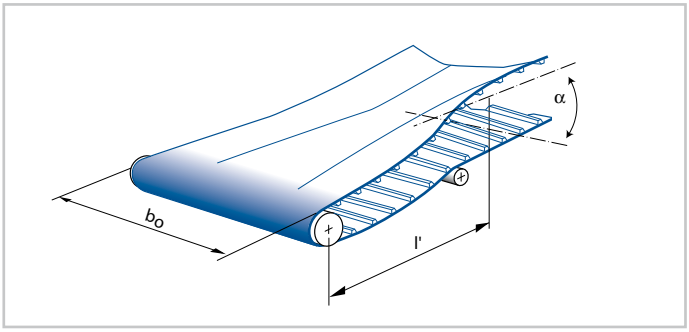



**Fig. 49** Lifted belt edges on troughed conveyor

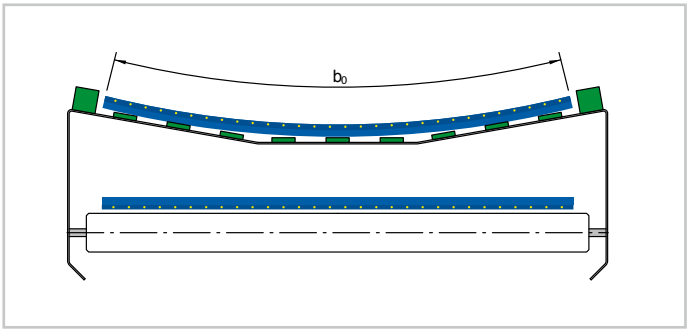



**Fig. 50** Cross-section of troughed conveyor

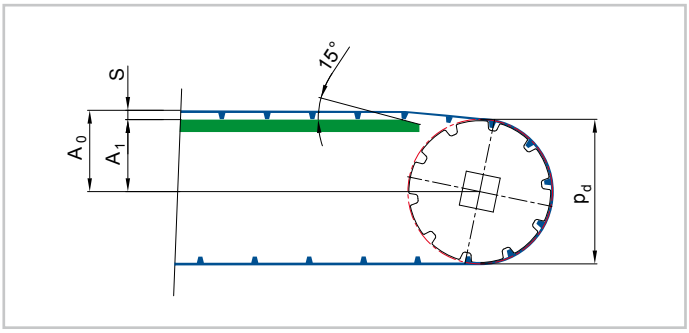



**Fig. 51** Slider bed support of troughed conveyor

# Design guide – positive drive belts
# Sprocket evaluation

### Number of sprockets and wear strips

(valid for CD M25 and CD M50 belts)
Lightly loaded belts with adjusted utilization below 50% can have the sprockets placed further apart. Heavily loaded belts with adjusted utilization above 50% and/or an application with scrapers must have the sprockets placed closer together with a larger number of sprockets on the drive shaft.

Belts can be cut to any size between 100 mm *(4")* and 1850 mm *(72")*. The table below shows the number of sprockets needed, including distances for typical belt widths $b_0$. To calculate the adjusted belt tensile force use the formulas on page 27, Calculation guide, or contact your Habasit representative. If you are in any doubt, use the larger number of sprockets.

| Belt width $b_0$ | Number of sprockets | | | | Edge distance x | Minimum number of wear strips | |
|---|---|---|---|---|---|---|---|
| mm / *inch* | Min. number sprockets | Distance a mm / inch | Number of sprockets for belt load >50% | Distance a mm / inch | mm / *inch* | Carry way * | Return way |
| 100 / *4* | 2 | 50 / *2.0* | 2 | 50 / *2.0* | 25 / *1.0* | 2 | 2 |
| 150 / *6* | 2 | 100 / *4.0* | 3 | 50 / *2.0* | 25 / *1.0* | 2 | 2 |
| 200 / *8* | 3 | 60 / *2.5* | 3 | 60 / *2.5* | 40 / *1.5* | 2 | 2 |
| 250 / *10* | 3 | 85 / *3.5* | 4 | 57 / *2.3* | 40 / *1.5* | 3 | 2 |
| 300 / *12* | 3 | 110 / *4.5* | 5 | 55 / *2.3* | 40 / *1.5* | 3 | 2 |
| 350 / *14* | 4 | 90 / *3.7* | 5 | 68 / *2.8* | 40 / *1.5* | 3 | 2 |
| 400 / *16* | 4 | 107 / *4.3* | 6 | 64 / *2.6* | 40 / *1.5* | 4 | 3 |
| 450 / *18* | 5 | 93 / *3.8* | 7 | 62 / *2.5* | 40 / *1.5* | 4 | 3 |
| 500 / *20* | 5 | 105 / *4.3* | 8 | 60 / *2.4* | 40 / *1.5* | 4 | 3 |
| 550 / *22* | 6 | 118 / *3.8* | 9 | 59 / *2.4* | 40 / *1.5* | 5 | 3 |
| 609 / *24* | 6 | 106 / *4.2* | 9 | 66 / *2.6* | 40 / *1.5* | 5 | 3 |
| 650 / *26* | 7 | 95 / *3.8* | 10 | 63 / *2.6* | 40 / *1.5* | 6 | 4 |
| 700 / *28* | 7 | 103 / *4.2* | 11 | 62 / *2.5* | 40 / *1.5* | 6 | 4 |
| 750 / *30* | 8 | 96 / *3.9* | 11 | 67 / *2.7* | 40 / *1.5* | 7 | 4 |
| 800 / *32* | 8 | 103 / *4.1* | 12 | 65 / *2.6* | 40 / *1.5* | 7 | 4 |
| 850 / *34* | 9 | 96 / *3.9* | 13 | 64 / *2.6* | 40 / *1.5* | 8 | 5 |
| 900 / *36* | 9 | 103 / *4.1* | 14 | 63 / *2.5* | 40 / *1.5* | 8 | 5 |
| 950 / *38* | 10 | 97 / *3.9* | 14 | 67 / *2.7* | 40 / *1.5* | 9 | 5 |
| 1000 / *40* | 10 | 102 / *4.1* | 15 | 66 / *2.6* | 40 / *1.5* | 9 | 5 |
| 1100 / *44* | 11 | 102 / *4.1* | 16 | 64 / *2.6* | 40 / *1.5* | 10 | 6 |
| 1200 / *48* | 12 | 102 / *4.1* | 18 | 66 / *2.6* | 40 / *1.5* | 11 | 6 |
| 1300 / *52* | 13 | 102 / *4.1* | 20 | 64 / *2.6* | 40 / *1.5* | 12 | 6 |
| 1400 / *56* | 14 | 102 / *4.1* | 22 | 63 / *2.5* | 40 / *1.5* | 13 | 7 |
| 1500 / *60* | 15 | 101 / *4.1* | 24 | 62 / *2.5* | 40 / *1.5* | 14 | 7 |
| 1650 / *64* | 17 | 98 / *3.8* | 26 | 63 / *2.4* | 40 / *1.5* | 16 | 8 |
| 1750 / *68* | 18 | 98 / *3.8* | 28 | 62 / *2.4* | 40 / *1.5* | 17 | 8 |
| 1850 / *72* | 19 | 98 / *3.8* | 30 | 61 / *2.4* | 40 / *1.5* | 18 | 9 |

*The required number of wear strips depends on the product size and weight.
The numbers above refer to a wear strip distance between 50 mm / *2"* and 100 mm / *4"*.

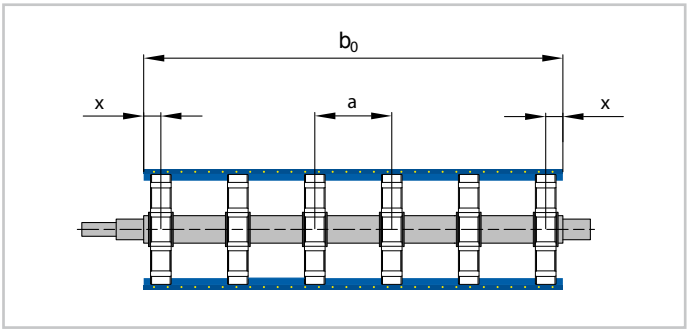



Fig. 52 Belt stiffness

If the width is in-between the indicated widths, choose the number of sprockets and wear strips from the nearest width and adjust distance a accordingly.

For wider belts, sprocket and wear strip placement can be provided on request.

# Design guide – positive drive belts
# Sprocket evaluation

### Design recommendations
The correct adjustment of the belt support or shaft placement (dimension $A_1$) is important. Noise, increased sprocket wear, and engagement problems may result if the recommendations are not followed.

### Slider bed support (Fig. 53)
If a slider bed is used, keep a small distance to the sprockets. We recommend beveling the support edge by 15° as shown. Make sure the guides do not touch the sprockets.

### Wear strip support (Fig. 54)
For smoother product transfer and optimal load support, wear strips (or a notched slider bed) can be placed between the sprockets. We recommend beveling the support edge by 15° as shown. Make sure the guides do not touch the sprockets.

### Retrofit
For conveyor retrofits compare $A_1/A_0$ values. It may be necessary to adjust the drive shaft or slider support height to keep the correct level of transport. Depending on the load weight or position, additional belt support (carry way) may be required. Replace the sprockets with dedicated sprockets specifically made for Habasit Cleandrive™ belts. All sprockets need to be fixed to avoid lateral movement on the shafts.

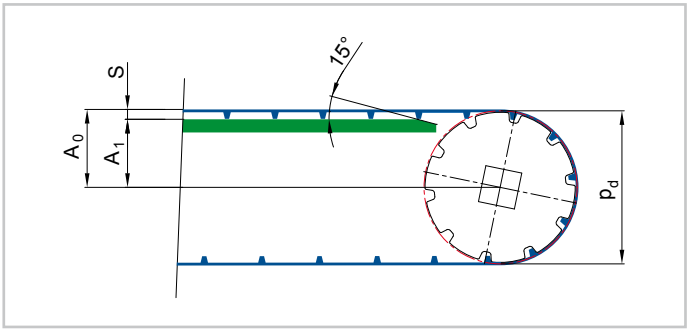



**Fig. 53** Slider bed support

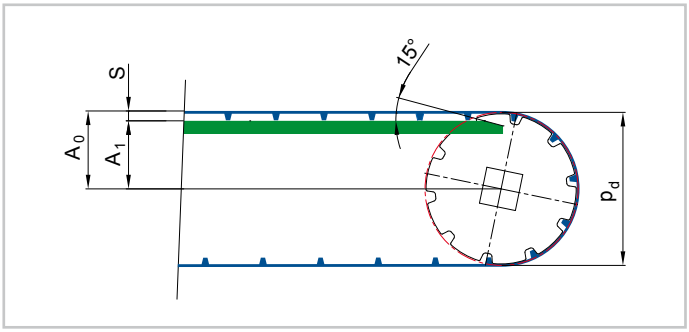



**Fig. 54** Belt support protruding between the sprockets

# Design guide – positive drive belts
# Sprocket evaluation

## Sprocket code

| CD | 50 | S | 10 | 40 | Q | 6 | – | C3 | 0 |
|---|---|---|---|---|---|---|---|---|---|

- 0 = Revision number for customized variants
- C3 = machined; M1 = standard molded; M2 = molded HyClean
- 6 = Material: 6 = POM (standard)
- Q = Shaft type: Q = square shaft; R = round shaft
- 40 = Shaft size
- 10 = Number of teeth
- S = Sprocket one-piece
- 50 = Belt pitch
- CD = Cleandrive (Habasit Cleandrive™)

## Dimensional requirements for installation

| Sprocket type for CD M25 | Standard material | No. of teeth | Nominal pitch Ø dp | | Hub width $B_L$ | | Square bore Q | | Round bore R | | $A_1$ + 1 mm (effective) | | $A_0$ + 1 mm S = 6 mm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mm | *inch* | mm | *inch* | mm | *inch* | mm | *inch* | mm | *inch* | mm | *inch* |
| CD25S05000-C3 * | POM | 5 | 43.0 | *1.69* | 30 | *1.18* | 15 | *0.60* | 20 | *0.75* | 16.5 | *0.65* | 22.5 | *0.89* |
| CD25S06000-C3 * | POM | 6 | 51.6 | *2.03* | 30 | *1.18* | 20 | *0.75* | 20 | *0.75* | 20.8 | *0.82* | 26.8 | *1.06* |
| CD25S07000-C3 | POM | 7 | 60.1 | *2.37* | 30 | *1.18* | 25 | *1.00* | 30 | *13/16* | 25.1 | *0.99* | 31.1 | *1.22* |
| CD25S08000-C3 | POM | 8 | 68.6 | *2.70* | 30 | *1.18* | 25 | *1.00* | 30 | *13/16* | 29.3 | *1.15* | 35.3 | *1.39* |
| CD25S10000-C3 | POM | 10 | 85.7 | *3.37* | 30 | *1.18* | 25/40 | *1.0/1.5* | 30 | *13/16* | 37.9 | *1.49* | 43.9 | *1.73* |
| CD25S12000-C3 | POM | 12 | 102.7 | *4.04* | 30 | *1.18* | 25/40 | *1.0/1.5* | 30 | *13/16* | 46.4 | *1.82* | 52.4 | *2.06* |
| CD25S14000-C3 | POM | 14 | 119.8 | *4.72* | 30 | *1.18* | 40/60 | *1.5/2.5* | 30/50 | *1.5/2.5* | 54.9 | *2.16* | 60.9 | *2.40* |
| CD25S16000-C3 | POM | 16 | 136.9 | *5.39* | 30 | *1.18* | 40/60 | *1.5/2.5* | 30/50 | *1.5/2.5* | 63.5 | *2.50* | 69.5 | *2.73* |
| CD25S10000-M2 | POM | 10 | 85.7 | *3.37* | 30 | *1.18* | 40 | *1.5* | 30 | *13/16* | 37.9 | *1.49* | 43.9 | *1.39* |
| CD25S12000-M2 | POM | 12 | 102.7 | *4.04* | 30 | *1.18* | 40 | *1.5* | 30 | *13/16* | 46.4 | *1.82* | 52.4 | *2.06* |
| CD25S20000-M2 | POM | 20 | 171.0 | *6.73* | 30 | *1.18* | 40 | *1.5* | 30 | *13/16* | 80.5 | *3.17* | 86.5 | *3.41* |

| Sprocket type for CD M50 | Standard material | No. of teeth | Nominal pitch Ø dp | | Hub width $B_L$ | | Square bore Q | | Round bore R | | $A_1$ + 1 mm (effective) | | $A_0$ + 1 mm S = 6 mm | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mm | *inch* | mm | *inch* | mm | *inch* | mm | *inch* | mm | *inch* | mm | *inch* |
| CD50S05000-C3 | POM | 5 | 80.8 | *3.18* | 30 | *1.18* | 25 | *1.00* | 30 | *1.5* | 33.2 | *1.31* | 41.9 | *1.65* |
| CD50S06000-C3 | POM | 6 | 96.9 | *3.82* | 30 | *1.18* | 40 | *1.5* | 30 | *1.5* | 41.3 | *1.62* | 50.0 | *1.97* |
| CD50S08000-C3 | POM | 8 | 129.1 | *5.08* | 30 | *1.18* | 40/60 | *1.5/2.5* | 30/50 | *1.5/2.5* | 57.4 | *2.26* | 66.1 | *2.60* |
| CD50S10000-C3 | POM | 10 | 161.2 | *6.35* | 30 | *1.18* | 40/60 | *1.5/2.5* | 30/50 | *1.5/2.5* | 73.4 | *2.89* | 82.1 | *3.23* |
| CD50S12000-C3 | POM | 12 | 193.4 | *7.31* | 30 | *1.18* | 40/60 | *1.5/2 5* | 30/50 | *1.5/2.5* | 89.5 | *3.52* | 98.2 | *3.87* |
| CD50S16000-C3 | POM | 16 | 257.8 | *10.15* | 30 | *1.18* | 40/60 | *1.5/2 5* | 30/50 | *1.5/2.5* | 121.7 | *4.79* | 130.4 | *5.13* |
| CD50S05000-M2 | POM | 5 | 80.8 | *3.18* | 30 | *1.18* | 40 | *1.5* | 30 | *13/16* | 33.2 | *1.31* | 41.9 | *1.65* |
| CD50S08000-M2 | POM | 8 | 129.1 | *5.08* | 30 | *1.18* | 40 | *1.5* | 30 | *13/16* | 57.4 | *2.26* | 66.1 | *2.60* |
| CD50S10000-M2 | POM | 10 | 161.2 | *6.35* | 30 | *1.18* | 40 | *1.5* | 30 | *13/16* | 73.4 | *2.89* | 82.1 | *3.23* |

-C3 *: Machined sprockets for idle shaft only (do not use as drive sprockets); -C3: Machined sprockets; -M2: Molded HyCLEAN sprockets
Other dimensions on request.

**Keyways** for the round bore shape follow European standards for metric sizes and US standards for imperial sizes. The S-M2 sprocket with round bore 30 mm is without a keyway.

### Sprocket installation

In general **all sprockets** on each shaft **are fixed** to avoid lateral movement. Depending on cleaning requirements, various locking methods are possible.

- Retainer rings (circlip) (Fig. 55)
- Plastic retainer rings (Habasit) (Fig. 56)
  - a simple low-cost method for most popular shafts
- Set screws and set collars (Fig. 57)
  - mainly used with round shafts on keyways

A small gap of 0.3 mm *(0.01")* should be maintained between the sprocket hub and the retaining device. All devices must be securely fastened.

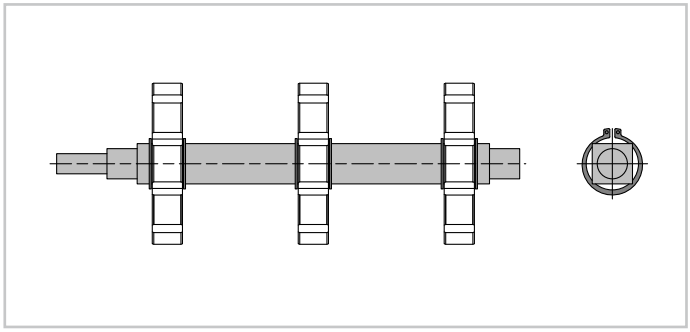


**Fig. 55** Retainer rings

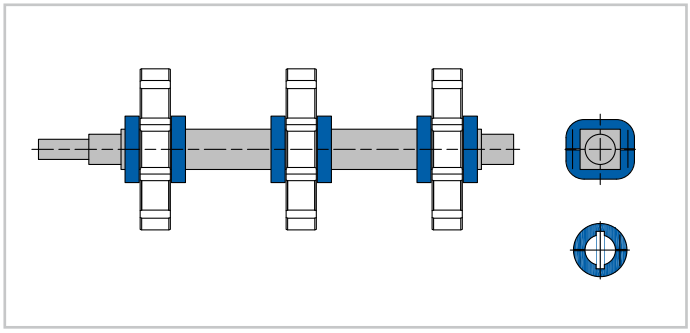


**Fig. 56** Plastic retainer rings

### Positioning and spacing of sprockets

The number of sprockets (n) and their spacing should be decided based on the table on page 18, Sprocket evaluation.

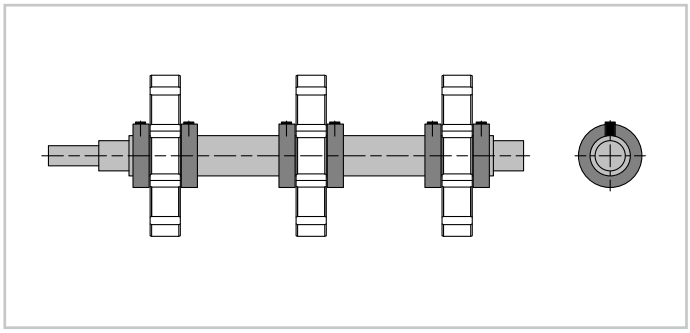


**Fig. 57** Set screws and set collars

### Sprocket alignment on the shafts (Fig. 58)

During installation of the sprockets on the shafts it is important to make sure that the teeth of all sprockets are correctly aligned. Sprockets normally have feature an alignment mark for this purpose. For square shafts, if the number of sprocket teeth is a multiple of 4, every radial orientation of the sprocket is possible. This is why some sprockets do not have alignment marks.

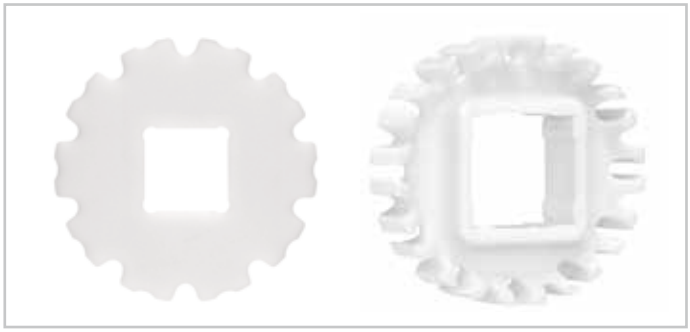


**Fig. 58** Standard (C3) (left) and HyCLEAN (M2) (right)

### Keyways for round shafts (Fig. 59)

| ø D | mm | 20 | 25 | 30 | 35 | 40 | 50 | 60 | 70 | 80 | 90 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | mm | 6 | 8 | 8 | 10 | 12 | 14 | 18 | 20 | 22 | 25 | | |
| a | mm | 2.8 | 3.3 | 3.3 | 3.3 | 3.3 | 3.8 | 4.4 | 4.9 | 5.4 | 5.4 | | |

According to DIN 6885 tolerance for a: 0/-0.2 mm

| ø D | *inch* | *¾* | *1* | *1 3/16* | *1 ¼* | *1 7/16* | *1 ½* | *2* | *2 ½* | *3* | *3 ½* | *4* | *4 ½* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | *inch* | *0.181* | *0.244* | *0.244* | *0.244* | *0.370* | *0.370* | *0.496* | *0.622* | *0.755* | *0.874* | *1.000* | *1.000* |
| a | *inch* | *0.090* | *0.118* | *0.118* | *0.118* | *0.141* | *0.173* | *0.228* | *0.283* | *0.334* | *0.389* | *0.448* | *0.448* |

According to ANSI B17.1 tolerance for a: 0/-0.001 *inch*

### Shaft tolerances

The dimensional tolerance of round and square shaft shapes is according to ISO 286-2 = **h12**.

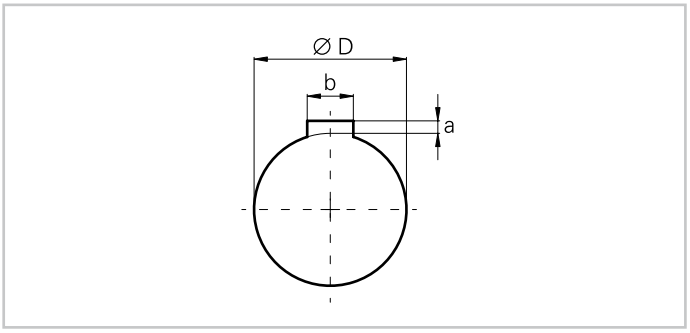



**Fig. 59** Keyways for round shafts

### Scraper

In a low-tension system, a belt scraper is usually placed below the drive sprockets. It could also be placed at the idle shaft. Apply the dedicated type and the larger recommended number of sprockets to ensure optimal belt support. See page 18, Sprocket evaluation.

The angle between the tip of the scraper and the belt surface should be between 100° and 120°. For Habasit Cleandrive™ belts, we advise using an abrasion resistant scraper material such as TPU with a hardness of about 85 Shore A.

For equal pressure distribution onto the belt surface, a support frame or solid shaft is required for scrapers made of TPU. If another thermoplastic material is chosen, a harder type like POM is advisable. Softer thermoplastic materials like PE will collect dirt over time, which is not hygienic. Dirt would also damage the belt surface.

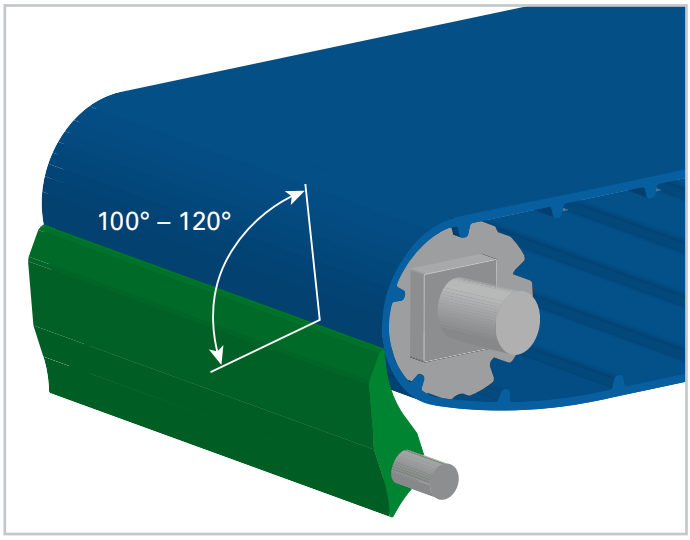



**Fig. 60** Positioning of scraper

# Design guide – positive drive belts
# Slider support systems and belt tracking

**Slider support systems** (Fig. 61)
Various design versions are possible. The following are commonly used:

A Parallel wear strip arrangement (Fig. 62). This is the most economical method. For lower belt wear, the parallel wear strip segments may be arranged alternating offset, instead of in-line or as a serpentine strip. For the number of wear strips, please refer to the product data sheets.

B V-shaped arrangement of wear strips (Fig. 63) chevron type. This provides equal distribution of the load and wear over the total belt width. The maximum distance between the wear strips must be 100 mm *(4")* for CD M50 belts. Max. angle β = 45°.

The supports consist of strips made from high-density polyethylene or other suitable low-wearing plastics. Running the belt directly on stainless steel supports other than round bars* is NOT recommended. This is because the very high friction causes blackening (carbon extraction), which changes the surface roughness and wears out the belt more quickly.

For the proposed **number of wear strips** see page 18, Sprocket evaluation. For both versions A and B it is important to allow for thermal expansion or contraction of the strips.

Formula to calculate the necessary clearance d:

$$d > \Delta l = l / 1000 \cdot \alpha \cdot (T - 20\ °C)\ [mm]$$

l = Length at installation temperature (20 °C) [mm]
T = Max. operating temperature [°C]

| Materials | Coefficient of linear thermal expansion α [mm/m · °C] | |
|---|---|---|
| | -73 to 30 °C | 31 to 100 °C |
| | *-100 to 86 °F* | *87 to 210 °F* |
| UHMW PE, HDPE | 0.14 | *0.20* |
| Steel | 0.01 | *0.01* |

**Belt tracking**
To track a belt, use a protruding conveyor frame, wear strips, or deflectors with an infeed angle of approx. 15° (Fig. 64). Flanged support or idle rollers are not recommended because the belt can rise onto the flange and be damaged at its edges. Consider a clearance C (Figs. 61 and 64) of about 2.5% of the belt width. Belt width ≈ Conveyor width – 2 × C.

* Round bars have a very low contact surface with the belt, but must feature a smooth finish.

Cross-section

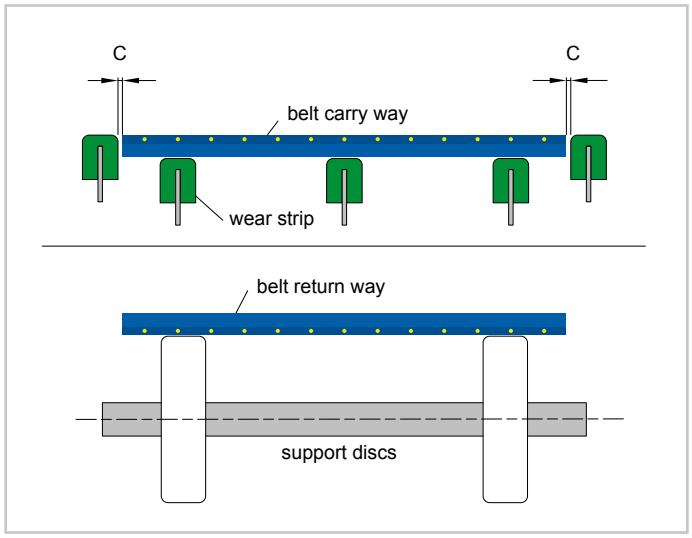



**Fig. 61** Belt sliding support

Version A

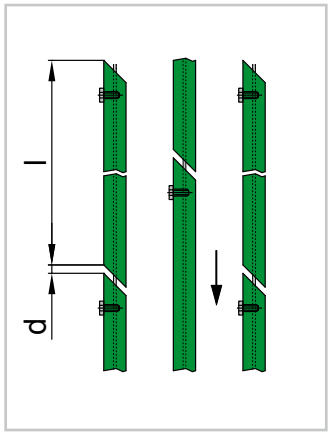



**Fig. 62** Parallel wear strips

Version B

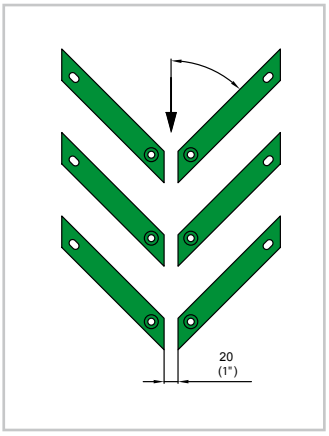



**Fig. 63** V-shaped arranged

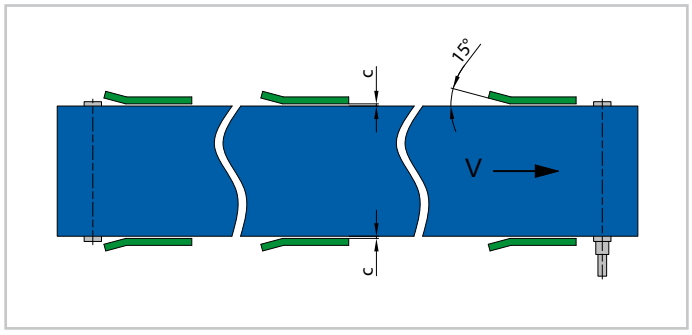



**Fig. 64** Lateral tracking guides

# Design guide – positive drive belts
# Slider support systems and belt tracking

### Wear strips and guiding profiles

Habasit offers various wear strips made of high molecular weight polyethylene (UHMW PE or HDPE and pre-lubricated UHMW PE). This material provides low friction between the belt and the support. Please ask for our literature on this. Stainless steel supports are possible but will increase the friction force on the belt.

**U-shaped** profiles (MB 01) are commonly used as wear strips for slider supports. They are fitted onto a metal upright of approx. 2.5 mm *(0.1")* or 3 mm *(0.12")* thickness. (Fig. 65)

### MB 01

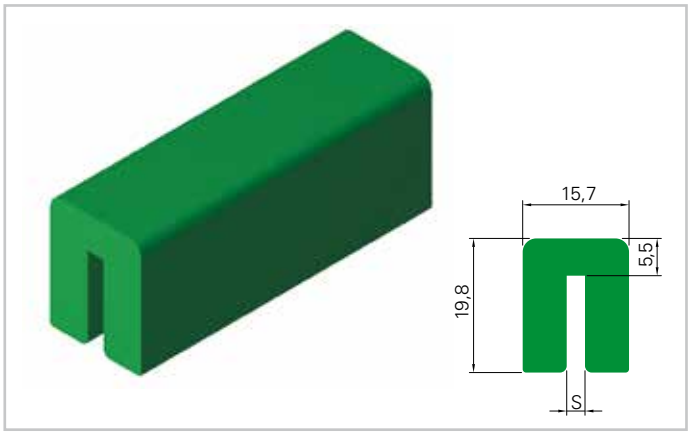



**Fig. 65** Extruded profile MB 01

The profile MB 02 is used on belt edges as a hold-down device (Fig. 66). The belt runs inside the corner of the profile.

### MB 02

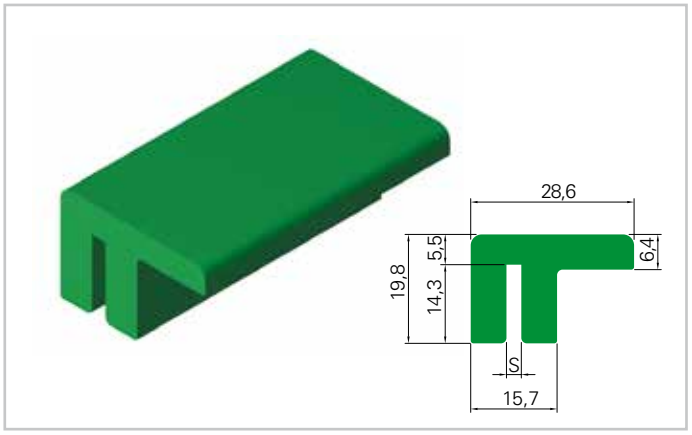



**Fig. 66** Extruded profile MB 02

| Type | Coil length (m) | Bar length (m) | S (mm) | *inch* |
|---|---|---|---|---|
| MB 01-X | – | 3.6 | 2.2 | *0.09* |
| MB 01-A | – | 3.6 | 2.7 | *0.11* |
| MB 01-B | – | 3.6 | 3.2 | *0.13* |
| MB 01-C | – | 3.6 | 4.5 | *0.18* |
| MB 01-D | – | 3.6 | 5.2 | *0.20* |
| MB 02-X | – | 3.6 | 2.2 | *0.09* |
| MB 02-A | – | 3.6 | 2.7 | *0.11* |
| MB 02-B | – | 3.6 | 3.2 | *0.13* |
| MB 02-D | – | 3.6 | 5.2 | *0.20* |

The profile WS 01 provides a larger contact surface for better belt/load support (Fig. 67). WS 01 is for slider bed retrofits changing a 100% flat closed surface to parallel support strips.

Special dimensions are possible on request; please contact your Habasit representative.

### WS 01 wear strip kit

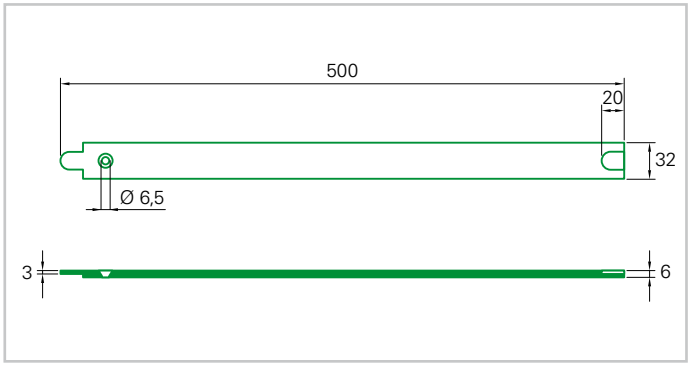



**Fig. 67** WS 01 kit (supplied with screws DIN963–M6x30 and nuts)

# Design guide – positive drive belts
# Design aspects for belt installation

**Belt joining** (Fig. 68)
Habasit Cleandrive™ belts are joined endless using the Quickmelt preferred method. Alternative joining methods such as butt-end and Flexproof are possible, although they reduce the performance of some parameters. It may be necessary to consider a framework opening (only if there is a transport-level protruding frame). In most cases the optimal belt joining area is near the drive section.

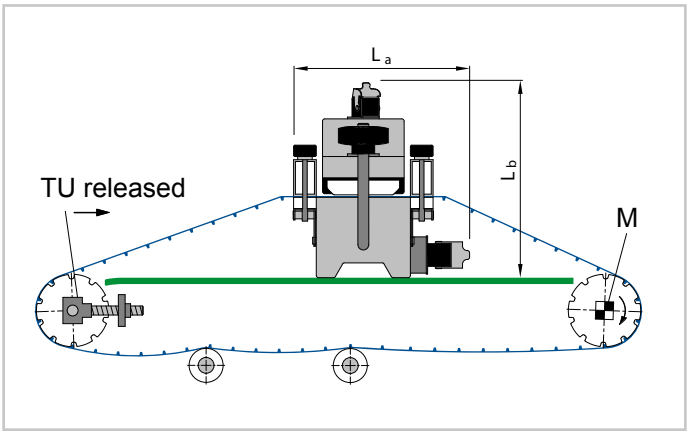



Fig. 68 Belt joining situation

**Press size**
Presses require access of $L_a$ x $L_b$. A typical Flexproof press is quite big and much heavier than other presses for the Quickmelt system. Make sure the belt support structure has enough beam strength to take a press weight.

| Quickmelt press | $L_a$ [mm / *inch*] | $L_b$ [mm / *inch*] | Weight [kg / *lbs*] |
|---|---|---|---|
| PQ-603 | 150 / *6* | 270 / *11* | 19 / *42* |
| PQ-1303 | 150 / *6* | 270 / *11* | 62 / *137* |
| PQ-1803 | 150 / *6* | 270 / *11* | 123 / *271* |
| PQ-601 | 300 / *12* | 450 / *18* | 30 / *66* |
| Flexproof press | | | |
| 804 series | 400 / *16* | 500 / *20* | 120 / *265* |

**Consider additional belt length**
If there is a TU device you can release the belt for joining. If this device is missing, the idle shaft can be dismantled to lift the belt into the press. Contact your Habasit representative for the required belt length. For proper belt joining consult the joining data sheet.

**Mechanical lace** (belt joining)
If the belt is equipped with a mechanical lace, no additional belt length is required. Mechanically joined belts require a small initial tension that can be applied by a TU unit.

# Calculation guide – positive drive belts
# Habasit support and belt calculation procedure

Habasit provides support for calculations to analyze the forces and verify the admissible belt strength for different conveyor designs. For further questions and additional documentation, please contact Habasit.

Having pre-selected a suitable belt style and type from product data sheets, the calculation of the belt must verify and prove the suitability of the belt for the application.

Please be aware that the following formulas are partially simplified.

**We recommend the following procedure:**

| Step | Procedure | Typical formula (for other formulas see detailed instructions) | Refer to page |
|---|---|---|---|
| 1 | Calculate the **effective tensile force (belt pull) $F'_E$** generated during the conveying process near the driving sprocket, taking into account the product weight, belt weight, friction values and inclination height. | $F'_E = (2\ m_B + m_P)\ l_0 \cdot \mu_G \cdot g$<br>$F'_E = [(2\ m_B + m_P)\ l_1 \cdot \mu_G + m_P \cdot h_0\ ]\ g$ | 28 |
| 2 | Calculate the **adjusted tensile force (belt pull) $F'_S$** multiplying by the adequate service factor of your application, taking into account frequent starts/stops, and direct or soft start drive. | $F'_S = F'_E \cdot c_S$ | 28 |
| 3 | Calculate the **admissible tensile force $F'_{adm}$**. Speed and high or low temperatures may limit the maximum admissible tensile force below nominal tensile strength F'N (refer to the product data sheet). | $F'_{adm} = F'_N \cdot c_T \cdot c_V$ | 29 |
| 4 | Verify the strength of the selected belt by **comparing $F'_S$** with the **admissible tensile force $F'_{adm}$**. | $F'_S \leq F'_{adm}$ | 30 |
| 5 | Check the dimensioning of the **driving shaft and sprocket**. | $f = 5/384 \cdot F_W \cdot lb^3 / (E \cdot I)$<br>$T_M = F'_S \cdot b_0 \cdot d_P/2$ | 31/32 |
| 6 | Establish the effective **belt length and catenary sag dimensions**, taking into account thermal expansion. | $F'_C = l_C^2 \cdot m_B \cdot g / (8 \cdot h_C)$<br>$l_g = d_P \cdot \pi + 2 \cdot l_0 + 2.66 \cdot h_C^2 / l_C$ | 33/34 |
| 7 | Calculate the required shaft **driving power**. | $P_M = F'_S \cdot b_0 \cdot v / 60$ | 37 |
| 8 | Check the **chemical resistance** of the belt material selected for your specific process. | Table of chemical resistance | 75 |
| 9 | Check if your **conveyor design** fulfills all calculated requirements. | | |

For abbreviations, a glossary of terms and conversion of units, see the tables in the Appendix.

# Calculation guide – positive drive belts
# Verification of belt strength

### 1) Effective tensile force (belt pull) $F'_E$

Horizontal straight belt without accumulation

$$F'_E = (2\ m_B + m_P)\ l_0 \cdot \mu_G \cdot g\ [N/m]$$

Inclined conveyor without accumulation

$$F'_E = [(2\ m_B + m_P)\ l_1 \cdot \mu_G + m_P \cdot h_0]\ g\ [N/m]$$

$F'_E$ = Effective tensile force [N/m]
$m_B$ = Weight of belt [kg/m²]
$m_P$ = Weight of conveyed product [kg/m²]
$\mu_G$ = Coefficient of friction belt to slider support
$l_0$ = Conveying length [m]
$h_0$ = Height of elevation [m]
$g$ = Acceleration factor due to gravity (9.81 m/s²)

(Values for $\mu_G$ see Appendix)

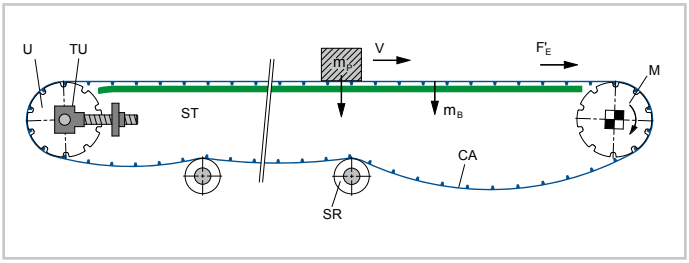



Fig. 69 Horizontal conveying

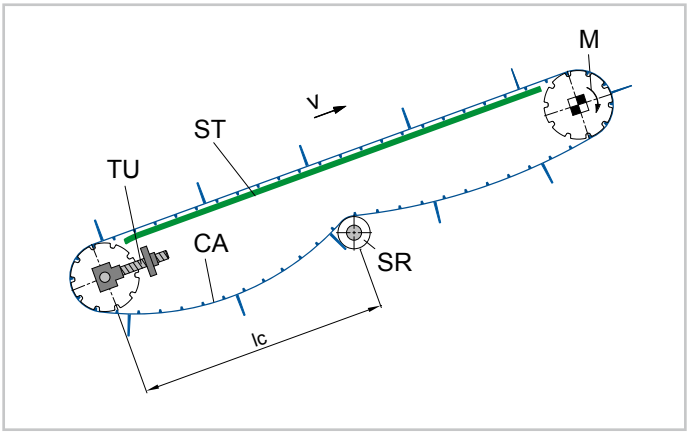



Fig. 70 Inclined transport

### 2) Adjusted tensile force (adj. belt pull) $F'_S$

$$F'_S = F'_E \cdot c_s\ [N/m]$$

$F'_S$ = Adjusted tensile force (belt pull) per m of belt width [N/m]
$F'_E$ = Effective tensile force [N/m]
$c_s$ = Service factor (see table below)

### Service factors $c_s$

Service factors take into account the impact of stress conditions that reduce belt life.

| Operating conditions | Service factors $c_s$ | | |
|---|---|---|---|
| | Standard head drive | Push drive (uni- and bi-directional) | Center drive (uni- and bi-directional) |
| Start-up prior to loading | 1 | 1.4 | 1.2 |
| Frequent starts/stops during process (more than once per hour) | +0.2 | +0.2 | +0.2 |

Note: Drive with soft start is recommended and is mandatory for frequent starts/stops and start-up with full load.

# Calculation guide – positive drive belts
# Verification of belt strength

### 3) Admissible tensile force $F'_{adm}$

Speed and temperature reduce the maximum admissible tensile force $F'_{adm}$ below nominal tensile strength $F'_N$. For nominal tensile strength $F'_N$ please refer to the product data sheets.

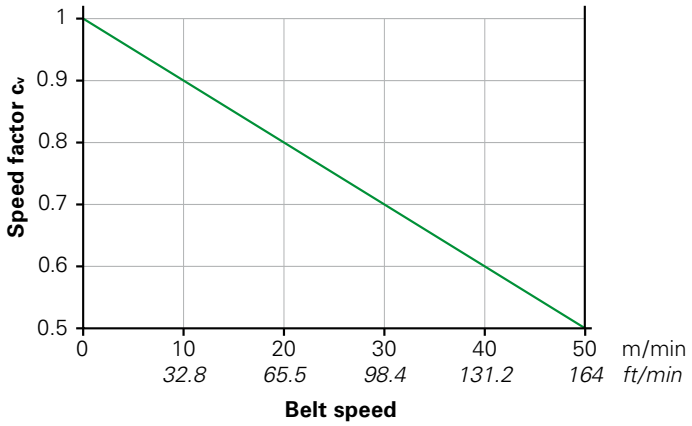
$$F'_{adm} = F'_N \cdot c_T \cdot c_V \; [N/m]$$

$F'_{adm}$ = Admissible tensile force [N/m]
$F'_N$ = Nominal tensile strength [N/m]
$c_T$ = Temperature factor
$c_V$ = Speed factor

### Speed factor $c_V$

Belt speed increases the stress on the belt mainly at the points where the direction of movement changes:

- Driving sprockets
- Idling shafts with or without sprockets
- Support rollers
- Snub rollers

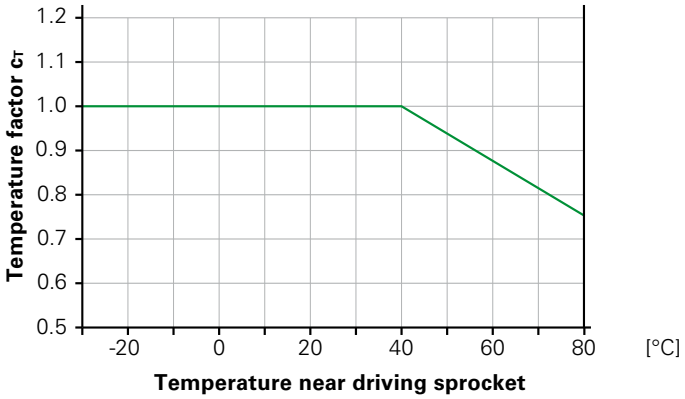



### Temperature factor $c_T$

The measured breaking strength (tensile test) of thermoplastic material increases at temperatures below 20 °C *(68 °F)*. At the same time other mechanical properties are reduced at low temperatures.

For this reason:
At temperatures ≤ 20 °C *(68 °F)*: $c_T = 1$

| Material | °C | *°F* |
|---|---|---|
| Thermoplastic polyurethane (TPU) | -30 to +80 | *-22 to +176* |




The temperature factor $c_T$ considers the belt joint. For applications with temperatures lower than 0 °C *(32 °F)* please contact your local partner.

# Calculation guide – positive drive belts
# Verification of belt strength

### 4) Comparison between adjusted tensile force $F'_S$ and admissible tensile force $F'_{adm}$

The selected belt is suitable for the application if the adjusted tensile force (belt pull) ($F'_S$) is smaller than or equal to the admissible tensile force ($F'_{adm}$).

$$F'_S \leq F'_{adm}\ [N/m]$$

$F'_{adm}$ = Admissible tensile force [N/m]
$F'_S$ = Adjusted tensile force (belt pull) per m of belt width [N/m]

## 5) Dimensioning of shafts

Select the shaft type, shaft material and size. The shaft must fulfill the following conditions:

- Max. shaft deflection ($f_{max}$) under full load ($F_W$):
  $f_{max}$ = 2.5 mm *(0.1")*.
  For a more accurate approach contact your local partner. If the calculated shaft deflection exceeds this maximum value, select a bigger shaft size or install an intermediate bearing on the shaft.
- Torque at max. load $F'_S$ below critical value (admissible torque, see table Maximum admissible torque on the next page).

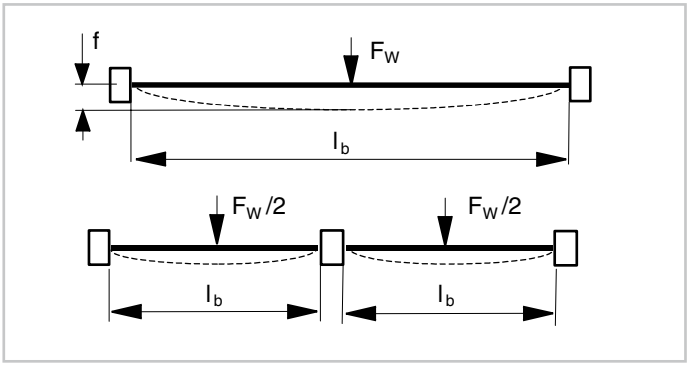



**Fig. 71** Shaft forces and deflection

### Shaft deflection

2 bearings: $f = 5/384 \cdot F_W \cdot lb^3 / (E \cdot I)$ [mm]
3 bearings: $f = 1/2960 \cdot F_W \cdot lb^3 / (E \cdot I)$ [mm]

For uni-directional head drives: $F_W = F'_S \cdot b_0$
For bi-directional center drives: $F_W = 2 \cdot F'_S \cdot b_0$
For uni-directional push drives: $F_W = 2.2 \cdot F'_S \cdot b_0$
For bi-directional push drives: $F_W = 3.2 \cdot F'_S \cdot b_0$

**Note**: Push drives need a tensioning device.

$b_0$ = Belt width [m]
$l_b$ = Distance between bearings [mm]
If the effective distance is not known use belt width + 100 mm
E = Modulus of elasticity [N/mm²]
I = Inertia

*Inertia is the resistance of any physical object to any change in its state of motion.*
(Newton's First Law of Motion – 1687)

| Shaft size | | Inertia I | |
|---|---|---|---|
| mm | *inch* | mm⁴ | *inch⁴* |
| Ø 20 | *Ø 0.75* | 7,850 | *0.0158* |
| Ø 25 | *Ø 1.0* | 19,170 | *0.05* |
| □ 25 | □ *1.0* | 32,550 | *0.083* |
| Ø 40 | *Ø 1.5* | 125,660 | *0.253* |
| □ 40 | □ *1.5* | 213,330 | *0.42* |
| Ø 60 | *Ø 2.5* | 636,170 | *1.95* |
| □ 60 | □ *2.5* | 1,080,000 | *3.25* |
| Ø 90 | *Ø 3.5* | 3,220,620 | *7.50* |
| □ 90 | □ *3.5* | 5,467,500 | *12.50* |

# Calculation guide – positive drive belts
# Dimensioning of shafts

| Shaft materials | Modulus of elasticity E | Shearing strength | Possible material specifications |
|---|---|---|---|
| Carbon steel* | 206,000 N/mm² | 60 N/mm² | St 37-2, KG-37 |
| Stainless steel (low strength) | 95,000 N/mm² | 60 N/mm² | X5CrNi18 10, AISI 316, 304 |
| Stainless steel (high strength) | 195,000 N/mm² | 90 N/mm² | X12CrNi 17 7, AISI 301 |
| Aluminum | 70,000 N/mm² | 40 N/mm² | AlMg3, AA 5052 |

* Not recommended in food applications

**Torque on journal (shaft end on motor side)**
Torque is calculated in order to evaluate the shaft journal diameter needed for transmission. Verify the selected size of the shaft journals by comparing the effective torque ($T_M$) with the **admissible torque** indicated in the table opposite.

Effective torque: $T_M = F'_S \cdot b_0 \cdot d_P/2 \cdot 10^{-3}$ [Nm]

Admissible torque: $T_{adm} = \tau_{adm} \cdot p \cdot d_W^3 / 16 \cdot 10^{-3}$
Simplified: $T_{adm} \approx \tau_{adm} \cdot d_W^3 / 5000$ [Nm]

$b_0$ = Belt width (m)
$d_P$ = Pitch diameter of sprocket [mm]
$T_{adm}$ = Max. admissible shearing stress [N/mm²]
- for carbon steel approx. 60 N/mm²
- for stainless steel approx. 90 N/mm²
- for aluminum alloy approx. 40 N/mm²

$d_W$ = Shaft diameter [mm]

| Maximum admissible torque | | | | | |
|---|---|---|---|---|---|
| Shaft Ø (dw) | | Carbon steel | | Stainless steel | |
| mm | *inch* | Nm | *in-lb* | Nm | *in-lb* |
| 20 | *0.75* | 94 | 834 | 141 | 1,251 |
| 25 | *1.00* | 184 | 1,629 | 276 | 2,444 |
| 30 | *1 3/16* | 318 | 2,815 | 477 | 4,233 |
| 40 | *1.50* | 754 | 6,673 | 1,131 | 10,009 |
| 45 | *1.25* | 1,074 | 9,501 | 1,610 | 14,251 |
| 50 | *2.00* | 1,473 | 13,033 | 2,209 | 19,549 |
| 55 | *1.25* | 1,960 | 17,347 | 2,940 | 26,020 |
| 60 | *2.50* | 2,545 | 22,520 | 3,817 | 33,781 |
| 80 | *3.00* | 6,032 | 53,382 | 9,048 | 80,073 |
| 90 | *3.50* | 8,588 | 76,007 | 12,882 | 114,010 |

# Calculation guide – positive drive belts
# Calculation of catenary sag

The catenary sag (belt sag) is an unsupported length of belt right after the driven sprockets. Due to its weight the sag exerts tension on the belt, which is necessary for firm engagement of the sprockets in the belt. This tension depends on the length ($l_C$) and height ($h_C$) of the sag.

Experience shows that sag of the dimensions proposed in the Design guide provides the belt tension needed for proper engagement of the sprockets.

Belt tension of catenary sag:

$$F'_C = (l_C^2 \cdot m_B \cdot g) / (8 \cdot h_C)\ [N/m]$$

Example:
For $l_C$ = 1 m, $m_B$ = 4.3 kg/m², $h_C$ = 0.025 m
$F'_C$ = 211 N/m (≈ 21 kg/m)

$F'_C$ = Belt tension of catenary sag [N]
$l_C$ = Length of sag [m]
$h_C$ = Height of sag [m]
$m_B$ = Weight of belt [kg/m²]
$g$ = Acceleration factor due to gravity (9.81 m/s²)

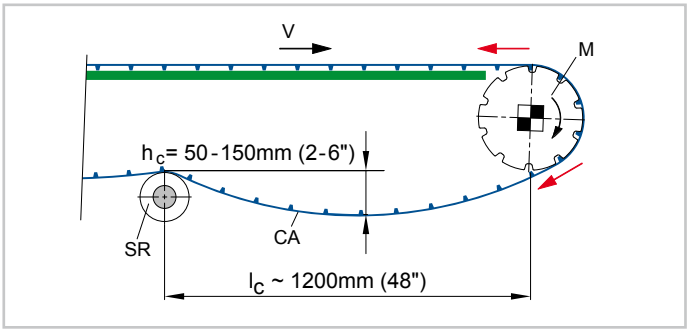



Fig. 72 Catenary sag endless

The catenary sag used with a mechanical lace or bi-directional center drive gives higher tension to the belt, which is needed for two reasons:

- The belt does not fold after the drive when unsupported
- When switching the running direction a short buffer (small CA) smooths the transfer and supports proper tracking of the belt

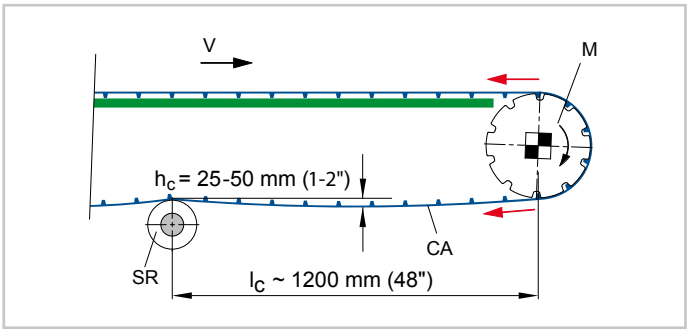



Fig. 73 Catenary sag mechanical lace

# Calculation guide – positive drive belts
# Effective belt length

The belt length must be a multiple of the belt pitch distance in order to ensure proper sprocket engagement. If the design uses a catenary sag (CA) or if a take-up unit (TU) is applied, the effective belt length ($l_g$) is the theoretical length rounded to the next belt pitch.

After the belt length ($l_g$), additional length ($\Delta l_C$) and catenary sag distance ($l_C$) have been established, it is important to calculate the height ($h_C$) required by the sag.

$$\Delta l_C = lg - (2 \cdot l_0 + d_P/1{,}000) \text{ [m]}$$

$$h_C = 1000 \cdot (\Delta l_C \cdot l_C / L_x)^{-1} \text{ [mm]}$$

$l_g$, $l_0$, $l_C$ = Length [m]
$d_P$ = Pitch diameter of sprocket [mm]
$h_C$ = Height of sag [mm]
$L_x$ = Calculation factor

The calculation factor $L_x$ differs according to the drive concept (uni- or bi-directional) and joining method (Quickmelt or mechanical lace). Use the factors in the table below.

| Belt type | $l_C$ | Factor $L_x$ | |
|---|---|---|---|
| | [mm] | Endless joined | Mechanical lace |
| CD.M25 | 900 | 1.68 | 0.84 |
| | 1200 | 3.36 | 1.12 |
| CD.M50 | 900 | 1.34 | 0.45 |
| | 1200 | 3.57 | 0.59 |

**Influence of thermal expansion**
After installation the belt may be heated or cooled by the application process, so its length will change and consequently the height of the catenary sag ($h_C$) will change as well. Length variations of Habasit Cleandrive™ belts are very small and negligible in most cases.

For very long belts that run under temperature conditions differing considerably from installation conditions, the necessary belt length correction can be calculated using the formula below.

The same formula can be applied in an analogous way to belt width. As relative variations in width are much higher, it may be necessary to factor them in when designing lateral guides.

$$l_g(T) = l_g + l_g / 1{,}000 \cdot \alpha \cdot (T_2 - T_1) \text{ [m]}$$

$l_g$ = Total belt length [m]
$T_1$ = Installation temperature [°C]
$T_2$ = Process temperature [°C]
$\alpha$ = Coefficient of linear thermal expansion (in longitudinal direction)

| Belt material | Coefficient of linear thermal expansion $\alpha$ | |
|---|---|---|
| | [mm/m · °C] | *in / ft · °F* |
| TPU/aramid (longitudinal direction) | 0.002 | *0.000013333* |
| TPU (transversal direction) | 0.16 | *0.00107* |

# Calculation guide – positive drive belts
# Effective belt width

**Dimensional changes due to humidity**
Due to humidity and environmental conditions a belt can change in width by up to 2.5%. The conveyor design must consider this increased belt width, and allow sufficient lateral play between the frame and the belt.

**The longitudinal** dimension is less affected thanks to belt reinforcement with aramid. Variations in length can be compensated for by a catenary sag or belt take-up unit.

Belt **width** behavior in different application situations is influenced by:

### Environmental humidity

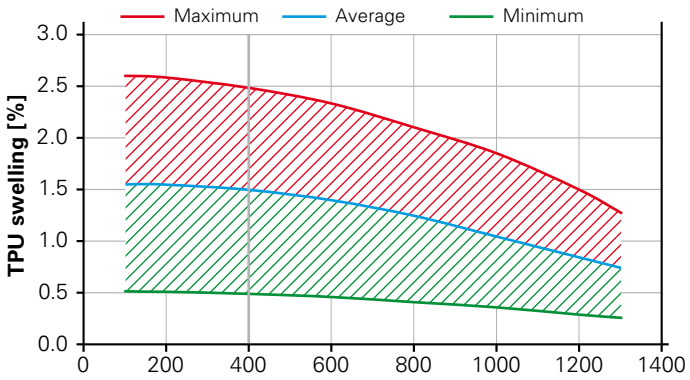
| Humidity | Time | Expansion |
|---|---|---|
| [%] | [hours / day] | [%] |
| 50 | 8 / 5 | 0.0 |
| 50 | 24 / 7 | 0.5 |
| 100 | 8 / 5 | 0.5 |
| 100 | 24 / 7 | 1.0 |

### Heat exposure in various applications

| Temperature of product conveyed | Contact time | Expansion |
|---|---|---|
| [°C / *°F*] | [hours / day] | [%] |
| **Meat and poultry processing** | | |
| 0 / *32* | 8 / 5 | 1.0 |
| 20 / *68* | 24 / 7 | 1.5 |
| **Meat and poultry processing** using wax for easy release treatment | | |
| 70 / *158* | 8 / 5 | 1.5 |
| 70 / *158* | 24 / 7 | 2.0 |
| **Cooked fish or pasta** | | |
| 100 / *212* | 8 / 5 | 1.5 |
| 100 / *212* | 24 / 7 | 2.0 |
| **Fried chicken or meat** | | |
| 180 / *356* | 8 / 5 | 2.0 |
| 180 / *356* | 24 / 7 | 2.5 |

Results based on 400 mm / *15.75"* belt width.

### Belt width changes in relation to total width



# Calculation guide – positive drive belts
# Dimensioning of belts with flights

If flights are applied the accumulated flight pitch distances must be equal to the effective belt length. The flight pitch is usually a multiple of the belt pitch distances, but this can vary.

If possible, determine the flight distance so that it always meets a drive bar, which avoids unnecessary belt waving. See the diagram below:

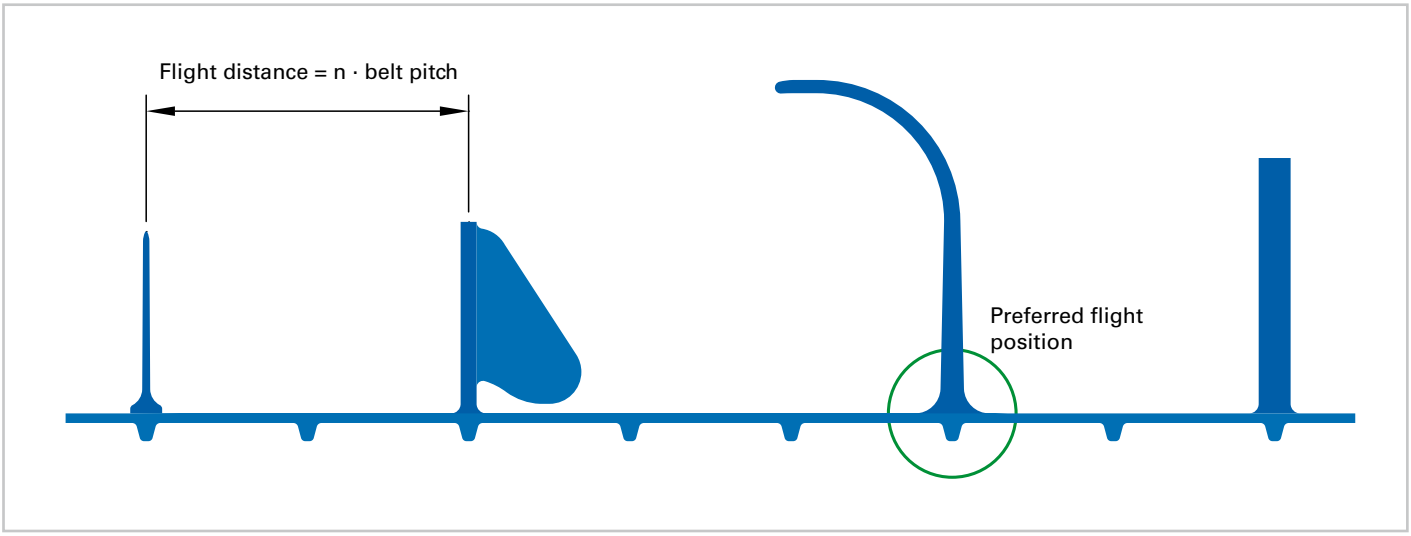



**Fig. 74** Positioning of flights

# Calculation guide – positive drive belts
# Calculation of driving power

The power required to drive a belt is the result of the friction forces on the conveyor, the change of height of elevators, plus the efficiency losses (also friction) of the drive itself. The latter are not taken into account in the following formula.

Note that the efficiency of the gear and drive motor must be considered for drive motor installation, and that the drive motor should not run at near 100% working load.

For the efficiency of the gear and drive motor and the necessary power installed, consult the drive manufacturer.

$$P_M = F'_S \cdot b_0 \cdot v / 60 \text{ [W]}$$

$P_M$ = Drive output power [W]
$F'_S$ = Adjusted tensile force (belt pull) per m of belt width [N/m]
$b_0$ = Belt width [m]
$v$ = Belt speed [m/min]

# Introduction
# Habasit Cleandrive™ friction drive conveyor belts

The Habasit Cleandrive™ friction drive aramid reinforced monolithic conveyor belt delivers significant advantages compared to conventional conveyor belts in dry and wet applications.

The advanced design of Habasit Cleandrive™ friction drive conveyor belts meets customers' most complex process requirements while also providing stringent levels of hygiene and cost-efficiency.



**Fig. 75** White Habasit Cleandrive™ friction drive belt

## Monolithic design for hygiene

The fully extruded monolithic belt design of Habasit Cleandrive™ belts is completely free of fabric members that could fray during use, posing a food safety risk. The solid yet flexible belt design is free of the cavities, joining rods and crevices normally found in hinged belts, making Habasit Cleandrive™ very easy to clean.

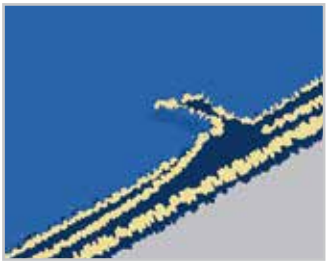


**Fig. 76** Frayed fabric belt edges



**Fig. 77** Habasit Cleandrive™ monolithic belt design

## Increased processing yield

Habasit Cleandrive™ friction drive conveyor belts with their flexible yet strong construction permit the smallest possible pulley diameters. This minimizes product damage and product losses in transfer situations, and improves processing yield.

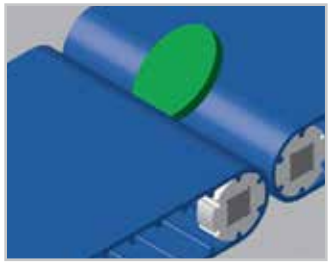


**Fig. 78** Conventional monolithic belts – large transfer diameter due to material hardness

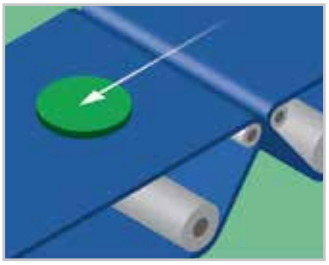


**Fig. 79** Habasit Cleandrive™ – narrow transfers

Habasit Cleandrive™ friction drive monolithic conveyor belts are the correct choice when the food processing application requires maximum hygiene and/or easy product transfer.

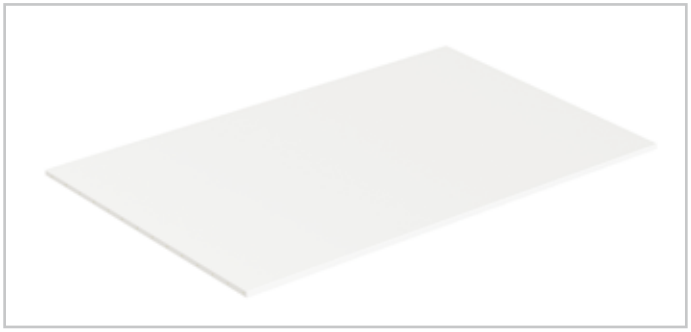


**Fig. 80** CD.M00.B-UA.WB.20
2 mm without drive bars, TPU elastomer material

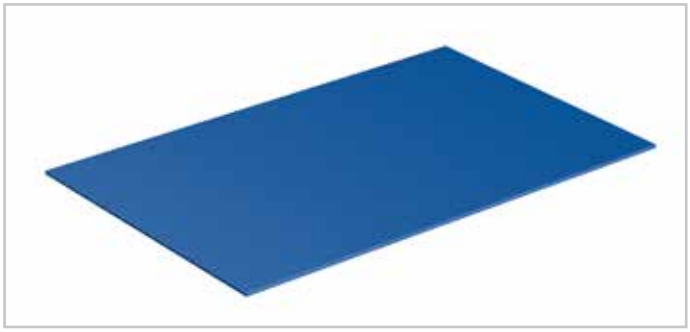


**Fig. 83** CD.M00.B-UA.CB.20
2 mm without drive bars, TPU elastomer material



**Fig. 81** CD.M00.B-UA.WB.30
3 mm without drive bars, TPU elastomer material

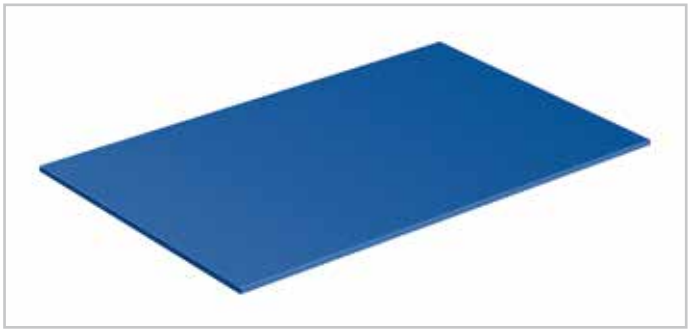


**Fig. 84** CD.M00.B-UA.CB.30
3 mm without drive bars, TPU elastomer material



**Fig. 82** CD.M00.W-UA.WB.30
3 mm without drive bars, waffle

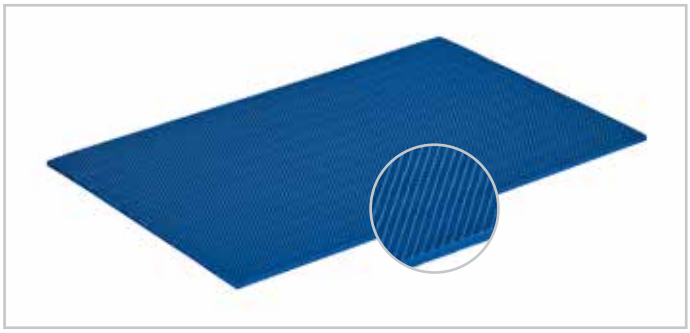


**Fig. 85** CD.M00.W-UA.CB.30
3 mm without drive bars, waffle

### System components

In its simplest form, a belt conveyor consists of a driving pulley (often the head pulley), a tail pulley, the tensioning device, a conveyor belt, and the supporting structure with the belt support (slider bed or carrying rollers).

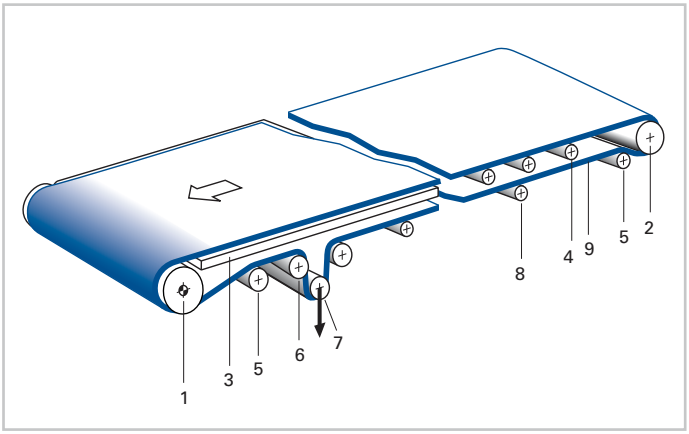



Fig. 86 Example: Head-driven conveyor

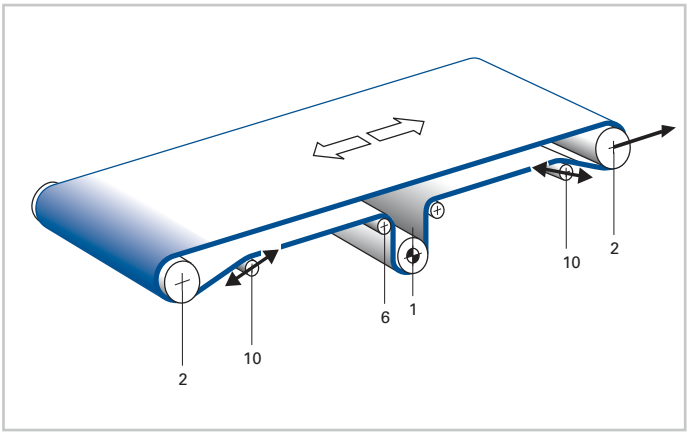



Fig. 87 Example: Center-driven conveyor

1 Driving pulley
2 Head or tail pulley (dep. on belt running direction)
3 Slider bed
4 Carrying roller
5 Snub pulley
6 Deflection roller (idler)
7 Tension pulley (take-up pulley)
8 Carrying roller (on the return side)
9 Conveyor belt
10 Guiding pulley

### Signs and their meaning



Sign for driving pulley



Sign for tension pulley
with tensioning direction



Belt running direction

If no additional information is available the conveying system is assumed to be horizontal.

Many conveyor systems have additional components such as nosebars, diverters, accumulators, belt tracking elements, cleaning systems, etc.

# Design guide – friction drive belts
# Support structure, pulley and roller fixing

Support structure

The supporting structure must be rigid. It must not distort or flex from the forces it is subjected to, e.g. belt tension, weight of the conveyed goods, uneven floors, etc. Without a rigid structure, it would be almost impossible to track the conveyor belt by conventional means and keep it from running off under varying operating conditions (no load/partial load/full load).

Furthermore, the supporting structure must be accurately aligned in all planes. Checking for squareness should preferably be done by measuring across the diagonals (see "Installation and Maintenance Guide").

The conveyor belt must be able to move slightly from side to side without interfering with any fixed components. For this to be possible, it is essential that the pulleys/rollers are of sufficient length, and the supporting structure has ample clearance from the belt edges.

Additionally, it is advantageous to configure the conveyor so the belt is visible along its path, and so there is sufficient accessibility for effective cleaning.

Note: Standard plastic pulleys and rollers, synthetic bearings and lubricants, and plastic slider beds are all insulators and will magnify the electrostatic charge of the belt.

In case low noise is of importance for conveying equipment, its superstructure requires special attention. The slider bed needs to be designed to dampen sound-generating vibration. The diffusion of sound conducted through solid components and rigid mounting points must be avoided. Noise-absorbent conveyor belts can merely support noise reduction, but cannot replace special design measures.

### Support strips

The main advantage of a belt supported using support strips is that the smaller contact area between the belt and its support results in less friction. This is a distinct benefit versus a similar design that employs a slider bed. Additionally, the belt is much more accessible due to the open frame design, which makes cleaning easier and faster. The use of cleaning in place systems (CIP) is also possible.

Habasit Cleandrive™ belts are not suitable for slider bed support.

Preferred support strip materials are:
- UHWM/PE (highly chemical resistant)
- POM (wear resistant)

Possibly:
- Stainless steel round bars
  (higher friction than PE or POM)

The friction between the support strips and the belt is considerably influenced by the material type and surface finish of the support strips, as well as by humidity, dust, dirt, etc.

Pay attention to the following points:
- The edge of the support must be rounded and lower than the pulley surface (Δh = approx. 2 mm / *0.08 in*).
- The heads of any mechanical fasteners must be recessed below the sliding surface.
- The support strips must be precisely aligned relative to the running direction of the belt, and each support strip must be laterally leveled to the pulley, otherwise the belt will tend to run off.
- Thoroughly clean the support strips before putting them into service. If necessary, the support strips, pulleys and conveyor belt should be periodically cleaned as dirt deposits can be a significant cause of performance problems, e.g. belt running problems, increased coefficient of friction, belt damage, etc.
- Excessive moisture between too wide support strips and the belt increases adhesion (suction effect), resulting in a higher energy requirement and potentially leading to overloading of the drive. Recommended measures to prevent the suction effect are to: narrow down the support strips, use a belt with an embossed running side (e.g. waffle structure), or use carrying rollers instead.
- When support strips are oriented in a "V" or chevron pattern, a belt tracking effect can be obtained simultaneously.
- A "V" or chevron pattern minimizes running noise.

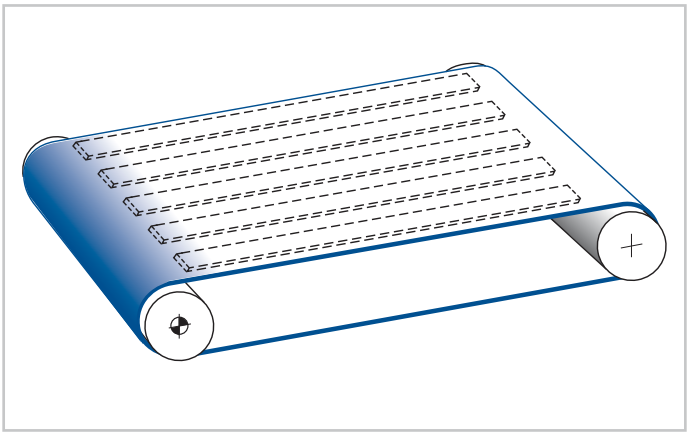


**Fig. 88** Friction drive belt with support strips

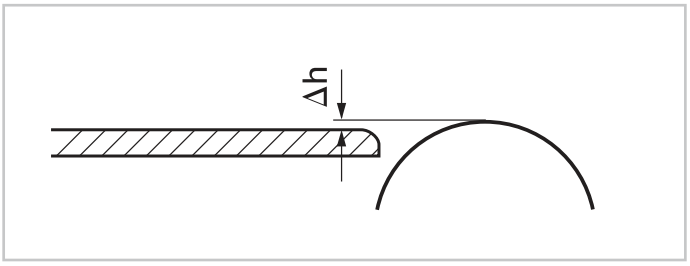



**Fig. 89** Height of belt support

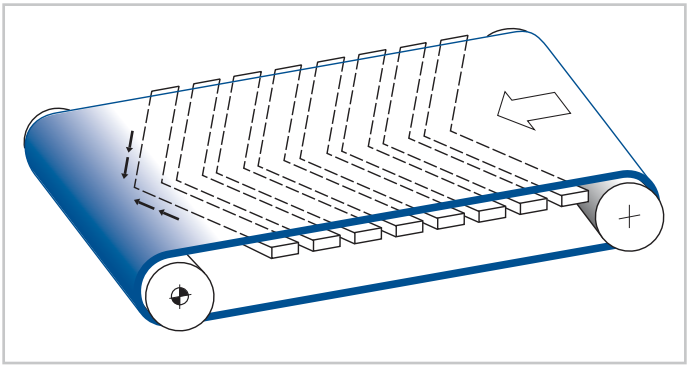


**Fig. 90** Chevron support design

### Support by carrying rollers

With long conveying distances and high overall product loads, carrying rollers can be used instead of support strips. In many cases, the roller bed reduces friction losses. Peripheral force and drive power requirements are proportionately reduced.

Rollers made from precision steel tubes and roller bearings are the most commonly used. Rollers with a plastic sheathing can also be used as they are resistant to corrosion and certain chemicals. A non-conductive synthetic cover can produce higher static charges during operation, particularly when used in conjunction with plastic bearings!

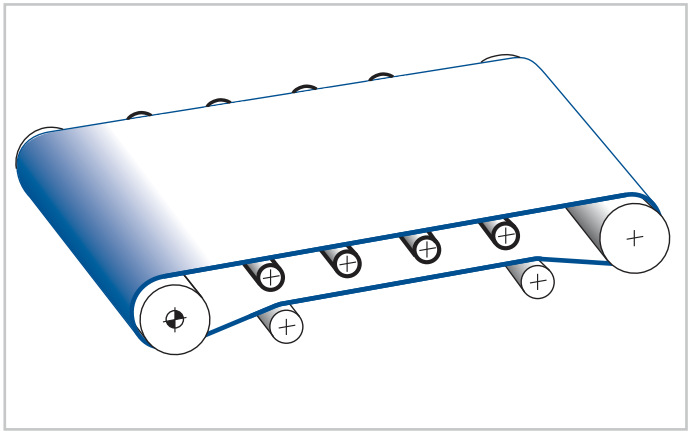


Fig. 91 Carrying roller support

Carrying rollers, in virtually all cases, have a cylindrical profile. As the conveyor belt only travels tangentially along the surface of these rollers and does not wrap around them, these rollers may have a smaller diameter than that specified for the belt's $d_{min}$ (see page 50). The specified diameter must resist excessive deflection when the conveyor belt is under operational load.

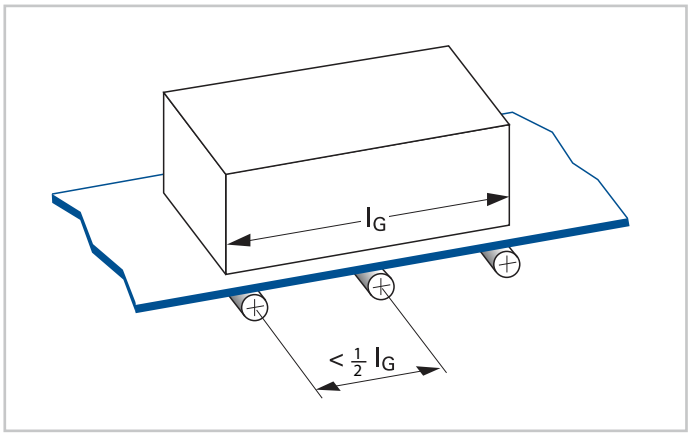



Fig. 92 Max. distance between carrying rollers

Pay attention to the following points:

- The distance between the carrying rollers should be less than half the length of the transported unit loads $l_G$, in order that the goods carried are always on at least two rollers.
- Carrying rollers must be accurately fitted at right angles to the belt running axis, as skewed carrying rollers are frequently the cause of belt tracking problems. It is sufficient if the rollers can only be adjusted from one side, i.e. by means of slots in the supporting structure.
- Pivotable carrying rollers can be installed for the purpose of guiding belt running; in these cases the pivot angle $\gamma$ must be at least ± 5° (see page 61). It is recommended, especially with long conveyors, that some of the carrying rollers are adjustable.

### Belt support on the return side

Return rollers are recommended to have a center distance of under 2 meters / *approx. 6 ft*, as this will prevent excessive belt sag due to the belt's own weight.

These carrying rollers on the return side must also be installed accurately at right angles to the belt running axis, since inaccurately aligned rollers will often cause belt tracking problems, particularly in cases where high friction or structured belt covers are used.

# Design guide – friction drive belts
# Drive concept

The following standard system illustrations depict those most commonly found in use for fabric belt conveyors, which are also valid for Habasit Cleandrive™ monolithic conveyor belts.

### Head drive

In the case of a head-driven conveyor, the conveyor belt is said to be pulled on the carrying side. The head drive is preferred to the tail drive because of lower belt stress and smaller forces imparted to the conveyor components, i.e. pulleys and bearings.[1)]

Examples of design variations with regard to the position of the tensioning device:

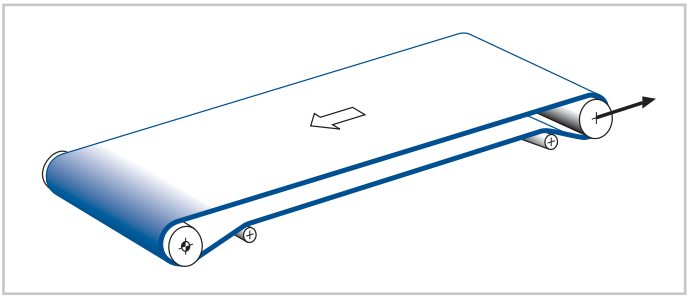


**Fig. 93** Head drive, tail pulley as tension pulley

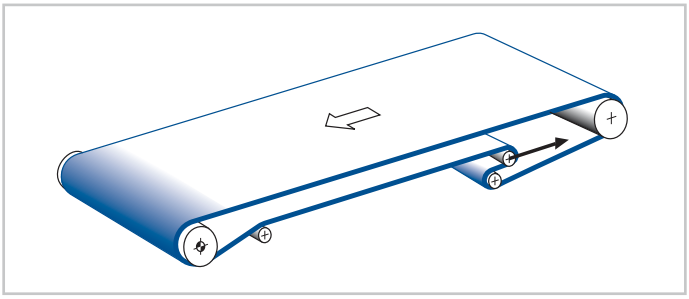


**Fig. 95** Head drive, tensioning device on the return side

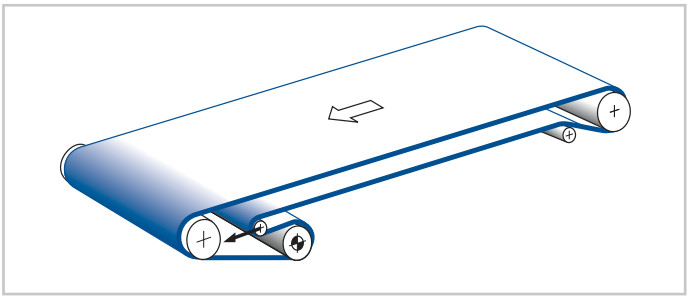


**Fig. 94** Driving pulley and tensioning device on the return side near the head pulley (equates to a head drive)

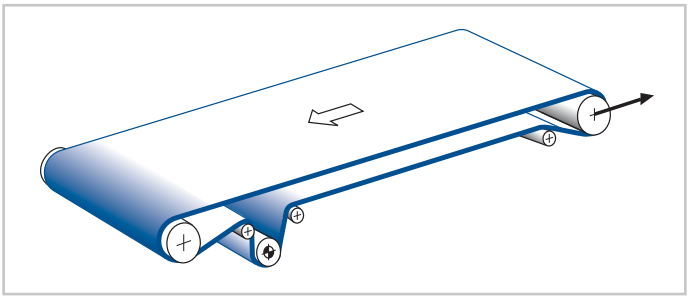


**Fig. 96** Driving pulley on the return side near the head pulley (equates to a head drive), tail pulley as tension pulley.

[1)] Two exceptions have to be mentioned:

A declined conveyor where the magnitude of the carried load, angle of decline, and friction make it possible for the conveyed product to drive, or push, the belt and create a "negative" peripheral force. In this case tail drive is recommended for optimum performance.

In case of reversing operation, center drive is recommended.

### Tail drive

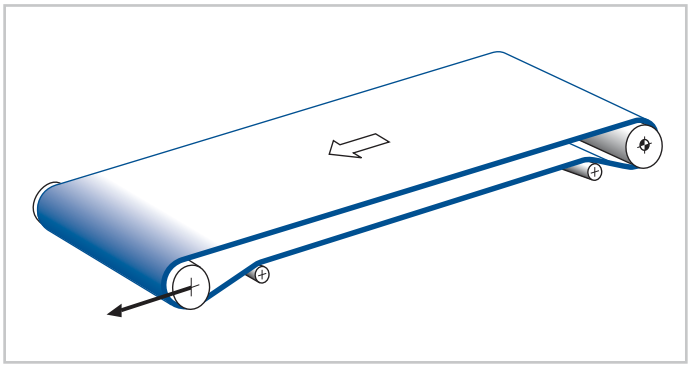


Fig. 97 Situation with tail drive concept

The greater belt tensile forces and higher shaft loads that occur in tail-driven installations may demand stronger and more robust system construction. This issue becomes far more significant in long installations and where the mass of goods transported is very great.

As mentioned above, tail drive is preferable on declined conveyors as the drive acts as a braking mechanism for the belt.

### Center drive

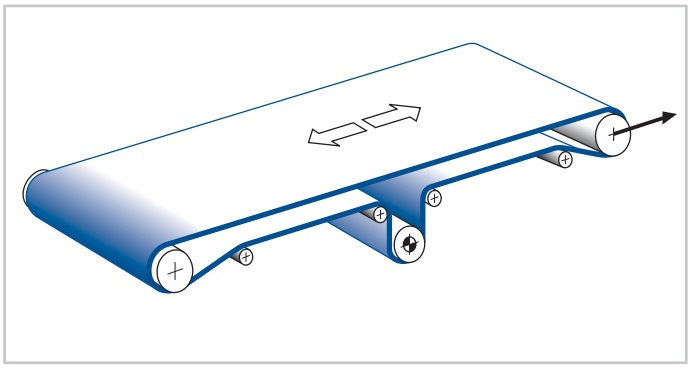


Fig. 98 Conveyor layout with center drive

Center drives are commonly specified for reversing operation. In this case, the rollers at each end of the conveyor may have a cylindrical-conical shape (see page 52).

The center drive is also used for conveyors equipped on both the infeed and discharge ends with a nosebar.

In such conveyor designs, peripheral force is significantly increased as a result of these fixed components. Consequently, the increased power consumption and shaft load must be considered. Belt guidance in conveyors with one or two nosebars and a center drive is quite demanding. It is best to minimize the arc of contact on nosebars and the total number of pulleys and rollers along the belt path.

### Tandem drive

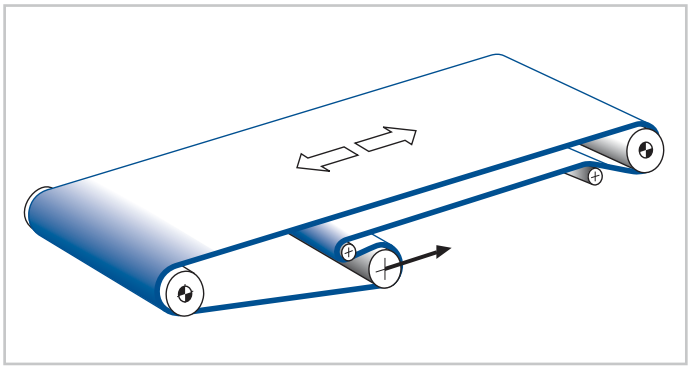


Fig. 99 Installation with two motors

In processes where a high degree of positioning accuracy is required, often in combination with reversing operation, or in situations demanding large drive power ratings, both end rollers are typically driven.

This is seldom the case with friction drive belt conveyors, as in most cases it is sufficient to increase the arc of contact on the driving pulley by means of a snub pulley, or to fit the driving pulley with a friction cover (see page 55).

Where each of the tandem driving pulleys is driven by a dedicated motor, the drive system should incorporate a speed control system. The drive of one motor by another is to be avoided, as this can lead to overloading of the belt.

### Drive units

Generally, the drive comprises an electric motor, a power transmission element (gearbox or belt), and the driving pulley.

Standardized three-phase squirrel-cage motors with star-delta start are preferable. Starting is usually smooth. The belt speed is often controlled through an electronic frequency inverter.

The drive power ratings of friction drive conveyor belts are usually relatively small (typically 0.5 to 5 kW). The effective required motor power needed to move the fully loaded belt along the support structure can easily be calculated by the CONVEY-SeleCalc program. But note that the calculation does not include bearing drag or belt flexion forces (particularly important in low temperature environments).

Converting motor speed to the required conveyor speed commonly takes place via a gearbox or a transmission belt and pulley combination. Often the motor and gearbox are directly combined in a compact design (gearmotor). Possible options are spur gear, bevel, or worm gears. If a power transmission belt is used, flat belt drives are recommended; these are space-saving, cost-effective, maintenance-free and highly efficient.

Drum motors are also often used with relatively low power ratings. It is important to note that drum motors are surface-cooled, thereby partially dissipating their heat through the belt. It is particularly noteworthy that in short conveyors with a highly loaded drum motor, motor heat can result in severe, sometimes unacceptable overheating of the belt. Excessive and non-uniform heating of the belt is a common cause of belt running problems such as mistracking and belt shrinkage.

In special cases the drive station can also act as a brake. With steep gradient conveying (incline or decline) the drive unit is used to prevent the belt from moving when at rest.

# Design guide – friction drive belts
# Drive concept

### Power transmission

Power has to be transferred from the drive to the belt. This is the function of the driving pulley (see page 55).

It transfers the drive force (peripheral force) from the pulley surface to the belt. In driving the friction drive conveyor belt, where there is no positive engagement with the driving pulley, power transmission capacity depends on the following factors:

- Arc of contact of the belt at the driving pulley
- Coefficient of friction between the belt and driving pulley
- Contact pressure between the belt and driving pulley

Commonly used measures for increasing this power transmission capacity are not applicable on Habasit Cleandrive™ belts:

- Increasing the initial elongation (tension) of the belt. This option, however, results in additional shaft and bearing load. Furthermore, the allowable elongation of the belt must never be exceeded.
- For appropriate initial tension values for Habasit Cleandrive™ friction drive belts, please refer to the SeleCalc online belt calculation program.

Effective power transmission is largely dependent on the friction between the belt and the pulley surfaces. Wax, grease, moisture, conveyed product build-up, etc., all reduce friction and increase the potential for slip. Consequently, the belt and the system as a whole can no longer function properly. To remedy this, consider:

- Use of a snub pulley to increase the arc of contact
- Use of a lagged driving pulley to increase the coefficient of friction

Cleanliness is equally important for issues such as belt tracking and service life. Take care to ensure that the belt and installation are kept as clean as possible. The following measures should be considered:

- Appropriate belt cleaning systems (see page 70)
- Effective cleaning procedures

# Design guide – friction drive belts
# Tensioning devices

The required contact pressure of the conveyor belt on the driving pulley is achieved by means of a belt tensioning device. The tensioning force and resulting shaft load are lower if the tensioning device is placed on the low tension (slack) side of the driving unit.

A distinction must be made between fixed tensioning devices and constant-force tensioning devices:

### Fixed tensioning devices

Fixed tensioning devices are used in installations where there is no need to compensate for variations in belt length or belt tension during operation, or for reversing operation under full load. Usually, fixed tensioning devices are sufficient for friction drive conveying belt installations, because Habasit Cleandrive™ belts are longitudinally stable, with negligible elongation changes during start-up and load changes.

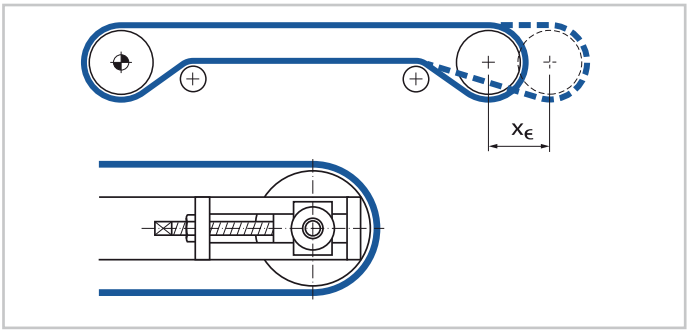



**Fig. 100** Tensioned tail pulley

A simple solution for tensioning is to use the tail pulley with a tensioning device that runs parallel to the belt's axis or the belt's running direction. (Fig. 100)

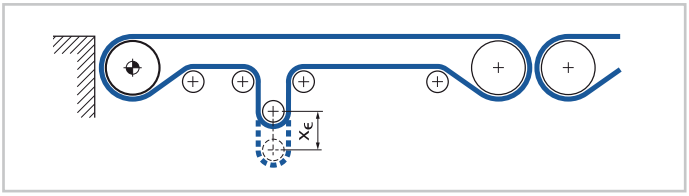



**Fig. 101** Return side tensioning system

When the center distance between the head and tail pulleys may not be changed, e.g. with intermediate or transition conveyors, the tensioning device is incorporated in the return side. (Fig. 101)

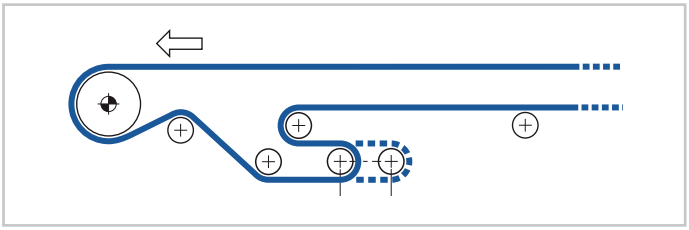


**Fig. 102** Tensioning on long conveyors

With long, heavily loaded installations, the tensioning device should be positioned directly after the driving pulley. (Fig. 102)

Tensioning pulleys can be adjusted manually, but may also be fitted with pneumatic or hydraulic cylinders or even electric positioning motors to provide a fixed take-up position.

### Constant-force tensioning devices

It is advisable to use constant-force tensioning devices where the conveyor installation is lengthy and if the weight of the transported goods is large relative to the force/elongation ratio (elastic modulus) of the belt, or if the load is rapidly fluctuating. Constant-force tensioning is also advisable for belts with polyamide tensile members and if there is considerable variation in humidity, but it is not recommended for reversing operation under full load (unless the conveyor is equipped with two tensioning devices, one on either side of the driving pulley).

With active, constant-force tensioning systems, belt length changes occurring during operation are compensated automatically. It is obvious, therefore, that these devices must be designed and built with the capability to compensate for these operational length changes, as well as to take up the belt length for the required initial tension. For appropriate initial tension values for Habasit Cleandrive™ friction drive belts, please refer to the SeleCalc online belt calculation program.

Constant-force belt tension is typically achieved either by spring-loaded tensioning or by pneumatic or hydraulic tensioners.

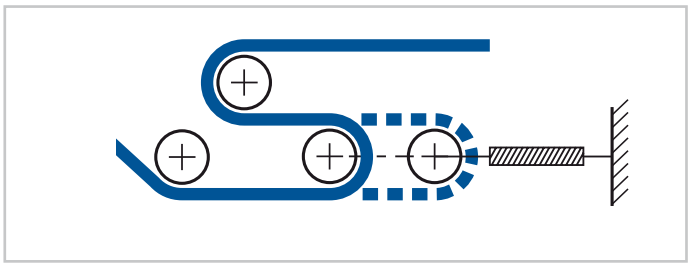


**Fig. 103** Constant-force tensioner

For long conveyors, gravity tensioners can also provide constant-force belt tension.

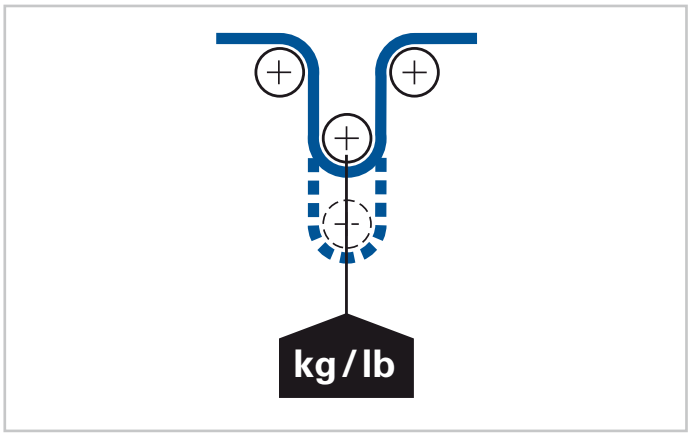



**Fig. 104** Gravity take-up

### Take-up $x_\varepsilon$

When determining the configuration and effective length of take-up, proper consideration must be given due to various factors: the required take-up for belt tensioning, influences to fluctuations in temperature and moisture, potential for the build-up of debris on the conveyor components (increasing the length of the belt path), manufacturing tolerances of the belt and installation, requirements to provide ease of installation (joining) and maintenance, etc.

Effective measures for keeping the take-up as short as possible are: a head drive (instead of a tail drive), a driving pulley with a friction cover, a large arc of contact at the driving pulley, and a conveyor belt with a high modulus of elasticity ($k_{1\%}$ value).

Although small pulley diameters are welcome in general because they reduce the overall conveyor height, decrease the installation weight and cut costs, it has to be remembered that the larger the pulley diameter, the greater the durability of the Habasit Cleandrive™ belt.

The following factors are used to determine the smallest possible diameter:

- Flexibility of the conveyor belt and of any applied profiles (V-guides, cleats, etc.) See "Minimum pulley diameter regarding bending flexibility ($d_{min}$)"
- Admissible pulley deflection
  See "Minimum pulley diameter with respect to pulley deflection ($d_y$)" (page 51)

**Minimum pulley diameter regarding bending flexibility ($d_{min}$)**

Habasit defines a minimum pulley diameter $d_{min}$ for each type of belt, applicable for an arc of contact greater than 30°. The minimum pulley diameter $d_{min}$ is stated in the product data sheet and is a key component when designing for optimum performance, so every effort should be made to be in compliance. The use of diameters smaller than those recommended can shorten belt life considerably.

In cases where the belt's arc of contact with pulleys and rollers is minimal, the specified diameter can be smaller. For an arc of contact of less than 30°, the admissible minimal diameter can be about 50% of $d_{min}$. For an arc of contact of less than 5°, as in the case of carrying rollers, the minimum pulley diameter $d_{min}$ does not need to be considered.

For **backward bending** the minimum pulley diameter with counterflection has to be considered (see conveyor belt product data sheet).

When bonded **profiles** are applied, the minimum pulley diameter is a function of belt flexibility as well as the size, shape, material and hardness of the profile and type of bond. Therefore, the minimum pulley diameter for belts with profiles is determined by comparing the $d_{min}$ of the belt to that listed for the desired profile, and then abiding by the larger.

[1] The stated value is valid for 23 °C / *73 °F*. For lower temperatures the pulley diameter should be increased accordingly.

### Minimum pulley diameter with respect to pulley deflection ($d_y$)

To support stable tracking of the conveyor belt, the pulley deflection y caused by the belt tension must be minimized.

As a rule of thumb, Habasit recommends the following values for the admissible deflection y:

| | |
|---|---|
| Cylindrical pulleys: | $y \leq 0.001 \cdot b_o$ [mm] |
| Cylindrical-conical pulleys: | $y \leq (0.001 \cdot d) + 0.07$ [mm] |

In order to check the pulley deflection, we recommend using the CONVEY-SeleCalc calculation program.

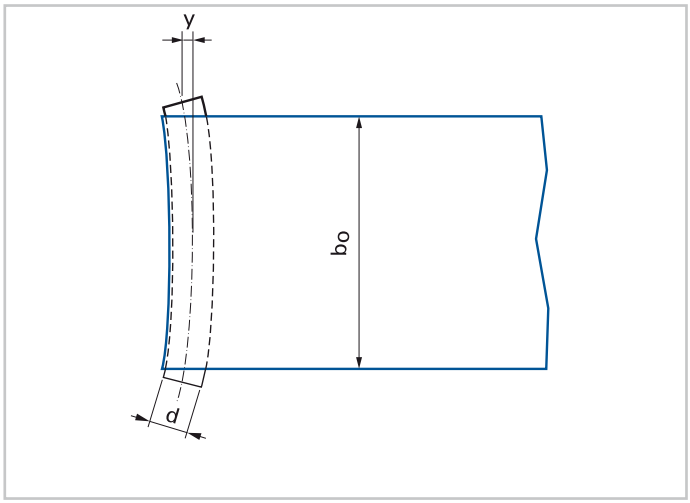



Fig. 105 Pulley deflection under tension

### Effective pulley diameter $d_{eff}$

The effective pulley diameter $d_{eff}$ must be at least as large as or larger than the minimum pulley diameter $d_{min}$ stated in the product data sheet **and** the smallest diameter with respect to the pulley deflection $d_y$:

$d_{eff} \geq d_{min}$ and $d_{eff} \geq d_y$

### Pulley width

Pulleys and rollers should be wide enough so that the belt makes full contact with them over its entire width, even when it is not positioned at the exact center of the pulley.

Pulley width recommendations:

| Belt width $b_o$ | Pulley width b |
|---|---|
| $b_o \leq$ 100 mm / *4 in* | $b = b_o$ + 20 mm / *0.8 in* |
| $b_o >$ 100 mm / *4 in* | $b = (1.08 \cdot b_o)$ + 12 mm / *0.5 in* |

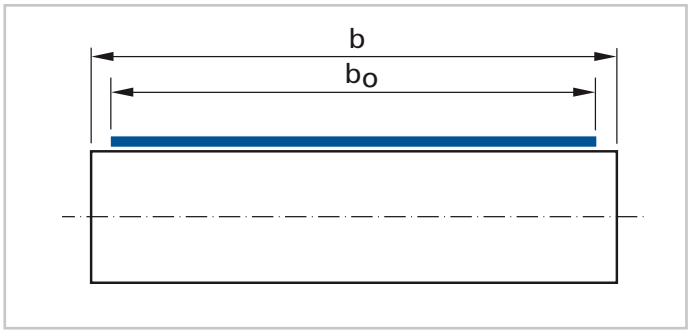



Fig. 106 Pulley width in relation to belt width

### Pulley surface

Clean, oil- and grease-free stainless steel pulleys with a smooth, almost polished surface, corresponding to a roughness $R_a$ = 1.6 µm are in most cases sufficient to ensure slip-free power transmission on **driving pulleys**. Pulleys with grooves or knurling are to be avoided as they may induce belt tracking problems and may also lead to excessive wear of the driven surface of the belt.

Fewer demands are made on the surface finish of pulleys and rollers without power transmission, **like tail, snub, tensioning, and deflection pulleys**. Since the tensile forces before and after these pulleys are identical, there is no elongation difference and no movement at the pulley surface. Recommended roughness $R_a$ = 3.2 µm.

### Cylindrical-conical (trapezoidal crowned) pulleys

For the tracking of Habasit Cleandrive™ friction drive belts cylindrical-conically formed (trapezoidal crowned) or simple crowned pulleys are effective for use. As the belt tries to run to the highest point of a pulley diameter, it is constantly directed towards the center of the pulley by the conical ends.

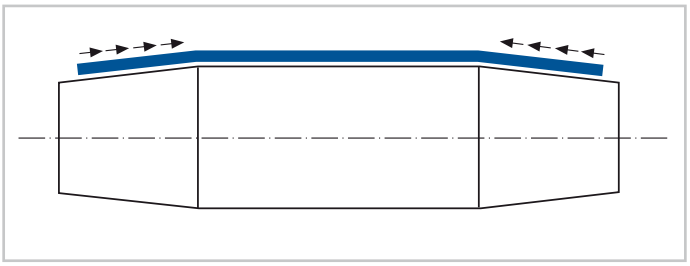


Fig. 107 Cylindrical-conical pulley shape

If the belt has the tendency to run to one side, e.g. to the left, the belt centering forces on the left increase as the contact area increases and, conversely, the tracking forces on the right end of the pulley decrease. The resultant force consequently directs the belt back toward its centered (neutral) location on the pulley, where the centering forces become balanced on each side.

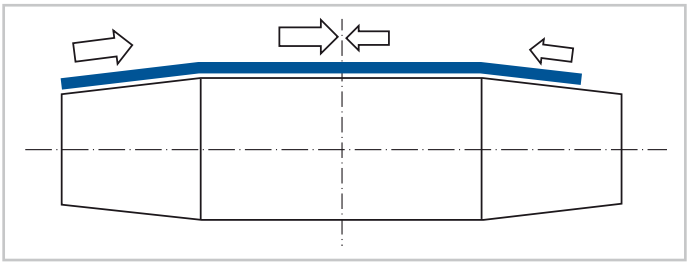


Fig. 108 Balancing tracking forces

Pulleys with this shape exert a **self-tracking** effect on the belt, so that even with changing run-off tendencies during operation, or with a reversed running direction, the belt will be tracked optimally without the need to adjust the axis.

The cylindrical-conical (crowned) form is commonly used for the driving pulley, but may also be incorporated on idling pulleys like tensioning and deflection pulleys.

# Design guide – friction drive belts
# Pulley design

In order to achieve effective belt tracking without experiencing any negative impacts on belt operating behavior or belt service life, the crown shape, i.e. the ratio of the conical parts to the cylindrical part and the crown height (conicity), should be made according to the following guidelines.

### Length of the cylindrical part $b_c$

$b_c = b_o / 2$

### Crown height h

The required crown height to track a conveyor belt depends on the lateral flexibility of the belt and/or the friction between the belt and the pulley.

Habasit recommends for Habasit Cleandrive™ friction drive belts (against stainless steel pulleys) an average crown height h of:

$h = 2 \text{ to } 3\ (0.001 \cdot d + 0.075)\ [mm]$

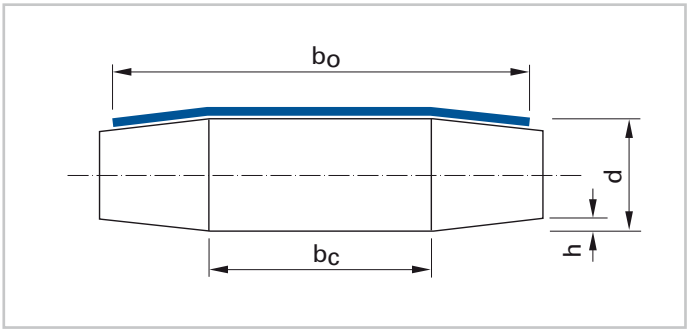



**Fig. 109** Belt width and length of cylindrical part of pulley

The resulting values are listed in the following table:

| Pulley diameter d | mm | ≤ 50 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Crown height h for conveyor belts against steel pulleys | mm | 0.25 to 0.4 | 0.35 to 0.5 | 0.45 to 0.7 | 0.55 to 0.8 | 0.65 to 1.0 | 0.75 to 1.1 | 0.85 to 1.3 | 0.95 to 1.4 | 1.05 to 1.6 | 1.15 to 1.7 |

| Pulley diameter d | *in* | ≤ 2 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Crown height h for conveyor belts against steel pulleys | *in* | 0.01 to 0.016 | 0.014 to 0.021 | 0.018 to 0.027 | 0.022 to 0.033 | 0.026 to 0.039 | 0.03 to 0.045 | 0.034 to 0.051 | 0.038 to 0.057 | 0.042 to 0.063 | 0.046 to 0.069 |

The above indications must be employed with regard to pulley width recommendations. These guidelines are suggestions only and may be adapted as necessary.

Note: Pulley crown dimensions according to C.E.M.A. standard 402 are focused on relatively thick and heavy belts and therefore can be considerably more agressive compared to the recommended values in the table above, which are deemed to be sufficient for Habasit Cleandrive™ friction drive belts.

# Design guide – friction drive belts
# Pulley design

Excessive crown height may either result:

- in a loss of the tracking effect because the belt does not conform to the conical ends (this is especially the case for belts with high transverse rigidity), or
- in longitudinal creasing, and in extreme cases, belt overlapping of thin and laterally very flexible belts

For the 2 mm thick, waffle embossed belt, or in applications with lagged pulleys, it is advisable to reduce the crown height h to approximately 50% of the afore-listed values.

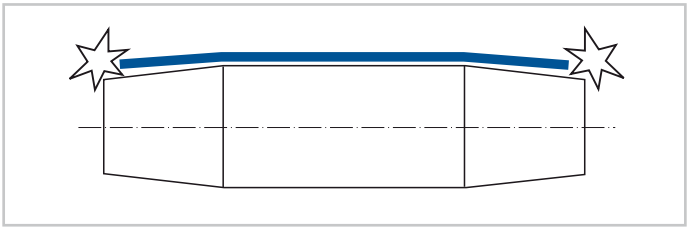


Fig. 110 Exaggerated crown height

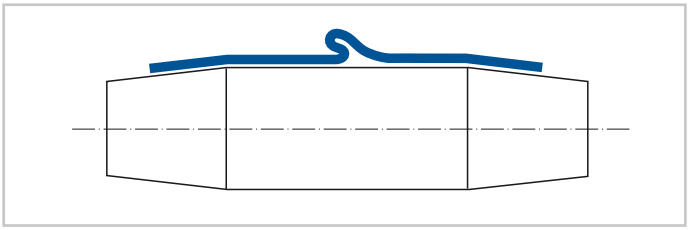


Fig. 111 Overlapping of belt due to excessive crown height

### Radially crowned pulley form

The afore-listed crown height is also valid for the radially crowned pulley form. In terms of the tracking effect, it makes no difference whether a pulley is crowned or has a cylindrical-conical (trapezoidal) profile.

Conversion of crown radius R and crown height h:

$$R = (h/2) + (b^2 / 8h)$$

$$h = (b/2) \tan ((\arcsin (b/ 2R)) / 2)$$

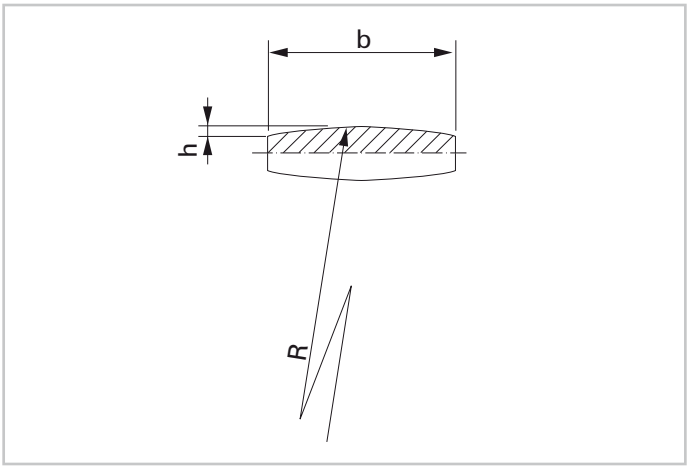



Fig. 112 Radially crowned pulley

### Cylindrical pulleys

Pulleys with a cylindrical shape exert **no centering effect** on the belt. It is, therefore, very important that the conveyor system features at least one measure to keep the belt centered, e.g. cylindrical-conical pulley(s), guiding pulley(s), or other tracking measures.

Tail, deflection, snub, guide and tension pulleys are usually made with a cylindrical shape.

Rollers and pulleys that run against the coated conveying side of the belt should normally be cylindrical.

### Driving pulleys

The principal function of the driving pulley is to transfer peripheral force from the driving system to the conveyor belt.

If the driving pulley is cylindrical-conical in shape, it will also produce a self-centering effect on the running behavior of the belt. For detailed information about cylindrical-conical pulleys refer to page 52.

Clean, oil- and grease-free stainless steel pulleys with a smooth, almost polished surface (corresponding to roughness $R_a$ = 1.6 µm) are in most cases sufficient to ensure slip-free power transmission.

Driving pulleys with grooves or knurling should be avoided as they may induce belt tracking problems and will also lead to excessive wear of the driven surface of the belt.

To improve traction between the belt and the driving pulley, increase the arc of contact or the coefficient of friction by providing the pulley surface with a friction cover (pulley lagging).

### Lagged driving pulleys

Driving pulleys covered with an abrasion-resistant elastomer, e.g. food approved rubber (recommended hardness 60 – 80 Shore A) or urethane (recommended hardness 80 – 90 Shore A), increase the coefficient of friction and thus the transferable peripheral force. Such friction covers may be applied in the form of a tube, a sheet, or dip coated or sprayed on. It is important to note that the surface finish of lagging should be a dull or matt finish or finely textured, as a glossy finish may create excessive friction and accumulate debris.

Habasit offers special lagging materials. Conveyor belts and flat belts have also successfully been used as friction cover material.

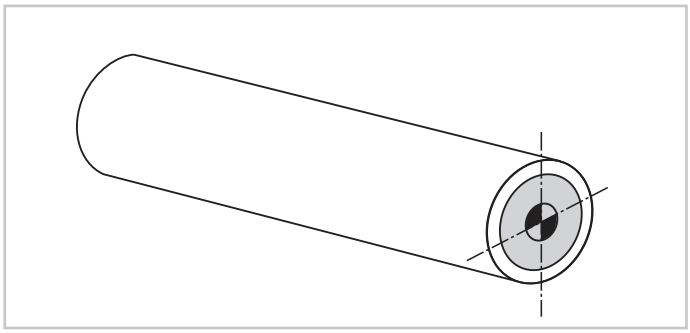


Fig. 113 Completely lagged driving pulley

### Snub pulleys

Snub pulleys are primarily used for the following reasons:

- To increase the arc of contact at the driving pulley (→ improvement in power transmission, lower initial tension, lower shaft load)
- To reduce the distance between the carrying side and the return side (→ reduced overall height of the conveyor installation)
- To provide tracking adjustment. **Adjustable** snub pulleys are particularly effective at improving belt "a" tracking. This is why adjustable snub pulleys are known as **guiding pulleys** (see page 59).

The center distance "a" between the end pulley and the snub or guiding pulley should be at least twice the diameter of the end pulley.

Observe the minimum diameter for counterflections according to the product data sheet.

Special attention is needed when belts with a structured surface are running over snub pulleys. The belt could be difficult to track, create noise, or have a shorter lifetime due to added abrasion.

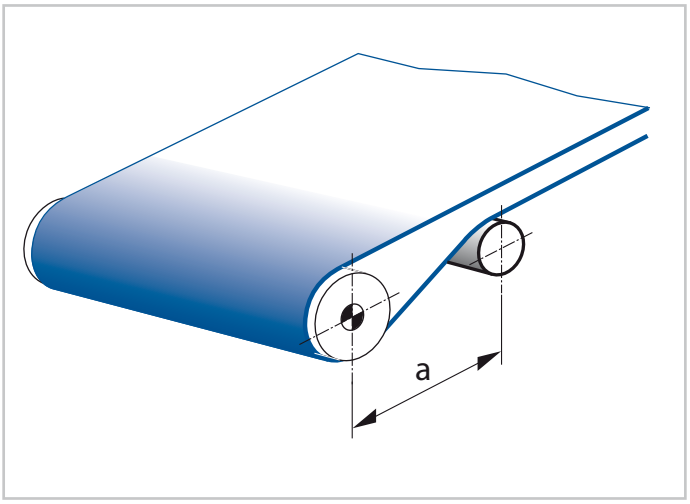



**Fig. 114** Snub roller positioning

Habasit Cleandrive™ friction drive belts are sometimes believed to be the cause of belt tracking issues. However, in most cases this is not true. The cause of the failure is usually to be found in the installation itself, and may be the result of poorly adjusted pulleys and rollers, incorrect application of belt tracking measures, or faulty design. It is therefore essential to be fully aware of the basic characteristics of the different belt tracking measures and to employ these correctly.

A distinction needs to be made between basic and additional measures for belt tracking. The former are appropriate for maintaining a correctly aligned belt in its central position as long as no major external influences are exerted on the belt, such as transverse forces. The latter are necessary when basic measures alone are either insufficient or inappropriate for controlling belt tracking.

Regardless of which measures are taken, the following conditions are essential for problem-free belt tracking:

- The supporting structure must be rigid and stable. It must be able to withstand all the forces acting upon it (belt tension, weight of the conveyed goods, uneven floors, etc.).
- All pulleys and rollers must be fitted at right angles to the belt running axis. Adjustable pulleys and rollers should only be adjusted after the belt has been properly run in.
- All parts of the installation that come into contact with the belt must be protected from dirt and soiling, and be cleaned as necessary.

What happens if a conveyor has no tracking measures at all?

Where a belt runs over **cylindrical** pulleys that are at right angles to its directional path, the forces acting upon it will be parallel to the running direction of the belt. No tracking forces are exerted on the belt.

In fact, the belt is running in a state of unstable equilibrium and would run off immediately if subjected to the slightest external factors such as off-center loading of product, dirt between the belt and the pulley, belt distortion, lateral feeding or diverting of goods.

The same scenario applies if one or both of the two pulleys are not positioned accurately at right angles to the belt running axis. The belt will inevitably run off towards the less-tensioned side.

**Tracking rule 1**
The belt tracks to the side with the least tension.

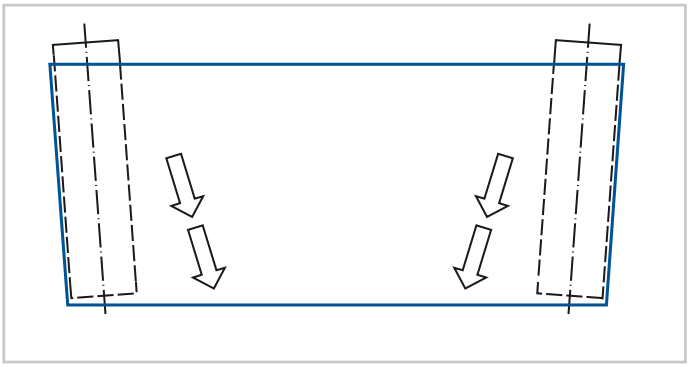


**Fig. 115** Tilted pulleys induce mistracking

### Tracking effect of cylindrical-conical or radially crowned pulleys

Habasit Cleandrive™ friction drive belt conveyors are normally equipped with at least one or sometimes several pulleys with a cylindrical-conical or radially crowned form. This basic measure is usually sufficient to achieve straight and stable running.

Pulleys with this shape exert a **self-tracking** effect. If there is a variable run-off tendency, or a reversal in running direction, the belt is centered without the need to adjust the axis. For detailed information on cylindrical-conical pulleys see page 52.

In simple two-pulley conveyors with a defined running direction, it is usually the head pulley that is the driving pulley. It is designed in a cylindrical-conical shape.

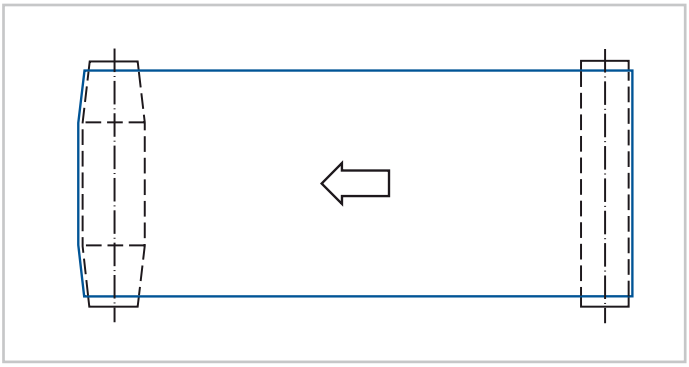


**Fig. 116** Short conveyor with one running direction

With a conveyor aspect ratio (conveyor length to belt width) in excess of about 5 to 1, and in installations with reversing operation, it is advisable to crown both the head pulley and the tail pulley.

Following this method, a correctly aligned belt can be maintained in its central position as long as there is no excessive deflection of the pulleys.

### Additional belt tracking measures

On installations with a pronounced run-off tendency and considerable transverse forces (side feed, diverter bar, a lot of redirection in the belt path, etc.), using of cylindrical-conical pulleys alone will not be sufficient. Additional belt tracking measures will be required, and these will be determined by the application and the operating conditions.

Please refer to the following pages for further details:

- Guiding pulley (page 59)
- Inclined rollers on the return side (page 60)
- Pivotable carrying rollers (page 61)
- Guiding profiles (page 62)
- Automatic belt control (page 64)

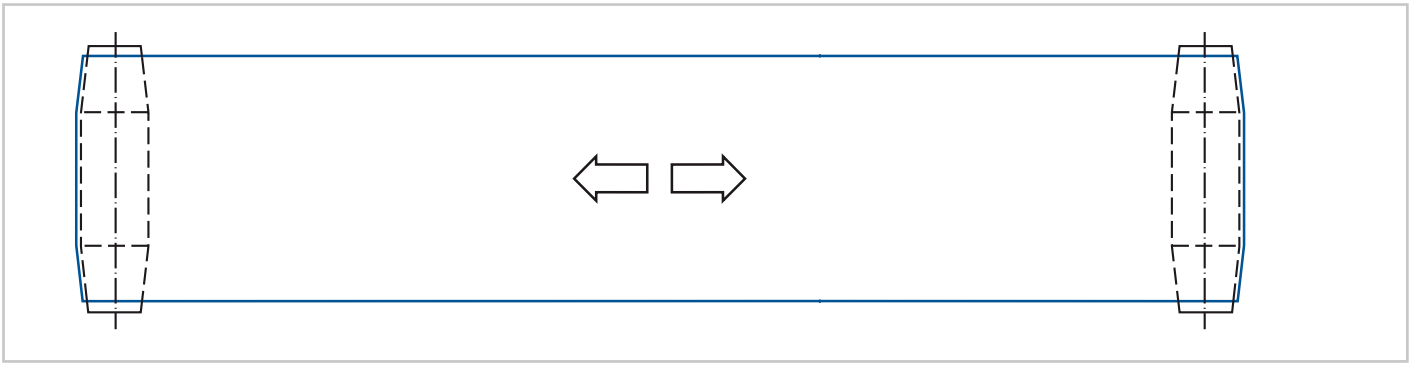


**Fig. 117** Bi-directional running conveyor

### Guiding pulleys

Guiding pulleys, also called control pulleys, are adjustable snub pulleys.

Guiding pulleys are usually cylindrical. Observe the minimum diameter for counterflections according to the product data sheets.

To achieve good tracking, the arc of contact at the guiding pulley should be a minimum of 30°. For belts with a non-adhesive surface, the tracking effect can be improved with a friction cover of abrasion-resistant food approved rubber or synthetic material (recommended hardness 80 – 90 Shore A).

**Tracking rule 2**
The larger the arc of contact and the higher the friction, the greater the tracking effect.

To keep the belt tension as low as possible, the pivoting movement should, be perpendicular to the median line of the arc of contact (plane A ↔ B) whenever possible. The center distance between the end pulley and guiding pulley should be at least twice the diameter of the larger pulley.

Unlike cylindrical-conical pulleys, adjustable cylindrical rollers are not self-tracking. This means that when the belt running direction changes, the pivoted position of cylindrical pulleys must be reset. As this is not practicable, the use of adjustable cylindrical rollers for belt tracking **is not recommended for reversing operation**.

However, an exception to this rule can be made for long conveyors. Provided there is sufficient distance between the guiding pulleys, they can be used even for reversing operation as well.

**Tracking rule 3**
In groups of pulleys and rollers, the one the belt first makes contact with has the larger tracking effect.

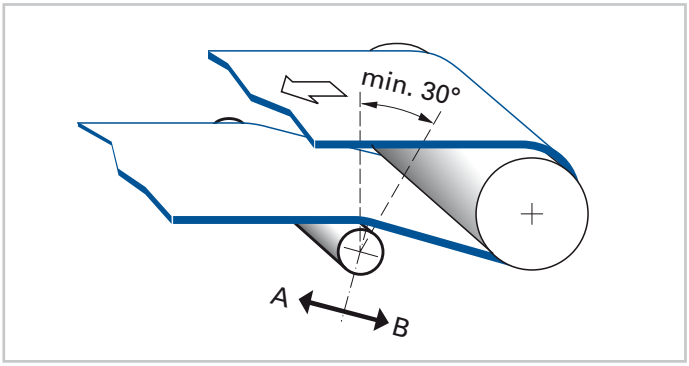



**Fig. 118** Arc of contact of the guiding pulley

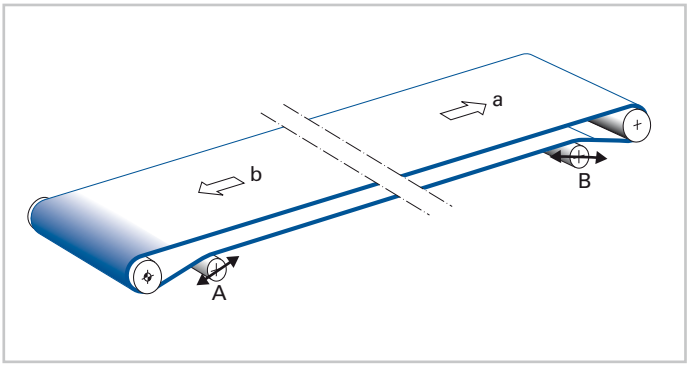



**Fig. 119** Guiding pulley A tracks the belt correctly in running direction a, guiding pulley B tracks the belt correctly in running direction b.

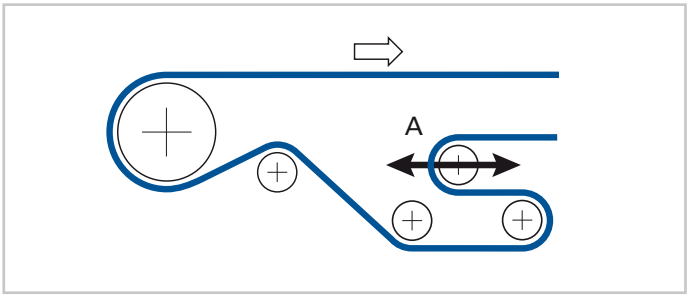



**Fig. 120** The first roller after the drive guides the most

### Inclined rollers on the return side

The tracking effect of inclined rollers on the return side is maximized if they are fitted to the running-on side in front of the tail pulley for head drive, and in front of the driving pulley for tail drive.

The positioning of rollers under the belt, i.e. on the conveying side of the belt, produces a good tracking effect due to the higher coefficient of friction. However, possible tracking marks on the belt cover must be taken into consideration.

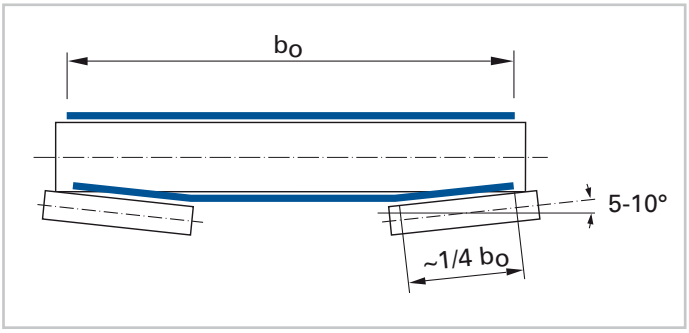



**Fig. 121** Inclined rollers on the belt conveying side

The rollers can also be positioned above the belt on its running side. This is desirable in cases where the belt has a delicate or highly structured conveying side, or has transversely mounted profiles.

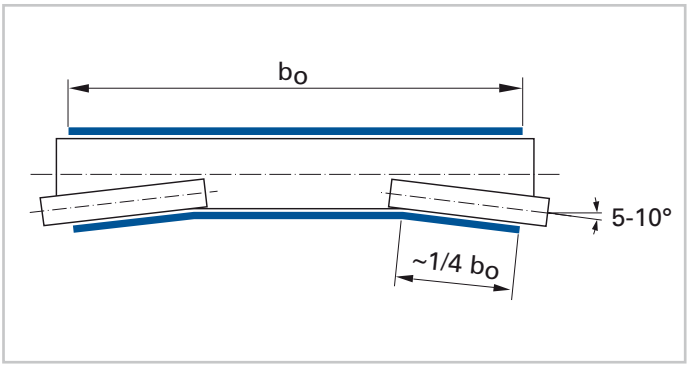



**Fig. 122** Inclined rollers on the belt running side

To achieve a satisfactory tracking effect, the belt contact of a roller should be around ¼ of the belt width, and the rollers, angle of incline should be 5° to 10°.

If the inclined rollers are fitted exactly at right angles to the belt running direction, the belt will automatically correct its own position should a change in run-off tendency occur.

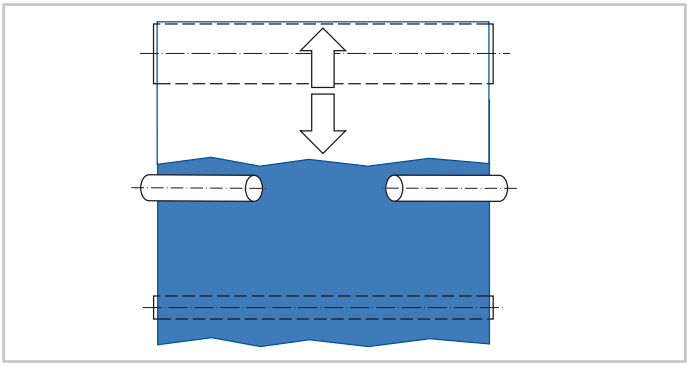


**Fig. 123** Inclined rollers for bi-directional drive

This measure works also for reversing operation. Belt tracking is further improved when the inclined rollers are **angled forward** by 8° to 10° at the belt edges in the running direction of the belt. Their effect can be enhanced by adding a friction cover.

However, rollers angled forward should not be used for reversing operation as the belt centering forces are thereby reversed as well.

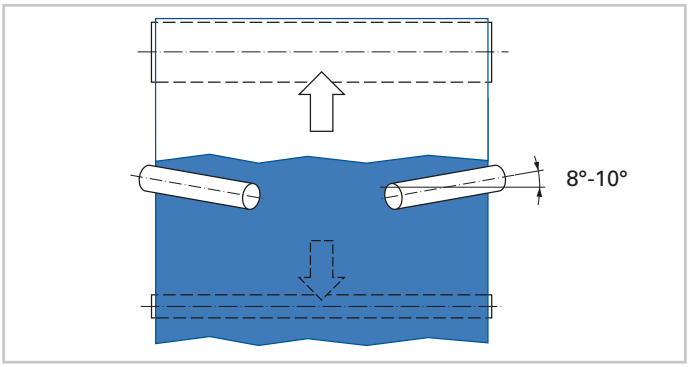



**Fig. 124** Angled inclined rollers for one running direction

Inclined rollers on the return side have also proven successful for tracking wide, short belts (see page 65) and with thin belts at high speeds. In this case driving pulleys and tail pulleys should be fitted with cylindrical profiles in order to avoid folding or creasing.

### Pivotable carrying rollers

Carrying rollers on the conveying and return side can also be installed for pivoted action, but as belt contact is minimal, the tracking effect of these adjustable rollers is limited.

Pivoted cylindrical rollers are **not self-tracking** as is the case with cylindrical-conical pulleys. This means that when the run-off tendency or running direction changes, the pivoted position must be reset. As this is not practicable, the use of pivotable cylindrical rollers for belt tracking is generally unsuitable for reversing operation.

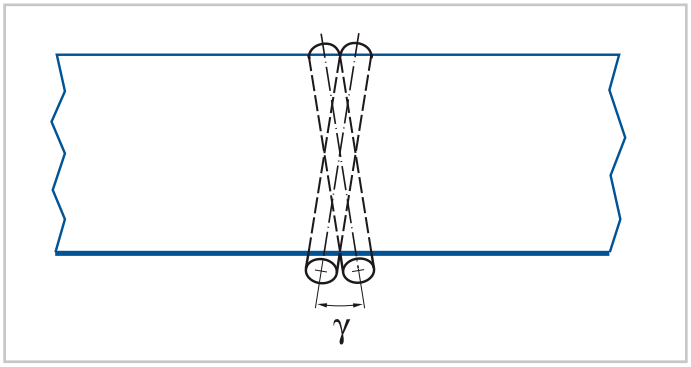



**Fig. 125** Pivoted carrying roller

For long installations, we recommend installing some pivotable carrying rollers. The adjustable pivoting angle γ should be at least ± 5°.

Prior to belt installation, care must be taken to ensure that all rollers are perpendicular to the direction of belt travel. After running-in, any run-off tendency can be corrected by adjustments to one or more rollers.

**Tracking rule 4**
The belt tracks to the side where it first makes contact with the roller.

Example:
To track a belt that is moving off to the right, the carrying roller must be adjusted so that the belt runs off towards the left.

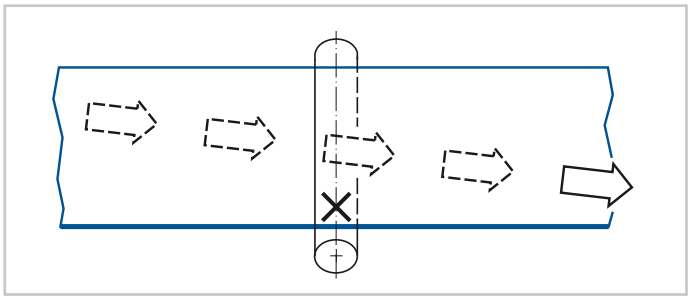


**Fig. 126** Belt running off to the right

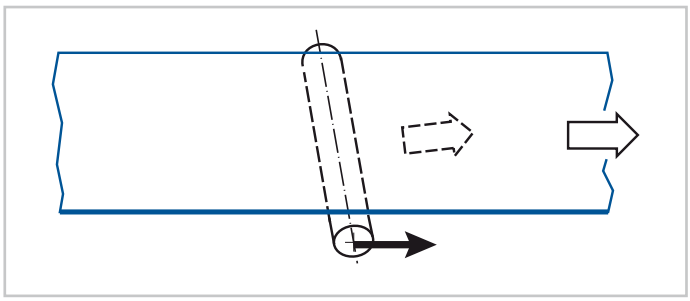


**Fig. 127** Corrected tracking with pivoted roller

Friction is the force that prevents the belt from running off and it results from the movement of the belt over the roller. The degree of friction force is determined by the amount of pressure exerted by the belt on the roller and on the coefficient of friction between the belt and the roller. The consequences of this are as follows:

- The tracking effect of skewed carrying rollers is dependent upon the belt load. Therefore the belt position will shift differently under different loading conditions.
- Belt slip on skewed carrying rollers causes friction-related drag and abrasion
- The tracking effect can be improved by fitting a friction cover to the skewed roller. This will increase abrasion and belt wear, however.

### Guiding profiles

Guiding profiles are usually V-shaped and welded onto the running side of the conveyor belt. Rectangular and semicircular profiles are also used at times.

Because of their relatively high production costs and limited effectiveness, guiding profiles are not recommended as a general belt tracking measure. They are particularly unsuitable in applications with high speeds, as they have a tendency to be forced out of the groove, which allows the belt to continue to run off.

Guiding profiles are well suited for offsetting localized transverse forces. In this context the term "transverse forces" refers to those forces exerted briefly on the side of the conveyor belt, for instance during side loading or diverting.

General rule:
In principle, the belt must be tracked by basic measures, usually by cylindrical-conical pulleys. Only in the zone where transverse forces can guiding profiles help to prevent the belt from running off.

This means that the groove dimensions should have different sizes:

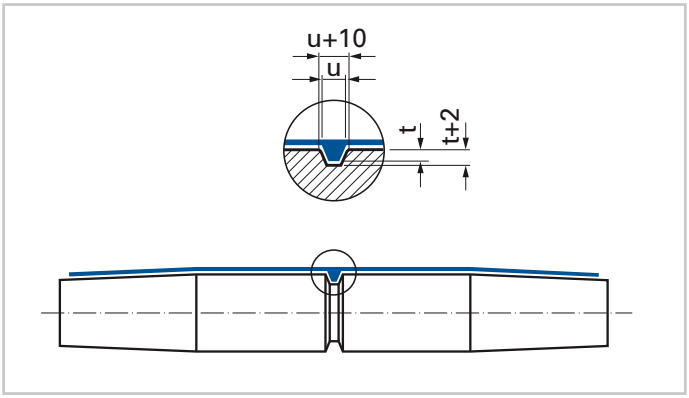



**Fig. 128** Wide groove in zones without lateral forces

a) In locations where no lateral forces occur, the **grooves should be wide**, that is around 8 to 10 mm / *0.31 to 0.39 in* wider than the guiding profile. This greater clearance permits adjustment of the belt without the guiding profiles permanently running against the sides of the grooves.

This is particularly true for the drive, head and tail pulleys.

An exception to this general rule has to be considered for guiding profiles in short but wide conveyors (see page 65). In this case it is advisable to make the grooves in the pulleys narrower than those in the slider bed.

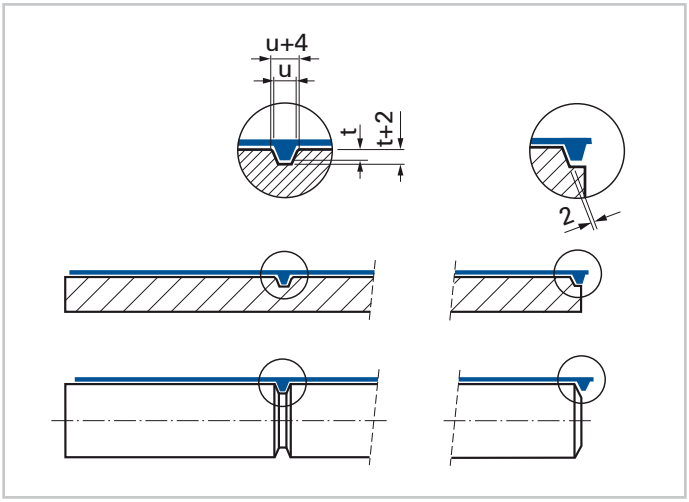



**Fig. 129** Narrow groove for laterally stressed areas

b) In the zone where the transverse force occurs, that i.e. on the slider bed or on the carrying rollers, the **grooves should be narrow**, i.e. only around 4 mm / *0.16 in* wider than the guiding profile.

Please always consider the following:

- The belt must have sufficient transverse rigidity to prevent it from being thrown out of the grooves by transverse forces.
- The minimum pulley diameter of the profile must be observed.
- Generally, a single V-profile in the center of the belt is sufficient.
- For thin belts with low transverse rigidity and also for wide belts, two guiding profiles should be used and positioned as near to the belt edges as possible. Both V-profiles and flat profiles can be used in these cases.
- With wide and fast-running belts, the use of idler rollers is recommended to prevent the profile from climbing out of the grooves.

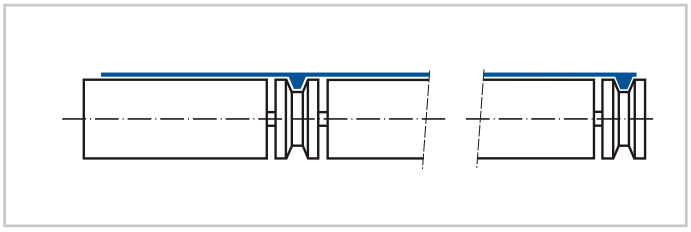


Fig. 130 Integrated idler within roller

- The edges of the grooves must have a 2 to 4 mm/ *0.08 to 0.16 in* chamfer to prevent damage to the guiding profiles.
- Before installing the belt, all grooves must be accurately aligned.
- Great care is necessary during running-in. Belts should be tracked using appropriate measures, e.g. cylindrical-conical pulleys. The guiding profile should run without touching the flanks of the groove, as soon as no transverse forces exist.
- Grooves may be wider than specified if there is sufficient clearance between the belt edges and the ends of pulleys and/or adjacent framework to prevent the belt from running off the end of the pulleys or colliding with framework. Additionally, consideration must be given to any required tolerance for product placement with respect to the center line or edges of the belt.

### Automatic belt control

Automatic belt control can solve even the most serious belt tracking problems. However, it is a comparatively expensive option, so is generally only used when belt tracking behavior is either highly critical and/or when other belt tracking methods have proven ineffective e.g., chronic build-up contaminating rollers/pulleys.

Automatic belt control works by sensing the edges of the belt, either by means of non-contact sensors or using mechanical means. A signal is sent to a control mechanism, which actuates a guiding pulley (see page 59), which accurately centers the belt.

It is advisable to make the tail pulley cylindrical. With a cylindrical-conical tail pulley, conflict between the two regulation systems could possibly result in a disturbed belt run.

We recommend that one side of the guide/control roller is equipped with a standard adjustment device so that the tracker assembly can be initially aligned manually. While this is being done, the automatic control should be in the neutral position.

A number of companies supply automatic belt tracker products and we recommend taking specialist advice when an installation demands these devices.

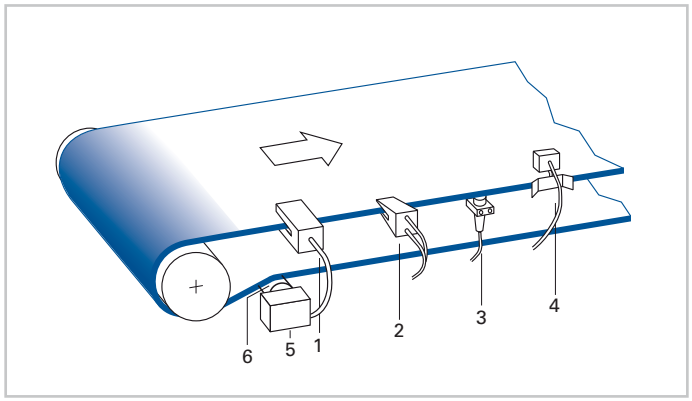



Fig. 131 Position of control sensors

1 Optical scanner (photocell, light barrier)
2 Pneumatic sensor (air jet)
3 Electrical sensor (capacitive sensor)
4 Mechanical sensor (microswitch, stylus)
5 Control mechanism: electrical (servodrive), pneumatic or hydraulic (pressure cylinder)
6 Guiding pulley

### Guiding of short, wide belts

Habasit Cleandrive™ friction drive belts on installations where the belt width is equal to or larger than the conveying length are increasingly difficult to guide. Thin belts with little lateral stiffness, particularly at high speed, have a tendency to buckle and potentially fold over when fitted on short conveying distances with cylindrical-conical pulleys. Habasit recommends that the head and tail pulleys should be cylindrical and installed absolutely parallel and square to the belt running direction.

Further measures, as recommended in the following sections, should be considered to ensure effective belt guidance in these cases.

### Inclined rollers on the return side

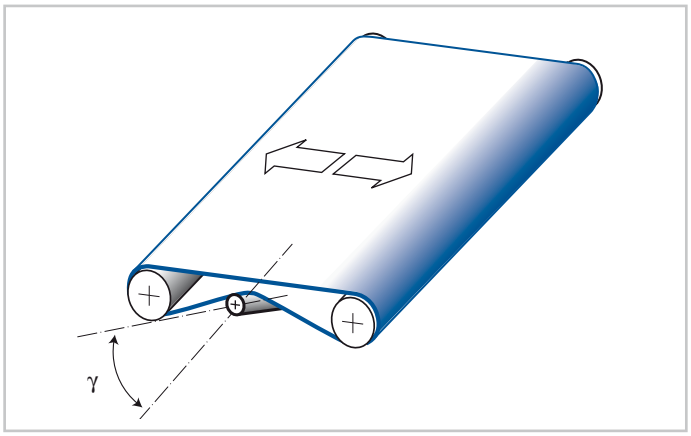



Fig. 132 Inclined rollers on the belt return side

Inclined rollers on the return side are advisable for guiding wide belts with short conveying distances (see page 60).

To achieve a satisfactory tracking effect, the roller inclination γ should be at minimum 5° to 10°, and in some cases up to 45°. This configuration provides a self-centering effect on the belt.

Provided the rollers are fitted at right angles to the belt running direction, this is also effective with reversing operation.

### Center drive

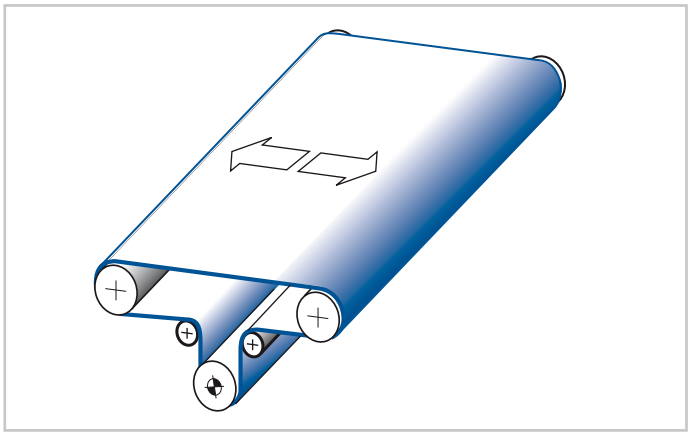


Fig. 133 Center drive set-up

Center drive is recommended for reversing operation. The driving pulley should be cylindrical-conical and lagged if required. Head and tail pulleys, as well as deflection rollers, are cylindrical in shape.

For slow belt speed the head and/or tail pulleys can be cylindrical-conical shaped.

### Guiding profiles

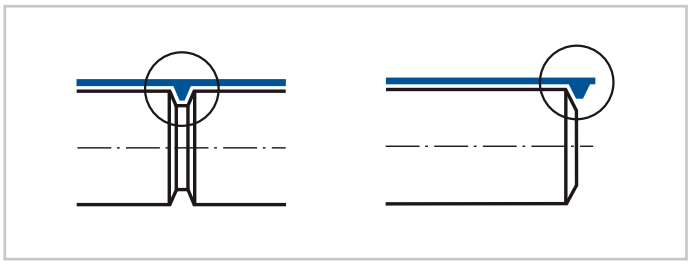


Fig. 134 Guiding profile positioning

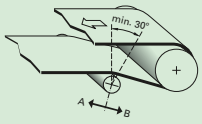
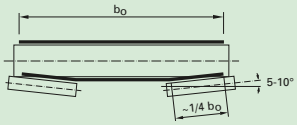
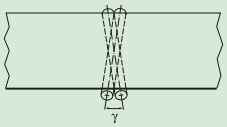
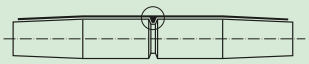
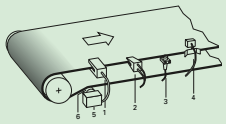
Short, wide belts can be guided effectively by using guiding profiles, provided there is sufficient belt transverse rigidity and a fairly low speed. It is advisable to guide the belt in the pulleys rather than in the slider bed. This means that the grooves in the pulleys should be narrower than those in the slider bed. This is an exception to the general rule described on page 62.

Grooved rollers must be large enough to offset the added deflection created by the small diameter of the roller at the base of the groove. By moving the groove to the edge of the roller, deflection is significantly reduced. As a result, it may be possible to use a smaller diameter roller without creating excessive deflection (the minimum pulley diameter of the guide must be considered).

# Design guide – friction drive belts
# Belt tracking

**Overview of tracking measures and recommendations**
As a basic measure it is recommended to equip at least one or even several pulleys with a cylindrical-conical or crowned shape. If this basic measure is insufficient to achieve straight and stable running, additional tracking measures need to be considered.

■ Highly effective, 1st priority
▼ Effective depending on the application or under observation of specific limitations
❑ Not recommended

| | Basic tracking measures | Additional tracking measures | For reversing operation | For absorbing local transverse forces | For short and wide belts | For heavy belts, high lateral stability | For light belts, low lateral stability |
|---|---|---|---|---|---|---|---|
| Cylindrical-conical or crowned pulley  | ■ | ■ | ■ | ❑ | ▼ | ■ | ■ |
| Guiding pulley   | ❑ | ■ | ▼ | ❑ | ■ | ■ | ■ |
| Inclined rollers on the return side   | ❑ | ■ | ▼ | ❑ | ■ | ■ | ▼ |
| Pivotable carrying rollers   | ❑ | ■ | ❑ | ❑ | ❑ | ■ | ❑ |
| Guiding profiles  | ❑ | ■ | ■ | ■ | ■ | ■ | ▼ |
| Automatic belt control   | ▼ | ■ | ▼ | ❑ | ❑ | ■ | ■ |

Checklist of design issues in order to avoid tracking problems

- Is the conveyor construction rigid enough? Is no inadmissible distortion of the supporting structure, pulleys or rollers under full load and maximal belt tension possible?
- Are the bearings for highly stressed pulleys like the head, tail, tension and deflection pulleys adjustable?
- Is there at least one cylindrical-conical or radial crowned pulley?
- Have the necessary belt tracking measures been taken, e.g. cylindrical-conical or radially crowned shaped pulleys, or other appropriate tracking measures mentioned in this guide?
- Is the crown height of the cylindrical-conical or radially crowned pulleys correct and made according to our recommendations?
- Has it been considered that the first pulley in the belt running direction has the largest tracking effect in a group of pulleys and rollers, and has it therefore been made adjustable?
- Have the snub rollers been made adjustable in order to allow their use for belt tracking?
- Have all common tracking methods been considered before using guiding profiles?
- If guiding profiles are used, e.g. to absorb temporary lateral forces, are the grooves narrow in the zone where the transverse forces occur and wider along the rest of the belt path?
- Is everything possible being done to keep the belt, pulleys, rollers and slider bed clean?

For a checklist for trouble-shooting tracking problems see the "Installation and Maintenance Guide".

### Loading of conveyor with goods to be carried

Habasit Cleandrive™ friction drive belts are mechanically stressed during the loading of goods, both by the impact of the loading as well as by the additional movement between the goods and the belt. Effective loading of goods onto conveyors can require a number of fixtures, such as side plates, chutes and funnels, to be fitted to the overall installation.

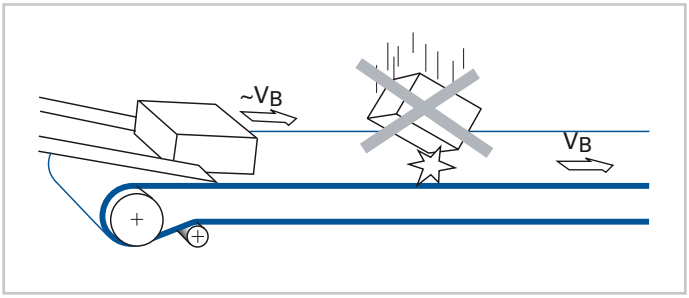



Fig. 135 Loading of goods onto a belt

Loading should preferably take place:

- With low energy impact
- In the same direction as the belt is running
- At belt speed
- With goods positioned centrally on the belt

These ideal conditions are not always possible, and in the case of lateral loading the belt is subject to unavoidable high stress. Accordingly, belts with high abrasion resistance and transverse rigidity must be employed.
It is essential that the belt remains centrally positioned on the conveying installation at the point of loading.
The following measure delivers good results:

- Guiding profiles (see page 62)

### Accumulation of carried goods

The term accumulation describes the situation that arises when either the whole or part of the belt becomes congested with goods while the belt continues to run. Special attention should be given to the following points when specifying belts for these cases:

- Install a conveyor belt with a low-friction, wear-resistant surface.
- Take into account the increase in the peripheral force resulting from the dynamic friction generated by the accumulated goods on the continuously running belt.

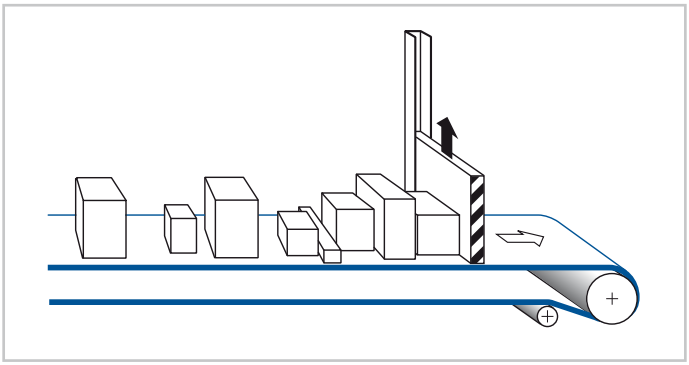


Fig. 136 Accumulated goods on a running belt

Where large amounts of goods have to be accumulated, a live roller conveyor or a plastic modular belt conveyor is probably more effective than a monolithic conveyor belt.

### Diverting of conveyed goods

Where piece goods are diverted or retrieved from the side, care must be taken to keep transverse forces on the belt as low as possible. Diverters must not touch the belt.

Common types of diverters are:

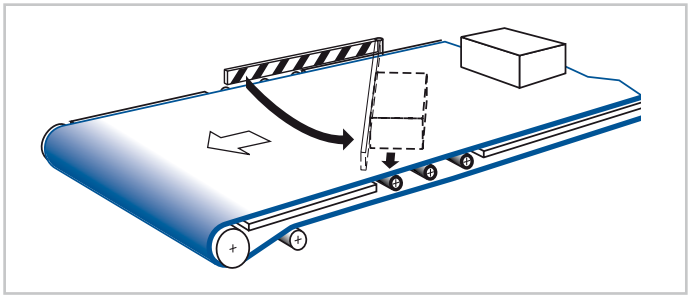


Fig. 137 Laterally pivoting, rigid diverters

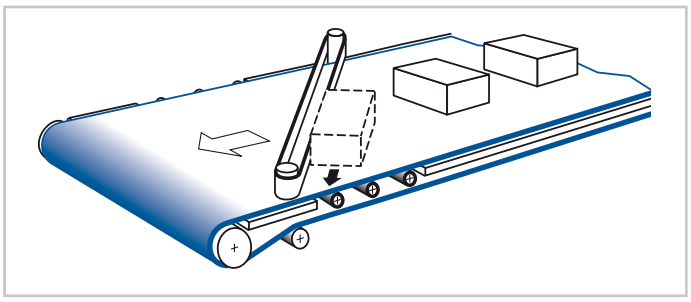


Fig. 138 Laterally pivoting diverters with driven discharge belts

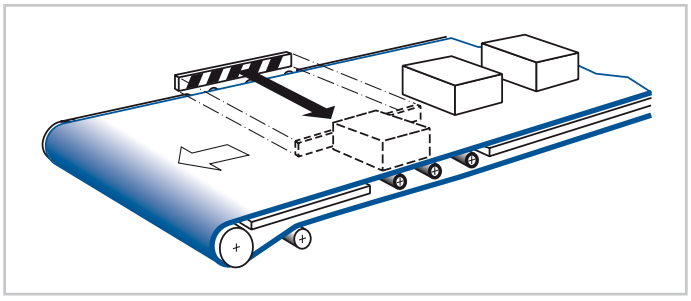


Fig. 139 Right-angled lateral diverters

As the belt is mechanically heavily stressed in the diverting zone, a belt with a relatively low coefficient of friction, high abrasion resistance and transverse rigidity should be installed. Measures must be taken to ensure that the belt remains centered on the conveying system at the point of diversion. The following measures can be recommended:

- Guiding profiles (see page 62)
- Increase the belt's initial tension (elongation)

Soiled belts and system components cause belt tracking and drive problems and shorten belt life. Dirty belt surfaces can impair the belt's carrying ability and release properties, and lead to conveying and processing problems. From a hygiene point of view dirty belts are unacceptable for food industry processes, and they are also undesirable for environmental and aesthetic reasons.

To maintain continuous cleanliness, various measures are available such as mounted scrapers and brushes.

Scrapers are bars of synthetic material or rubber fitted across the belt's running direction. The scraper material should be less durable than that of the belt and should be adjustable, since it is subject to wear.

Scrapers (1) should be mounted very close to the belt, and in fact may lightly touch it. Fixed brushes (2) will help to protect the coating on the conveying side. Brushes that rotate against the belt running direction (3) are well suited to cleaning applications where the waste material is sticky or dusty, especially on textured surfaces. It is also possible to attach water spray devices if this is deemed necessary. Scrapers and brushes must of course be thoroughly cleaned on a regular basis.

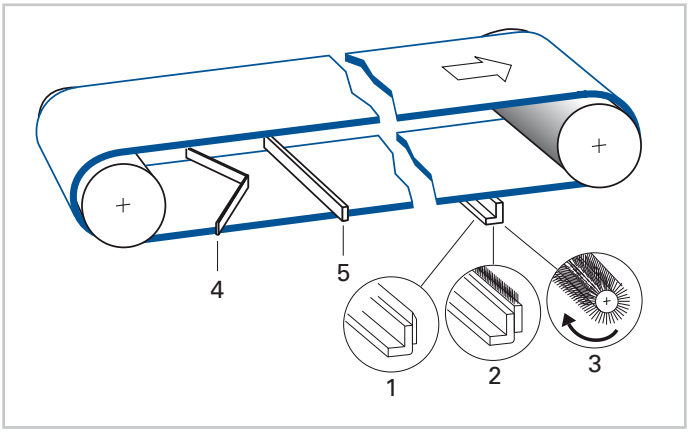



**Fig. 140** Scrapers and brushes for belt cleaning

It may also be necessary to prevent the build up of debris on rollers as well. In such cases, a scraper may be installed against the pulley face.

To prevent the accumulation of dirt and other material between the pulleys and the belt, scrapers should be fitted on the running side as close as possible to the tail pulley. Plow-type scrapers (4) do not affect belt running behavior as is the case with adjustable/slanted scrapers (5).

Attention must be paid to ensuring that cleaning systems are properly and correctly installed; otherwise, belt tracking problems may occur. Another point that must be considered is the increase in peripheral force due to friction.

### Steep-angle conveyor installation

Head drive is recommended for upward conveyance, while tail drive is preferable for downward installations as it acts as a brake when required. This means that in both cases it is best to install the drive station at the top of the conveyor.

The maximum gradient on which goods can be conveyed without slipping or toppling depends on the following factors:

- Weight, surface finish (material, structure) and position of the center of gravity of the conveyed goods
- Surface finish (material, structure) of the conveyor belt
- Operating conditions (belt speed, stop-and-go, vibration)
- External influences (humidity, temperature, soiling)

The choice of the correct conveyor belt is very important. As a general rule, belts with a smooth but adhesive surface can be used for installations with gradients of about $\delta \leq 20°$.

Belts with a structured conveying side can be used for gradients of up to $\delta \cong 40°$. From about $\delta > 40°$ transverse profiles are typically required. Extreme gradients are often managed by spiral conveyors.

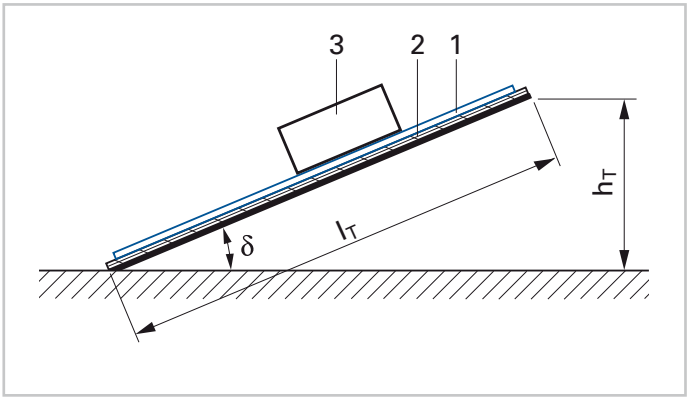



**Fig. 141** Testing of inclination angle

The maximum possible angle of inclination $\delta$ for the conveyance of product X with belt Y can be determined by a simple method. Fix a sample belt (1) on a fixed support, such as a wooden board (2), and place on it one or more of the goods to be conveyed (3). Now incline the support until the goods start to slide. Measure the gradient height $h_T$ just before sliding starts, and divide this height by the length of support $l_T$. This will give you the maximum possible angle of inclination:

$$\delta_{max} \leq \arcsin (h_T / l_T)$$

Of course, the maximum angle of inclination will in practice be greatly affected by external influences such as temperature, humidity and soiling, as well as by general operating conditions and the belt's age. These factors must be fully taken into account when determining the effective angle of incline $\delta_{eff}$ for a particular installation: always be sure to set $\delta_{eff} < \delta_{max}$!

Care must be taken that the goods do not fall over. In other words, it is essential that the center of gravity S of each conveyed piece is in front of point P. This applies to belts both with and without short profiles.

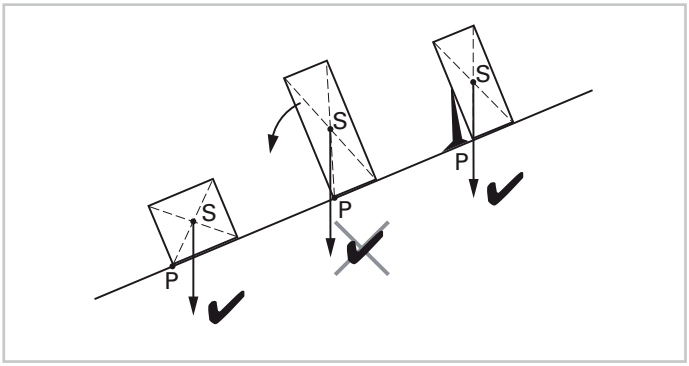



**Fig. 142** Gravity effect on inclined transport

### Z-conveyor installations

Due to its special appearance, the Z-conveyor is also known as the swan-neck conveyor.

In general the same points apply for the Z-conveyor as for a simple steep-angle conveyor. However, with the Z-conveyor it is essential to pay particular attention to the transition point due to the increased transverse belt stress in this area.

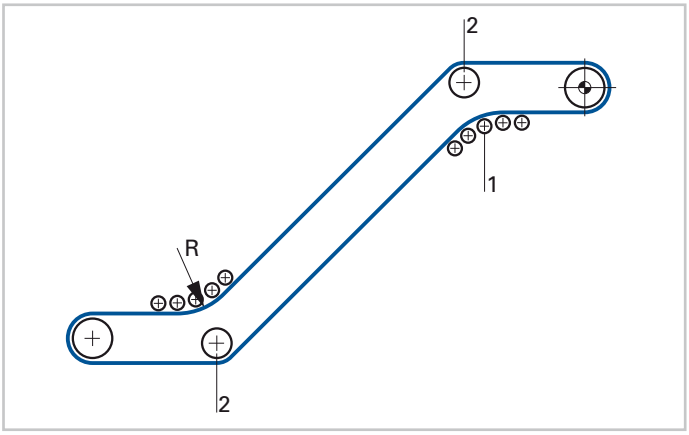



**Fig. 143** Basic layout of a Z conveyor

- Select the smallest practical transition radius R. The smaller the radius, the greater the lateral stiffness of the belt.
- On the conveying side, install preferably 3 to 5 smaller supporting rollers (1); alternatively fit a deflection roller (2) with a diameter of at least d = 200 mm / *8 in.*




**Fig. 144** Widths of supporting rollers

- Select the widest possible supporting rollers. Recommendation: B ≥ 50 mm / *2 in*



**Fig. 145** Transverse profile between supporting rollers

- Fit the supporting rollers as close as possible to the transverse profiles and corrugated side walls.
- As the supporting rollers have bearings on only one side, must care to ensure that they are rigidly supported and stable. The rollers must be installed at right angles to the belt running direction and must not be affected by the tensile forces acting on the belt.
- Specify a conveyor belt with the highest possible transversal rigidity.
- To keep the belt tension as low as possible, it is advisable to provide the driving pulley with a friction cover and large arc of contact.
- For belts fitted with transverse profiles, at least one profile should be mounted across the splice to add to its transverse rigidity.

# Design guide – friction drive belts
# Troughed conveyors

Troughed conveyor belts are used by conveying systems that transport bulk materials. In principle, any conveyor belt can be used for troughed conveyors, provided it is laterally not too stiff. The angle of the inclined rollers is critical.

With most troughed installations, belt support is provided on the carrying side by either two or three carrying rollers. On occasion, however, support is provided by means of a trough-form slider bed and longitudinally oriented rails.

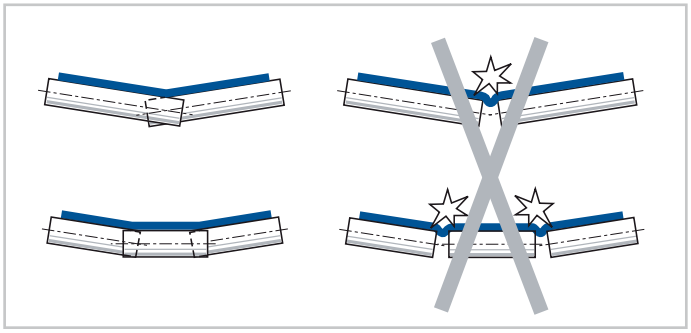


**Fig. 146** Troughed support rollers

If the arrangement of carrying rollers is staggered with sufficient overlap, this will prevent belt buckling. It is advisable that the inclined angle $\alpha$ for the lateral carrying rollers should not exceed 25° in installations with two rollers, and 40° where there are three rollers. On the carrying side, the degree of belt sag under load must be no more than 1% of the pitch of the carrying rollers. The pitch of the carrying rollers can be calculated as follows:

$$l_R \cong (8 \cdot F) / (m' + m'_B)$$

F = Belt tensile force at the relevant point [N]
$m' + m'_B$ = Weight of carried goods and belt per meter [kg/m]

The belt edges will be subject to increased elongation and forces as the belt moves from the drive roller to the first $\alpha$ set of troughed rollers. It is important to ensure that the selected transition length l' is not too small.

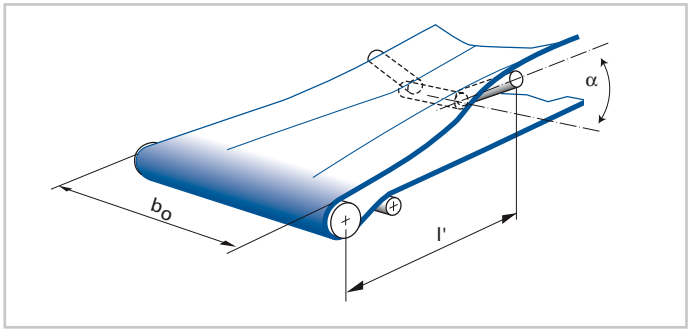



**Fig. 147** Transition length of a troughed conveyor belt

Recommended transition length $l' = c \cdot b_o$

| Trough angle α | 10° | 20° | 30° | 40° |
|---|---|---|---|---|
| Factor c | 0.5 | 1.0 | 1.5 | 2.0 |

The upper edge of the end pulley should be the same height as the middle carrying roller.

The belt guidance measures are in general the same as for flat fabric-based conveyor belts. We recommend installing cylindrical-conical pulleys for belt tracking (see page 52).

With troughed belts an additional tracking effect can be obtained by angling forward some of the sets of carrying rollers by a few degrees (max. 3°) in the running direction of the belt. However, angled rollers are not self-tracking and have to be reset when used with reversing operation.

On systems with three sets of carrying rollers the belt should always be completely in contact with the center roller while in a tensioned but unloaded state.

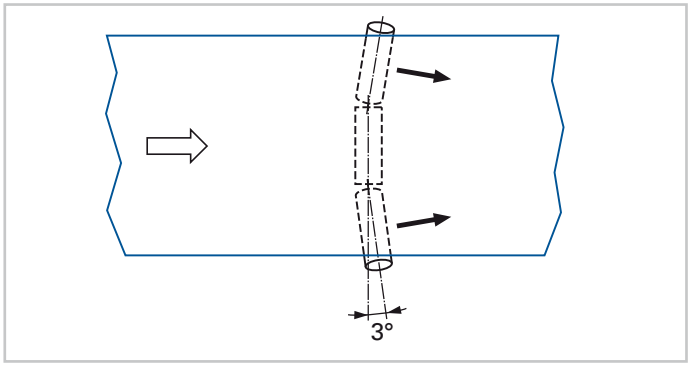



**Fig. 148** Angled carrying rollers on troughed conveyor

# Appendix
# Material properties – coefficient of friction

### Coefficient of friction between belt and slider support (wear strips), $\mu_G$

The following tables list the coefficient of friction. The lower values in the range given are typical under lab condition (new clean belt and new wear strip); the higher values are based on experimental data after a considerable running time. The latter should be used for calculation.

| Belt material | Condition | UHMW PE | Stainless steel |
|---|---|---|---|
| TPU | dry | 0.4..1.0 | 0.5..1.3 |
| | wet (water) | 0.3..1.0 | 0.4..1.0 |

### Dimensional changes due to humidity

Due to humidity and environmental conditions a belt can change in width by up to 2.5%. The conveyor design must consider this increased belt width, and allow sufficient lateral play between the frame and the belt.

The longitudinal dimension is less affected thanks to belt reinforcement with aramid. Variations in length can be compensated for by a catenary sag or belt take-up unit.

For details see page 35.

# Appendix
# Material properties – chemical resistance

## Cleaning agents

**The following tables show the assumed chemical resistance of Habasit Cleandrive™ to various cleaning agents and disinfectants. Please note that the resistance may vary with concentrations, temperatures, mechanisms and contact times. Synergies between two or more ingredients in a formulation are difficult to predict, but may reinforce the ageing effect.**

Disinfectants and cleaning agents have different properties and are chosen according to the type of soiling to be removed and the disinfection required. Alkaline cleaning is often used in food processing environments because most of the deposits to be removed are organic in nature. Sporadic acid cleaning is recommended for removing inorganic stains (e. g. hard water deposits). However, areas being cleaned should always be rinsed off thoroughly with water in between.

Example: W-A-W-S-W-D-W
(W = rinsing with water; A = alkaline cleaning; S = acid cleaning; D = disinfecting)

For perfect sanitation, procedures must be established (GMP/ HACCP …), strictly followed, and monitored.

The following table assumes a maximum contact time of 15 minutes per day.

### Cleaning agents

| | 23 °C | 50 °C | Remarks |
|---|---|---|---|
| Acid (weak) | ■ | ▼ | Possible swelling, max. 3% concentration |
| Acid (strong) | ▼ | ❑ | Severe degradation |
| Alkaline (weak) | ■ | ▼ | Possible swelling, max. 3% concentration |
| Alkaline (strong) | ▼ | ❑ | Severe degradation |
| Neutral | ■ | ■ | |
| Water | ■ | ■ | |

■ Suitable/recommended ▼ Limitation/check ❑ Not suitable/not recommended

**Acid cleaning agent (weak):**
acetic acid, lactic acid, citric acid, phosphoric acid, sulphuric acid, oleic acid, stearic acid, butyric acid

**Acid cleaning agent (strong):**
nitric acid, hydrochloric acid

**Alkaline cleaning agent (weak):**
urea solution, ammonia

**Alkaline cleaning agent (strong):**
caustic soda (NaOH), triethanolamine

### Disinfecting agents

| | 23 °C | 50 °C | Remarks |
|---|---|---|---|
| Alcohol (ethanol, isopropanol) | ■ | ■ | Possible swelling |
| Chlorine | ■ | ▼ | Possible swelling, < 1% concentration |
| Chlorinated solution (bleach, 3%) | ▼ | ❑ | Severe degradation |
| Chlorinated solution (bleach, 0.5%) | ■ | ▼ | Possible discoloration |
| Chlorine dioxin | ▼ | ❑ | |
| Iodine | ❑ | ❑ | Severe degradation |
| Peroxy compound 33% | ■ | – | Possible discoloration |
| Ozone | ■ | ■ | |
| QAC | ■ | ■ | |
| UV-C | ▼ | ▼ | Cracking, degradation |

■ Auitable/recommended ▼ Limitation/check ❑ Not suitable/not recommended

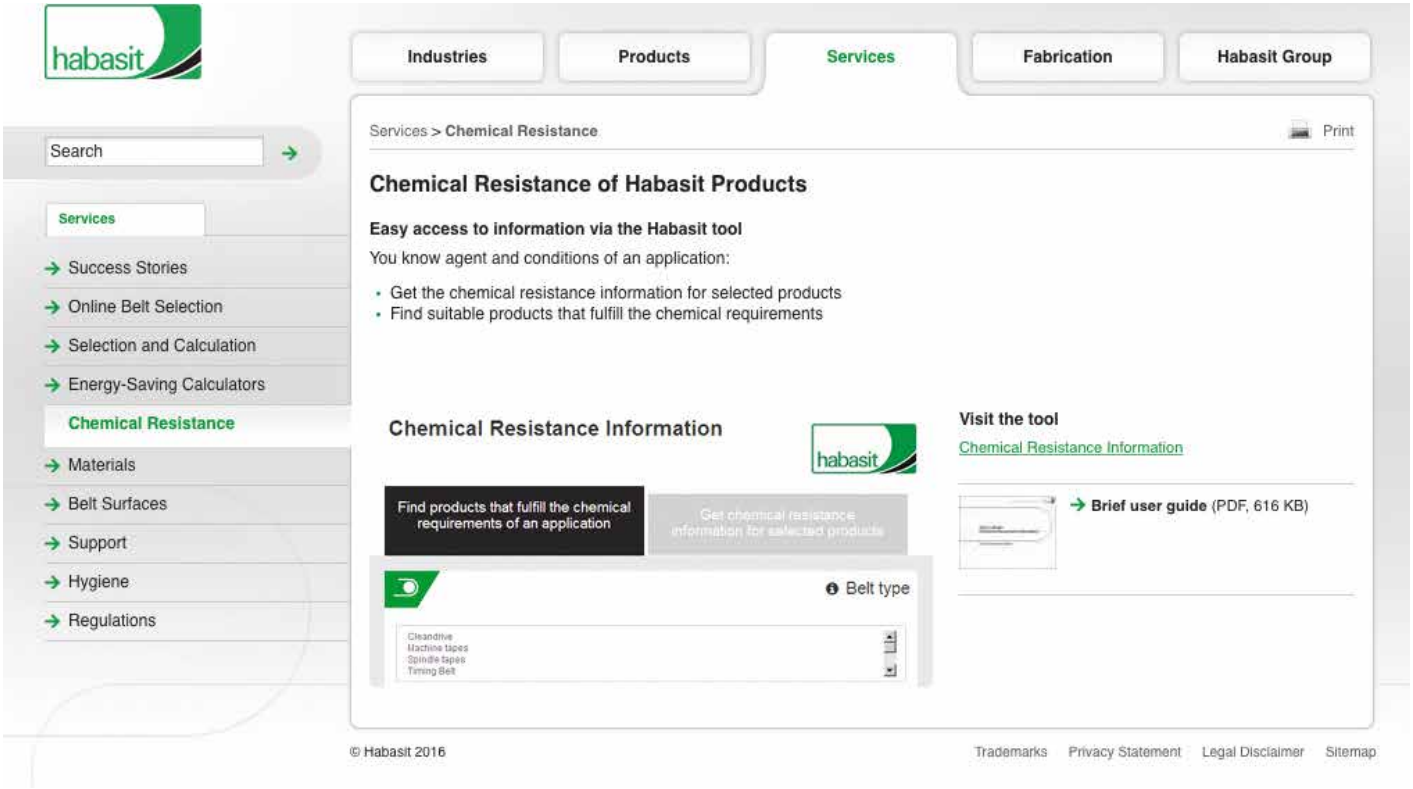
# Appendix
# Material properties – chemical resistance

Information on a cleaning agent or disinfectant can be obtained from the supplier by requesting a Technical Data Sheet (TDS) or by checking the Material and Safety Data Sheet (MSDS) of the product. Details will be given on the concentration to use and the type of cleaning procedure to be followed.

The formulations are very diverse and the tables provided are solely for information. We strongly recommend that you refer to the supplier's guidelines and that you carry out a test on the Habasit belt prior to use (e.g. apply the product on a small area with a contact time of 15–30 minutes).

The chemical resistance of particular Habasit conveyor belts is available on our website at:
http://www.habasit.com/en/chemical-resistance.htm

Habasit technical support can provide information on tests carried out with many common cleaners and disinfectants on the market.



# Appendix
# Material properties – chemical resistance

**Chemical substances**
The data presented in the following table is based on information provided by manufacturers and suppliers of the materials. The information is provided solely as technical guidance, and does not constitute any warranty. In individual cases the stability of the material in the medium must be examined.

Conditions: 20 °C *(68 °F)*

Recommendation:
■ Good resistance ▼ Limited resistant ❑ Not resistant

| | | | |
|---|---|---|---|
| Acetic acid >25% | ❑ | Decaline | ■ |
| Acetone | ▼ | Developer, photographic | ■ |
| Ammonia, gaseous and aqueous | ■ | Diazonium salts | ■ |
| Amyl acetate | ▼ | Diesel oil | ■ |
| Amyl alcohol | ▼ | Diethylene glycol | ❑ |
| Aniline | ▼ | Edible fats and salad oils | ■ |
| Arachis oil | ■ | Essential oils | ■ |
| Baking fats | ■ | Ester | ▼ |
| Baking powder | ■ | Ether | ■ |
| Beer | ■ | Ethyl acetate | ▼ |
| Benzene | ▼ | Ethyl alcohol | ■ |
| Benzoic acid | ■ | Fats | ■ |
| Bitter almond oil | ■ | Fatty acids | ■ |
| Bitumen | ■ | Fatty alcohols | ❑ |
| Bleaching lyes | ❑ | Fertilizers | ■ |
| Boric acid | ❑ | Fish, fish waste | ■ |
| Brandy | ❑ | Formaldehyde | ▼ |
| Bromine | ▼ | Formic acid | ▼ |
| Butanol | ▼ | Fructose | ■ |
| Butter | ■ | Fruit juices | ■ |
| Butyric acid | ■ | Fuel oil | ■ |
| Calcium cyanamide | ■ | Glacial acetic acid | ▼ |
| Carbon tetrachloride | ▼ | Glucose | ■ |
| Castor oil | ■ | Glycerine | ■ |
| Chlorobenzene | ▼ | Glycol | ❑ |
| Chromic acid | ❑ | Heptane | ■ |
| Cider | ■ | Hexane | ■ |
| Citric acid | ■ | Hydrocarbons, aliphatic | ■ |
| Coconut oil | ■ | Hydrocarbons, aromatic | ❑ |
| Cola concentrates | ■ | Hydrocarbons, chlorinated | ▼ |
| Common salt | ■ | Hydrochloric acid <20% | ❑ |
| Cottonseed oil | ■ | Hydrofluoric acid | ▼ |
| Cresol | ▼ | Hydroquinone | ■ |
| Cyclohexane | ❑ | Inks | ■ |
| Cyclohexanol | ▼ | Isooctane | ■ |
| Cyclohexanone | ▼ | Isopropanol | ■ |

# Appendix
# Material properties – chemical resistance

| | |
|---|---|
| Kerosene | ■ |
| Ketones | ▼ |
| Latex | ■ |
| Lemonades | ■ |
| Linseed oil | ■ |
| Liqueurs | ■ |
| Margarine | ■ |
| Methanol | ▼ |
| Methyl acetate | ▼ |
| Methyl ethyl ketone | ▼ |
| Methylene chloride | ▼ |
| Milk | ■ |
| Mineral oil | ■ |
| Molasses | ■ |
| Motor oil | ■ |
| Mustard | ■ |
| Nitric acid <40% | ❑ |
| Nitrocellulose thinners | ▼ |
| Oils, mineral | ■ |
| Oils, vegetable | ■ |
| Oxalic acid | ■ |
| Palm oil | ■ |
| Paraffin oil | ■ |
| Peanut oil | ■ |
| Perfumes | ■ |
| Petrol | ■ |
| Petroleum ether | ■ |
| Phenol | ❑ |
| Phthalic acid | ■ |
| Plaster | ■ |
| Plasticizer | ■ |
| Potash lye | ❑ |
| Potassium comp. | ■ |
| Potassium salts | ■ |
| Propanol | ■ |
| Proteins | ■ |

| | |
|---|---|
| Resorcinol | ❑ |
| Salicylic acid | ■ |
| Salt water | ■ |
| Sea water | ■ |
| Sewage | ■ |
| Soaps | ■ |
| Starch syrup | ■ |
| Stearic acid | ■ |
| Sugar | ■ |
| Sulfite waste liquors | ■ |
| Sulfuric acid < 50% | ■ |
| Tallow | ■ |
| Tanning agents | ■ |
| Tar | ■ |
| Tartaric acid | ■ |
| Tetrachloroethylene | ▼ |
| Toluene | ❑ |
| Transformer oil | ■ |
| Trichloroethylene | ▼ |
| Turpentine oil | ❑ |
| Urea | ■ |
| Urine | ■ |
| UV | ▼ |
| Vaseline | ■ |
| Wetting agents | ■ |
| Wine | ■ |
| Xylene | ❑ |
| Yeast | ■ |

The concentration of a chemical can affect the resistance of our Habasit Cleandrive™ belts and accessories. If no concentration is specified for a substance, the chemical resistance rating refers to either the pure chemical or to normal commercially available concentrations of it. When a chemical is used in a substantially lower concentration than listed in this table, the Habasit product may have a better chemical resistance rating than given in this table. Be aware that contact time, temperature and concentration of the substances also affect the chemical resistance of the Habasit product.

# Appendix
# Symbols for calculations

| Term | Symbol | Metric value | Imperial value |
|---|---|---|---|
| Acceleration factor due to gravity | g | 9.81 m/s² | – |
| Adjusted tensile force (belt pull) with service factor, per m of belt width | $F'_S$ | N/m | *lb/ft* |
| Admissible tensile force, per unit of belt width | $F'_{adm}$ | N/m | *lb/ft* |
| Belt length with accumulated products | $l_a$ | m | *ft* |
| Belt pitch | p | mm | *inch* |
| Belt speed | v | m/s | *ft/min* |
| Belt tension caused by the catenary sag | $F'_C$ | N/m | *lb/ft* |
| Belt width | $b_0$ | mm | *inch* |
| Coefficient of friction belt/product | $\mu_P$ | – | – |
| Coefficient of friction belt/support | $\mu_G$ | – | – |
| Coefficient of thermal expansion | $\alpha$ | $\frac{mm}{m \cdot °C}$ | $\frac{inch}{ft \cdot °F}$ |
| Conveying distance, horizontal projection | $l_1$ | m | *ft* |
| Conveying height | $h_0$ | mm | *inch* |
| Distance between bearings | $l_b$ | mm | *inch* |
| Distance between conveyor shafts | $l_0$ | m | *ft* |
| Effective tensile force (belt pull), per m of belt | $F'_E$ | N/m | *lb/ft* |
| Height of catenary sag | $h_C$ | mm | *inch* |
| Length of catenary sag | $l_C$ | mm | *inch* |
| Mass of belt / m² (weight of belt / m²) | $m_B$ | kg/m² | *lb/sqft* |
| Mass of product / m² (weight of prod. / m²) | $m_P$ | kg/m² | *lb/sqft* |
| Nominal tensile strength, per m of belt width | $F'_N$ | N/m | *lb/ft* |
| Operation temperature | T | °C | *°F* |
| Pitch diameter of sprocket | $d_P$ | mm | *inch* |
| Power, motor output | $P_M$ | $k_W$ | *PS* |
| Service factor | $c_S$ | – | – |
| Shaft deflection | f | mm | *inch* |
| Shaft diameter | $d_W$ | mm | *inch* |
| Shaft load | $F_W$ | N | *lb* |
| Speed factor | $c_V$ | – | – |
| Temperature factor | $c_T$ | – | – |
| Torque of motor | $T_M$ | Nm | *in-lb* |
| Total geometrical belt length | $l_g$ | mm | *inch* |

# Appendix
# Symbols for illustrations

| Term | Symbol | Metric value | Imperial value |
|---|---|---|---|
| Belt | BE | | |
| Belt thickness | S | mm | *inch* |
| Catenary sag | CA | – | – |
| Distance between end of slider support and sprocket shaft center | C | mm | *inch* |
| Flight indent (free belt edge) | E | mm | *inch* |
| Free belt edge outside of side guard | F | mm | *inch* |
| Height of flights | H | mm | *inch* |
| Hub size (shaft diameter) of sprocket, square or round | B | mm | *inch* |
| Idling shaft | U | – | – |
| Length of flight module | L | mm | *inch* |
| Level (height) of belt surface from the shaft center | $A_0$ | mm | *inch* |
| Level (height) of slider support from the shaft center | $A_1$ | mm | *inch* |
| Motor/drive shaft | M | – | – |
| Partial belt lengths | $D_1$, $D_2$ | mm | *inch* |
| Pitch diameter of sprocket | $d_p$ | mm | *inch* |
| Retainer clip for sprockets | RC | – | – |
| Slider shoe for hold-down or support of belt | SH | – | – |
| Slider support return side | SR | – | – |
| Slider support transport side | ST | – | – |
| Snub roller | SN | – | – |
| Sprocket | SP | – | – |
| Sprocket distance | a | mm | *inch* |
| Sprocket distance to belt edge | X | mm | *inch* |
| Take-up device (tensioning device) | TU | – | – |
| Thickness of transfer plate | K | mm | *inch* |
| Width (length) of sprocket hub | $B_L$ | mm | *inch* |

# Appendix
# Conversion of units

| Metric units | | Multiply by ... > for imperial units | | | Multiply by ... > for metric units | | |
|---|---|---|---|---|---|---|---|
| **Length** | | | | | | | |
| mm | millimeter | 0.0394 | *in* | *inch* | 25.4 | mm | millimeter |
| m | meter | 3.281 | *ft* | *foot* | 0.3048 | m | meter |
| **Area** | | | | | | | |
| $mm^2$ | square-millimeter | 0.00155 | *$in^2$* | *square-inch* | 645.2 | $mm^2$ | square-millimeter |
| $m^2$ | square-meter | 10.764 | *$ft^2$* | *square-foot* | 0.0929 | $m^2$ | square-meter |
| **Speed** | | | | | | | |
| m/min | meter/minute | 3.281 | *ft/min* | *foot/minute* | 0.3048 | m/min | meter/minute |
| **Mass** | | | | | | | |
| kg | kilogram | 2.205 | *lb* | *pound-weight* | 0.4536 | kg | kilogram |
| **Force** | | | | | | | |
| N | Newton | 0.225 | *lbf* | *pound-force* | 4.448 | N | Newton |
| **Strength** | | | | | | | |
| $N/mm^2$ | Newton/ square-millimeter | 145 | *psi = lbf/$inch^2$* | *pound-force/ square-inch* | $6.89 \cdot 10^{-3}$ | $N/mm^2$ | Newton/ square-millimeter |
| **Power** | | | | | | | |
| kW | kilowatt | 1.341 | *hp* | *horsepower* | 0.7457 | kW | kilowatt |
| **Torque** | | | | | | | |
| Nm | Newton-meter | 8.85 | *in-lb* | *inch-pound* | 0.113 | Nm | Newton-meter |
| **Temperature** | | | | | | | |
| °C | Celsius | 9 · (°C/5) + 32° | *°F* | *Fahrenheit* | 5/9 · (°F -32°) | °C | Celsius |

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# Notes

# Notes

# Notes

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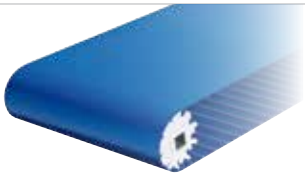
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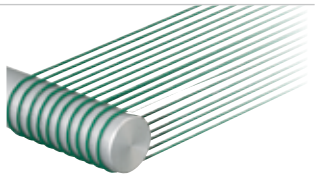
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