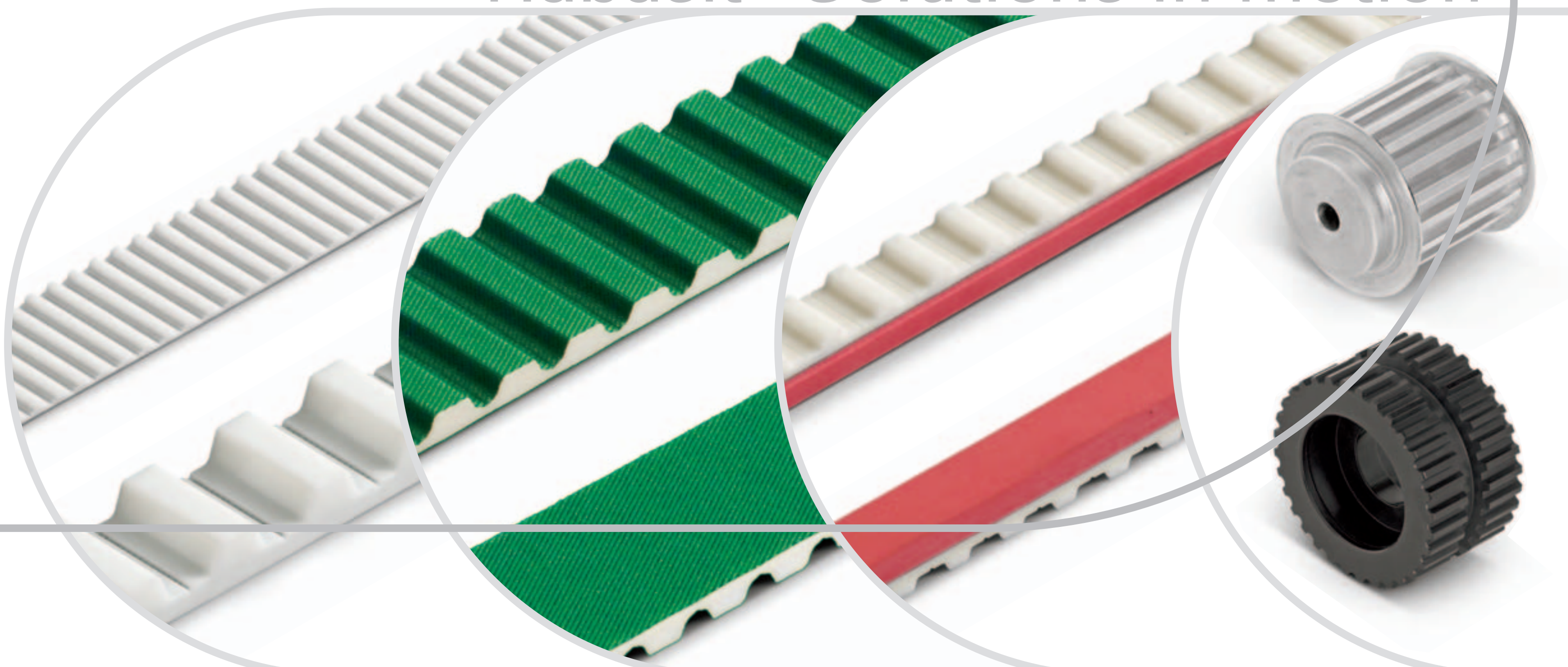
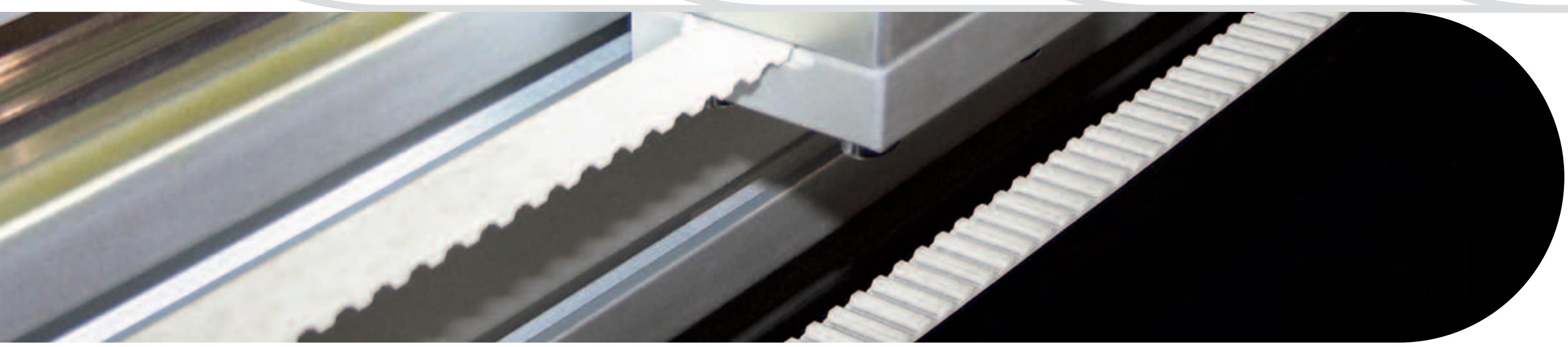
Services
Media No. 6018

Engineering Guidelines HabaSYNC® – Timing Belts

Habasit – Solutions in motion





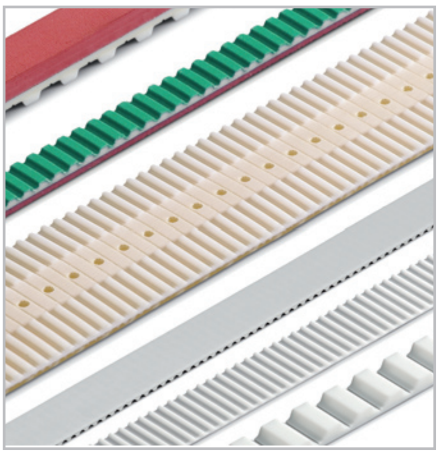
Contents

The Habasit Solution

Habasit is the worldwide market leader in the belting industry, providing the entire range of belts and delivering the highest levels of service. Our key objective is to offer superior solutions in motion for our customers. Anywhere. Anytime.

HabaSYNC®
Invaluable in countless applications, open-ended polyurethane timing belts are stable at high operating speeds. They are used wherever synchronous or parallel conveyors, accumulation, positioning conveying, capstan haul-offs, linear drives, indexing conveyors are required.

Your solutions partner
Habasit is committed to understanding your design parameters and application needs. After reviewing your requirements, our specialists will suggest the best solution for each application and cooperate closely with you for a perfect implementation.



The complete range of products
To meet all your needs, we supply plastic modular as well as fabric belting, accessories and gears. Based on over 60 years of experience and continuous innovation, you receive the best solution for your application. Exactly the right products, right on time.

Major investments in R&D
Because your belting challenges never let up, we have dedicated more than 3% of our employees to the research and development of new products and to improving our existing range. We own the best laboratory facilities in the industry, and the annual R&D budget for belts is over 8% of the company's turnover.

Unparalleled global service coverage
Habasit serves you through its more than 30 fully owned Affiliated Companies around the world. Every company has its own inventory, fabrication, assembly and service facilities. Each one is committed to customers with a single aim: to react on time, expertly and reliably.

Full commitment of the leading global belting supplier
Our entire organization of more than 3,300 employees is dedicated to meeting your needs for solutions in motion. No matter how fast they develop. At all times, Habasit is driven by the absolute commitment to adding true value to your business.

For additional information please visit: www.habasit.com

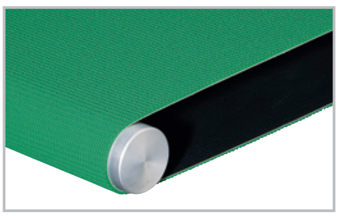
The Habasit Solution

Worldwide leading product range
Habasit offers the largest selection of belting, conveying, processing and complementary products in the industry. Our response to any request is exactly your best solution.

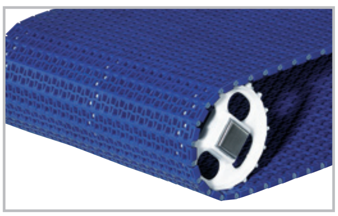
Certified for quality
We deliver the highest quality standards not only in our products and solutions, but also in our employees' daily work processes.
Habasit AG is certified according to ISO 9001:2000.

Certified Management System SQS ISO 9001

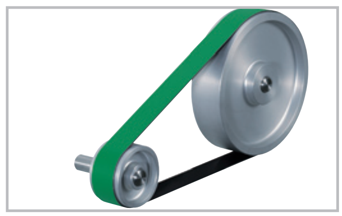
Our key product ranges



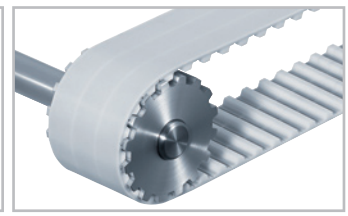
HabaFLOW®
Fabric-based conveyor and processing belts



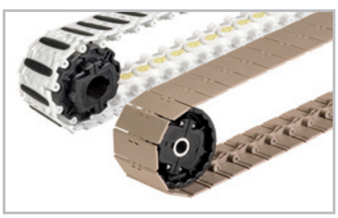
HabasitLINK®
Plastic modular belts



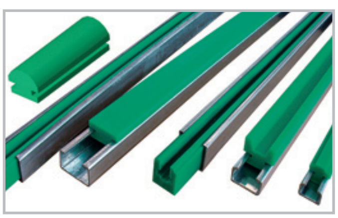
HabaDRIVE®
Power transmission belts



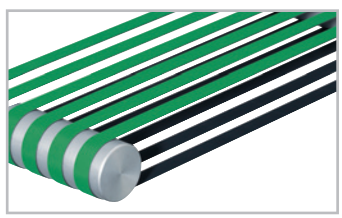
HabaSYNC®
Timing belts



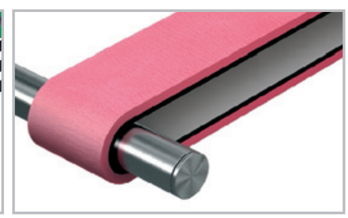
HabaCHAIN®
Slat and conveyor chains



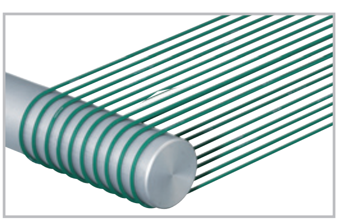
HabiPLAST®
Profiles, Guides, Wearstrips



Machine tapes

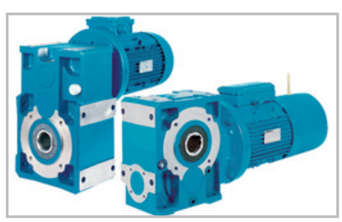


Seamless belts

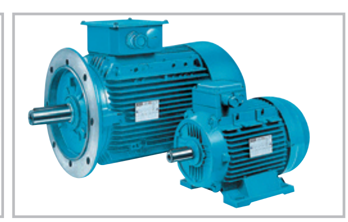


Round belts

Fabrication tools (joining tools)



Gear reducers, Gear motors, Motion control



Electric motors

Introduction
HabaSYNC® applications

Industries/Applications
Business machines
Materials handling
Printing, paper, postal
Food
Packaging
Textiles
Automation

Business machines
- Large format printers
- Engineering plotters
- Tape libraries
- Document storage systems
- Copiers
- Lifts and elevating devices
- XY and XYZ movement devices
- Labeling equipment

Materials handling
- Glass conveying systems
- Wood and veneer conveying systems
- Brick and aggregate conveying
- Semiconductor wafer conveying
- Circuit board conveying
- Assembly line conveying
- Pick-n-place conveying and placement
- Package handling
- Exercise equipment
- Automatic storage and retrieval systems
- Tile conveying
- Sheet metal stamping lines
- Wallboard manufacturing lines

Printing, paper and postal
- Diverters
- Collators
- Inserters
- Cutting lines
- Distribution and feed-off lines
- Sheet processing
- Document feed systems
- Diaper-making equipment
- Hygienic product manufacture

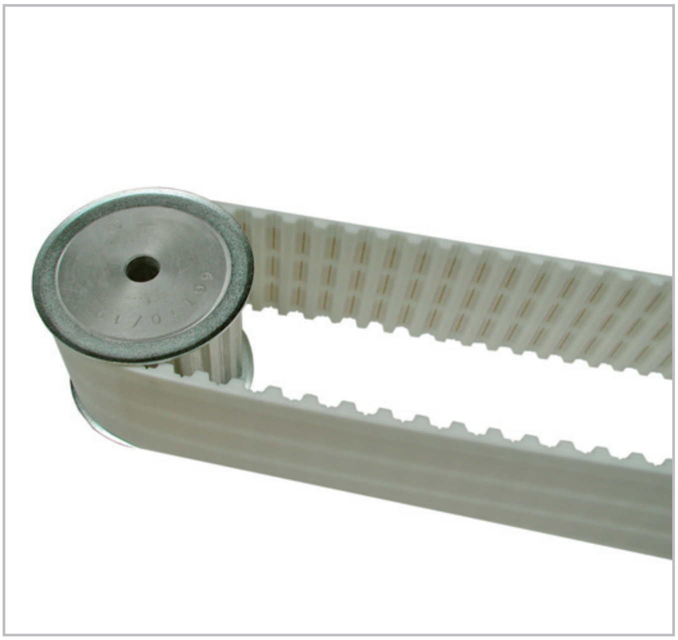
Food
- Tray conveying
- Sizing lines
- Consumer goods finished products
- Packing lines
- Assembly lines
- Distribution lines
- Fruit and vegetable conveying lines
- Packaged snack lines
- Filling lines
- Candy lines

Packaging
- Bottling lines
- Filling lines
- Finished product packing

Textiles
- Fabric cutting lines
- Pattern scanners
- Circular knit machines

Automation
- Door openers
- Garage openers
- Gate openers
- Car wash drives
- Lifting assemblies/mobility lifts
- Robotic positioning
- Pick-n-place assembly lines
- Semiconductor assembly
- Assembly line automation
- Vending machines
- Tire-making equipment
- Linear actuators
- Window-making lines
- Furniture assembly lines
- Exercise equipment

Habasit thermoplastic polyurethane TPU timing belts provide precise indexing and accurate positioning for conveying and linear movement applications due to the precise interface that occurs when accurately formed belt teeth mesh with matching pitch pulleys.



HabaSYNC® thermoplastic polyurethane timing belt benefits include:
- High strength cords for longitudinal stability and low elongation
- Exact tooth molding, meaning high positional accuracy – no belt slip
- Strong abrasion resistance
- Truly encapsulated cord

In application these benefits yield:
- Quiet running performance
- Efficient operation
- Structural flexibility for streamlined design
- Oil and ozone resistance
- Low installed tension meaning low bearing loads

State-of-the-art manufacturing equipment and innovative manufacturing processes enable us to produce high quality perfectly formed tooth designs. When intermeshed with pulleys, HabaSYNC® timing belts offer positive synchronization that yields low noise and vibration.

Additional features include:
- Polyamide facings that deliver a low coefficient of friction and excellent abrasion resistance.
  This allows slider bed applications or accumulation of heavy goods moved
- Well developed joining technology that delivers excellent length of life and low bending fatigue

HabaSYNC® timing belts are manufactured from two primary materials:
Thermoplastic polyurethane is the elastomer, with a tensile cord reinforcement that can be either steel or aramide.

Our standard product is manufactured from thermoplastic polyurethane in 92 Shore A hardness polyester polyurethane, which is white in color.

Polyurethane is the preferred choice of elastomer due to its high strength and application performance. Thermoplastic polyurethane also allows the belt to be finished to any length by using a thermal welding process.

HabaSYNC® thermoplastic polyurethane (TPU) advantages include:

- Excellent dimensional stability
- Excellent wear resistance
- Excellent chemical resistance
- High tear resistance
- High tooth-shear strength
- Runs with no lubrication; no maintenance
- Precision-formed teeth
- High linear and angular positioning precision
- Good temperature range
- Good structural flexibility

Thermoplastic polyurethane
HabaSYNC® timing belts are highly resistant to abrasion. They are ideal for applications that require extremely clean running conditions. 92 Shore A hardness polyurethane provides greater stiffness than less hard materials such as rubber or softer urethanes. As a result, our teeth have less deflection, which provides more efficient belt-to-pulley meshing. The end result is better overall drive performance.

Standard material	Code	Hardness	Properties	Cord	Temperature range
White thermoplastic polyurethane	01 TPU	92 Shore A	• Homogeneously molded teeth • Highly resistant to abrasion • Long shelf life, no aging • Resistant to ozone, oils and grease	S = Steel A = Aramide	-30 to +80 °C -22 to +176 °F

Steel or aramide cords
Both steel and aramide cord tensile members offer significant, but still flexible stiffness. This is important in linear drive and precision conveying applications where minimal creep is needed, with structural flexibility required to yield precise bi-directional movement and accurate positional product placement.

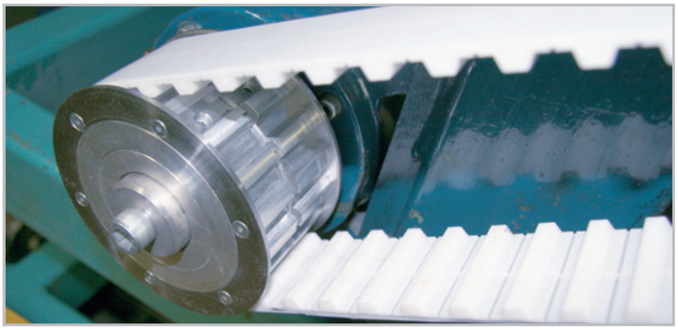
Our tensile cords yield low elongation that delivers high positional accuracy and excellent structural flexibility. All this means long life with little or no re-tensioning required.

Truly encapsulated cord reinforcement
Accurately machined tooling and a state-of-the-art tension control system allow for precise placement of steel or aramide cords in the body of each pitch belt. In our standard product, pre-designed slit lanes are engineered to ensure slitting does not cut into and expose the cord reinforcement.

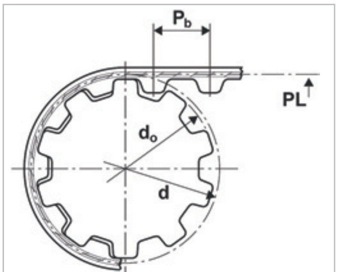
Introduction
Timing belt nomenclature

HabaSYNC® timing belts are made up of several key component parts. Each must complement the other precisely in order to provide a highly effective synchronous drive solution.

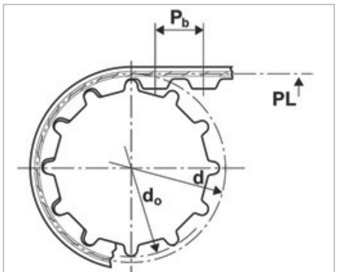
Geometry-related nomenclature: Teeth
The teeth on a timing belt are responsible for the intermeshing action that occurs when a timing belt and pulley are engaged. HabaSYNC® teeth are homogeneously formed through extrusion. They mesh with matching pulleys to yield accurate positioning of the belt, allowing the component or product being conveyed to be in the right place at the right time.



The teeth on HabaSYNC® standard belts are designed with a trapezoid form. The trapezoid tooth has straight-line dimensions.

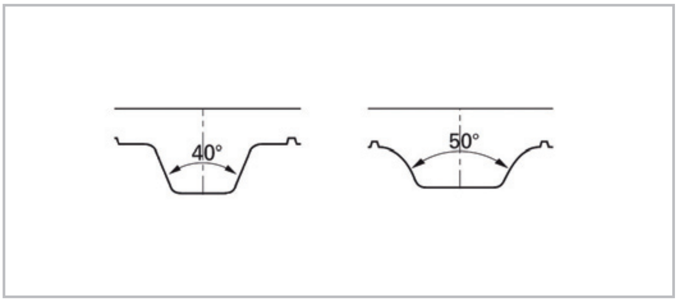


Trapezoid

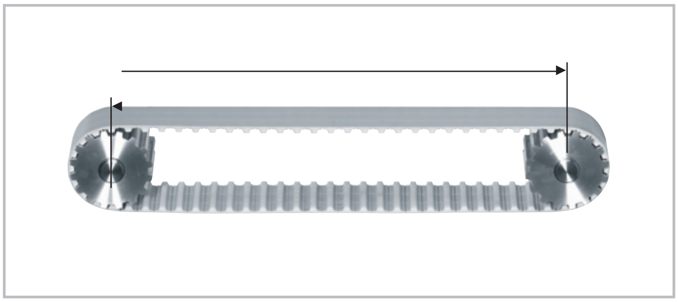


Modified Trapezoid

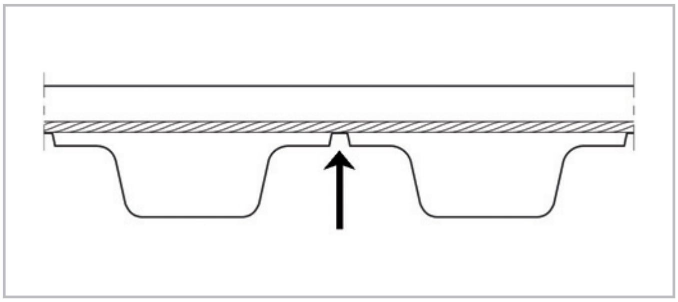
Tooth angle
The tooth angle identifies the necessary geometry for the belt. The matching pulley of the trapezoid shape pulley must be designed to mesh with the belt to operate at optimum. A perfectly formed tooth angle will intermesh with matching pulleys and deliver high accuracy. This is a key factor that assures accurate positional placement in synchronous conveying and linear movement applications.



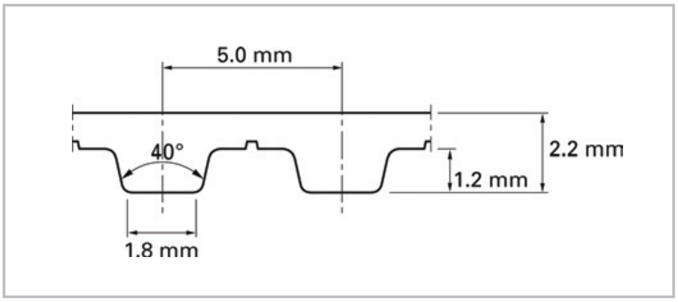
Center distance
The center distance of a two pulley belt drive is measured from the center of one pulley to the center of the next.



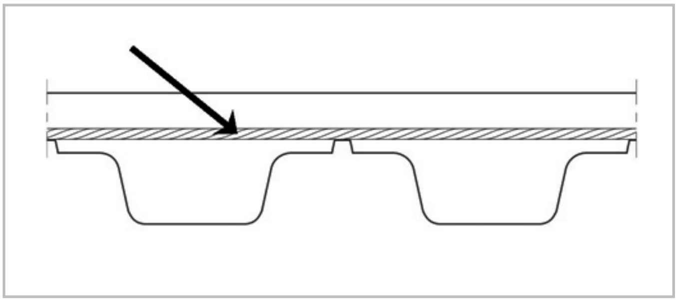
Flight
The flight is a machined point on the tool that is designed to locate cord placement. This critical position for cord resting ensures that the belt will mesh smoothly. It yields low drive noise and delivers vibration-free interaction with the pulley. The flight is a key part of the mold design. It is also an important factor for determining the pitch belt length of a belt.



Measurement nomenclature: Tooth pitch
The tooth pitch is the accurate measurement of the distance from the vertical centerline of one tooth to the vertical centerline of the next tooth. T and AT pitch belts are measured in millimeters. Imperial pitch belts are measured in inches.

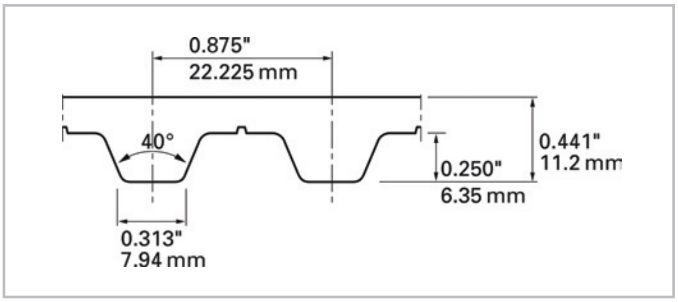


Pitch line
The pitch line is the centerline of the cord measured around the entire belt length. The measurement of the cord around the entire belt is the result of the cord resting on each flight as the belt is made. The belt length is calculated from the pitch line.



Total height
The total height of a (single-sided) belt is the measurement from the tip of the tooth to the conveying surface of the belt. The tooth height is indicated on the drawing as well.

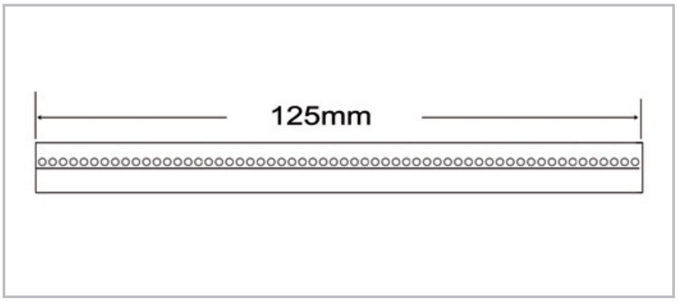
Imperial pitch belts are typically measured in inches; metric pitch belts are measured in millimetres.



Belt width
This is the actual measured dimension of the width of the belt.

Metric belts are measured in millimeters.
For example, a "25" is used to specify 25 mm width and "100" is used to specify 100 mm width.

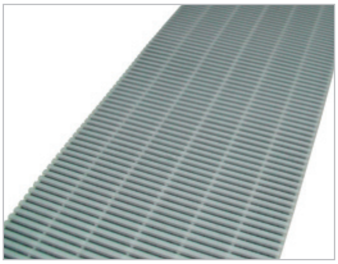
Imperial timing belts are measured in inches and are noted to 3 digits. For example "200" is a 2.00 inch belt width and "075" is a 0.75 (3/4) inch belt width.

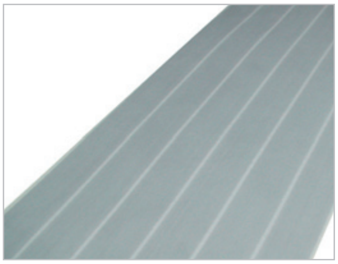


Slitting lane
A slitting lane is a pre-determined location in the belt length that allows precision slitting to specific widths without exposing the cord.

Standard HabaSYNC® slitting lanes are 25 mm and 16 mm increments for metric pitch belts, 0.75 and 1 inch increments for imperial pitch belts.

HabaSYNC® belts can be customized with no slitting lanes.
Contact: info.habasync@habasit.com for details.





HabaSYNC® slitting lanes	
Standard	
Imperial pitch	3/4, 1, 2, 3, 4, 5 and 6
Metric pitch	16, 25, 32, 50, 75, 100, 125, 150
Specials	On demand

HabaSYNC® timing belts are highly effective in conveying and linear movement applications offering 98–99 % performance efficiency. Homogeneously formed teeth run in matching pulleys under low installed loads to provide the synchronization required to locate a product or position a component accurately.

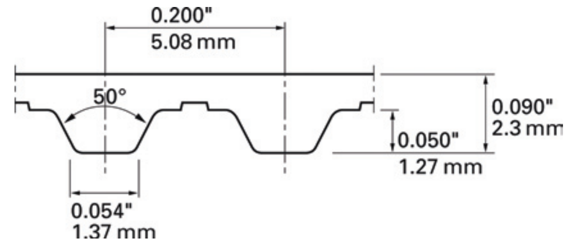
Timing belt teeth are generally formed in either a trapezoid or curvilinear design. All tooth designs will yield good results in general conveying applications. The modified trapezoid AT-series is used in bi-directional and critical product positioning applications where zero backlash is important.

Imperial pitch belts (trapezoid design)
Imperial pitch sizes include: XL, L, H and XH in standard 92 Shore A white TPU. Imperial pitch sizes are available with either steel or aramide cords.

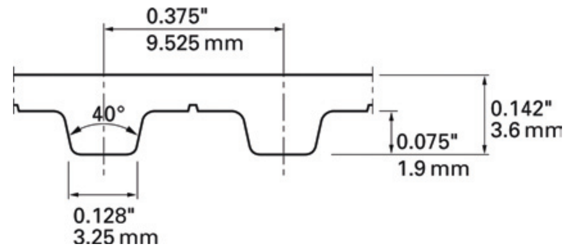
Polyamide facings are available on either the tooth side, conveying side, or on both sides.

Imperial pitch belts are extruded in 6 inch widths. Standard slitting lanes are: 0.75, 1, 2, 3, 4, 5 and 6 inch widths.

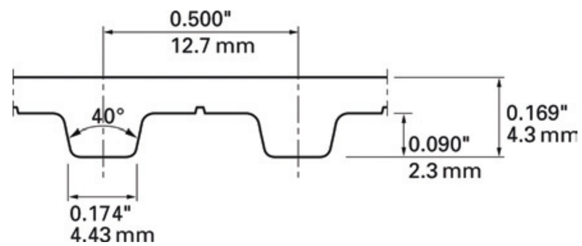
Imperial pitch belts can only be used with the respective imperial pitch timing belt pulleys.



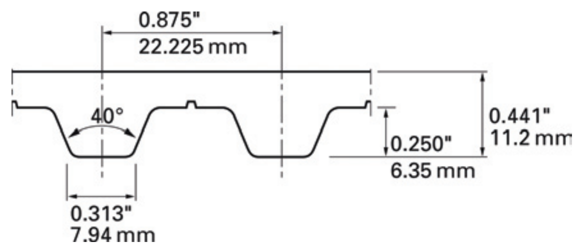
XL



L



H



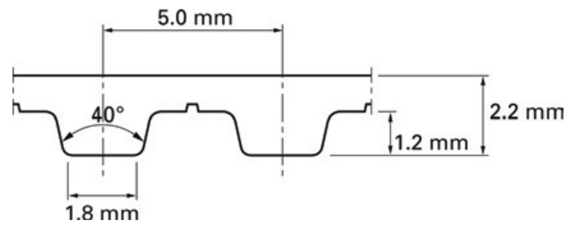
XH

Metric T belts (trapezoid design)
Trapezoid metric T pitch sizes include: T5, T10 and T20 in standard 92 Shore A white TPU. Metric pitch sizes are available with either steel or aramide cords.

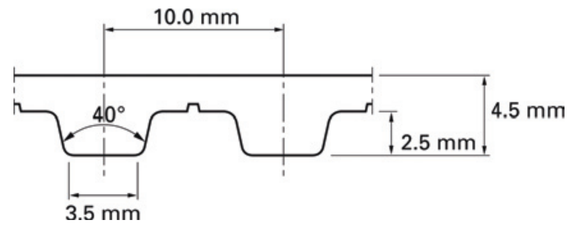
Polyamide facings are available on either the tooth side, conveying side, or on both sides.

Metric pitch belts are extruded in 150 mm widths. Standard slitting lanes are 16, 25, 32, 50, 75, 100, 125 and 150 mm widths.

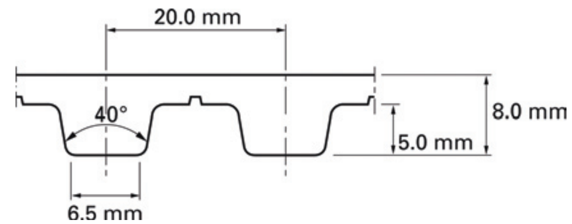
Metric pitch belts can only be run with standard metric pitch timing belt pulleys.



T5



T10



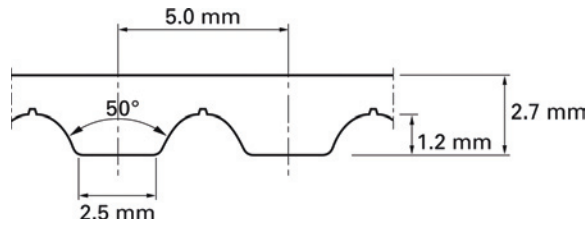
T20

Metric AT belts (modified trapezoid)
Modified trapezoid metric pitches include:
AT5, AT10 and AT20 in standard 92 Shore A white TPU. Metric AT pitch sizes are available with steel cords.

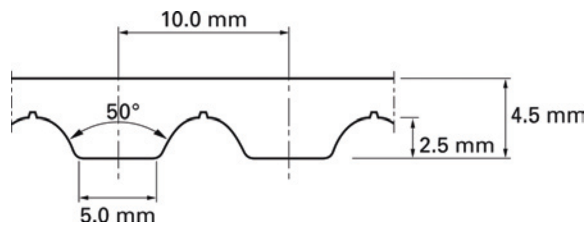
Polyamide facings are available on either the tooth side, conveying side, or on both sides.

AT pitch belts are extruded in 150 mm widths. Standard slitting lanes are: 16, 25, 32, 50, 75, 100, 125 and 150 mm widths.

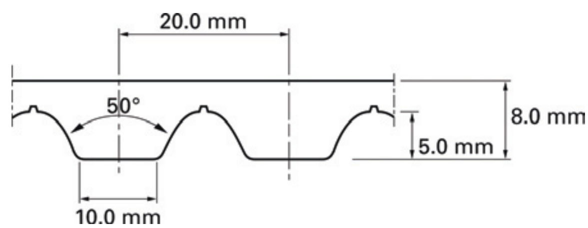
AT metric pitch belts can only be run with AT metric pitch timing belt pulleys.



AT5



AT10

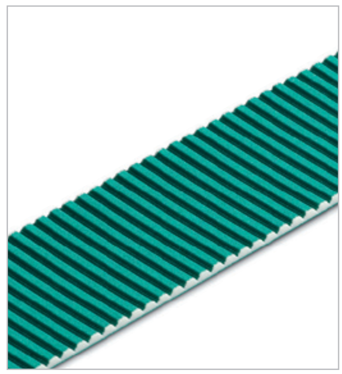
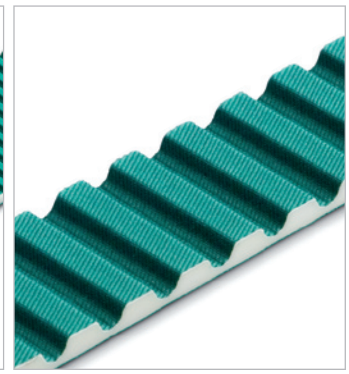


AT20

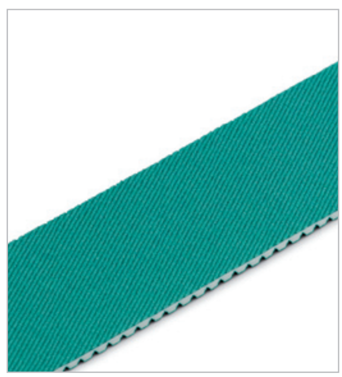
Introduction
Polyamide facings

Habasit offers different facings for our base steel and aramide timing belts with polyamide fabric to reduce the coefficient of friction (COF). A polyamide finish can also provide incremental wear resistance and offer the benefit of lower noise in certain applications.

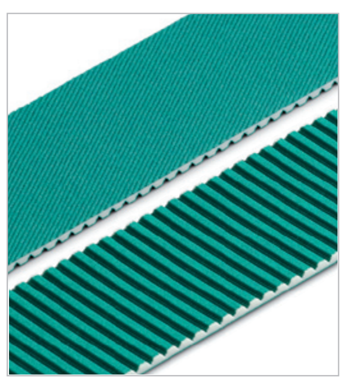
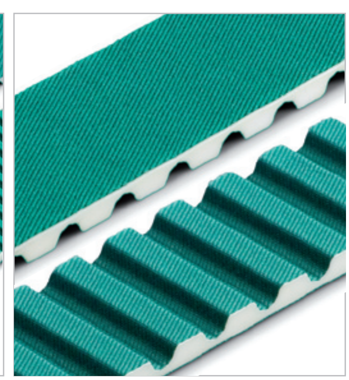
Polyamide tooth side (PT)
Polyamide added to the tooth side of the belt reduces the coefficient of friction (COF) as the belt meshes with the pulley teeth. This yields smoother tooth engagement and offers lower application noise. A lower COF can also extend wear resistance when the tooth side contacts with the slider bed in conveying applications. A side effect of this is lower energy consumption.

Polyamide conveying side (PC)
Polyamide on the conveying or reverse side of a timing belt can reduce friction between the surface of the product conveyed and the surface of the belt. This feature is beneficial in applications where backup or accumulation of product can occur. With a polyamide conveying surface the product can slip in place while belt motion continues. This can reduce wear and tear on the product conveyed.

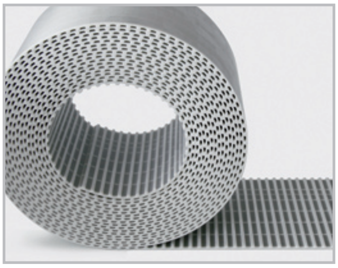


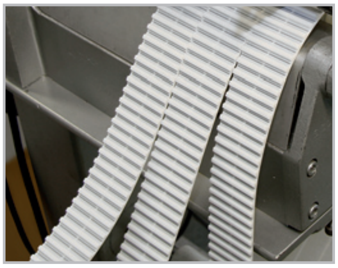

Polyamide on both tooth and conveying sides (PTC)
Polyamide on both sides of the timing belt offers reduced friction, leading to quiet, smooth conveying. This feature is particularly attractive where very fragile or sensitive products are being moved.

HabaSYNC® timing belt construction allows belts to be joined endless to any length. The joining process provides a multitude of belt length options when designing a new conveyor system. Joining takes place in four steps:

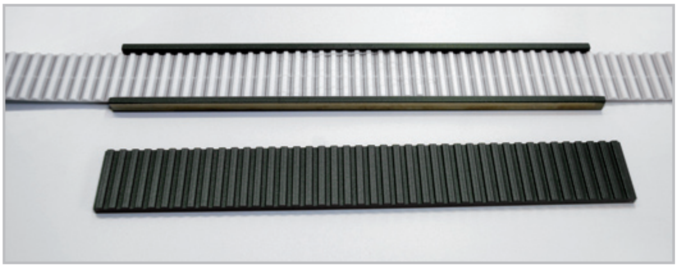
Slit to width
The HabaSYNC® belt is manufactured in open end length. We slit along pre-designed slitting lanes on the coil to create rolls of belt.



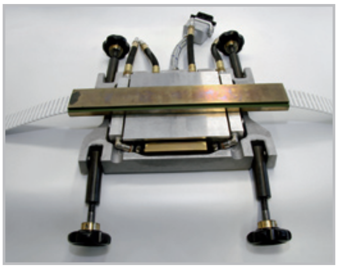


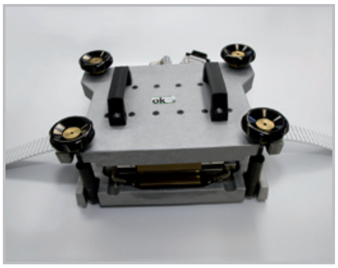
Finger cutting
In order to prepare the open end belt to be joined endless, it is cut using HabaSYNC's finger geometry to create prepared ends for the joining process. Dedicated finger geometry can be obtained using HabaSYNC® cutting dies.

Interlocking into joining plates
After fingers have been cut into both ends of the belt, the belt ends are interlocked into a HabaSYNC® fixed width joining plate.

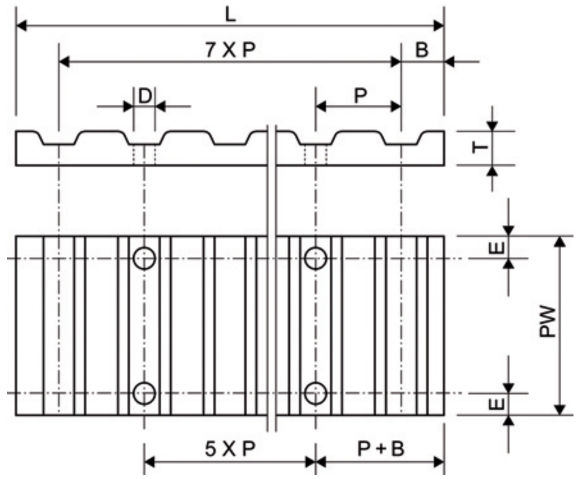


Hot pressing
After the fingers are interlocked in the joining plate, the plate is placed in the PF-150C hot-pressing device.





Clamping plates – an alternative joining mechanism
Clamping plates provide an effective joining mechanism for use in applications where the belt moves in a bi-directional fashion. In these cases the belt joint never rotates around the pulley. It simply moves backwards and forwards. Mechanical clamping plates are typically found in linear movement applications.



XL–L–H–T5–T10–T20–AT5–AT10–AT20

Clamping plates

Pitch	E (in)	D (in)	B (in)	L (in)	T (in)
XL (0.200")	0.24	0.22	0.14	1.67	0.31
L (0.375")	0.31	0.35	0.2	3.02	0.59
H (0.500")	0.39	0.43	0.35	4.21	0.87

Pitch	E (mm)	D (mm)	B (mm)	L (mm)	T (mm)
T5 (5 mm)	6	5.5	3.2	41.8	8
T10 (10 mm)	8	9	5	80	15
T20 (20 mm)	10	11	10	160	20
AT5 (5 mm)	6	5.5	3.2	41.8	8
AT10 (10 mm)	8	9	5	80	15
AT20 (20 mm)	10	11	10	60	20

Plate widths PW

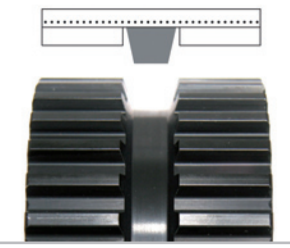
Belt width in inches	0.25	0.375	0.500	0.750	1.000	1.500	2.000	3.000	4.000
XL Plate width (in)	-	1.12	-	-	-	-	-	-	-
L Plate width (in)	-	-	1.54	1.77	2.03	1.37	3.03	-	-
H Plate width (in)	-	-	1.77	2.00	2.26	2.75	3.26	4.25	5.27

Belt width in mm	25	50	75	100
T5 Plate width	44	-	-	-
T10 Plate width	50	75	100	125
T20 Plate width	56	81	106	132
AT5 Plate width	44	-	-	-
AT10 Plate width	50	75	100	125
AT20 Plate width	56	81	106	132

HabaSYNC® attachments are added to improve the effectiveness of the belt when used in certain applications that require accurate belt tracking, product pushing, separation, indexing or actuation.

HabaSYNC® attachments include:
- Tracking guides
- Profiles
- Covers

Tracking guides
Tracking guides are attached to the drive side of the HabaSYNC® belt. They are used on long center distance conveyors where true belt tracking is critical and where pulley flanges would interfere with the product being conveyed. They are also used where cross loading or unloading of the product conveyed could cause a side load that forced the belt to one side of the conveyor.



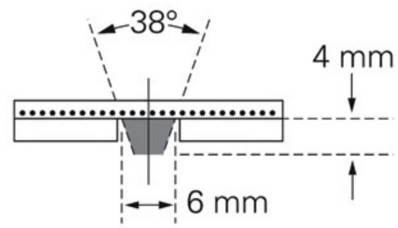
Tracking guides can also be used on linear positioning and conveyor applications where the belt is run in a vertical position rather than lying flat on a conveyor surface.

HabaSYNC® tracking guides are available in G6, G10 and G13 sizes. Our standard TPU hardness is 92 Shore A, the same hardness as the base belt.

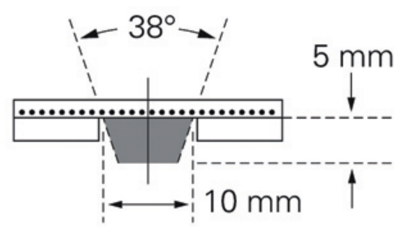
Tracking guides are typically notched to allow maximum flexibility of the belt when running around pulleys.

For information on special colors or other hardness guides contact: info.habasync@habasit.com

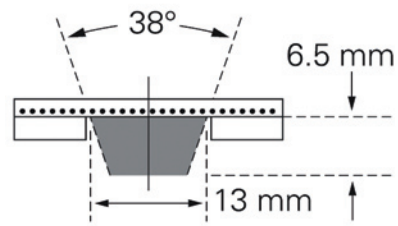
HabaSYNC® tracking guides must run in timing belt pulleys designed with a matching groove to fit the tracking guide dimension. Here are the matching pulley profiles for G6, G10 and G13 guides:



G6



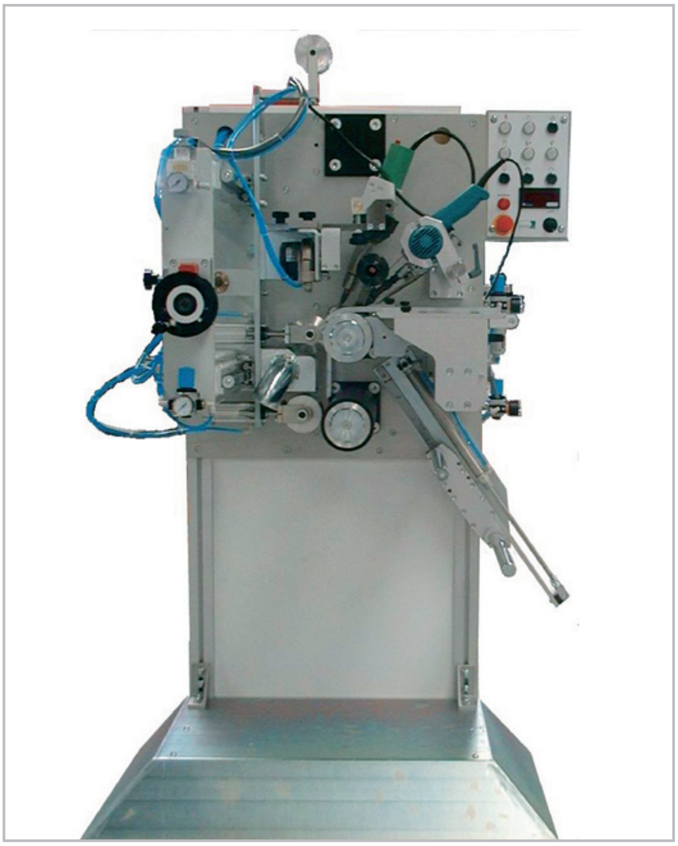
G10



G13

Methods of guide installation

Tracking guide welding
Tracking guides can be applied in two ways:
1. In line at extrusion
2. Heat welded



Tracking guides can be applied at the same time as the base belt is made. Using a special mold the guide can be added as a homogeneous part of the belt. This process ensures that the guide will be securely and accurately placed on the belt.

Tracking guides can also be placed on the belt using heat. This option provides the greatest degree of design flexibility.

In the first step the teeth in the area where the guide is to be placed are removed. Once removed, a thermoplastic polyurethane guide made of the same material as the belt is attached by using a heat welding process, such as the Habasit WB-301 machine.

Because both the belt and the guide are made of the same melt-point material, the guide will securely attach to the belt.

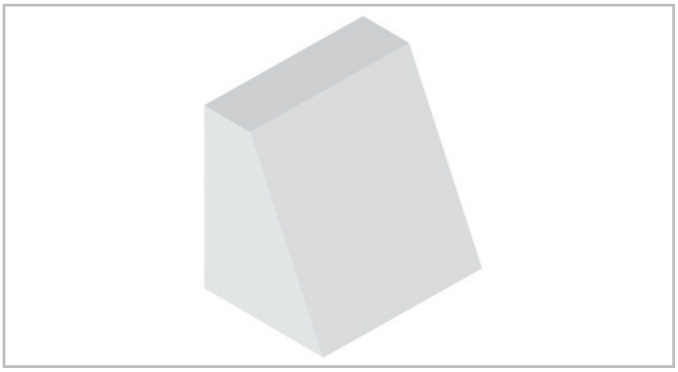
All guides are then notched to ensure maximum flexibility in application. Notching should be done in line with the flight position on the belt. This will provide maximum flexibility.

Profiles are attachments placed on the conveying side of HabaSYNC® belts. Profiles, available in 92 Shore A hardness TPU, provide a simple solution for conveying applications that require indexing, product separation, component placement or exact guidance of the product being conveyed.

Thermoplastic polyurethane profiles can be easily added to HabaSYNC® TPU timing belts with both manual and automated equipment. The choice of equipment is typically related to the quantity and complexity of the profile design.

HabaSYNC® profiles can be produced in three ways. Manufacturing processes include:
1. Machining
2. Injection molding
3. Extrusion

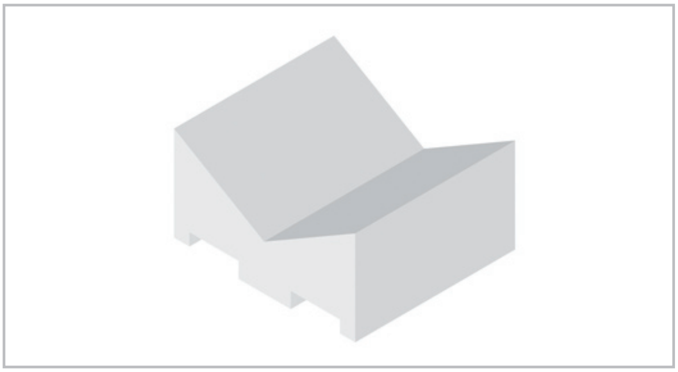
Machining
Machined profiles are produced with CNC equipment designed to machine plastic. We hold material in square or rectangular shapes in 92 Shore A hardness in stock, which can be machined to provide any HabaSYNC® standard design.



Typically, machined profiles are chosen when small to medium production quantities are required, for example for prototypes where several variations in design must be evaluated before molds or dies can be justified, and where complex designs may prohibit the use of more advanced welding methods.

Machined profiles are usually easily obtained with short lead-times.

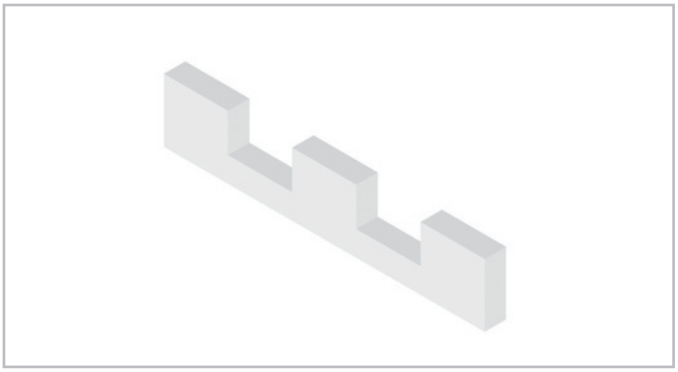
Injection molding
Profiles can be injection molded if the profile design is conducive to the molding process and if volumes are large enough to justify mold investment.



HabaSYNC® injection molded profiles can be produced in the same material as the base belt, and in many cases can be produced up to 6 inches or 150 mm wide to match the widest standard belt produced by Habasit.

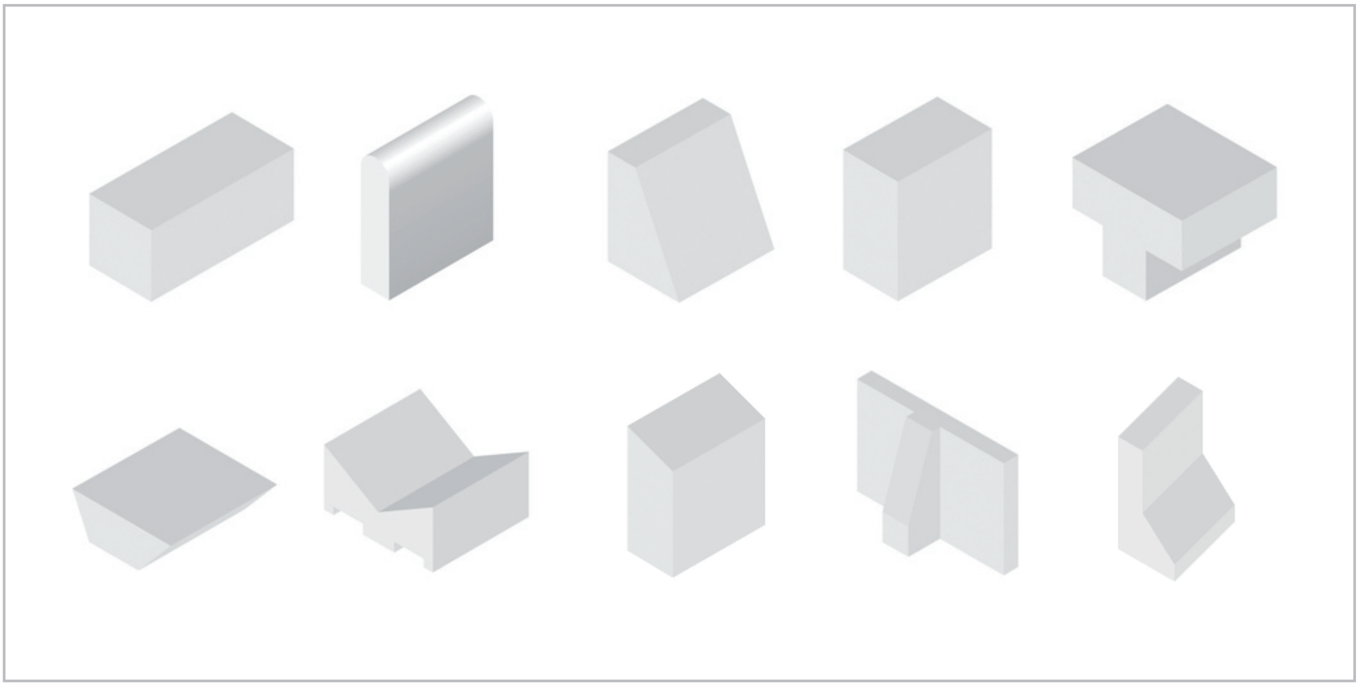
Extrusion
Where larger quantities of profiles are needed, extrusion can be an economical option. Traditional Habasit extruded conveyor belt profiles may also be considered as an option if a softer material hardness is sufficient. Traditional conveyor belt stock profiles offered by Habasit are in the range of 85 Shore A hardness.

If you have any questions on the right profiles to use, please contact: info.habasync@habasit.com.

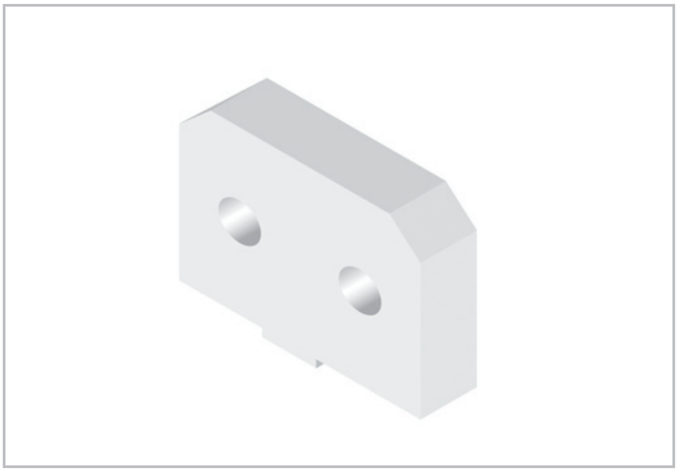


Profile availability
HabaSYNC® 92 Shore A profiles are available in both standard stock and standard made-to-order versions. In addition, custom made-to-order profiles are available on demand.

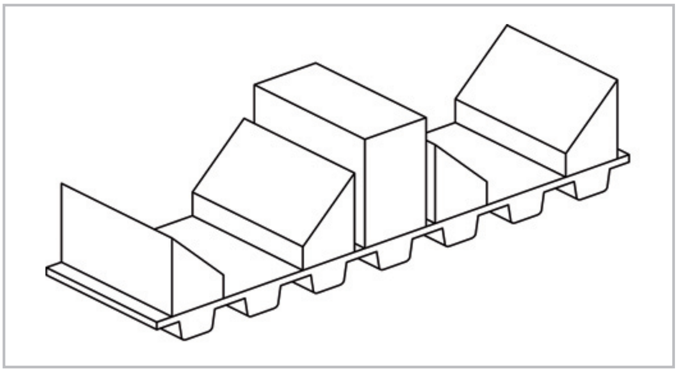
Standard stock profiles
Habasit has identified those profiles that are most popular in general conveying applications. These profiles are shown below.



Standard made-to-order profiles



Custom made-to-order profiles
In many applications a standard profile design will not suffice. Habasit can design custom profiles to meet the exact needs of your design. Please consult your local Habasit representative to discuss the details.



The drawing to the left shows an example of a custom profile designed for a battery conveying application. In this case, the batteries are securely held between the profile openings.

Guidelines for profile design

- Profile spacing: We suggest that the spacing of profiles should be a multiple of the belt pitch being used. This provides for a whole number of profiles on the belt, and easily considers tolerances from one profile to the next.
- Dimension of the profile base: Ideally the base of the profile should be as thin as possible to ensure maximum flexibility. The profile should be welded directly over the tooth of the belt to provide maximum flexibility.

As the thickness of the profile base increases, so does the need for larger pulleys.

Minimum number of pulley teeth for profiles over a tooth

Profile base thickness in	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4
mm	1.6	3	5	6	8	10	11	13	16	19
XL	10	10	18	25	40	50	60	100	-	-
L	12	12	12	28	30	40	50	60	100	-
H	14	14	14	14	18	25	35	45	80	100
XH	18	18	18	18	18	18	18	20	35	50
T5	12	12	18	25	40	50	60	100	-	-
AT5	15	15	18	25	40	50	60	100	-	-
T10, AT10	16	16	16	16	18	25	35	45	80	100
T20, AT20	18	18	18	18	18	18	18	20	35	50

Minimum number of pulley teeth for profiles NOT over a tooth

Profile base thickness in	1/16	1/8	3/16	1/4	5/16	3/8	7/16	1/2	5/8	3/4
mm	1.6	3	5	6	8	10	11	13	16	19
XL	12	30	45	50	60	100	-	-	-	-
L	12	20	40	45	55	60	70	80	100	-
H	14	14	25	30	45	50	55	65	80	100
XH	18	18	20	30	40	45	50	54	58	60
T5	12	30	45	50	60	100	-	-	-	-
AT5	15	30	45	50	60	100	-	-	-	-
T10, AT10	18	20	30	40	45	50	55	65	80	100
T20, AT20	18	18	20	30	40	45	50	54	58	60

- **Profile strength:** The strength of the profile weld is a direct factor of the dimension of the base weld. When reviewing profile strength, it is vital to consider the direction of force on the profile and the location of the force.
- **Wide base profiles:** In many cases, the profile will be welded to a belt leaving one side of the base to float. In other words, part of the profile is not welded to the belt surface. This provides maximum flexibility over the pulley.

Please contact your local Habasit representative to discuss your application and required tolerances.

Methods used to fabricate profiles
Attachments can be welded to HabaSYNC® belts using various welding processes, including a hot knife, hot air or high frequency welding equipment. Profile complexity and the quantity of profiles needed are two factors that typically help to define the process selected. Equipment can range from manual to automated.

Manual fabrication
This is typically used where small quantities of profiles are required. It is also used where the design of the profile may be too complex and not conducive to special tooling for automated attachment.

In order to bond the profile to the belt conveying surface, a hot knife or heat gun can be used.
Both the surface of the belt and that of the profile must be processed with heat to enable a satisfactory bond to take place. A disadvantage of this process is the residue or bead flash created from the molten urethane. To ensure a clean-looking result, and for certain application requirements, the bead should be trimmed away.

Automated fabrication equipment
Several contact and non-contact technologies can be used to weld thermoplastic profiles to HabaSYNC® belts. This included:

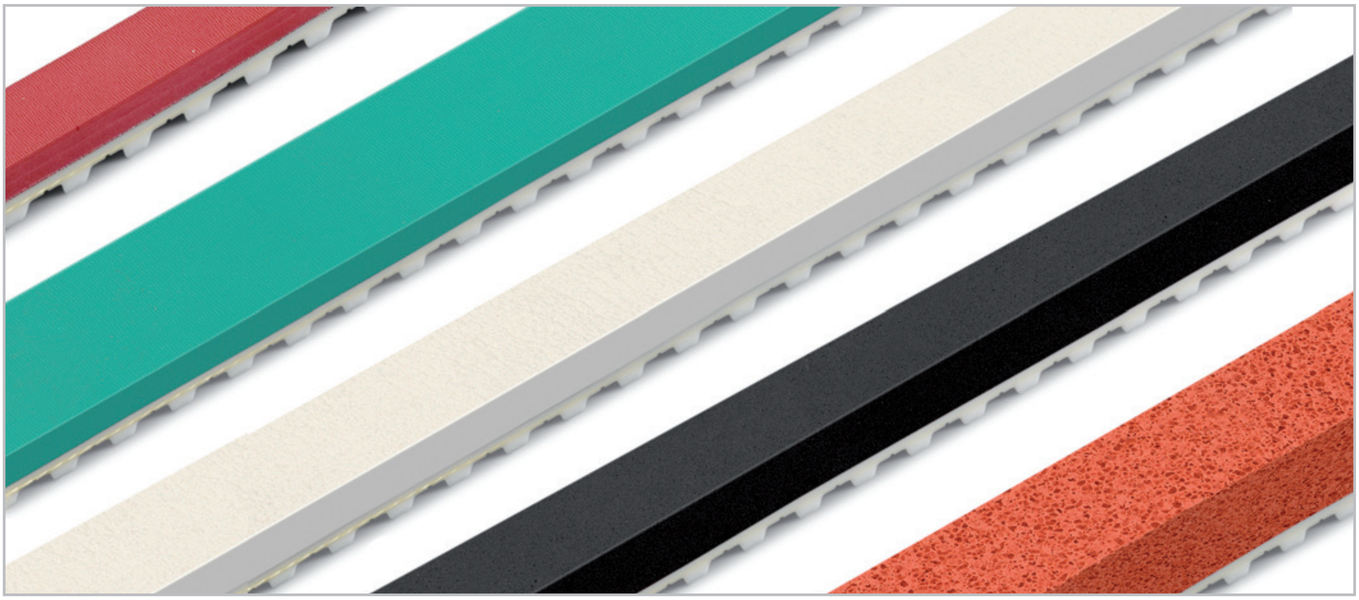
- Ultrasonics
- Induction heating
- HF technology

Habasit Italiana HF equipment, such as the WB-604H, may be used with traditional Habasit extruded profiles. Electrodes will be required and can be obtained from Habasit Italiana through your local Habasit affiliate. Please consult Habasit to ensure that your machine is capable of being used with both aramide and steel cord belts.

Contact your local Habasit representative to discuss your profile application and to determine the best process for your application.

Introduction
Covers

HabaSYNC® timing belts can be supplied with a variety of cover choices that offer benefits in conveying and product movement applications. Materials that offer higher or lower friction, additional wear resistance, compressibility, shock absorption, and ease of release characteristics can be supplied.



Features and benefits offered with HabaSYNC® covered timing belts

Traditionally, higher coefficient of friction materials such as Linatex and gum rubber are used to increase grab on incline or feed applications.

High friction	35A Red NR
	40A Tan NR
	55A Green NR
	85 A Polyurethane
	60A White Nitrile (G06)
	60A White EPDM
	40A White Neoprene
	52A Yellow PU Foam
	PVC Rough Top
	Linatex Rubber
	Blue Polyurethane

In many applications such as those in accumulation conveyors, the product conveyed must be held stationary while the belt continues to operate. If the belt cover friction is too high, it can cause a conveying disruption. In such cases, a polyamide facing on the conveying side (PC) can be used to reduce friction. Several other materials may also be considered.

Low friction	Silicone
	Polyamide
	Teflon
	Polyamide Fabric
	Nomex Fabric

Increased covers of TPU and PVC can provide longer belt life in applications where abrasion is a factor. Some choices are:

Additional wear resistance	55 A Green PU
	60 A Red EPDM
	52 A Yellow PU

In many applications a softer material, such as sponge rubber, can be placed on the conveying side of the belt to help fit the product to the surface it is conveyed on. Some choices are:

Compressibility	75 A Polyurethane
	52 A Yellow PU Foam
	Black Neoprene Sponge
	Black Polyolefin Foam
	Orange Natural Rubber

In many transfer conveying applications, products are moved from one level to the next. In some cases precautions must be taken to ensure that the product does not drop too hard. A cushioning effect can be obtained with:

Shock absorption	PU – Foam and Flat Stock
	Rubber – Foam and Flat Stock

In many conveying applications sticky or hot products are conveyed. Without the aid of easy release, product covers would stick and not discharge easily from the belt surface. HabaSYNC® belts can be covered with materials such as silicone and EPDM for ease of release.

Ease of release	Silicone
	EPDM

Introduction
Modifications and accessories

In many applications, particularly those in general conveying, modifications may be made to HabaSYNC® to enhance product movement performance.

Modifications are changes made to the base belt and possibly to the attachments placed on the belt to improve and or control product movement.

Modifications that can made to HabaSYNC® belts include:
- Profile grinding
- Surface grinding
- Routing
- Lateral and longitudinal machining
- Slotting and hole punching

Modifications are typically designed for the following types of applications:
- Vacuum/hold down conveyors
- Product capture points
- Sizing and separation of material conveyed
- Attachment ports for metal clamps or profiles
- Applications where precision thickness tolerances are required

Modifications are largely dependent on application circumstances. Please contact your nearest Habasit representative to discuss your specific needs.

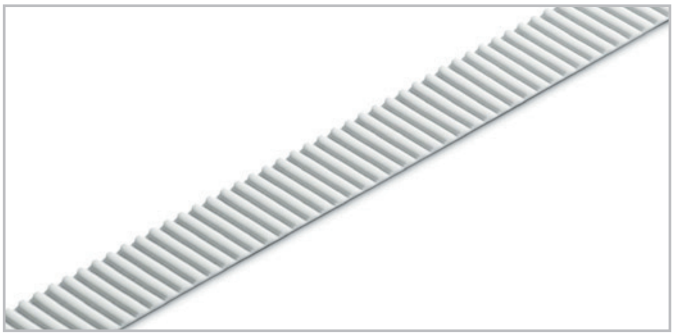
Accessories
Pulleys, clamps and guide plates complement most applications involving conveying and linear movement. For details consult our website: www.habasync.com or contact your Habasit representative.

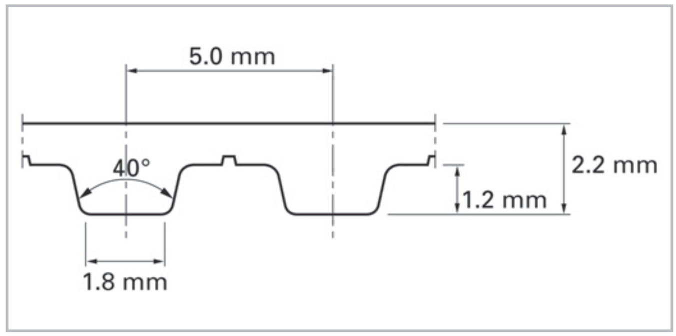
HabaSYNC®
T5 Steel

Main industry segments
Textiles, materials handling, packaging, automation and paper

Belt applications
Large format printers, automatic gate and door entry systems, automatic vending machines, window opening devices, robotic positioning arms, pick-n-place transports, small parts conveying, XYZ axis drives, textile scanning, cutting and knitting machines, media and paper conveying, electronic assembly equipment, package conveying, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 40° tooth angle are spaced on 5 mm centers. Thermoplastic polyurethane provides excellent wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	2100 *472*	4200 *944*	6300 *1416*	8400 *1888*	12600 *2832*
Admissible tensile force, open belt	N *lbf*	840 *189*	1680 *378*	2520 *567*	3360 *758*	5040 *1134*
Admissible tensile force, joined belt	N *lbf*	420 *94*	840 *188*	1260 *282*	1680 *376*	2520 *564*
Minimum number of teeth of joined belt		180	180	180	180	180
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.06 *0.04*	0.12 *0.08*	0.17 *0.12*	0.23 *0.16*	0.35 *0.23*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

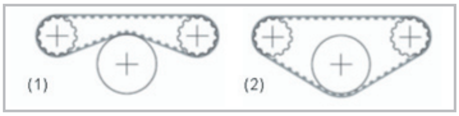
The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	30 *1.18*
Without counter flection (2):		
- Minimum number of teeth		12
- Minimum pulley diameter	mm *inch*	30 *1.18*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

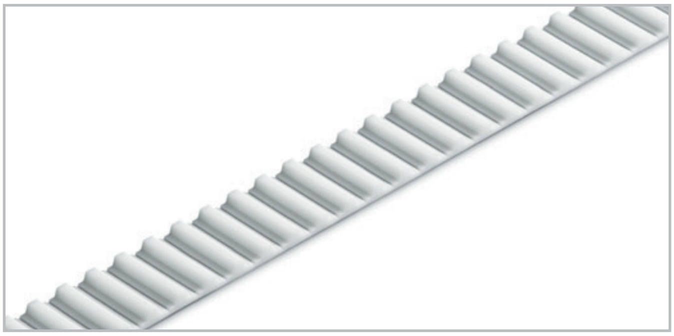


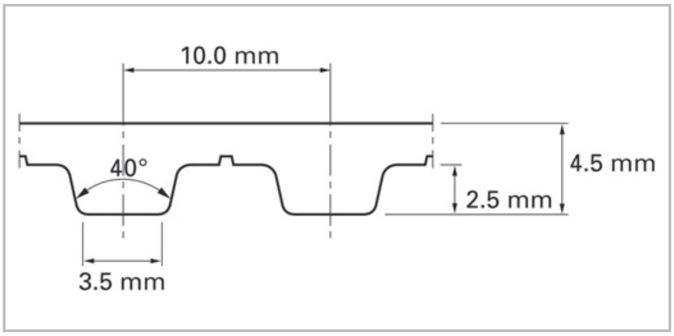
For detailed material properties and colors
please contact your Habasit representative.

Main industry segments
Materials handling, packaging, automation and wood

Belt applications
Large format printers, automatic gate and door entry systems, automatic vending machines, window opening devices, robotic positioning arms, pick-n-place transports, small parts conveying, XYZ axis drives, textile scanning, cutting and knitting machines, media and paper conveying, electronic assembly equipment, package conveying, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 40° tooth angle are spaced on 10 mm centers. Thermoplastic polyurethane provides excellent wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	5500 *1236*	11000 *2476*	16500 *3708*	22000 *4944*	33000 *7416*
Admissible tensile force, open belt	N *lbf*	2200 *495*	4400 *990*	6600 *1485*	8800 *1980*	13200 *2970*
Admissible tensile force, joined belt	N *lbf*	1100 *247*	2200 *494*	3300 *741*	4400 *988*	6600 *1482*
Minimum number of teeth of joined belt		90	90	90	90	90
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.12 *0.08*	0.24 *0.16*	0.35 *0.24*	0.47 *0.32*	0.71 *0.47*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

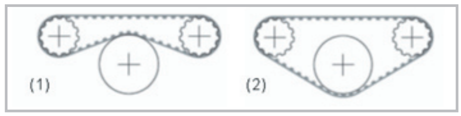
HabaSYNC®
T10 Steel

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection [(1)]:		
- Minimum number of teeth		20
- Minimum pulley diameter	mm *inch*	60 *2.36*
Without counter flection [(2)]:		
- Minimum number of teeth		12
- Minimum pulley diameter	mm *inch*	60 *2.36*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

For detailed material properties and colors
please contact your Habasit representative.

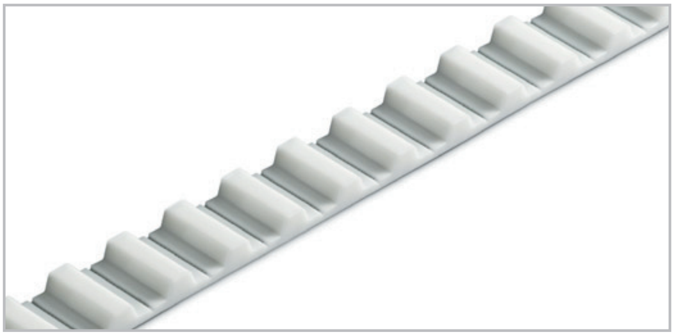


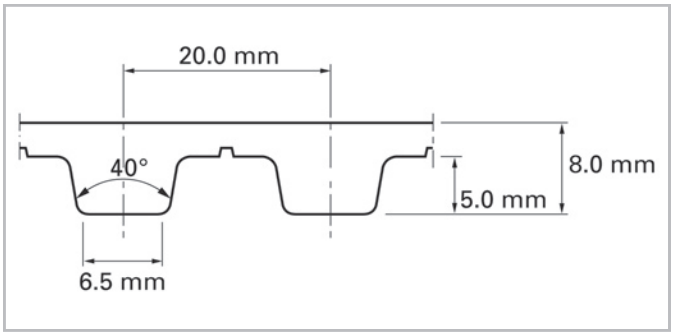
HabaSYNC®
T20 Steel

Main industry segments
Materials handling, packaging, automation and wood

Belt applications
Packaging machinery, pick-n-place transports, parts conveying, automated storage systems, XYZ axis drives, scanning and cutting machines, glass conveying, electronic assembly equipment, robotics, wood panel conveying

Description
Trapezoid teeth with a 40° tooth angle are spaced on 20 mm centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	8750 *1967*	17500 *3934*	26250 *5901*	35000 *7868*	52500 *11802*
Admissible tensile force, open belt	N *lbf*	3500 *787*	7000 *1574*	10500 *2361*	14000 *3148*	21000 *4722*
Admissible tensile force, joined belt	N *lbf*	1750 *393*	3500 *786*	5250 *1179*	7000 *1572*	10500 *2358*
Minimum number of teeth of joined belt		50	50	50	50	50
Minimum length of joined belt	mm *inch*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*
Minimum clamping length	mm *inch*	130 *5.1*	130 *5.1*	130 *5.1*	130 *5.1*	130 *5.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.19 *0.13*	0.38 *0.26*	0.57 *0.38*	0.76 *0.51*	1.14 *0.77*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

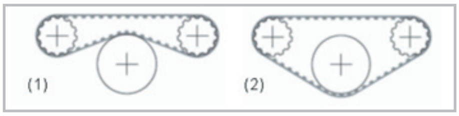
The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection [1]:		
- Minimum number of teeth		25
- Minimum pulley diameter	mm *inch*	120 *4.72*
Without counter flection [2]:		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	120 *4.72*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed



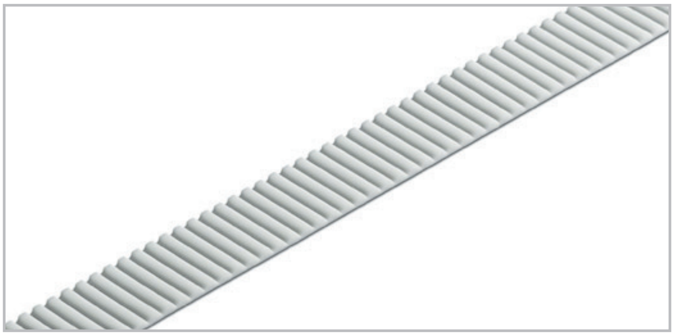
For detailed material properties and colors
please contact your Habasit representative.

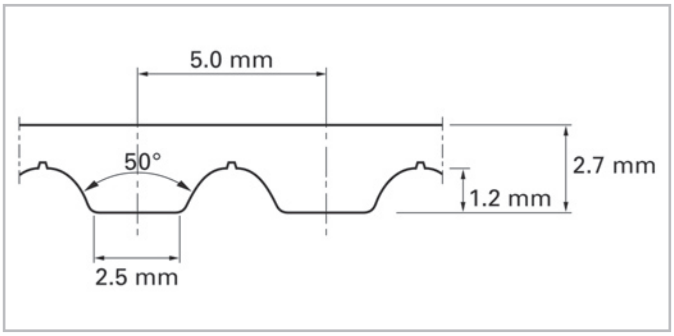
HabaSYNC®
AT5 Steel

Main industry segments
Textiles, materials handling, packaging, automation, postal, paper and wood

Belt applications
Large format printers, photocopiers, automatic gate and door entry systems, roll up doors, vending machines, window opening devices, robotic positioning arms, pick-n-place transports, small parts conveying, XYZ axis drives, textile scanning, textile cutting and knitting machines, cardboard manufacturing, sheet folder conveying, inserting systems, electronic assembly equipment, food conveying, board and panel manufacturing, sorting lines.

Description
Trapezoid teeth with a 50° tooth angle are spaced on 5 mm centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	4375 *984*	8750 *1968*	13125 *2952*	17500 *3936*	26250 *5904*
Admissible tensile force, open belt	N *lbf*	1750 *393*	3500 *786*	5250 *1179*	7000 *1572*	10500 *2358*
Admissible tensile force, joined belt	N *lbf*	875 *197*	1750 *394*	2625 *591*	3500 *788*	5250 *1182*
Minimum number of teeth of joined belt		180	180	180	180	180
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.09 *0.06*	0.17 *0.11*	0.26 *0.17*	0.34 *0.23*	0.51 *0.34*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

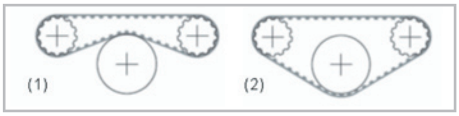
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		25
- Minimum pulley diameter	mm *inch*	60 *2.36*
Without counter flection (2):		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	25 *0.98*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

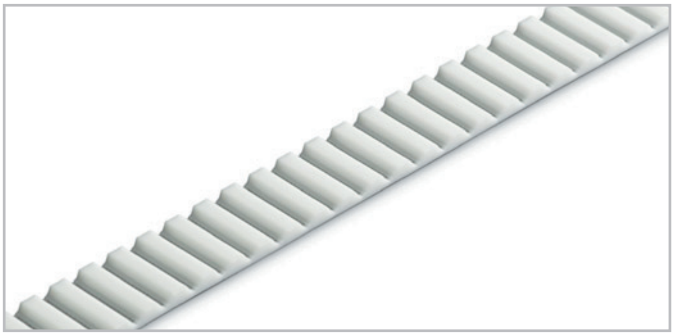
For detailed material properties and colors
please contact your Habasit representative.

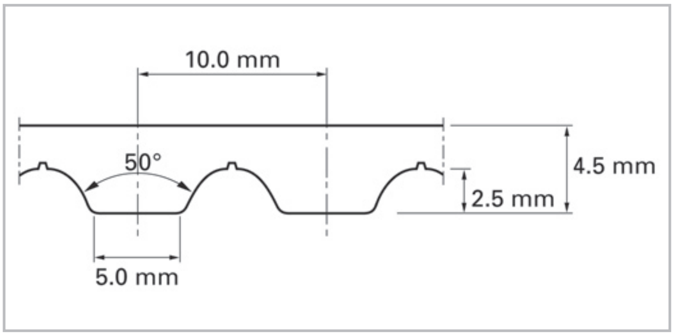


Main industry segments
Textiles, materials handling, packaging, automation, postal, paper and wood

Belt applications
General conveying systems, ceramic tile conveying, packaging machinery, hygienic paper production, pick-n-place transports, small parts conveying, door and gate openers, XYZ axis drives, scanning and cutting machines, windshield and window glass conveying, inserting systems, sheet folder conveying systems, electronic assembly equipment, food conveying, candy manufacturing, robotics, board and panel manufacturing, sorting

Description
Trapezoid teeth with a 50° tooth angle are spaced on 10mm centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	8750 *1967*	17500 *3934*	26250 *5901*	35000 *7868*	52500 *11802*
Admissible tensile force, open belt	N *lbf*	3500 *787*	7000 *1574*	10500 *2361*	14000 *3148*	21000 *4722*
Admissible tensile force, joined belt	N *lbf*	1750 *393*	3500 *786*	5250 *1179*	7000 *1572*	10500 *2358*
Minimum number of teeth of joined belt		90	90	90	90	90
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.15 *0.10*	0.29 *0.19*	0.44 *0.29*	0.58 *0.39*	0.87 *0.58*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds with a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

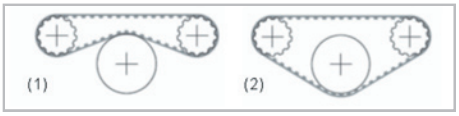
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		25
- Minimum pulley diameter	mm *inch*	120 *4.72*
Without counter flection (2):		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	50 *1.97*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

For detailed material properties and colors
please contact your Habasit representative.

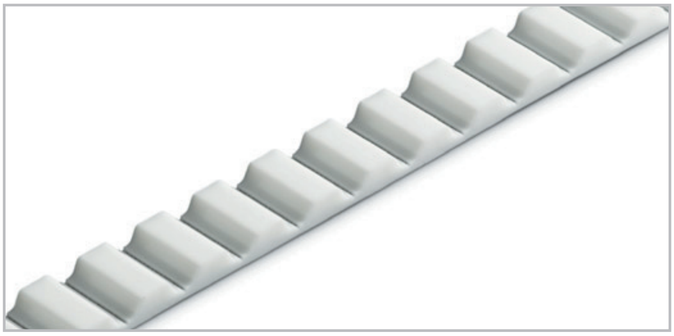


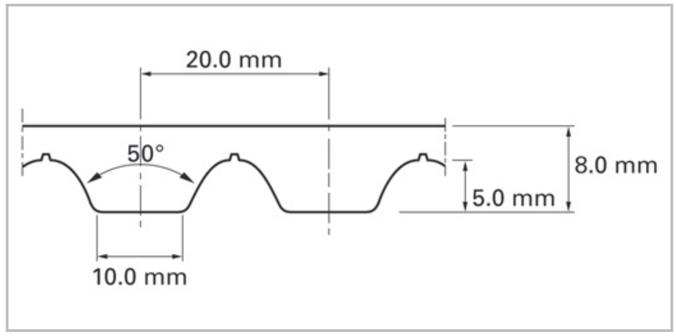
HabaSYNC®
AT20 Steel

Main industry segments
Materials handling, packaging, automation, wood and automotive

Belt applications
Metal stamping, brick making equipment, packaging machinery, automated storage systems, glass conveying, board and panel manufacturing, panel surface processing, sorting lines

Description
Trapezoid teeth with a 50° tooth angle are spaced on 20 mm centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	12500 *2810*	25000 *5620*	37500 *8430*	50000 *11240*	75000 *16860*
Admissible tensile force, open belt	N *lbf*	5000 *1124*	10000 *2248*	15000 *3372*	20000 *4496*	30000 *6744*
Admissible tensile force, joined belt	N *lbf*	2500 *562*	5000 *1124*	7500 *1686*	10000 *2248*	15000 *3372*
Minimum number of teeth of joined belt		50	50	50	50	50
Minimum length of joined belt	mm *inch*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*
Minimum clamping length	mm *inch*	130 *5.1*	130 *5.1*	130 *5.1*	130 *5.1*	130 *5.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.24 *0.16*	0.49 *0.33*	0.73 *0.49*	0.97 *0.65*	1.46 *0.98*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

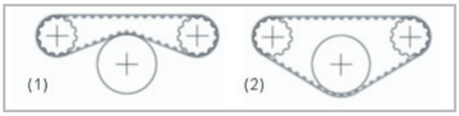
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		25
- Minimum pulley diameter	mm *inch*	180 *7.09*
Without counter flection (2):		
- Minimum number of teeth		18
- Minimum pulley diameter	mm *inch*	120 *4.72*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

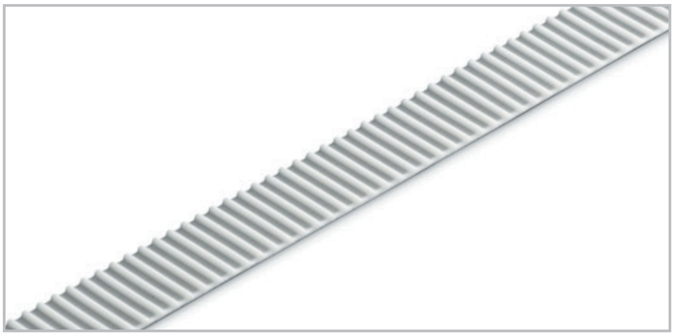
For detailed material properties and colors
please contact your Habasit representative.

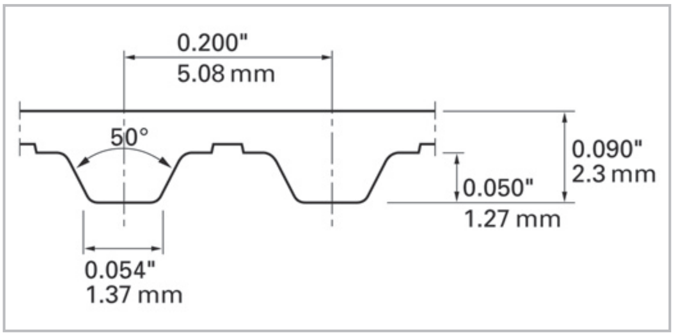


Main industry segments
Textiles, materials handling, packaging, automation, wood and fitness

Belt applications
Textile processing and knitting equipment, packaging machinery, pick-n-place transports, small parts conveying, automated storage systems, XYZ axis drives, scanning and cutting machines, glass conveying, electronic assembly equipment, robotics, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 50° tooth angle are spaced on 0.200 inch (5.1 mm) centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25.4 *1.00*	50.8 *2.00*	76.2 *3.00*	101.6 *4.00*	152.4 *6.00*
Tensile force for 1% elongation	N *lbf*	2100 *472*	4200 *944*	6300 *1416*	8400 *1888*	12600 *2832*
Admissible tensile force, open belt	N *lbf*	840 *189*	1680 *378*	2520 *567*	3360 *758*	5040 *1134*
Admissible tensile force, joined belt	N *lbf*	420 *94*	840 *188*	1260 *282*	1680 *376*	2520 *564*
Minimum number of teeth of joined belt		178	178	178	178	178
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.06 *0.04*	0.11 *0.08*	0.17 *0.11*	0.22 *0.15*	0.34 *0.23*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

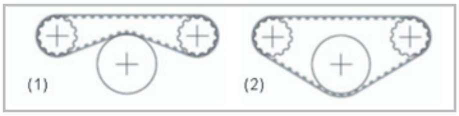
The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	30 *1.18*
Without counter flection (2):		
- Minimum number of teeth		12
- Minimum pulley diameter	mm *inch*	30 *1.18*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed



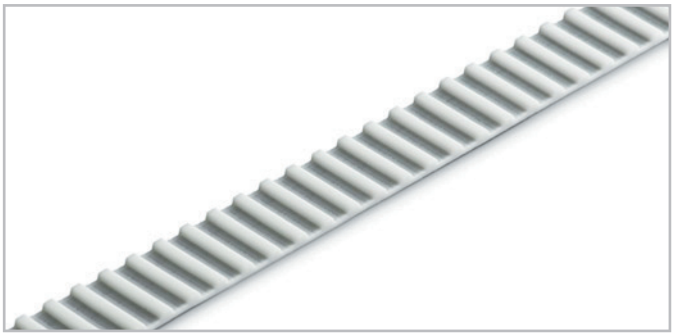
For detailed material properties and colors
please contact your Habasit representative.

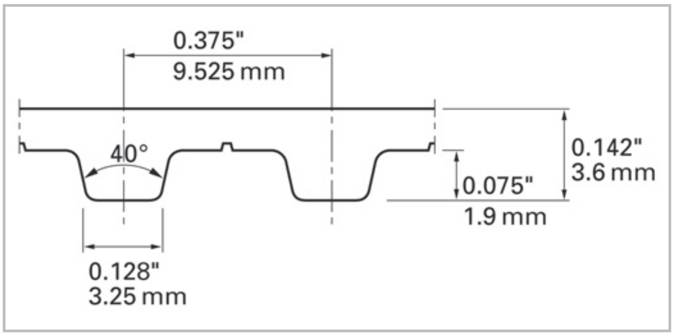
HabaSYNC®
L Steel

Main industry segments
Textiles, materials handling, packaging, automation, wood and fitness

Belt applications
Package conveying, packaging machinery, small parts conveying, automated storage systems, XYZ axis drives, scanning and cutting machines, glass conveying, electronic assembly equipment, robotics, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 40° tooth angle are spaced on 0.375 inch (9.5 mm) centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25.4 *1.00*	50.8 *2.00*	76.2 *3.00*	101.6 *4.00*	152.4 *6.00*
Tensile force for 1% elongation	N *lbf*	4250 *955*	8500 *1910*	12750 *2865*	17000 *3820*	25500 *5730*
Admissible tensile force, open belt	N *lbf*	1700 *382*	3400 *764*	5100 *1146*	6800 *1528*	10200 *2292*
Admissible tensile force, joined belt	N *lbf*	850 *191*	1700 *382*	2550 *573*	3400 *764*	5100 *1146*
Minimum number of teeth of joined belt		95	95	95	95	95
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.10 *0.07*	0.20 *0.14*	0.29 *0.20*	0.39 *0.26*	0.58 *0.39*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

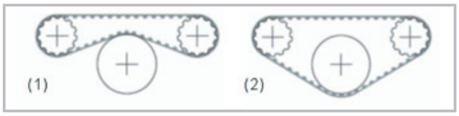
The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		20
- Minimum pulley diameter	mm *inch*	60 *2.36*
Without counter flection (2):		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	60 *2.36*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

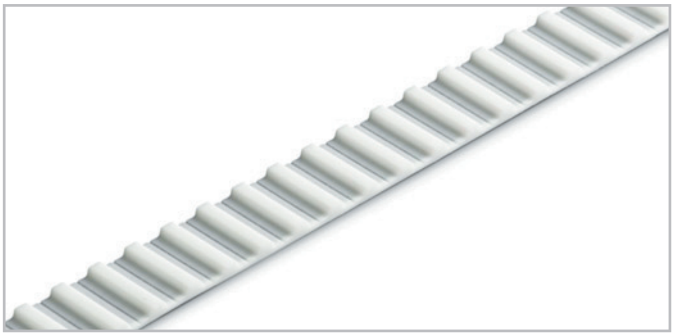


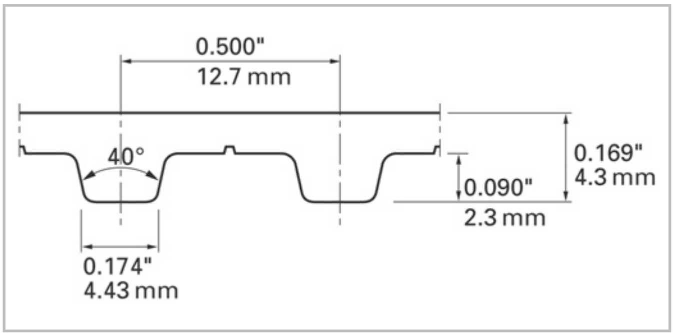
For detailed material properties and colors
please contact your Habasit representative.

Main industry segments
Materials handling, packaging, automation and wood

Belt applications
Packaging machinery, pick-n-place transports, automated storage systems, scanning and cutting machines, hygienic paper production, glass conveying, electronic assembly equipment, robotics, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 40° tooth angle are spaced on 0.500 inch (12.7 mm) centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25.4 *1.00*	50.8 *2.00*	76.2 *3.00*	101.6 *4.00*	152.4 *6.00*
Tensile force for 1% elongation	N *lbf*	5500 *1236*	11000 *2472*	16500 *3708*	22000 *4944*	33000 *7416*
Admissible tensile force, open belt	N *lbf*	2200 *495*	4400 *990*	6600 *1485*	8800 *1980*	13200 *2970*
Admissible tensile force, joined belt	N *lbf*	1100 *247*	2200 *494*	3300 *741*	4400 *988*	6600 *1482*
Minimum number of teeth of joined belt		71	71	71	71	71
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	90 *3.5*	90 *3.5*	90 *3.5*	90 *3.5*	90 *3.5*
Mass of belt (belt weight)	kg/m *lb/ft*	0.12 *0.08*	0.23 *0.16*	0.35 *0.24*	0.47 *0.32*	0.70 *0.47*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

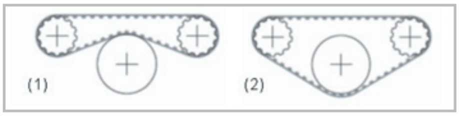
HabaSYNC®
H Steel

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection [(1)]:		
- Minimum number of teeth		20
- Minimum pulley diameter	mm *inch*	80 *3.15*
Without counter flection [(2)]:		
- Minimum number of teeth		14
- Minimum pulley diameter	mm *inch*	60 *2.36*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

For detailed material properties and colors
please contact your Habasit representative.

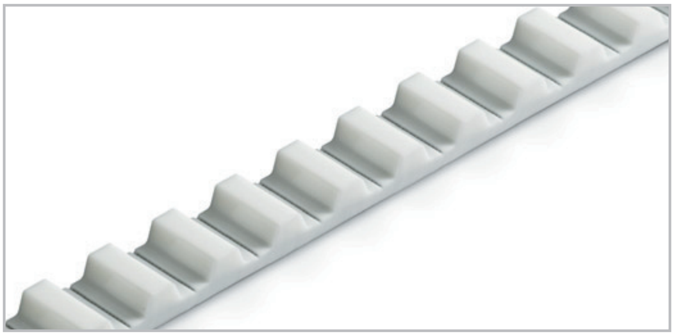


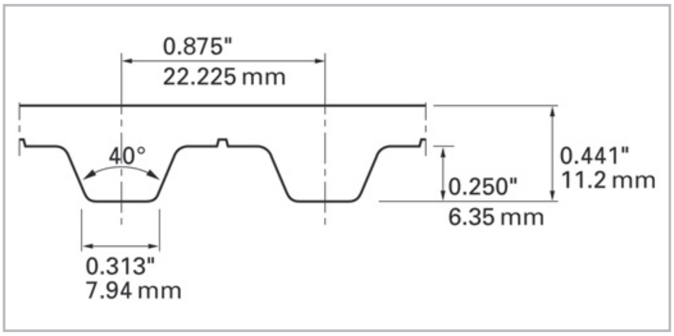
HabaSYNC®
XH Steel

Main industry segments
Materials handling, automation and wood

Belt applications
Conveying pallets, glass conveying, furniture assembly, automated storage systems

Description
Trapezoid teeth with a 40° tooth angle are spaced on 0.875 inch (22.2 mm) centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the steel tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25.4 *1.00*	50.8 *2.00*	76.2 *3.00*	101.6 *4.00*	152.4 *6.00*
Tensile force for 1% elongation	N *lbf*	8750 *1967*	17500 *3934*	26250 *5901*	35000 *7868*	52500 *11802*
Admissible tensile force, open belt	N *lbf*	3500 *787*	7000 *1574*	10500 *2361*	14000 *3148*	21000 *4722*
Admissible tensile force, joined belt	N *lbf*	1750 *393*	3500 *786*	5250 *1179*	7000 *1572*	10500 *2358*
Minimum number of teeth of joined belt		45	45	45	45	45
Minimum length of joined belt	mm *inch*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*
Minimum clamping length	mm *inch*	140 *5.5*	140 *5.5*	140 *5.5*	140 *5.5*	140 *5.5*
Mass of belt (belt weight)	kg/m *lb/ft*	0.28 *0.19*	0.56 *0.38*	0.84 *0.56*	1.12 *0.75*	1.67 *1.13*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.4%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

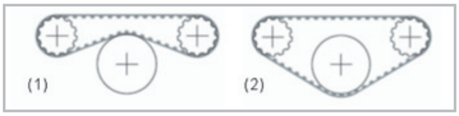
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection [(1)]:		
- Minimum number of teeth		20
- Minimum pulley diameter	mm *inch*	180 *7.09*
Without counter flection [(2)]:		
- Minimum number of teeth		18
- Minimum pulley diameter	mm *inch*	150 *5.91*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

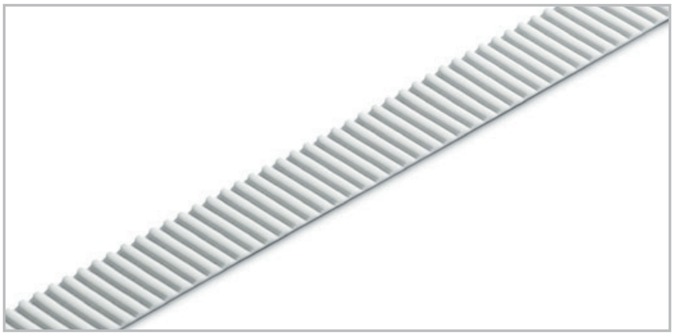
For detailed material properties and colors
please contact your Habasit representative.

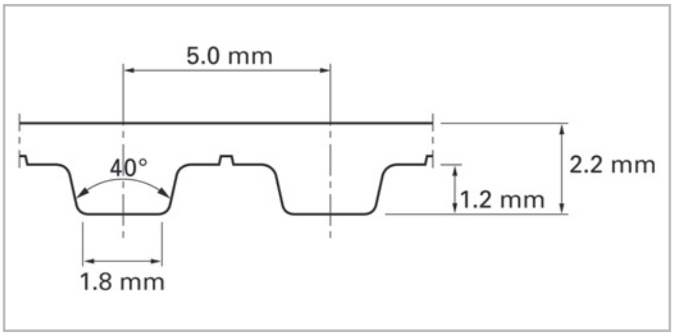


Main industry segments
Textiles, business machines, materials handling, packaging, automation, paper and postal

Belt applications
Large format printers, automatic gate and door entry systems, automatic vending machines, window opening devices, robotic positioning arms, pick-n-place transports, small parts conveying, XYZ axis drives, textile scanning, cutting and knitting machines, media and paper conveying, electronic assembly equipment, package conveying, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 40° tooth angle are spaced on 5 mm centers. Thermoplastic polyurethane provides excellent wear resistance on the tooth side and protects the aramide tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	1400 *315*	2800 *630*	4200 *945*	5600 *1260*	8400 *1890*
Admissible tensile force, open belt	N *lbf*	840 *189*	1680 *378*	2520 *567*	3360 *758*	5040 *1134*
Admissible tensile force, joined belt	N *lbf*	420 *94*	840 *188*	1260 *282*	1680 *376*	2520 *564*
Minimum number of teeth of joined belt		180	180	180	180	180
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.05 *0.04*	0.11 *0.07*	0.16 *0.10*	0.21 *0.14*	0.32 *0.21*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.6%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

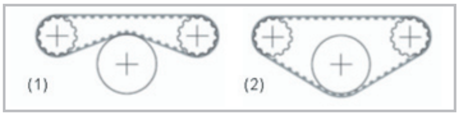
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

HabaSYNC®
T5 Aramid

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection [(1)]:		
- Minimum number of teeth		18
- Minimum pulley diameter	mm *inch*	30 *1.18*
Without counter flection [(2)]:		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	30 *1.18*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed



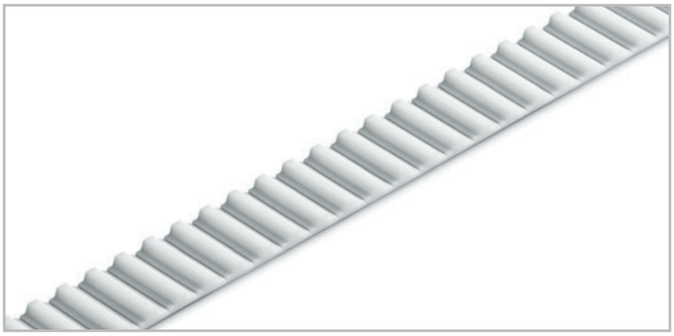
For detailed material properties and colors
please contact your Habasit representative.

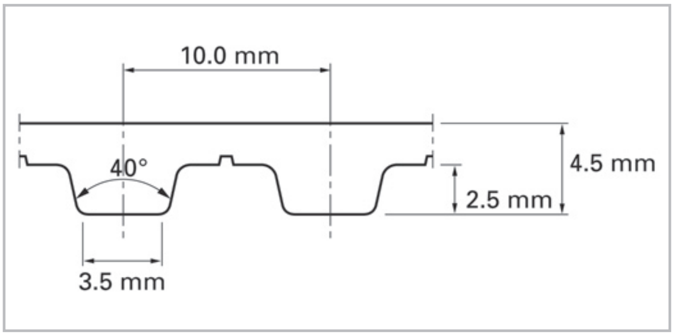
HabaSYNC®
T10 Aramid

Main industry segments
Materials handling, packaging, automation, wood, printing, paper and postal

Belt applications
Automatic gate and door entry systems, automatic vending machines, window opening devices, robotic positioning arms, pick-n-place transports, small parts conveying, XYZ axis drives, textile scanning, cutting and knitting machines, media and paper conveying, electronic assembly equipment, package conveying, ceramic tile conveying, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 40° tooth angle are spaced on 10 mm centers. Thermoplastic polyurethane provides excellent wear resistance on the tooth side and protects the aramide tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	3333 *749*	6666 *1498*	9999 *2247*	13332 *2996*	19998 *4494*
Admissible tensile force, open belt	N *lbf*	2000 *450*	4000 *900*	6000 *1350*	8000 *1800*	12000 *2700*
Admissible tensile force, joined belt	N *lbf*	1000 *225*	2000 *450*	3000 *675*	4000 *900*	6000 *1350*
Minimum number of teeth of joined belt		90	90	90	90	90
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.10 *0.07*	0.20 *0.13*	0.30 *0.20*	0.40 *0.27*	0.60 *0.40*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.6%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

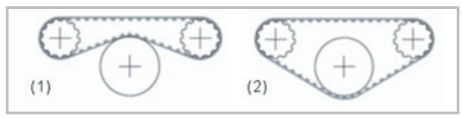
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

HabaSYNC®
T10 Aramid

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		20
- Minimum pulley diameter	mm *inch*	60 *2.36*
Without counter flection (2):		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	60 *2.36*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed



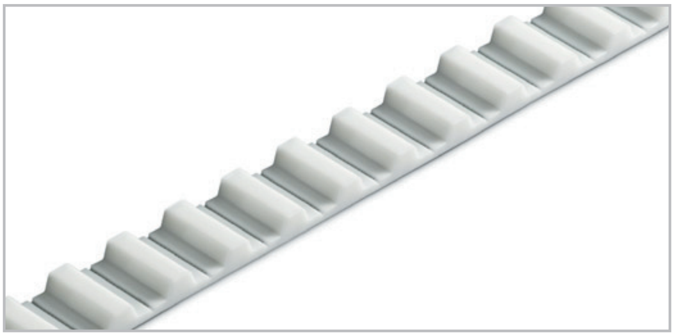
For detailed material properties and colors
please contact your Habasit representative.

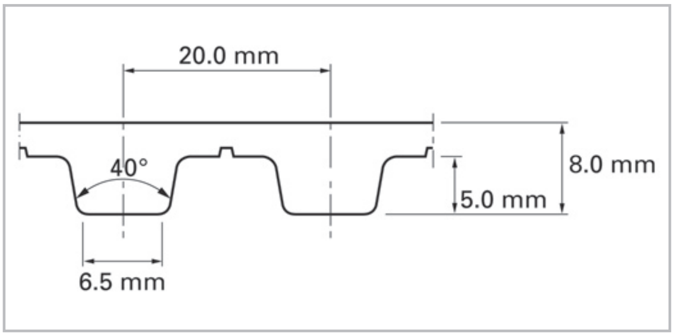
HabaSYNC®
T20 Aramid

Main industry segments
Materials handling, packaging and automation

Belt applications
Packaging machinery, pick-n-place transports, parts conveying, automated storage systems, XYZ axis drives, scanning and cutting machines, glass conveying, electronic assembly equipment, robotics, wood panel conveying, metal stamping lines

Description
Trapezoid teeth with a 40° tooth angle are spaced on 20 mm centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the aramide tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25 *0.98*	50 *1.97*	75 *2.95*	100 *3.94*	150 *5.91*
Tensile force for 1% elongation	N *lbf*	5833 *1311*	11666 *2622*	17499 *3933*	23332 *5244*	34998 *7866*
Admissible tensile force, open belt	N *lbf*	3500 *787*	7000 *1574*	10500 *2361*	14000 *3148*	21000 *4722*
Admissible tensile force, joined belt	N *lbf*	1750 *393*	3500 *786*	5250 *1179*	7000 *1572*	10500 *2358*
Minimum number of teeth of joined belt		50	50	50	50	50
Minimum length of joined belt	mm *inch*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*
Minimum clamping length	mm *inch*	130 *5.1*	130 *5.1*	130 *5.1*	130 *5.1*	130 *5.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.16 *0.10*	0.31 *0.21*	0.47 *0.31*	0.62 *0.42*	0.93 *0.62*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.6%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

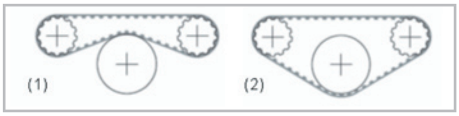
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

HabaSYNC®
T20 Aramid

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection [(1)]:		
- Minimum number of teeth		25
- Minimum pulley diameter	mm *inch*	120 *4.72*
Without counter flection [(2)]:		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	120 *4.72*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed



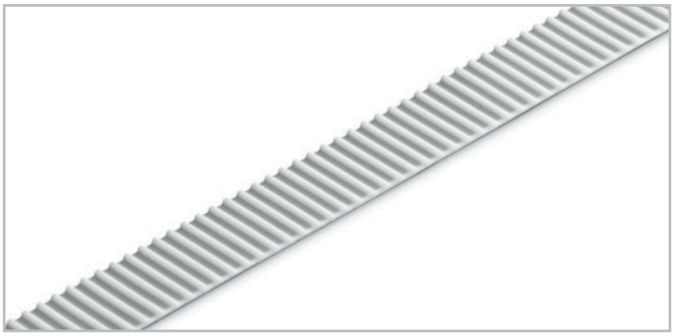
For detailed material properties and colors
please contact your Habasit representative.

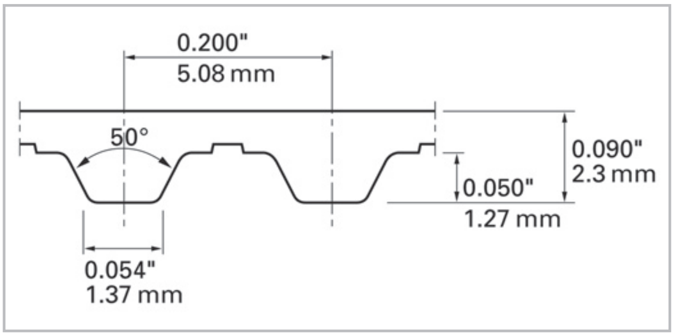
HabaSYNC®
XL Aramid

Main industry segments
Textiles, business machines, materials handling, packaging, automation, printing, postal and paper

Belt applications
Textile processing and knitting equipment, packaging machinery, pick-n-place transports, small parts conveying, automated storage systems, XYZ axis drives, scanning and cutting machines, glass conveying, electronic assembly equipment, robotics, board and panel manufacturing, sorting lines, fitness equipment

Description
Trapezoid teeth with a 50° tooth angle are spaced on 0.200 inch (5.1 mm) centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the aramide tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25.4 *1.00*	50.8 *2.00*	76.2 *3.00*	101.6 *4.00*	152.4 *6.00*
Tensile force for 1% elongation	N *lbf*	1400 *315*	2800 *630*	4200 *945*	5600 *1260*	8400 *1890*
Admissible tensile force, open belt	N *lbf*	840 *189*	1680 *378*	2520 *567*	3360 *758*	5040 *1134*
Admissible tensile force, joined belt	N *lbf*	420 *94*	840 *188*	1260 *282*	1680 *376*	2520 *564*
Minimum number of teeth of joined belt		178	178	178	178	178
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.05 *0.03*	0.10 *0.07*	0.15 *0.10*	0.20 *0.14*	0.31 *0.20*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.6%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

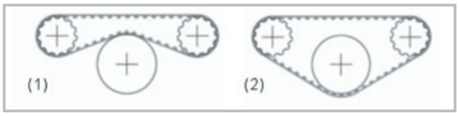
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

HabaSYNC®
XL Aramid

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection [(1)]:		
- Minimum number of teeth		18
- Minimum pulley diameter	mm *inch*	30 *1.18*
Without counter flection [(2)]:		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	30 *1.18*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed



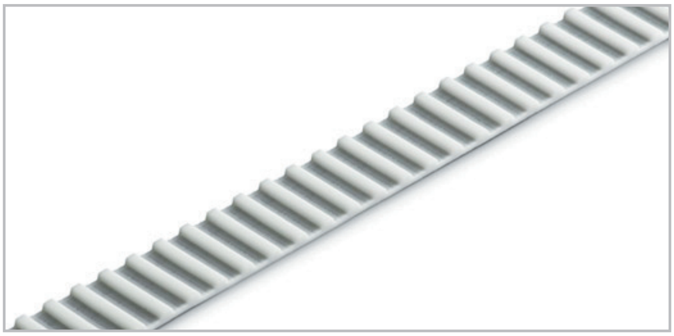
For detailed material properties and colors
please contact your Habasit representative.

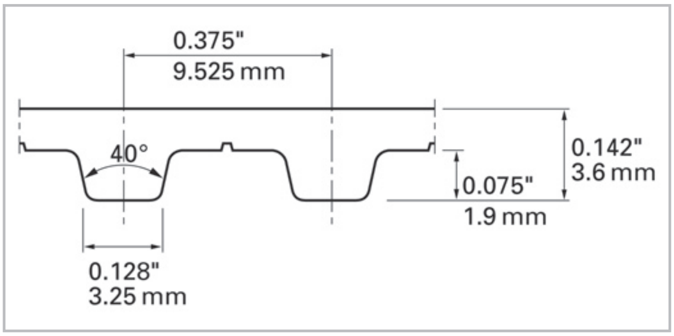
HabaSYNC®
L Aramid

Main industry segments
Textiles, materials handling, packaging, automation, printing, postal and paper

Belt applications
Package conveying, packaging machinery, small parts conveying, automated storage systems, vending machines, photocopiers, XYZ axis drives, scanning and cutting machines, glass conveying, electronic assembly equipment, robotics, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 40° tooth angle are spaced on 0.375 inch (9.5 mm) centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the aramide tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25.4 *1.00*	50.8 *2.00*	76.2 *3.00*	101.8 *4.00*	152.4 *6.00*
Tensile force for 1% elongation	N *lbf*	2833 *637*	5666 *1274*	8499 *1911*	11332 *2548*	16998 *3822*
Admissible tensile force, open belt	N *lbf*	1700 *382*	3400 *764*	5100 *1146*	6800 *1528*	10200 *2292*
Admissible tensile force, joined belt	N *lbf*	850 *191*	1700 *382*	2550 *573*	3400 *764*	5100 *1146*
Minimum number of teeth of joined belt		95	95	95	95	95
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*	80 *3.1*
Mass of belt (belt weight)	kg/m *lb/ft*	0.08 *0.06*	0.16 *0.11*	0.24 *0.17*	0.32 *0.22*	0.49 *0.33*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.6%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

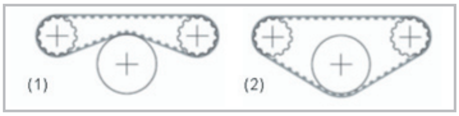
All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

HabaSYNC®
L Aramid

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection [1]:		
- Minimum number of teeth		20
- Minimum pulley diameter	mm *inch*	60 *2.36*
Without counter flection [2]:		
- Minimum number of teeth		15
- Minimum pulley diameter	mm *inch*	60 *2.36*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

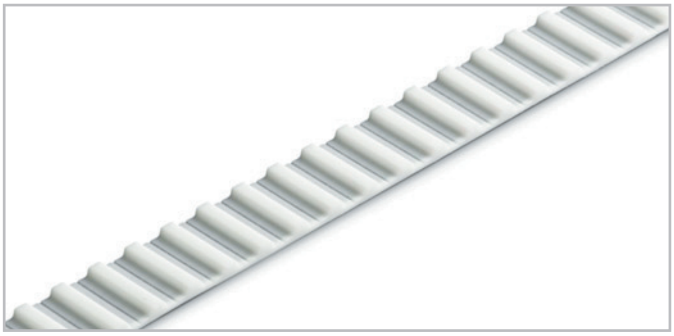


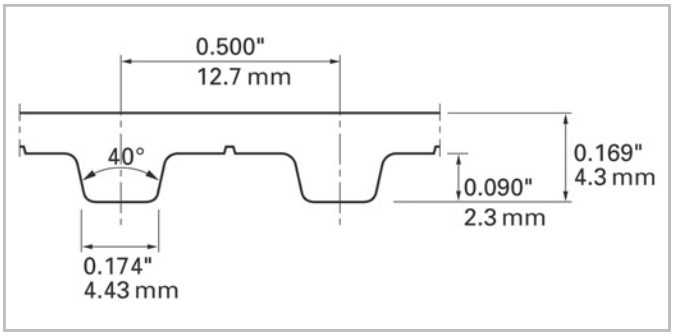
For detailed material properties and colors
please contact your Habasit representative.

Main industry segments
Materials handling, packaging and automation

Belt applications
Packaging machinery, pick-n-place transports, automated storage systems, scanning and cutting machines, glass conveying, electronic assembly equipment, robotics, wood panel conveying, fitness equipment

Description
Trapezoid teeth with a 40° tooth angle are spaced on 0.500 inch (12.7 mm) centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the aramide tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25.4 *1.00*	50.8 *2.00*	76.2 *3.00*	101.8 *4.00*	152.4 *6.00*
Tensile force for 1% elongation	N *lbf*	3333 *749*	6666 *1498*	9999 *2247*	13332 *2996*	19998 *4494*
Admissible tensile force, open belt	N *lbf*	2000 *450*	4000 *900*	6000 *1350*	8000 *1800*	12000 *2700*
Admissible tensile force, joined belt	N *lbf*	1000 *225*	2000 *450*	3000 *675*	4000 *900*	6000 *1350*
Minimum number of teeth of joined belt		71	71	71	71	71
Minimum length of joined belt	mm *inch*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*	900 *35.4*
Minimum clamping length	mm *inch*	90 *3.5*	90 *3.5*	90 *3.5*	90 *3.5*	90 *3.5*
Mass of belt (belt weight)	kg/m *lb/ft*	0.10 *0.07*	0.20 *0.13*	0.30 *0.20*	0.40 *0.27*	0.59 *0.40*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

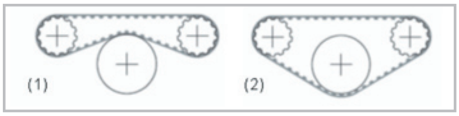
The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.6%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

Elastomer		TPU 92 Shore A
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.7
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		20
- Minimum pulley diameter	mm *inch*	80 *3.15*
Without counter flection (2):		
- Minimum number of teeth		14
- Minimum pulley diameter	mm *inch*	60 *2.36*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

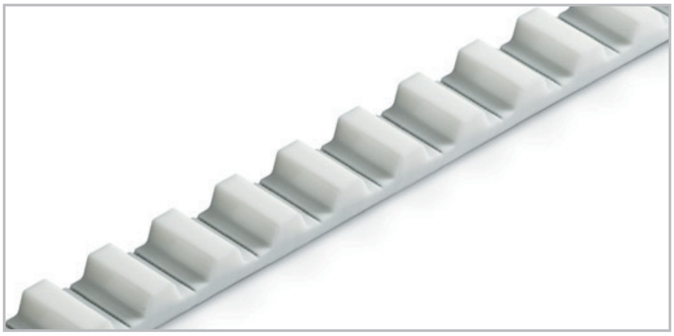


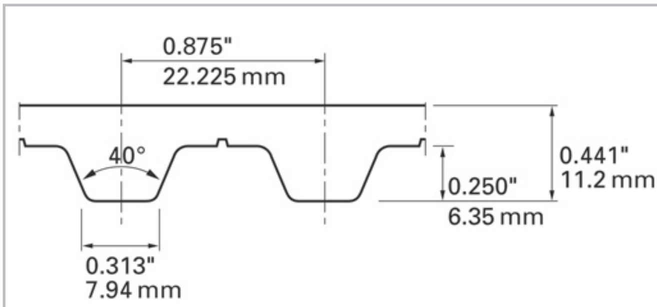
For detailed material properties and colors
please contact your Habasit representative.

Main industry segments
Materials handling, packaging and automation

Belt applications
Conveying pallets, glass conveying, furniture assembly, automated storage systems, board and panel manufacturing, metal stamping, metal stamping lines

Description
Trapezoid teeth with a 40° tooth angle are spaced on 0.875 inch (22.2 mm) centers. Thermoplastic polyurethane provides wear resistance on the tooth side and protects the aramide tensile member. Our material also provides high lubricity, which yields low noise and vibration meshing in and out of the drive pulley.





Belt data

Nominal belt width	mm *inch*	25.4 *1.00*	50.8 *2.00*	76.2 *3.00*	101.6 *4.00*	152.4 *6.00*
Tensile force for 1% elongation	N *lbf*	5833 *1311*	11666 *2622*	17499 *3633*	23332 *5244*	34998 *7266*
Admissible tensile force, open belt	N *lbf*	3500 *787*	7000 *1574*	10500 *2361*	14000 *3148*	21000 *4722*
Admissible tensile force, joined belt	N *lbf*	1750 *393*	3500 *786*	5250 *1179*	7000 *1572*	10500 *2358*
Minimum number of teeth of joined belt		45	45	45	45	45
Minimum length of joined belt	mm *inch*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*	1000 *39.4*
Minimum clamping length	mm *inch*	140 *5.5*	140 *5.5*	140 *5.5*	140 *5.5*	140 *5.5*
Mass of belt (belt weight)	kg/m *lb/ft*	0.24 *0.16*	0.49 *0.33*	0.73 *0.49*	0.98 *0.66*	1.46 *0.98*

The tensile force for 1% elongation (k1% static) per unit of width determines the stress-strain behavior of the belt. It defines the resulting strain if a certain stress is applied and vice versa. This value corresponds to the belt without joint.

The admissible tensile force of a running belt is defined by the strength of the joint or by the strength of the belt without joint. Habasit defines an admissible belt force (without joint) for all belts, which always corresponds to a belt elongation of 0.6%. Joined belts are calculated with half admissible force. Please contact Habasit for detailed information and calculations.

All data are approximate values under standard climatic conditions: 23°C / 73°F, 50% relative humidity (DIN 50005 / ISO 554), and are based on the Master Joining Method.

Belt options

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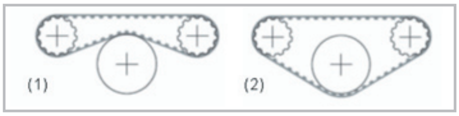
Type of surface - Tooth side		U
Type of surface - Conveying side		U
Coefficient of friction tooth side	•Pickled steel	0.7
	•UHMW PE	0.5
	•Stainless steel	-
Standard color of elastomer		white
With counter flection (1):		
- Minimum number of teeth		20
- Minimum pulley diameter	mm *inch*	180 *7.09*
Without counter flection (2):		
- Minimum number of teeth		18
- Minimum pulley diameter	mm *inch*	150 *5.81*
Maximum operation temperature (continuous)	°C *°F*	80 *176*
Minimum operation temperature (continuous)	°C *°F*	-30 *-22*

Type of surface : U: unprocessed

For detailed material properties and colors
please contact your Habasit representative.

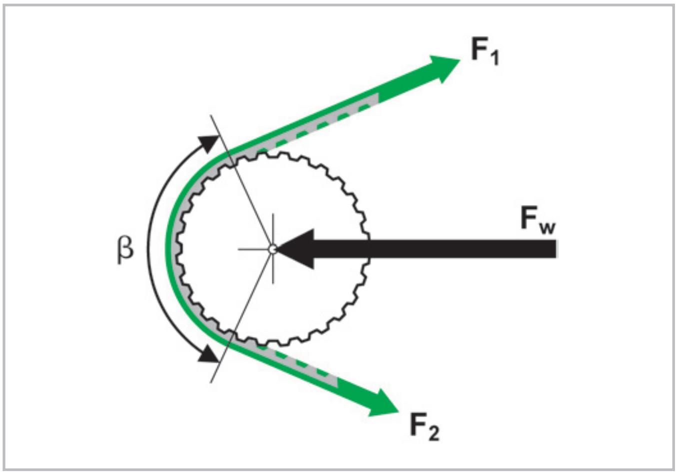


To transmit the peripheral force (F_u) from the periphery of the driving pulley to the timing belt recuires a certain belt tension. The required tensile force is determined by a calculation.

However, if the belt wraps the drive pulley with an angle of about 180°, the required shaft load F_W on the drive pulley should be about 1.2 times the peripheral force F_u.

$$F_W = 1.2 \cdot F_U$$

F_W = Shaft load ($F_W = F_1 + F_2$)
F_1 = Tensile force in the tight side of the belt
F_2 = Tensile force in the slack side of the belt

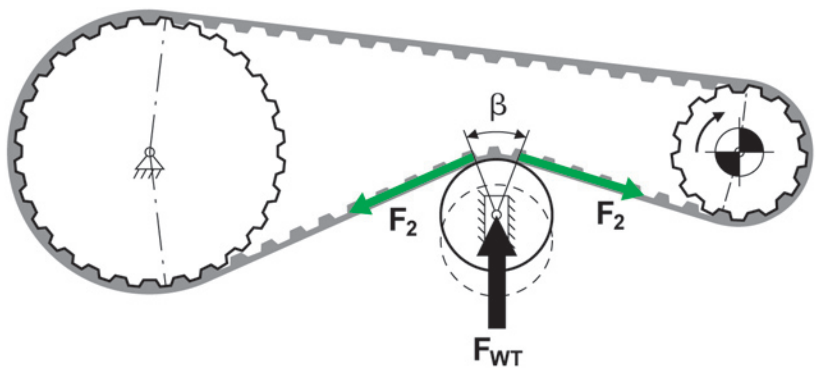


For an arc of contact $\beta \neq 180°$, the respective shaft load can be determined by the following approximation method:

$$F_W = 1.2 \cdot F_U \cdot \sin\left(\frac{\beta}{2}\right) \quad [N]$$

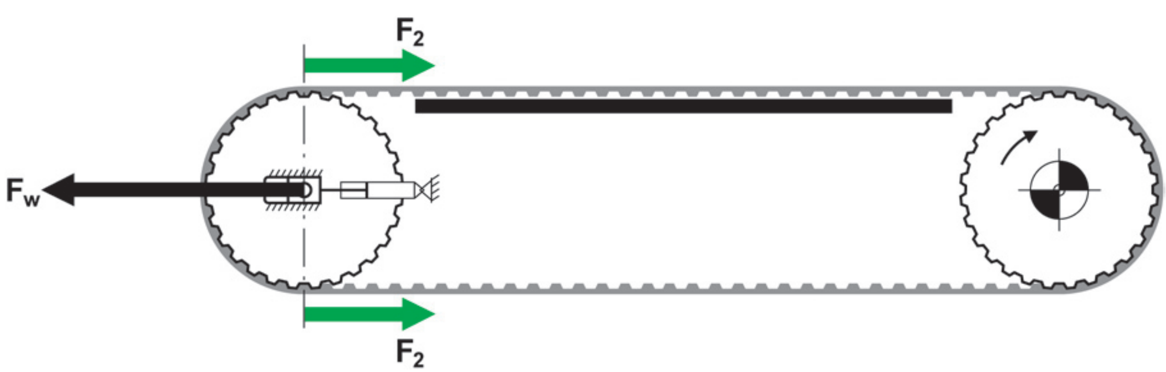
For non-driven pulleys (tension pulley, idlers, etc.) the forces F_1 and F_2 are the same.

Drives with controlled belt tension
Since HabaSYNC® timing belts have a very high stress-strain ratio it is highly recommended (at least for belt lengths below 6 m/20 ft) to use a tensioning device to provide controlled belt tension. Typically a constant shaft load or slack side tension is incorporated by using pneumatic cylinders, spring-loaded or gravity tensioners, etc. Such tensioning devices provide the advantages of reduced maintenance and minimized maximum belt tension. Both have a positive influence on the overall life of the belt.



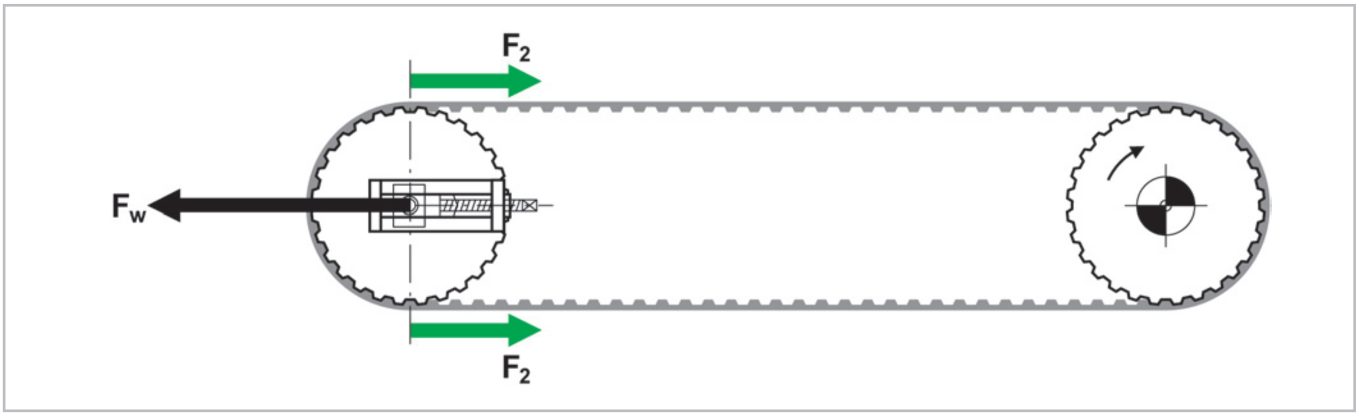
$$F_2 = \frac{F_{WT}}{2 \cdot \sin\left(\frac{\beta}{2}\right)}$$

F_{WT} = Pressure force of tension roller
F_2 = Tensile force in the slack side of the belt
β = Arc of contact on tension roller

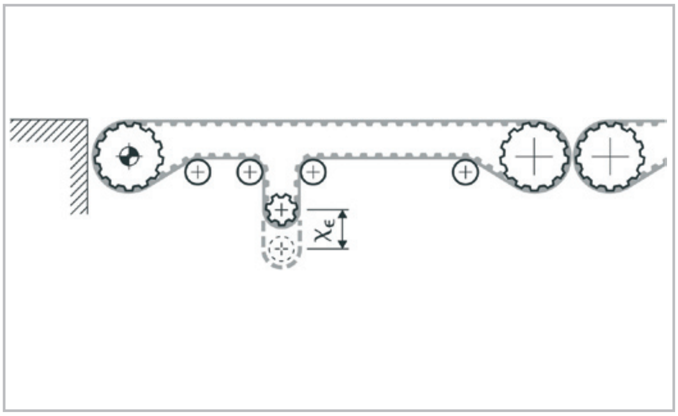


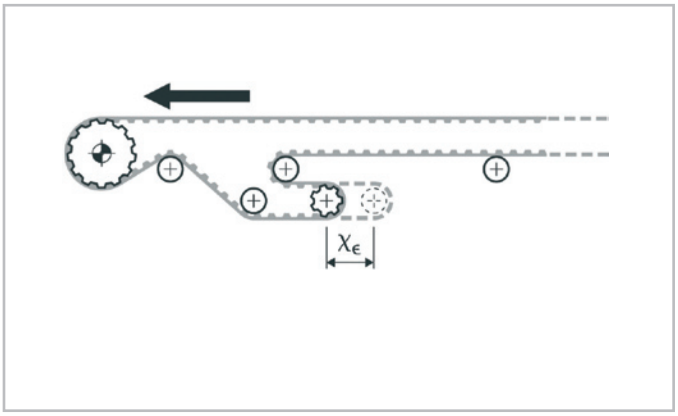
Drives with a fixed center-to-center distance
Fixed tensioning devices are used in applications where there is no need to compensate for variations in belt length or belt extension during operation.

The simplest solution for tensioning is to use the tail roller to tension and lock down.



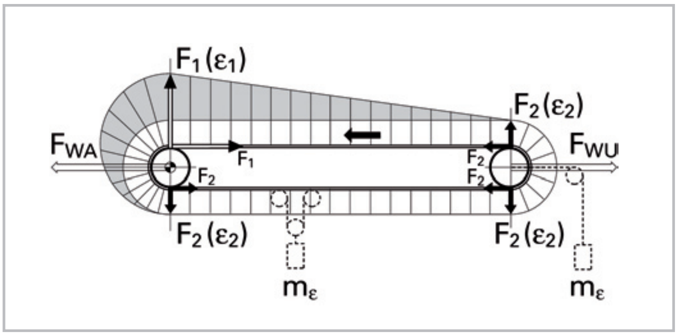
When the center distance between the head and tail rollers may not be changed, e.g. with intermediate or transition conveyors, the tension station is incorporated in the return side.



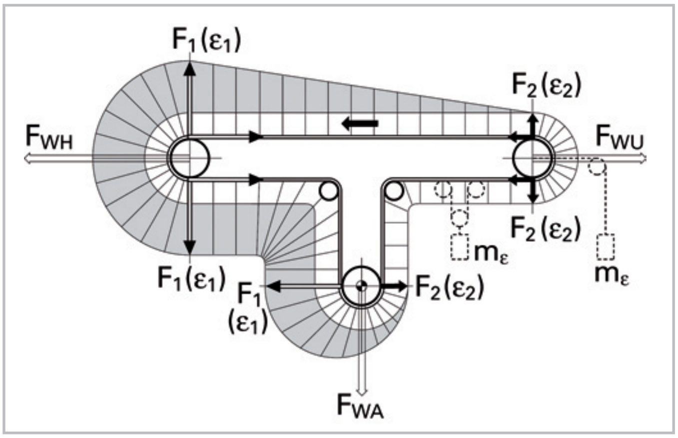


Position of drive
In order to calculate the initial belt extension, the position of the drive is extremely important.

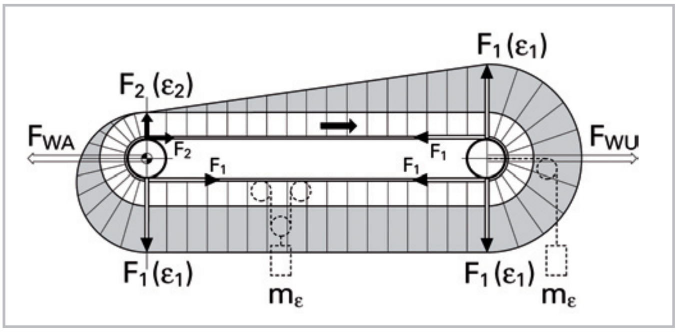
Head drive
This illustration indicates how the tensile force in the belt continuously increases due to the conveying of the mass. Since in this example the drive is placed at the head of the conveyor (on the left side of the illustration), the belt length with the higher tensile force level (F_1) is much shorter than the belt section with low tensile force (F_2). Therefore a lower initial belt extension is required. This configu ration is recommended if the belt is running in one direction.



Center drive
This illustration shows that the belt section with high tensile force (F_1) has more or less the same length as the section with low force (F_2). This symmetrical situation is an advantage in bi-directional applications. Therefore this configuration is recommended if the belt running direction changes.



Tail drive
In contrast to the head drive, the tail driven conveyor belt is exposed to a high tensile force F_1 in the return side. As a result, the belt length with the lower tensile force level (F_2) is much shorter than the length of the belt section with high tensile force (F_1). Therefore higher initial belt extension is required. For this reason, this configuration should be avoided whenever possible.



Belt evaluation

The evaluation of the optimal timing belt for a specific application is primarily a question of requirements. Initial questions include:

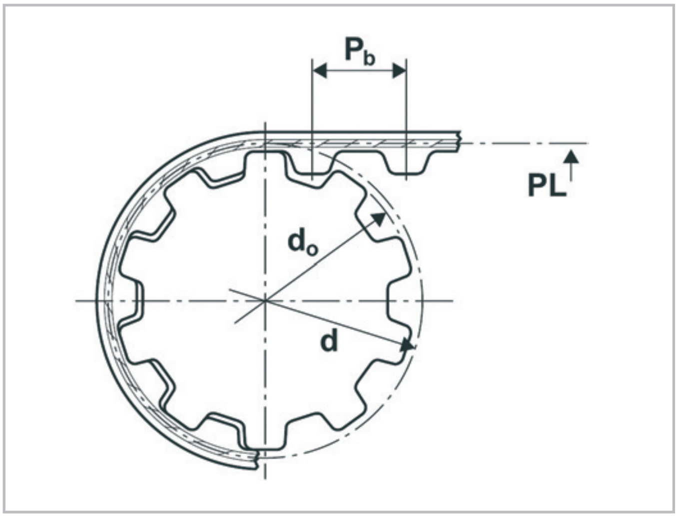
- Minimum pulley diameters
- Coefficient of friction of surfaces
- Properties of materials (suitable for food applications, chemical resistance, surface suitable for applying attachments, etc.)

Secondly, the chosen belt type must be dimensioned in terms of required forces and possible belt width. For the evaluation of pitch and belt width, the peripheral force on the drive pulley and the maximum load on the teeth must be considered.

In some cases, not every detail of the drive can be considered. In very rare cases, it is possible that the final calculation will indicate that the belt selected according to these guidelines does not meet the requirements. In such cases, a second belt evaluation and calculation is required.

Evaluation of belt family
The first step is to choose whether a trapezoid or a modified trapezoid (AT Series) is preferable.

Trapezoid tooth shape

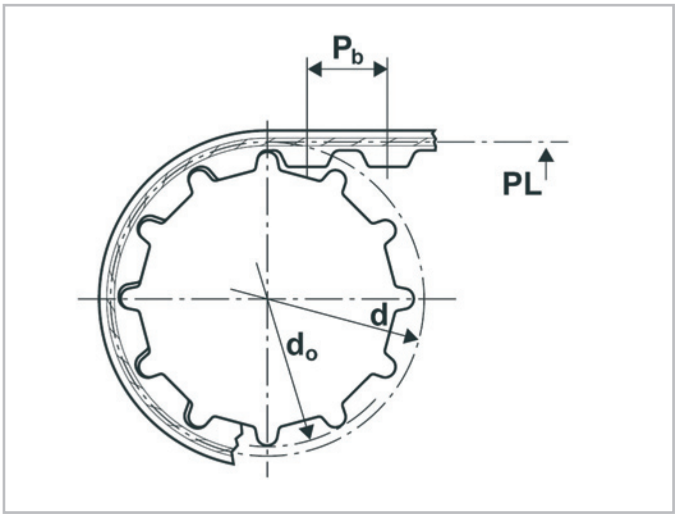


PL = Pitch line

Advantages:
- Optimal for standard drive tasks
- Greater flexibility in drives with counter flections

Belt series with trapezoid tooth shape
- T5 (5 mm pitch)
- T10 (10 mm pitch)
- T20 (20 mm pitch)
- XL (1/5″ pitch / 5.08 mm)
- L (3/8″ pitch / 9.525 mm)
- H (1/2″ pitch / 12.7 mm)
- XH (7/8″ pitch / 22.225 mm)

Modified trapezoid tooth shape (AT Series)



Advantages:
- Higher tooth strength
- Stronger tension members
- Superior backlash control
- Reduction of meshing impacts (lower noise and vibration)
- Larger tooth area in contact with slider bed

Belt series with modified trapezoid tooth shape
- AT5 (5 mm pitch)
- AT10 (10 mm pitch)
- AT20 (20 mm pitch)

Belt options
In addition to specific requirements like those for food applications and chemical resistance, another factor in belt selection must be the coefficient of friction required on the belt surfaces (tooth side and conveying side).

The belt surface of the unprocessed standard belt is extremely wear-resistant polyurethane with a hardness of 92 Shore A.

This material provides a coefficient of friction that is high enough to provide a good grip, without being too high. It performs well when running over slider beds or in applications with the accumulation of lightweight goods.

If a higher coefficient of friction (grip) is required (e.g. for steep transportation, etc.) we recommend the use of belts with special covers and surface structures, such as profiles or modifications on the conveying side. In order to select the optimal belt surface we recommend that you seek the support of your local Habasit representative.

If a low coefficient of friction is required (e.g. if a belt with a high load runs over a slider bed, or if there is a relative movement between the belt and heavy goods), we recommend using a belt with polyamide facing. Polyamide fabric is available on the tooth side (PT), conveying side (PC), or on both sides (PTC). Further advantages of polyamide facing are:

- Improved wear resistance
- Reduced peripheral force when running over a slider bed or when goods are accumulated. Therefore less drive power and less belt width are required
- Low noise properties

Evaluation of belt pitch
For the evaluation of pitch and belt width the peripheral force on the drive pulley and the maximum load on the teeth need to be considered.

How to determine the peripheral force
The peripheral force F_u at the drive pulley is the sum of all individual forces resisting the belt motion. The individual loads contributing to the peripheral force F_U must be identified and calculated based on the loading conditions and drive configuration. However, some loads cannot be calculated until the layout has been decided.
To determine the peripheral force F_U, use the following methods for either conveying or linear positioning:

- The friction force F_{US} [N]

$$F_{US} = 9.81 \cdot m \cdot \mu_G \quad [N]$$

m = Total mass to be carried over the slider bed [kg]
μ_G = Coefficient of friction between the belt and slider bed [-]

For linear positioning applications the friction force F_f [N] of the slide needs to be considered. If this force is not defined by the supplier of the linear bearings, it must be determined experimentally (e.g. by means of a spring scale).

- Force required to elevate the carried goods F_{Ui} [N] (not required for horizontal conveyors).

$$F_{Ui} = 9.81 \cdot m \cdot \frac{h_T}{l_T} \quad [N]$$

h_T = Elevating height [mm]
l_T = Conveying length [mm]

- In applications where a mass is accelerated (actuator, stop-and-go operation): Force F_{Ua} required for the acceleration of the carried goods:

$$F_{Ua} = m \cdot a \quad [N]$$

m = Mass of carried goods on total conveying length (total load) [kg]
a = Acceleration [m/s²]

$$a = \frac{v}{t} \quad [m/s^2]$$

v = Belt speed [m/s]
t = Time required to run the conveyor up to speed [s]

Therefore the peripheral force F_u at the drive pulley is primarily the sum of the following forces resisting the belt motion:

$$F_U = F_{Us} + F_{Ui} + F_{Ua} \quad [N]$$

In applications with less than 5 teeth in mesh on the drive pulley (less than 11 teeth in mesh for open ended belts) the F_u value has to be corrected with the tooth-in-mesh factor t_m:

Joined endless belts

No. of teeth in mesh z_m	Tooth-in-mesh factor t_m
1	0.2
2	0.4
3	0.55
4	0.7
5	0.85
> 5	1

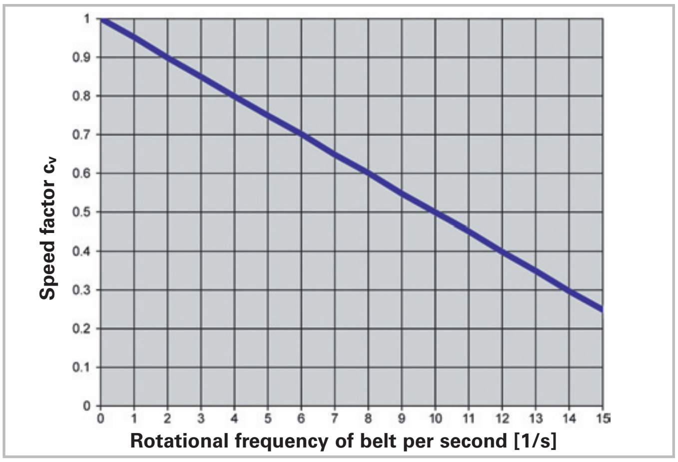
No. of teeth in mesh z_m	Tooth-in-mesh factor t_m
1	0.15
2	0.3
3	0.4
4	0.5
5	0.6
6	0.7
7	0.8
8	0.85
9	0.9
10	0.95
11	0.97
> 11	1

Since a high rotational frequency of the belt may lead to high stress on the belt teeth (due to build-up of heat on the drive pulley), the speed factor c_v has to be considered if the belt rotates more than once per second.
In order to find this speed factor, the rotational frequency f_R of the belt has to be defined:

$$f_R = \frac{v \cdot 1000}{l_0} \quad 1/s$$

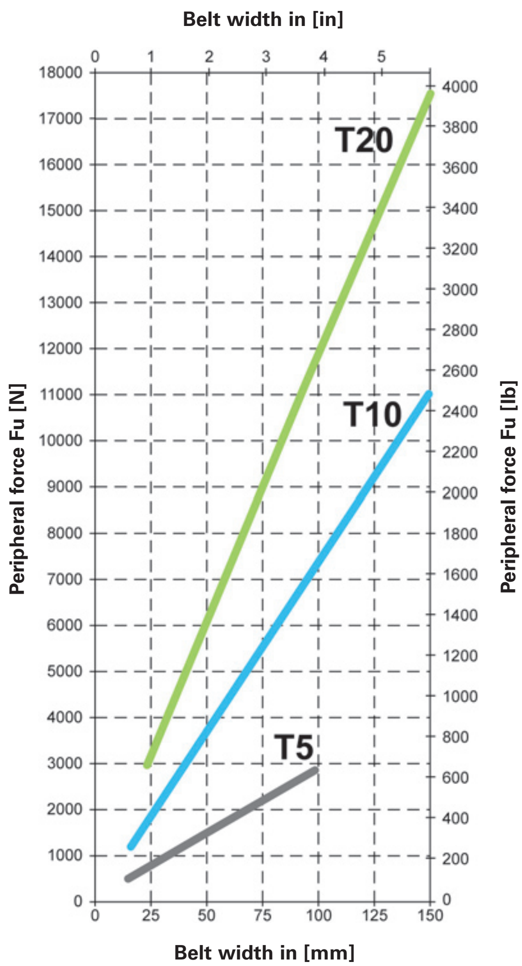
v = Belt speed [m/s]
l_0 = Belt length [mm]

$$F_u(\text{corrected}) = \frac{F_U}{t_m \cdot c_v}$$

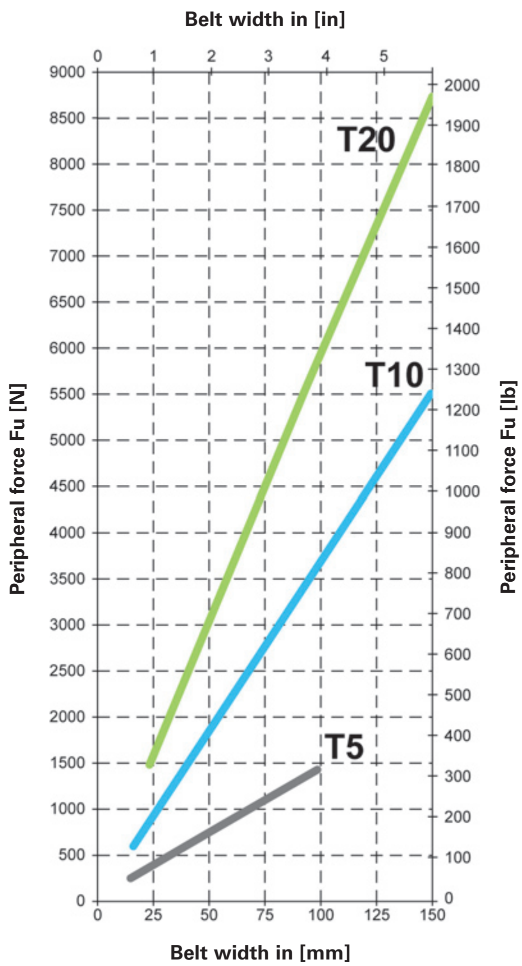


Pitch selection for T series belts

Open ended belts

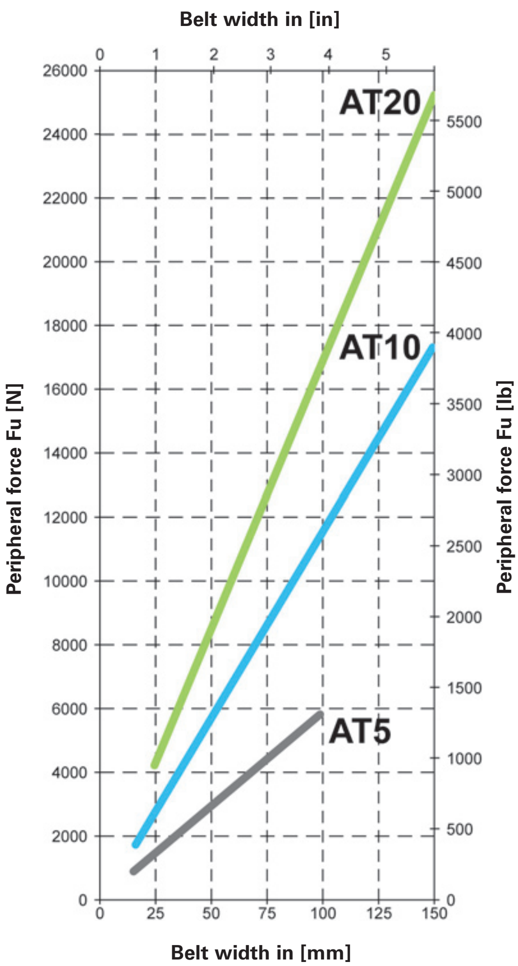


Joined endless belts

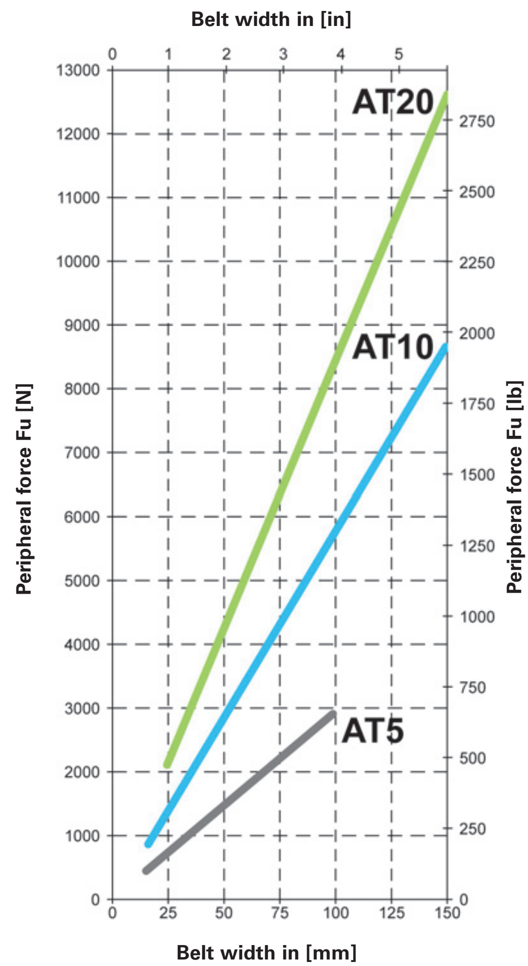


Pitch selection for AT series belts

Open ended belts

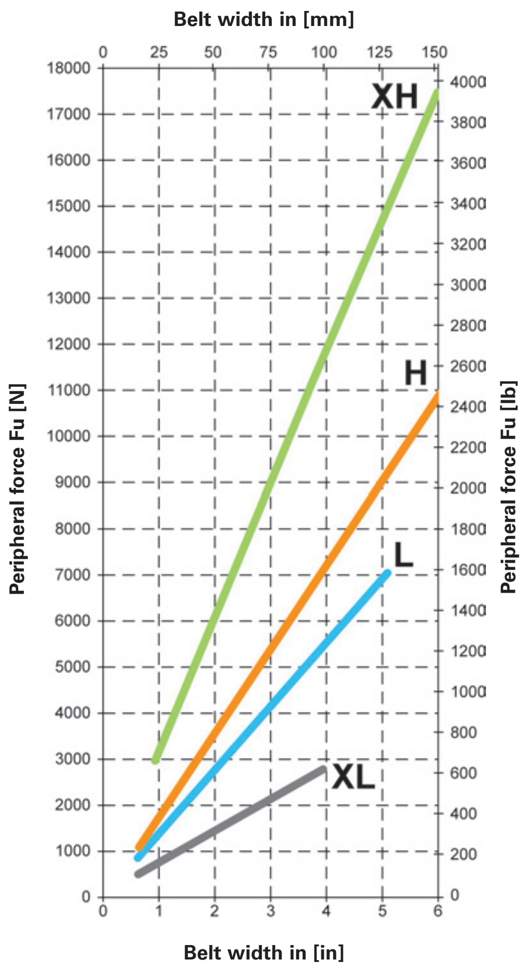


Joined endless belts

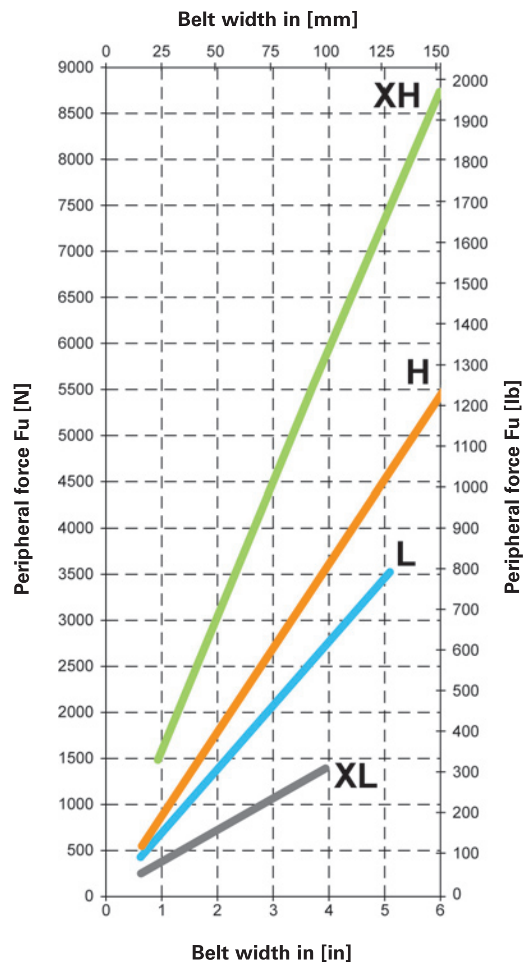


Pitch selection for belts of series with imperial pitches

Open ended belts



Joined endless belts



Calculation Guide
Belt calculation procedure

A timing belt used in conveying applications typically operates well below its rated nominal tensile strength. For many applications the belt is selected according to the dimensional requirements of the drive system (pulley diameter, size of conveying load, required belt features, etc.) without considering a belt calculation. In such cases where the transmission of power is of minor importance we recommend useing the smallest belt pitch possible. For these applications we recommend operating with an initial belt elongation of about 0.1% (= 1‰).

For applications where belts need to be selected according to their load capacity, we highly recommend a belt calculation like that described below or using SYNC-SeleCalc.

Belt calculation procedure

Peripheral force has to be evaluated
Whether for a conveying or linear positioning application, the first step is to determine the peripheral force F_u at the drive pulley (this is the sum of all individual forces resisting the belt motion). All individual loads contributing to the peripheral force F_U must be identified and calculated based on the loading conditions and drive configuration.
In some cases however, certain loads cannot be calculated until the layout has been determined.

Evaluation of belt and pitch
In order to determine the belt pitch and width the peripheral force on the drive pulley and the maximum load on the teeth have to be considered.

Please see the Design Guide chapter to learn how to determine peripheral force and how to evaluate the belt type.

Calculation of installation parameters
Required belt width, required belt tension, shaft loads, and safety (utilized tensile force) are the common results of calculations for conveying, indexing conveyors and linear drive applications.

For linear drive applications the accuracy of positioning (possibly for different masses or positions) has to be ascertained.

Belt selection and calculation for timing belt applications requires the following steps

1. Determination of peripheral force
   1.a. For conveying or indexing conveyors
   1.b. For linear positioning applications
2. Selection of belt, belt width and pitch
3. Definition of pulley diameters / number of pulley teeth
4. Definition of center distances and belt length
5. Calculation of the number of teeth in mesh on the drive pulley
6. Determination of minimal tensile force in the slack belt strand
7. Calculation of elongations and forces in the tight and slack side
8. Calculation of required belt width
9. Calculation of shaft loads
10. Calculation of drive power and required motor power

For the calculation of linear drives an additional calculation is often required:

11. Calculation of positioning error

Step 1. Determination of peripheral force

1.a. Determination of peripheral force (for conveying or indexing conveyors)

The peripheral force F_u at the drive pulley is the sum of all individual forces resisting the belt motion. The individual loads contributing to the peripheral force F_U must be identified and calculated based on the loading conditions and drive configuration. However, some loads cannot be calculated until the layout has been decided. Therefore in some cases a correction of belt width or pitch is needed, and revision of the calculation will be required.

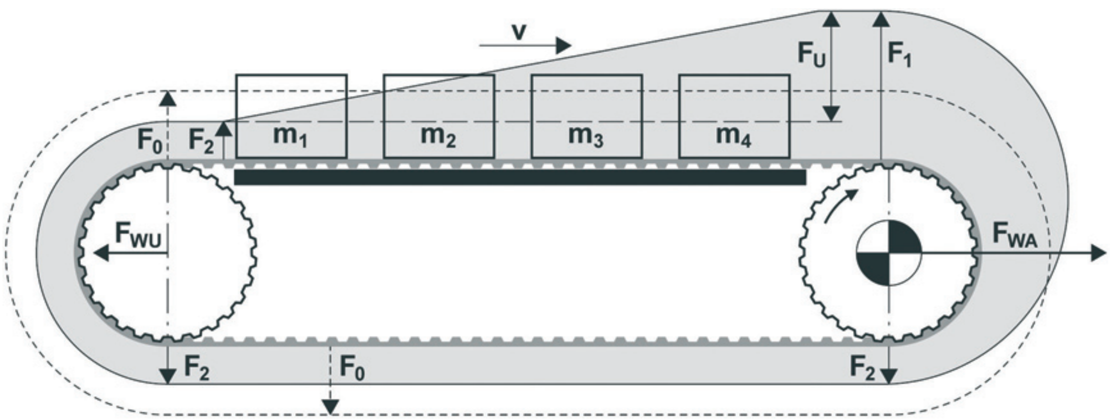
F_U for a conveying application is primarily the sum of the following addends resisting the belt motion:

- Resistance due to friction between the belt and the slider bed (F_{US})
- Elevating the carried goods (F_{Ui})
- Acceleration forces (F_{Ua})
- Other contributing friction forces (F_{Uau})

The peripheral force Fu at the drive pulley is therefor the sum of these forces:

$$F_u = F_{US} + F_{Ui} + F_{Ua} + F_{Uau} \quad [N]$$

Friction force F_{US} (1st addend)
The friction force F_{US} [N] is the resistance due to friction between the belt and the slider bed.



$$m_{tot} = m + m_B = m + \frac{l_T \cdot m'}{1000} \qquad [kg]$$

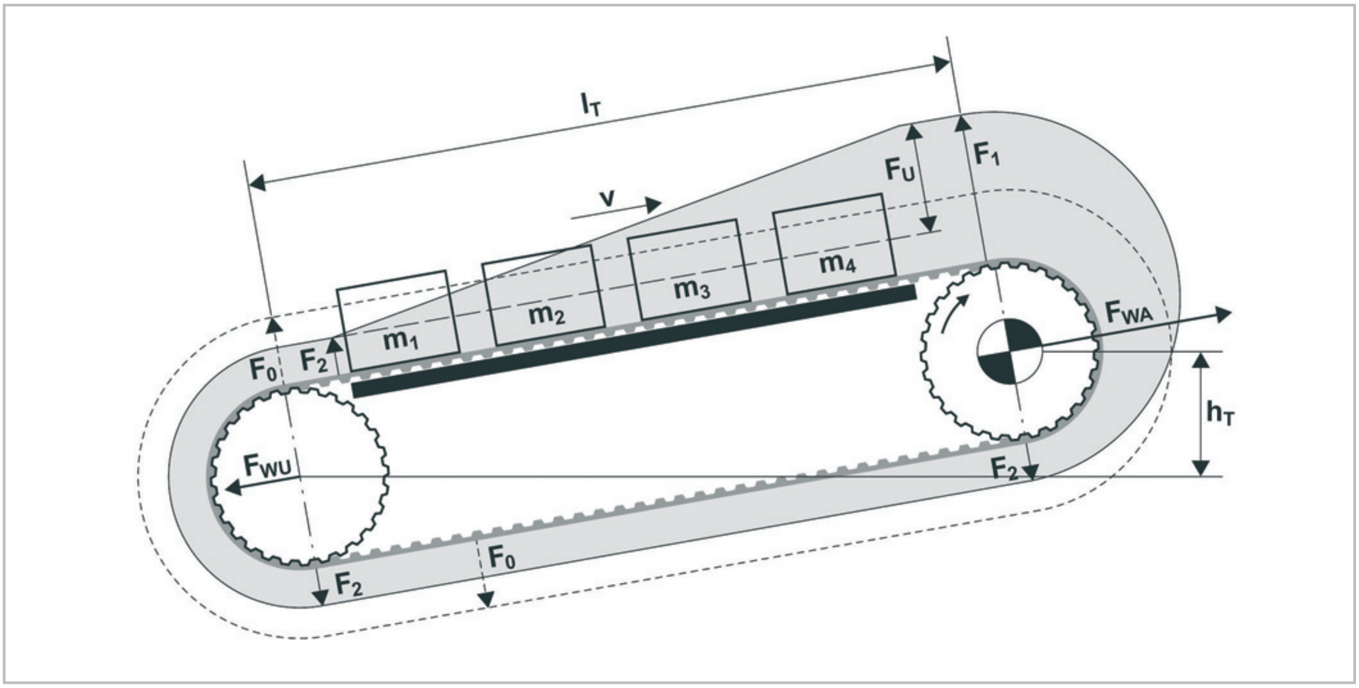
$$F_{US} = 9.81 \cdot m_{tot} \cdot \mu_G \qquad [N]$$

m_{tot} = Total mass to be moved across the slider bed [kg]
m = Mass of carried goods on total conveying length (total load) [kg]
m_B = Mass of the belt moved over the slider bed [kg]
m' = Mass of belt per meter [kg/m]
l_T = Conveying length [mm]
μ_G = Coefficient of friction between the belt and the slider bed [-]

The total mass to be carried over the slider bed (m_{tot}) consists of the mass of the carried goods ($m = m_1 + m_2 + ... + m_n$) and the mass of the belt moving across the slider bed (m_B).

Force required to elevate the carried goods
F_{Ui} (2nd addend)

F_{Ui} is the force required to elevate the mass m of the carried goods (not required in horizontal drives).



Formula for inclined transportation

$$F_{Ui} = 9.81 \cdot m \cdot \frac{h_T}{l_T} \quad [N]$$

h_T = Elevating height [mm]
l_T = Conveying length [mm]

For declining conveyor applications the elevating height h_T becomes negative and therefore the force component F_{Ui} will be negative.

Force required for the acceleration of the total mass F_{Ua} (3rd addend)
Force F_{Uma} required for the acceleration of the total mass:

$$F_{Ua} = \left(m + \frac{m' \cdot l_0}{1000} \right) \quad [N]$$

m = Mass of carried goods on total conveying length (total load) [kg]
m' = Mass of belt per meter [kg/m]
l_0 = Belt length [mm]
a = Acceleration [m/s²]

The average acceleration is equal to the belt velocity per unit of time required to accelerate up to speed.

$$a = \frac{v}{t} \quad [m/s^2]$$

v = Belt speed [m/s]
t = Time required to accelerate up to [s]

Other contributing factors to the friction force F_{Uau} (4th addend)
Other contributing factors to the friction force (F_{Uau}) are:

- Resistance due to bearing friction of the rollers or idlers
- Resistance due to friction between the belt and the conveyed goods due to accumulation or diversion
- Resistance due to friction from auxiliary elements such as tracking devices (profiles), belt cleaning devices, etc.

In most cases these resistances are negligible or not relevant for timing belt conveyors. However, in rare cases they become relevant and have to be considered.
The peripheral force F_u at the drive pulley is therefore the sum of the above forces

$$F_u = F_{US} + F_{Ui} + F_{Ua} + F_{Uau} \quad [N]$$

1.b. Determination of peripheral force (for linear positioning applications

The peripheral force F_u at the drive pulley is the sum of all individual forces resisting the belt motion. The individual loads contributing to the peripheral force F_U must be identified and calculated based on the loading conditions and drive configuration. However, some loads cannot be calculated until the layout has been decided. Therefore in some cases a correction of belt width or pitch is needed, and a revision of the calculation will be required.

The peripheral force F_u at the drive pulley is therefore the sum of these forces:

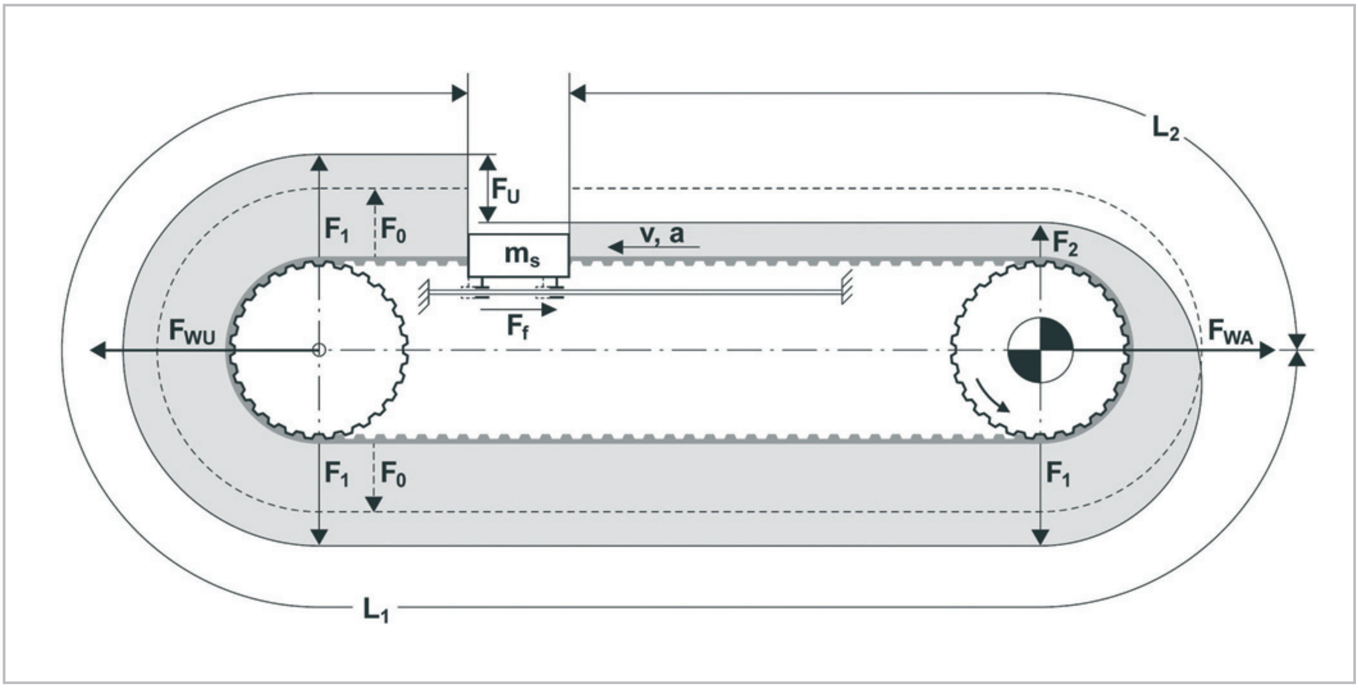
$$F_u = F_{Ua} + F_f + F_E + F_{Ui} \quad [N]$$

F_U for a linear positioning application is primarily the sum of the following addends resisting the belt motion:

- Force required for the acceleration of a loaded slide (F_{Ua})
- Fiction force of the slide against the linear rail (F_f)
- Externally applied working load (F_E)
- Force required to elevate the mass Fs of the slide and working load (F_{Ui})

Force required for the acceleration of a loaded slide F_{Ua} (1st addend)

Force F_{Ua} required for the acceleration of a loaded slide with mass m_S:



$$F_{Ua} = m_s \cdot a \quad \text{[N]}$$

m_S = Mass of the slider plus maximum load [kg]
a = Acceleration [m/s²]

The average acceleration is equal to the change in velocity per unit time.

$$a = \frac{\Delta v}{t} \quad \text{[m/s}^2\text{]}$$

Δv = Speed difference (final speed minus initial speed) [m/s]
t = Time required to accelerate up to speed [s]

Friction force F_f (2nd addend)

The friction force F_f [N] of the slide against the linear may be provided by the supplier of the linear bearing. If it is not it will need to be determined experimentally. Friction force from bearing losses of rollers or idlers must be considered as part of the investigation.

Externally applied working load F_E (3rd addend)

Externally applied working load F_E (if existing). It is possible, for example that an actuator pulls a mass over a table. The respective friction force has to be considered as an "externally applied working load."

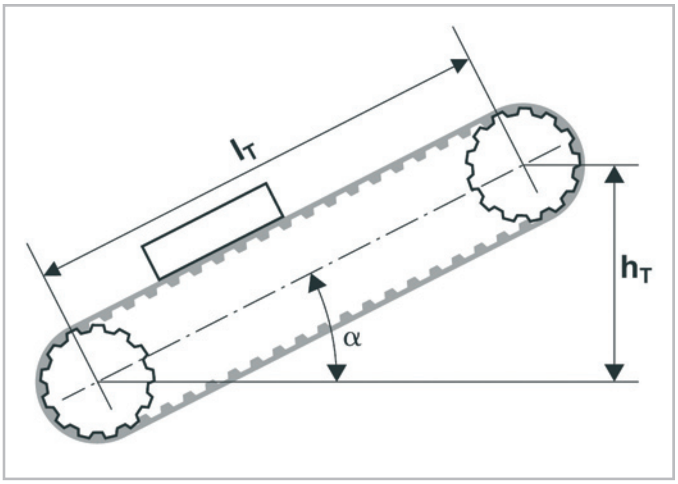
Force required to elevate the mass F_{Ui} (4th addend)

F_{Ui} is the force required to elevate the mass m of the slide and working load (not required in horizontal drives).

Formula for inclining actuation

$$F_{Ui} = 9.81 \cdot m \cdot \sin\alpha \quad [N]$$

For declining actuation sin α becomes negative and therefore the force component F_{Ui} will be negative.



$$\sin\alpha = \frac{h_T}{l_T} \quad => \quad F_{Ui} = 9.81 \cdot m \cdot \frac{h_T}{l_T}$$

α = Angle of inclination [°]
h_T = Elevating height [mm]
l_T = Conveying length [mm]

The peripheral force Fu at the drive pulley is therefore the sum of the above forces

$$F_u = F_{Ua} + F_f + F_E + F_{Ui} \quad [N]$$

Step 2. Selection of belt, belt width and pitch
To select the belt pitch please follow the instructions in the chapter entitled "Design Guide". This chapter will help you safely evaluate the tooth and select the belt pitch P_b according to the peripheral force F_U. The graphs also provide an estimate of the required belt width.

Step 3. Definition of pulley diameters / number of pulley teeth
Use the preliminary pulley diameter *d* desired for the design envelope and the selected pitch *t* to determine the preliminary number of pulley teeth.

$$z_p = \frac{d \cdot \pi}{P_b}$$

z_p = Number of pulley teeth [-]
d = Effective pulley diameter [mm]
P_b = Belt pitch [mm]

Round off to a whole number of pulley teeth z_p. Give preference to stock pulley diameters. Check against the minimum number of pulley teeth z_{min} for the selected belt type given in the product data sheets.

Determine the pitch diameter *d* according to the number of pulley teeth z_p choosen:

$$d = \frac{P_b \cdot z_p}{\pi}$$

Step 4. Define center distances and belt length
For applications with more than two pulleys the design envelope is commonly calculated on a CAD system or manually.

For two pulley applications use the following procedure:

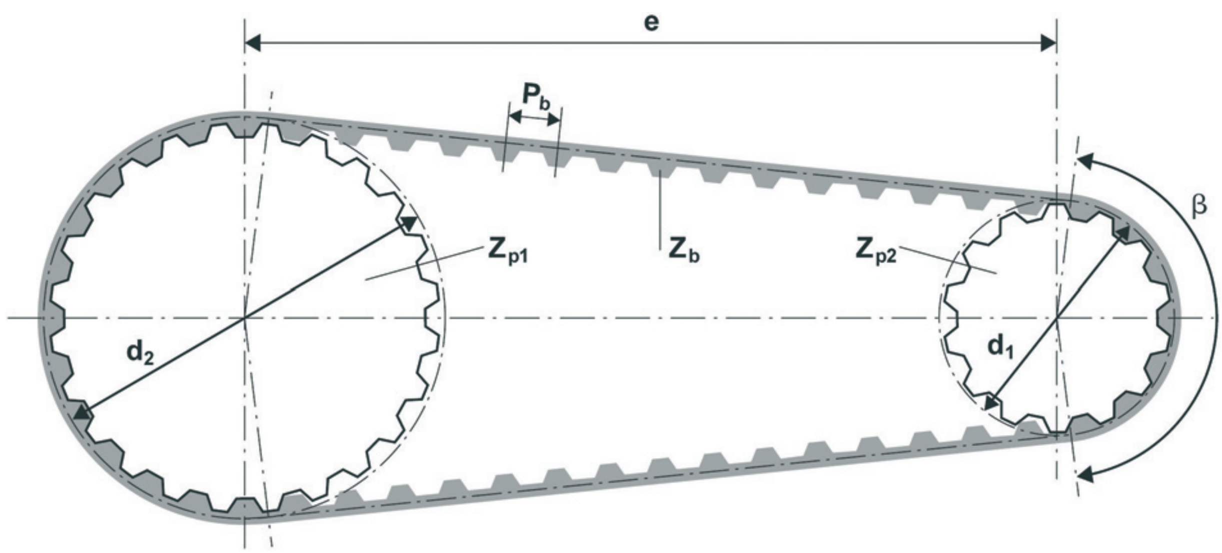
Use the preliminary center distance *e* desired for the design envelope to determine a preliminary number of belt teeth z_b:

$$z_b = \frac{2 \cdot e}{P_b} + z_p$$

z_b = Number of belt teeth [-]
z_p = Number of pulley teeth [-]
e = Center-to-center distance [mm]
P_b = Belt pitch [mm]

For unequal pulley diameters:

$$z_b = \frac{2 \cdot e}{P_b} + \frac{z_{p1} + z_{p2}}{2} + \frac{P_b}{4e}\left(\frac{z_{p2} - z_{p1}}{\pi}\right)^2$$



Round off to a whole number of belt teeth z_b.
If your application requires profiles, consider the profile spacing when selected the number of belt teeth. Please note that the ideal profile design locates the profile over the tooth (not between the teeth).

Determine the belt length l_0 according to the number of belt teeth choosen:

$$l_0 = z_b \cdot P_b$$

Determine the center-to-center distance *e* corresponding to the chosen belt length.

For equal diameter pulleys:

$$e = \frac{l_0 - d \cdot \pi}{2}$$

For unequal diameter pulleys:

$$e = \frac{l_0 - \frac{\pi(d_2 + d_1)}{2} + \sqrt{\left(l_0 - \frac{\pi \cdot (d_2 + d_1)}{2}\right)^2 - 2(d_2 + d_1)^2}}{4}$$

l_0 = Belt length [mm]
z_b = Number of belt teeth [-]
z_p = Number of pulley teeth [-]
e = Center-to-center distance [mm]
d = Pitch diameter of pulley [mm]
P_b = Belt pitch [mm]

Step 5. Calculation of the number of teeth in mesh on the drive pulley
Calculate the number of teeth in mesh z_m using the appropriate formula.

z_a = Number of pulley teeth of the drive pulley [-]
β = Arc of contact on the respective pulley [°]

For two equal diameter pulleys:

$$z_m = \frac{z_a}{2}$$

For two unequal diameter pulleys:

$$z_m \approx z_a\left(0.5 - \frac{d_2 - d_1}{2\pi \cdot e}\right)$$

For pulleys with a known arc of contact:

$$z_m = \frac{z_a \cdot \beta}{360}$$

Determine the tooth-in-mesh factor according to these tables:

Joined endless belts

No. of teeth in mesh z_m	Toot-in-mesh factor t_m
1	0.2
2	0.4
3	0.55
4	0.7
5	0.85
> 5	1

Open ended belts (without joint)

No. of teeth in mesh z_m	Toot-in-mesh factor t_m
1	0.15
2	0.3
3	0.4
4	0.5
5	0.6
6	0.7
7	0.8
8	0.85
9	0.9
10	0.95
11	0.97
> 11	1

Step 6. Determination of minimal tensile force in the slack belt strand

The tensile force in the slack belt side (F_2) prevents jumping of the pulley teeth during belt operation. Based on experience, timing belts perform best with slack side tension in the range 0.1 to 0.3 times the peripheral force F_U. Therefore:

$$F_2 \approx 0.2 \cdot F_u \quad [N]$$

F_2 = Tensile force in the slack belt strand [N]
F_U = Peripheral force [N]

or expressed in elongation:

$$\varepsilon_2 \approx 0.2 \cdot \varepsilon_u \quad [\%]$$

ε_u = Belt elongation generated by peripheral force F_U
ε_2 = Minimal belt elongation in the slack side

$$\varepsilon_u = \frac{F_u}{k_{1\%}} \quad [\%]$$

$k_{1\%}$ = Tensile force for 1% elongation [N]

Drives with controlled belt tension

Since HabaSYNC® timing belts have a very high stress-strain ratio, it is highly recommended (at least for belt lengths below 6 m/20 ft) to use a tensioning device to provide controlled belt tension. Typically a constant shaft load or slack side tension is incorporated by using pneumatic cylinders, spring-loaded or gravity tensioners, etc. Such tensioning devices provide the advantages of reduced maintenance and minimized maximum belt tension, both of which have a positive influence on belt life.

The minimum tensile force in the slack side should be in the range 0.1 to 0.2 times the peripheral force F_U. The pressure force of a tensioning idler F_{WT} can therefore be calculated as follows:

$$F_{WT} = 0.4 \cdot F_u \cdot \sin\left(\frac{\beta_T}{2}\right) \quad [N]$$

F_{WT} = Pressure force of slack side tensioning idler [N]
β_T = Arc of contact of the belt on the tensioning idler (see Table 2 at the end of the Calculation Guide)

Drives with a fixed center-to-center distance
Drives with fixed center distances typically incorporate an adjustable shaft locked after pre-tensioning the belt. Assuming tight and slack side tensions are constant over the respective belt lengths, and a minimum slack side elongation in the range of the above relationship, the initial belt tension ε_0 is:

$$\varepsilon_0 = \varepsilon_2 + \varepsilon_u \cdot \frac{l_1}{l_0} \quad [\%]$$

ε_0 = Initial belt elongation [%]
ε_2 = Minimal belt elongation in the slack side [%]
ε_U = Belt elongation generated by peripheral force F_U [%]*
l_0 = Belt length = $l_1 + l_2$ [mm]
l_1 = Length of the tight belt strand [mm]
l_2 = Length of the slack belt strand [mm]

* See Step 6 on previous page

The initial elongation for belt applications with fixed center distance can also be approximated using the following formulas:

Head drives**:

$$\varepsilon_0 = 0.5 \cdot \varepsilon_u$$

Tail drives**:

$$\varepsilon_0 = \varepsilon_u$$

Center drives**:

$$\varepsilon_0 = 0.75 \cdot \varepsilon_u$$

** See Design Guide/Drive concept

Step 7. Calculation of elongations and forces in the tight and slack sides

The belt elongation in the tight belt strand ε_1 is obtained by:

$$\varepsilon_1 = \varepsilon_0 + \varepsilon_u \cdot \frac{l_2}{l_0} \quad [\%]$$

(for fixed center distances)

The respective force in the tight side F_1 is obtained by:

$$F_1 = F_0 + F_u \cdot \frac{l_2}{l_0} \quad [N]$$

(for fixed center distances)

The expression $\frac{l_2}{l_0}$ is commonly substituted by

- 0.75 for the head drive
- 0.5 for the center drive
- 0.25 for the tail drive

The belt elongation in the slack belt strand ε_2 is obtained by (for fixed center distance):

$$\varepsilon_2 = \varepsilon_0 - \varepsilon_u \cdot \frac{l_1}{l_0} \quad [\%]$$

(for fixed center distances)

The respective force in the slack side F_2 is obtained by:

$$F_2 = F_0 - F_u \cdot \frac{l_1}{l_0} \quad [N]$$

(for fixed center distances)

The expression $\frac{l_1}{l_0}$ is commonly substituted by

- 0.25 for the head drive
- 0.5 for the centre drive
- 0.75 for the tail drive

For drives with constant slack side tension the force in the slack side F_2 is defined by the tensioning device and the force in the tight side $F_1 = F_2 + F_U$.

F_0 = Tensile force due to initial tension = $\varepsilon_0 \cdot k_{1\%}$ [N]
F_1 = Maximum tensile force in the tight belt strand [N]
F_2 = Minimum tensile force in the slack belt strand [N]
F_U = Peripheral force [N] ($F_U = F_1 - F_2$)
ε_0 = Initial belt extension [%]
ε_1 = Maximal belt elongation in the tight side [%]
ε_2 = Minimal belt elongation in the slack side [%]
ε_U = Belt elongation generated by peripheral force F_U [%] ($\varepsilon_U = \varepsilon_1 - \varepsilon_2$)
l_0 = Belt length = $l_1 + l_2$ [mm]
l_1 = Length of the tight belt strand [mm]
l_2 = Length of the slack belt strand [mm]

Step 8. Calculation of required belt width
The determination of the required belt width has to include two independent criteria; required belt width in terms of:

A admissible tensile force
B admissible load on teeth

A Determine the admissible tensile force F_{adm} [N] of the selected pitch given in the data sheets. Note that F_{adm} [N] is different for open ended and joined endless belts.

Since a high rotational frequency of the belt may lead to high stress on the belt teeth (due to build-up of heat on the drive pulley), the speed factor c_v has to be considered if the belt rotates more than once per second.

To find this speed factor the rotational frequency f_R of the belt has to be defined:

$$f_R = \frac{v \cdot 1000}{l_0} \quad 1/s$$

v = Belt speed [m/s]
l_0 = Belt length [mm]

The speed factor can be derived by means of the graph below or mathematically:

$$c_v = 1 - \frac{50 \cdot v}{l_0}$$

v = Belt speed [m/s]
l_0 = Belt length [mm]

Determine the required belt width b_{req} in terms of admissible tensile force and speed factor:

$$b_{req} = \frac{F_1 \cdot b_0}{F_{adm} \cdot c_v} \quad [mm]$$

B To determine the admissible load on teeth specify the tooth-in-mesh factor t_m for joined or endless belts (see Step 5).

Determine the required belt width b_{req} in terms of tooth strength:

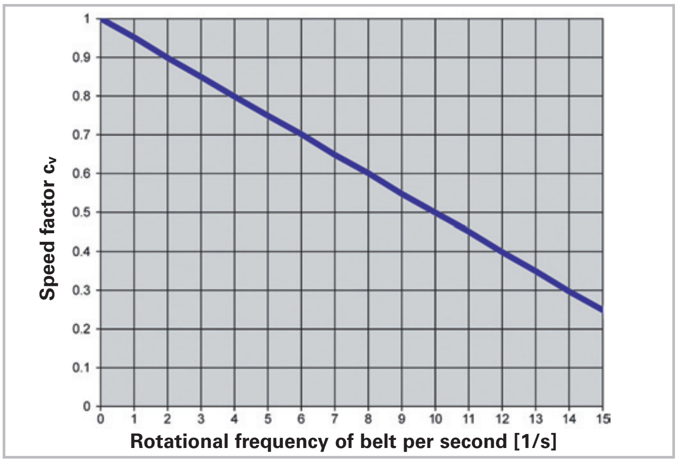
$$b_{req} = \frac{F_U \cdot b_0}{F_{adm} \cdot t_m \cdot c_v} \quad [mm]$$

b_{req} = Minimum required belt width [mm]
b_0 = Estimated belt width [mm]
F_U = Peripheral force [N]
F_1 = Maximum tensile force in the tight belt strand [N]
F_{adm} = Admissible tensile force (different values for open and joined belts!) [N]
t_m = Tooth-in-mesh factor (Table Step 5) [-]
c_v = Speed factor [-]

Select the standard belt width that satisfies the last two conditions.

The forces contributing to F_U which in Step 1 were estimated can now be calculated accurately. Evaluate the contribution of these forces to the peripheral force F_U and, if necessary, recalculate F_U and repeat Steps 6, 7 and 8.

For conveyors, the dimensions of the transported products will normally determine the belt width.



Step 9. Calculatíon of shaft loads
For an arc of contact of 180° the shaft load F_W is:

$$F_W = F_1 + F_2 \quad [N]$$

For pulleys and rollers with an arc of contact $\beta \neq 180°$, the shaft load can be determined using the following approximation method:

$$F_W = (F_1 + F_2) \cdot \sin\left(\frac{\beta}{2}\right) \quad [N]$$

For non-driven pulleys (tail pulley, idlers, etc.) the forces F_1 and F_2 are the same.

Determine the shaft load F_{WA} static (F_{WAs}) and dynamic (F_{WAd}) at the drive pulley:

$$F_{WAs} = 2 \cdot F_0 \cdot \sin\left(\frac{\beta}{2}\right) \quad [N]$$

$$F_{WAd} = (F_1 + F_2) \cdot \sin\left(\frac{\beta}{2}\right) \quad [N]$$

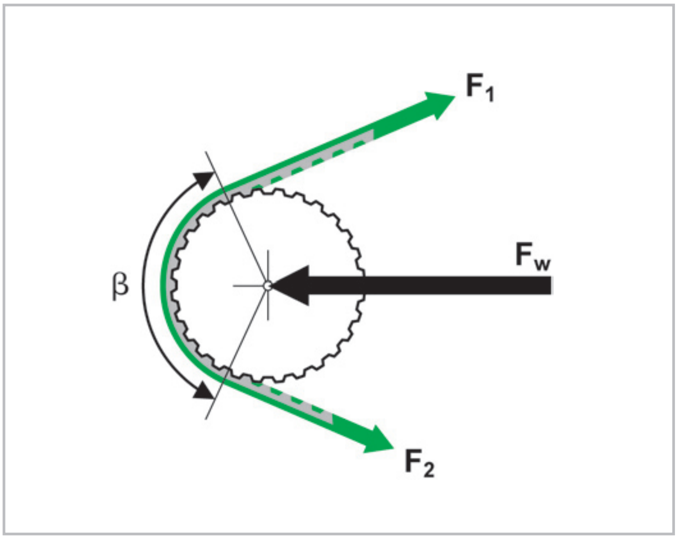
Determine the shaft load F_{WU} static (F_{WUs}) and dynamic (F_{WUd}) at the tail pulley:

$$F_{WUs} = 2 \cdot F_0 \cdot \sin\left(\frac{\beta}{2}\right) \quad [N]$$

F_W = Shaft load [N]
F_{WAs} = Static shaft load on the drive pulley [N
F_{WAd} = Dynamic shaft load on the drive pulley [N]
F_0 = tensile force due to initial tension ($F_0 = \varepsilon_0 \cdot k_{1\%}$) [N]
F_1 = Maximum tensile force in the tight belt strand [N]
F_2 = Minimum tensile force in the slack belt strand [N]

Since in linear positioning applications the highest shaft load at the tail pulley (F_{WUd}) occurs during acceleration when the load moves away from the drive pulley, the tension of both belt strands of the tail pulley is equivalent to F_1.

$$F_{WUd} = 2 \cdot F_1 \cdot \sin\left(\frac{\beta}{2}\right) \quad [N]$$



Arc of contact β		sin β/2
10 °	350 °	0.087
20 °	340 °	0.174
30 °	330 °	0.259
40 °	320 °	0.342
50 °	310 °	0.423
60 °	300 °	0.500
70 °	290 °	0.574
80 °	280 °	0.643
90 °	270 °	0.707
100 °	260 °	0.766
110 °	250 °	0.819
120 °	240 °	0.866
130 °	230 °	0.906
140 °	220 °	0.940
150 °	210 °	0.966
160 °	200 °	0.985
170 °	190 °	0.996
180 °		1.000

Step 10. Calculation of the drive power and required motor power

The required power on the drive pulley is:

$$P = \frac{F_u \cdot v}{1000} \quad [kW] \text{ or}$$

$$P = \frac{F_u \cdot d_a \cdot \pi \cdot n_1}{60'000} \quad [kW]$$

When considering the efficiency of the gearbox placed between the drive pulley and the motor, the required power of the motor P_M is:

$$P_M = \frac{P \cdot 100}{Eta} \quad [kW]$$

The respective torque M_a on the drive pulley shaft is:

$$M_a = \frac{F_u \cdot d_a}{2000} \quad [Nm]$$

F_u = Peripheral force [N]
v = Belt speed [m/s]
d_a = Pitch diameter of driving pulley [mm]
n_1 = Number of revolutions of driving pulley [1/min]
Eta = Efficiency of gearbox [%] *

* For an application with a normal motor/gearbox unit we recommend using the default value of 75% if the exact figure is unknown.

Step 11. Calculation of the positioning error
Positioning errors have to be distinguished in terms of

- random positioning error Δx_R (tolerance when many positioning procedures are compared with each other)
- systematic positioning error Δx_S (referring to the tolerance of the belt pitch)

The total tolerance (tolerance referring to an angle of rotation of the drive pulley) is the sum of the above partial addends.
In both cases the random positioning error has to be calculated. To definine the total error Δx the accuracy factor of the specific belt [%] times the maximum covered distance of the slide has to be added to the random positioning error.

$$\Delta x = \Delta x_R + \Delta x_S = \Delta x_R + \frac{l_T \cdot af}{100}$$

l_T = Maximal covered distance of the slide [mm]
af = Accuracy factor of belt [%]

The random positioning error Δx_R is the sum of the following three partial errors:

A Belt elongation due to elasticity of the belt Δx_1
B Deformation of tooth in mesh on the drive pulley Δx_2
C Backlash due to the clearance between the belt teeth and the pulley grooves Δx_3

A When positioning the mass, a force component generates a belt elongation which causes a positioning error. This force is caused by resistance of the bearings or by external forces at the slider (e.g. mass on an inclined linear positioning drive).

This positioning error is influenced by:
- Position of the slider (length of tight and slack belt strand)
- Belt strength
- The possible variation of the force on the slider ΔF

The partial error Δx_1 of a slider in a determined position is:

$$\Delta x_1 = \frac{\Delta F \cdot l_1 \cdot (l_0 - l_1)}{l_0 \cdot k_{1\%} \cdot 100} \quad [mm]$$

Δx_1 = Maximal possible deviation of slider position caused by belt elongation
ΔF = Highest possible variation of force component on the positioned slider [N]
l_0 = Belt length [mm]
l_1 = Length of tight belt strand if the slider is in critical position [mm]*
$k_{1\%}$ = Tensile force for 1% elongation [N]

* In most cases the critical position of the slider means the maximum distance from the drive pulley.

B The deformation of teeth in mesh on the drive pulley is in most cases negligible. However in highly demanding applications it has to be considered.
Since an exact calculation of this deformation is very complex, we have developed a simplified estimation:

$$\Delta x_2 = \frac{\Delta F \cdot df}{t_m} \quad [mm]$$

Δx_2 = Maximal possible deviation of the slider position caused by the deformation of belt teeth
ΔF = Highest possible variation of force component on the positioned slider [N]
df = Deformation factor
t_m = Tooth-in-mesh factor

Since the deformation factor df is dependent on the tooth load and tooth shape, we recommend using the following approximations:

$$df = 0.125 \cdot \frac{P_b}{k_{1\%}}$$

For belts with a trapezoid tooth shape (T5, T10, T20, XL, L, H, XH)

$$df = 0.075 \cdot \frac{P_b}{k_{1\%}}$$

For belts with a modified trapezoid tooth shape (AT5, AT10, AT20)

P_b = Belt pitch [mm]
$k_{1\%}$ = Tensile force for 1% elongation [N]

C The backlash (the clearance between the belt teeth and the pulley grooves) may be negligible if the positioning is always done from the same side with a similar braking procedure.

If the braking procedure varies from case to case, or if the positioning of the slide is done from both sides, we recommend adding a clearance value Δx_3 to define the Δx_R value. Since this clearance value Δx_3 is determined by both the belt and by the tolerances of the pulley, in principle it is impossible to define a value for a specific belt, but only for a belt and pulley combination.
If the respective tolerances are not mentioned and common pulleys are used, we recommend using a general factor of 0.05* times the belt pitch.

* Since AT belts generally have fewer backlashes, a factor of 0.03 is usually sufficient for AT belts.

$$\Delta x_3 = 0.05 \cdot P_b$$

Δx_3 = Maximal clearance between the belt teeth and the pulley grooves
P_b = Belt pitch [mm]

For demanding applications where minimal backlash is required, use zero backlash pulleys. If such pulleys are used, it is not necessary to use Δx_3.

Resulting positioning error
Random error:

$$\Delta x_R = \Delta x_1 + \Delta x_2 + \Delta x_3 \quad [mm]$$

Systematic error:

$$\Delta x_S = \frac{l_T \cdot af}{100} \quad [mm]$$

Total error (absolute)

$$\Delta x = \Delta x_R + \Delta x_S \quad [mm]$$

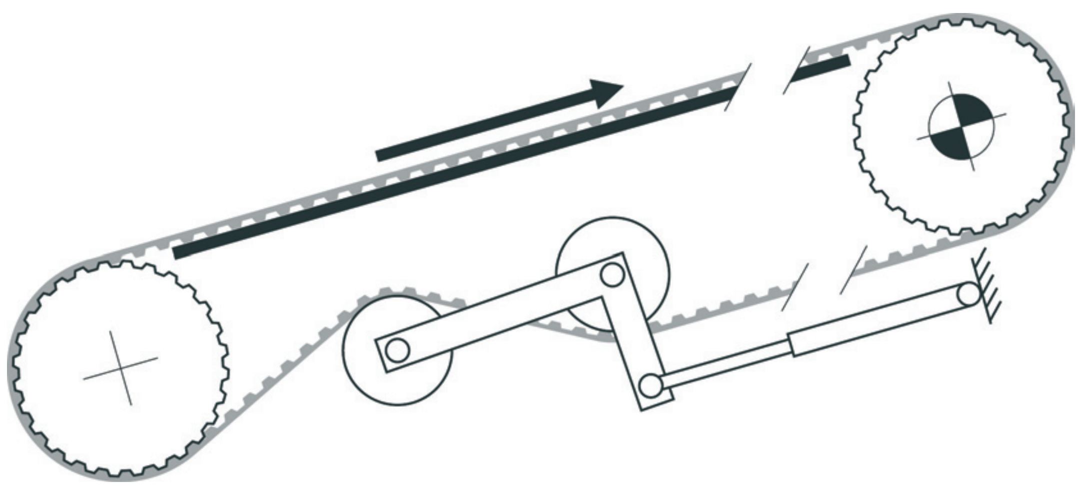
Total error (relative)

$$x = \frac{\Delta x \cdot 100}{l_T} \quad [\%]$$

l_T = Maximum covered distance of the slide [mm]
af = Accuracy factor of belt [%]

Calculation example

An inclined conveyor with two timing belts is used to transport heavy containers. The belt is supported by Habiplast® guide strips made out of ultrahigh molecular weight PE (UHMW PE).
A gas spring provides constant belt tension in the slack side.



Technical data and parameters

Belt series	Metric pitch, trapezoid tooth shape
Conveying length	3000 mm
Elevating height	800 mm
Total load on belt	900 kg (450 kg per belt)
Position of drive	head
Arc of contact on drive pulley	180 °
Arc of contact on pressure roller	60 °
Conveyor bed	Slider bed (UHMW PE)
Diameter of drive pulley	≈ 150 mm
Diameter of tension pulleys	as small as possible
Belt speed	40 m/min

Evaluation of tooth and pitch according to the Design Guide
In order to evaluate of the tooth, pitch and belt width, the peripheral force F_u at the drive pulley needs to be estimated.

F_U for a conveying application is primarily the sum of the following partial forces resisting the belt motion:
- friction force F_{US} [N]

Total mass to be carried over the slider bed = 900 kg (450 kg per belt)

Coefficient of friction between the belt and the slider bed = 0.4 according to the Product Data Sheet for the T belt series

$$F_{US} = 9.81 \cdot m \cdot \mu_G = 9.81 \cdot 450 \cdot 0.4 = 1766 \text{ N}$$

- Force required to elevate the carried goods F_{Ui} [N]

Conveying length	= 3000 mm
Elevating height	= 800 mm

$$F_{Ui} = 9.81 \cdot m \cdot \frac{h_T}{l_T} = 9.81 \cdot 450 \cdot \frac{800}{3000} = 1177 \text{ N}$$

Therefore, the estimated peripheral force F_U is 2943 N

The graphic in the Design Guide for T series joined belts indicates that for this peripheral force a T10 with a width of 100 mm is required.

Therefore the 150 mm drive pulley with a 10 mm pitch is required, with the following number of teeth:

$$z_p = \frac{d \cdot \pi}{P_b} = \frac{150 \cdot 3.14}{10} \approx 47$$

=> Chosen z_P = 48 (stock pulley diameter)

d = Effective pulley diameter [mm]
P_b = Belt pitch [mm]

Following the Design Guide, it is obvious that for a drive pulley with 48 teeth and an arc of contact of 180°, there will be more than five teeth in mesh.

To define the speed factor we have to proceed as follows:

$$v[m/s] = \frac{v[m/min]}{60}$$

The indicated belt speed of 40 m/min corresponds to 0.67 m/s.

To define the belt length, a rough approximation is enough. Since the belt is a little longer than twice the conveying length, we will consider a belt length of 7000 mm.

Accordingly, the rotational frequency f_R is:

$$f_R = \frac{v \cdot 1000}{l_0} \approx \frac{0.67 \cdot 1000}{7000} \approx 0.1 \quad 1/s$$

Since f_R is well below 1 rotation per second, no speed factor has to be considered.

Therefore, the consideration of a tooth-in-mesh or speed factor is not required (which means that $\mathbf{t_m = 1.0}$ and $\mathbf{c_v = 1.0}$).

The pre-selected belts are therefore two T10 belts with a width of 100 mm each.

Calculation according to the Calculation Guide

Step 1. Determination of peripheral force
For an accurate determination of the peripheral force F_u at the drive pulley, it is now possible to also consider the belt mass. However, since the transported mass of 1000 kg is so much greater than the mass of the belts, the consideration of the belt mass to define the friction force on the slider bed is not required.

Therefore the already estimated peripheral force F_U of 2943 N is accurate enough for the final calculation.

Step 2. Selection of the belt, belt width and pitch
Selected belt according to Design Guide:
T10, 100 mm wide

Step 3. Pulley diameters/number of pulley teeth
To define the design envelope around all pulleys the effective pulley diameters have to be defined.

Since the number of teeth for the drive and tail pulley is already defined, the respective effective diameter according to the chosen number of pulley teeth z_p is:

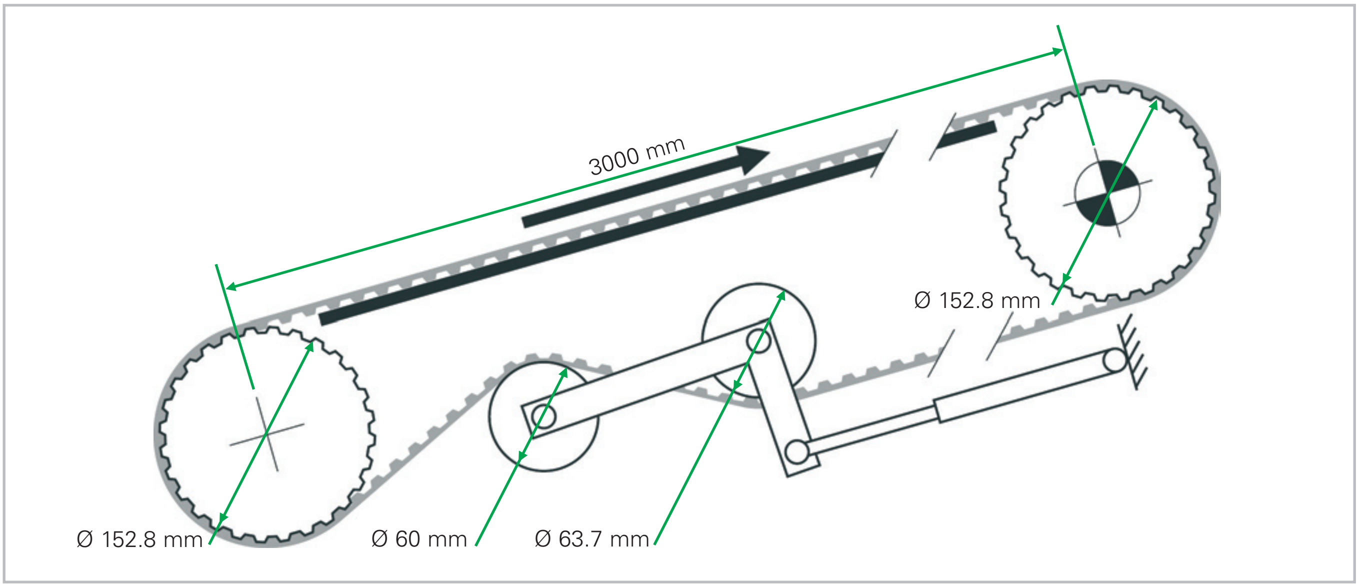
$$d = \frac{P_b \cdot z_p}{\pi} = \frac{10 \cdot 48}{3.14} = 152.8 \text{ mm}$$

For the tensioner, the minimum pulley diameter for counter flection is found on the T10 Product Data Sheet:
d_T = 60 mm

Idler: For forward flection the minimum number of pulley teeth is 20. Using this the respective effective diameter can be defined:

$$d = \frac{P_b \cdot z_p}{\pi} = \frac{10 \cdot 20}{3.14} = 63.7 \text{ mm}$$

Step 4. Define the center distances and belt length



If all pulley diameters are known, the belt length of 6.540 mm (654 teeth) can be specified manually or by using a CAD tool.

Step 5. Calculate the number of teeth in mesh on the drive pulley
Following the Calculation Guide it is obvious that for the drive pulley with 48 teeth and an arc of contact of 180°, there will be more than five teeth in mesh. **Therefore consideration of a tooth-in-mesh factor is not required** (which means that $\mathbf{t_m = 1.0}$).

Step 6. Determine the minimal tensile force in the slack belt strand

Peripheral force = 2943N

$$F_2 \approx 0.2 \cdot F_u = 0.2 \cdot 2943 \approx 589\ N$$

$k_{1\%}$ (stress-strain ratio per unit of width) = 22000 N

$$\varepsilon_u = \frac{F_u}{k_{1\%}} = \frac{2943}{22000} = 0.134\ \%$$

$$\varepsilon_2 \approx 0.2 \cdot \varepsilon_u = 0.2 \cdot 0.134 \approx 0.0268\ \%$$

For drives with controlled slack side tension

Arc of contact of the belt on the tensioning idler = 60°

Pressure force of a tensioning idler F_{WT} is:

$$F_{WT} = 0.4 \cdot F_u \cdot \sin\left(\frac{\beta_T}{2}\right) = 0.4 \cdot 2943 \cdot \sin\left(\frac{60}{2}\right) = 589\ N$$

Step 7. Calculate the elongations and forces in the tight and slack sides
For drives with constant slack side tension the force in the slack side F_2 is defined by the tensioning device and the force in the tight side:

$$F_1 = F_2 + F_u = 589 + 2943 = 3532 \text{ N}$$

Step 8. Calculate the required belt width
Determine the required belt width b_{req} in terms of admissible tensile force:

Admissible tensile force joined belt = 4400 N

$$b_{req} = \frac{F_1 \cdot b_0}{F_{adm} \cdot c_v} = \frac{3532 \cdot 100}{4400 \cdot 1} = 80.2 \text{ mm}$$

Determine the required belt width b_{req} in terms of tooth strength:

$$b_{req} = \frac{F_U \cdot b_0}{F_{adm} \cdot t_m \cdot c_v} = \frac{2943 \cdot 100}{4400 \cdot 1 \cdot 1} = 67 \text{ mm}$$

Step 9. Calculate the shaft loads
Drive pulley
For the arc of contact of 180° the dynamic shaft load F_{Wad} is:

$$F_{WAd} = F_1 + F_2 = 3532 + 589 = 4121 \text{ N}$$

Since the belt has a constant slack side tension, the tension in the tight side is at the level of the slack side tension if the conveyor is switched off or if no load is on the conveyor. Therefore the static shaft load F_{Was} is:

$$F_{WAs} = 2 \cdot F_2 = 2 \cdot 589 = 1178 \text{ N}$$

Tail pulley
On the non-driven tail pulley both belt strands are loaded with the tensile force controlled by the slack side tensioning device. Therefore the static and dynamic shaft loads (F_{Wus} and F_{Wud}) are equal:

Arc of contact on tail pulley = 210°

$$F_{WUs} = F_{WUd} = 2 \cdot F_2 \cdot \sin\left(\frac{\beta}{2}\right) = 2 \cdot 589 \cdot 0.966 = 1137 \text{ N}$$

Arc of contact β		sin β/2
10 °	350 °	0.087
20 °	340 °	0.174
30 °	330 °	0.259
40 °	320 °	0.342
50 °	310 °	0.423
60 °	300 °	0.500
70 °	290 °	0.574
80 °	280 °	0.643
90 °	270 °	0.707
100 °	260 °	0.766
110 °	250 °	0.819
120 °	240 °	0.866
130 °	230 °	0.906
140 °	220 °	0.940
150 °	210 °	0.966
160 °	200 °	0.985
170 °	190 °	0.996
180 °		1.000

Step 10. Calculate the drive power and required motor power

The belt speed is given as 40 m/min. To define the power on the drive pulley the belt speed in m/s has to be calculated:

$$v[m/s] = \frac{v[m/min]}{60} = \frac{40}{60} = 0.667 \quad \text{m/s}$$

The power P on the drive pulley is:

$$P = \frac{F_u \cdot v}{1000} = \frac{2943 \cdot 0.667}{1000} = 1.96 \quad \text{kW}$$

Considering the efficiency of the gearbox of Eta = 75%, which is a recommended value if the correct figure is not known, the required motor power P_M is:

$$P_M = \frac{P \cdot 100}{Eta} = \frac{1.96 \cdot 100}{75} = 2.61 \quad \text{kW}$$

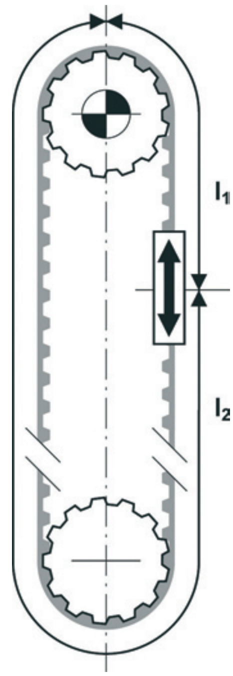
Calculation example

A timing belt driven vertical actuator is positioning a mass. The belt is pre-tensioned with a fixed center-to-center distance.

Technical data and parameters

No belt joint is required (belt ends are mechanically clamped on the slide).

Belt series	Metric pitch
Maximum covered distance of slide	3000 mm
Elevating height	3000 mm
Center-to-center distance	3500 mm
Total load (slide plus load)	300 kg
Weight of slide	20 kg
Belt speed	0.6 m/s
Acceleration time	0.5 s
Position of drive	top
Arc of contact on pulleys	180 °
Diameter of pulleys	< 80 mm
Friction force of slide	20 N



Evaluation of tooth and pitch according to the Design Guide

Determination of peripheral force F_u:

The peripheral force F_u at the drive pulley is the sum of all individual forces resisting the belt motion:

- Force required to elevate the carried good (mass) F_{Ui}:

$$F_{Ui} = 9.81 \cdot m \cdot \frac{h_T}{l_T} \quad [N]$$

For vertical applications the elevating height h_T and conveying length l_T is identical.

$$F_{Ui} = 9.81 \cdot m \cdot 1 = 9.81 \cdot 300 = 2943 \text{ N}$$

- Force F_{Ua} required for the acceleration of the mass:

$$F_{Ua} = m \cdot a \quad [N]$$

$$a = \frac{v}{t} = \frac{0.6}{0.5} = 1.2 \text{ m/s}^2$$

$$F_{Ua} = m \cdot a = 300 \cdot 1.2 = 360 \text{ N}$$

- Since the friction force of the slide F_f is known, it can be considered.

$$F_f = 20 \text{ N}$$

The peripheral force F_u at the drive pulley is primarily the sum of the following forces resisting the belt motion:

$$F_U = F_{Ui} + F_{Ua} + F_f = 2943 + 360 + 20 = 3323 \text{ N}$$

The estimated peripheral force F_U is 3323 N.

Following the Design Guide we can assume that for an arc of contact of 180°, more than eleven teeth are in mesh. Therefore, considering a teeth-in-mesh factor may not be required.

To define the speed factor we have to proceed as follows:

The belt speed is given (0.6 m/s).

To define the belt length, a rough approximation is enough. Since the belt is slightly longer than twice the center-to-center distance, we will consider a belt length of 7200 mm.

Accordingly, the rotational frequency f_R is:

$$f_R = \frac{v \cdot 1000}{l_0} \approx \frac{0.6 \cdot 1000}{7000} \approx 0.86 \quad 1/s$$

Since f_R is below 1 rotation per second, no speed factor has to be considered.

Therefore the consideration of a tooth-in-mesh or speed factor is not required (which means that **t_m = 1.0** and **c_v = 1.0**).

The graphic in the Design Guide for AT series open ended belts shows that for this peripheral force an AT5 in a width of 75 mm or an AT10 in a width of 50 mm are required.

If small pulleys and precise positioning have higher priority, the AT5 is the right choice. If the priority is for a small belt width, AT10 shoud be selected.

In our calculation example we have given priority to a smaller belt width. Therefore we have choosen **AT10 in a width of 50 mm.**

Using this information, we can make further calculations based on the Calculation Guide.

Calculation according to the Calculation Guide

Step 1. Determination of peripheral force
For an accurate determination of the peripheral force F_u at the drive pulley, no additional forces have to be considered relating to the estimation according to the Design Guide.

The already estimated peripheral force F_U of 3323 N is the correct value for the final calculation.

Step 2. Selection of the belt, belt width and pitch
Selected belt according to the Design Guide:
AT10, 50 mm wide

Step 3. Define pulley diameters/number of pulley teeth
According to the Product Data Sheet for AT10 Steel the minimum number of pulley teeth is 25. Thus the pitch diameter d according to the chosen number of pulley teeth z_p is:

$$d = \frac{P_b \cdot z_p}{\pi} = \frac{10 \cdot 25}{3.14} = 79.6 \text{ mm}$$

Step 4. Define the center distances and belt length
Number of belt teeth z_b:

Number of pulley teeth	= 25
Center-to-center distance	= 3500 mm
Belt pitch	= 10 mm

$$z_b = \frac{2 \cdot e}{P_b} + z_p = \frac{2 \cdot 3500}{10} + 25 = 725$$

Determine the belt length l_0 according to the chosen number of belt teeth:

$$l_0 = z_b \cdot P_b = 725 \cdot 10 = 7250 \text{mm}$$

Determine the center-to-center distance *e* corresponding to the chosen belt length (for equal diameters):

$$e = \frac{l_0 - d \cdot \pi}{2} = \frac{7250 - 79.6 \cdot 3.14}{2} = 3500 \text{ mm}$$

Step 5. Calculate the number of teeth in mesh on the drive pulley
For two equal pulley diameters:

$$z_m = \frac{z_a}{2} = \frac{25}{2} = 12.5$$

No tooth-in-mesh factor to consider (more than 11 teeth in mesh)

Step 6. Determine the minimal tensile force in the slack belt strand and initial belt extension

Peripheral force = 3323 N

$$F_2 \approx 0.2 \cdot F_u = 0.2 \cdot 3323 \approx 665 \text{ N}$$

$k_{1\%}$ (tensile force for 1% elongation) = 17500 N

$$\varepsilon_u = \frac{F_u}{k_{1\%}} = \frac{3323}{17500} = 0.190 \text{ \%}$$

$$\varepsilon_2 \approx 0.2 \cdot \varepsilon_u = 0.2 \cdot 0.19 \approx 0.0380 \text{ \%}$$

Initial belt elongation ε_0 for drives with fixed center distance

To determine the initial belt tension the critical position of the slide has to be rated. The critical position of the slide means the maximum length of the tight belt strand (usually the case when the slide is at the maximum distance from the drive pulley). In our case this is the situation with the mass in the lowest position.

In the lowest position the slide is about 3250 mm beyond the lower roller bearing. Therefore the tight belt strand has a maximal length of about 3300 mm.

Length of the tight belt strand l_1	≈ 3300 mm
Belt length $l_0 = l_1 + l_2$	= 7250 mm
(Length of the slack belt strand l_2	≈ 3950 mm)
Belt elongation ε_U generated by peripheral force F_U	= 0.184 %

$$\varepsilon_0 = \varepsilon_2 + \varepsilon_u \cdot \frac{l_1}{l_0} = 0.038 + 0.19 \cdot \frac{3300}{7250} = 0.124\ \% \qquad [\%]$$

Thus the tensile force due to initial tension is:

$$F_0 = \varepsilon_0 \cdot k1\% = 0.124 \cdot 17500 = 2170\ \text{N}$$

Step 7. Calculate the elongations and forces in the tight and slack sides

The force in the tight side F_1 is obtained by:

$$F_1 = F_0 + F_u \cdot \frac{l_2}{l_0} = 2170 + 3323 \cdot \frac{3950}{7250} = 3980\ \text{N}$$

The belt elongation in the slack belt strand ε_2 is obtained by:

$$\varepsilon_2 = \varepsilon_0 - \varepsilon_u \cdot \frac{l_1}{l_0} = 0.124 - 0.19 \cdot \frac{3300}{7250} = 0.0375\ \%$$

The respective force in the slack side F_2 is obtained by:

$$F_2 = F_0 - F_u \cdot \frac{l_1}{l_0} = 2170 - 3323 \cdot \frac{3300}{7250} = 657\ \text{N}$$

Step 8. Calculate the required belt width

Required belt width b_{req} in terms of admissible tensile force:

Admissible tensile force open belt = 7000 N

$$b_{req} = \frac{F_1 \cdot b_0}{F_{adm}} = \frac{3980 \cdot 50}{7000} = 28.4\ \text{mm}$$

Required belt width b_{req} in terms of tooth strength:

$$b_{req} = \frac{F_U \cdot b_0}{F_{adm} \cdot t_m} = \frac{3323 \cdot 50}{7000 \cdot 1} = 23.7\ \text{mm}$$

The selected belt width of 50 mm satisfies these requirements.

Step 9. Calculate the shaft loads

For an arc of contact of 180° the shaft load F_{WAd} on the drive pulley:

$$F_{WAd} = F_1 + F_2 = 3980 + 657 = 4637\text{N} \qquad [\text{N}]$$

On the non-driven pulley the forces of both belt strands are the same. The highest load on the pulley shaft occurs if no load is on the slide (static conditions). In this case, both belt strands have a tensile force due to initial tension F_0. The respective shaft load F_{WAs} is:

$$F_{WAs} = 2 \cdot F_0 = 2 \cdot \varepsilon_0 \cdot k1\% = 2 \cdot 0.124 \cdot 17500 = 4340\ \text{N}$$

Step 10. Calculate the drive power and respective torque

The required power P on the drive pulley is:

$$P = \frac{F_u \cdot v}{1000} = \frac{3323 \cdot 0.6}{1000} = 1.99 \qquad \text{kW}$$

The respective torque M_a on the drive pulley shaft is:

$$M_a = \frac{F_u \cdot d_a}{2000} = \frac{3323 \cdot 79.6}{2000} = 132 \qquad \text{Nm}$$

Step 11. Calculate the positioning error

The random positioning error Δx_R is the sum of the following three partial errors:

A Belt elongation due to elasticity of the belt Δx_1

B Deformation of the tooth in mesh on the drive pulley Δx_2

C Backlash due to the clearance between the belt teeth and the pulley grooves Δx_3

A The partial error Δx_1 is considered for the already mentioned critical position of the slide (maximum distance from the drive pulley). In our case this is when the mass is in the lowest position. In this position the slide may be loaded (max. weight 300 kg) or not (weight of slide 20 kg). The mass variation Δm is therefore 280 kg.

$$\Delta F = 9.81 \cdot \Delta m = 9.81 \cdot 280 = 2747\ \text{N}$$

Length of the tight belt strand l_1	≈ 3300 mm
Length of the slack belt strand l_2	≈ 3950 mm
Belt length $l_0 = l_1 + l_2$	= 7250 mm

$$\Delta x_1 = \frac{\Delta F \cdot l_1 \cdot (l_0 - l_1)}{l_0 \cdot k_{1\%} \cdot 100} = \frac{2747 \cdot 3300 \cdot (7250 - 3300)}{7250 \cdot 17500 \cdot 100} = 2.82\ \text{mm}$$

B Deformation of the tooth in mesh on the drive pulley Δx_2

We use the estimated deformation factor for the AT series:

$$df = 0.075 \cdot \frac{P_b}{k_{1\%}} = 0.075 \cdot \frac{10}{17500} = 0.000043$$

The maximal possible deviation of the slide position caused by the deformation of belt teeth Δx_2 is

Tooth-in-mesh factor tm = 1.0

$$\Delta x_2 = \frac{\Delta F \cdot df}{t_m} = \frac{2747 \cdot 0.000043}{1.0} = 0.12\ \text{mm}$$

C The backlash due to the clearance between the belt teeth and the pulley grooves is negligible since the weight of the slide is greater than the respective friction force. Therefore the backlash of the pulley has no influence.

Resulting positioning error

Random error

$$\Delta x_R = \Delta x_1 + \Delta x_2 = 2.82 + 0.12 = 2.94\ \text{mm}$$

Systematic error

Since HabaSYNC® timing belts commonly have at least a pitch tolerance of 0.04% (accuracy factor af = 0.04) and the maximum covered distance of slide is 3000 mm:

$$\Delta x_S = \frac{l_T \cdot af}{100} = \frac{3000 \cdot 0.04}{100} = 1.2\ \text{mm}$$

Maximum covered distance of slide l_T = 3000 mm

Total error (absolute)

$$\Delta x = \Delta x_R + \Delta x_S = 2.94 + 1.2 = 4.14\ \text{mm}$$

Total error (relative)

$$x = \frac{\Delta x \cdot 100}{l_T} = \frac{4.14 \cdot 100}{3000} = 0.14\ \%$$

HabaSYNC® Belt Material Properties Chemical resistance

The data presented in the chart below is based on data provided by our raw materials manufacturers and suppliers. The data is presented in ambient conditions at 20 degrees C and 70 degrees F. This does not relieve the user of a qualification test to insure use in your application. For additional detail, please contact your local Habasit representative.

Code: ■ = good resistance ▼ = conditionally / sometimes resistant ❑ = not resistant (not to be used)

Designation of chemical	Polyurethane	Neoprene	Natural rubber	Hypalon	Nitrile	Silicone
Acetic acid	❑	■	■	■	■	■
Acetone	❑	❑	▼	■	❑	▼
Acetyl chloride	❑	❑	❑	■	❑	▼
Alkyl benzene	❑	❑	❑		❑	■
Alkyl chloride	▼	❑	❑		■	
Alkyl alcohol	■	❑	❑		■	■
Aluminum acetate	❑	■	■	■	❑	❑
Aluminum chloride	■	■	■	■	■	■
Aluminum nitrate	▼	■	■	■	■	■
Ammonia anhydrous	❑	■	❑	■	■	■
Ammonia gas - hot	❑	❑	▼	■	❑	■
Ammonia gas -cold	■	■	■	■	■	■
Ammonium chloride	■	■	■	■	■	▼
Ammonium hydroxide	❑	▼	▼	■	❑	■
Amyl acetate	❑	❑		❑	❑	❑
Animal fat	▼	▼		❑	▼	❑
Antifreeze	❑	▼	■	■	❑	▼
Antimony pentachloride	❑	❑	❑	❑	❑	❑
Argon	■	❑	■	❑	■	■
Aromatic fuels	❑	❑	■	❑	■	❑
Aromatic hydrocarbons	▼	❑	■		❑	▼
Aromatic vinegar	■	■	■		▼	■
Baking soda	■	■	■		■	■
Barium fluoride	■	■	▼	▼	■	❑
Barium nitrate	■	■	■	■	■	■
Benzene	❑	❑	■	❑	❑	❑
Bleach	❑	❑		■	❑	■
Blood	■	■	■		▼	■
Boric acid	■	■	■	■	■	■
Butadiene	❑	❑	❑	▼	❑	❑
Butyric acid	❑	❑	■	■	■	■
Calcium carbonate	❑	■	■	■	■	❑
Calcium nitrate	■	■	■	■	■	■
Calcium phosphate	■	■	■	■	■	■
Calcium sulfate	■	❑	▼	■	■	
Carbon monoxide	■	❑	▼	■	■	■
Carbonated beverages	■	❑		■	■	▼
Carbonic acid	■	❑	■	■	■	■
Castor oil	■	■	■	■	■	■
Chlorine water	❑	❑	❑		▼	❑
Chloroethane	▼	❑			■	
Chloroform	❑	❑	❑	❑	❑	❑
Chromic acid	❑	❑			❑	▼
Citric acid	■	■	■	■	■	■
Coconut oil	▼	❑	❑	▼	■	■
Copper sulphate	❑	■	■	■	■	■

HabaSYNC® Belt Material Properties

Chemical resistance

Designation of chemical	Polyurethane	Neoprene	Natural rubber	Hypalon	Nitrile	Silicone
Cottonseed oil	■	▼	❏	■	■	■
Creosote	▼	■	❏	❏	■	❏
Degreasing agents	■		❏	❏	❏	
Detergent	■			■	■	■
Dichlorethylene	▼	❏	❏	❏	❏	
Dichloroethane	▼	❏	❏		■	
Diesel oil	▼	❏	❏	▼	■	❏
Dimethyl formamide	❏	❏	❏	❏	▼	❏
Dry cleaning fluids	❏	❏	❏	❏	▼	
Ethyl hexyl alcohol	❏	■	■	■	■	■
Ethylene alcohol	▼	■	■	■	■	■
Ethylene chloride	❏	❏	❏	❏	❏	❏
Ethylene glycol coolant						
Ferric sulfate	■	■	■	■	■	▼
Fish oil	■	■	❏		■	❏
Fluorine	❏	❏	❏		❏	❏
Freon	❏	■	❏	■	▼	❏
Gallic acid	❏	■	■	■	■	
Gasoline - premium	■	▼	❏	▼	■	❏
Gelatin	❏	■	■	■	■	■
Glue	■	■	■	■	■	■
Glycerin	❏	■	■	■	■	■
Honey	▼	■			■	
Hydrogen	■	■	■	■	■	■
Hydrogen peroxide	▼	❏	❏	■	❏	▼
Iodine	❏	❏	❏	■	■	▼
Isobutyl alcohol	❏	■	■	■	■	■
Isopropanol	❏	▼	■	■	■	■
Lactic acid	❏	■	■	■	■	■
Magnesium acetate	❏	❏	❏	■	❏	❏
Magnesium salts	■	■	■	■	■	■
Mercury	■	■	■	■	■	■
Methane	▼	❏	▼	■	■	■
Methanol	❏	❏	■	■	■	■
Methyl butyl ketone	❏	❏	❏	❏	❏	❏
Methyl chloride	❏	❏	❏	❏	❏	❏
Methyl ethyl ketone	❏	❏	❏	❏	❏	❏
Nicotine	■	▼				
Nitrogen	■	■	■	■	■	■
Nitrous oxide	■		■	■	■	■
Oleic acid	■	❏	❏	■	■	❏
Ozone	■	❏	❏	■	❏	■
Peanut oil	■	❏	❏	■	■	■
Pectin	■	▼			■	■
Phosphoric acid	▼	▼	■	■	❏	▼
Pine oil	■	❏	❏	❏	■	❏
Potassium acid sulfate	❏	■	■		▼	■
Radiation	▼	▼	▼	▼	▼	■
Salt	■	■	■	■	■	▼
Salt water	❏	■	■	■	■	■
Silicone grease	■	■	■	■	■	▼
Silver nitrate	■	■	■	■	■	■
Soap	▼	■	■	■	■	■
Soybean oil	■	■	❏	■	■	■
Steam	❏	▼		❏	❏	▼

HabaSYNC® Belt Material Properties

Chemical resistance

Designation of chemical	Polyurethane	Neoprene	Natural rubber	Hypalon	Nitrile	Silicone
Sugar cane liquor	❑	■	■		■	■
Tannic acid	■	■	■	■	■	■
Toluene	❑	❑	❑	❑	❑	❑
Turpentine	❑	❑	❑	❑	■	❑
Vegetable oils	■	■	❑	■	■	■
Vinegar	❑	■	■	■	■	▼
Vinyl acetate	❑	❑	❑	▼	❑	❑
Vinyl chloride		❑	❑		❑	
Water - deionized	■	■	■	■	■	■
Xylene	❑	❑	❑	❑	❑	❑
Zinx acetate	❑	■	■	■	■	❑

Term	Symbol	Metric value	Imperial value
Peripheral force on drive pulley	F_U	N	lb
Peripheral force component due to friction on slider bed	F_{US}	N	lb
Peripheral force component due to mass elevation	F_{Ui}	N	lb
Peripheral force component due to mass acceleration	F_{Ua}	N	lb
Peripheral force component due to other factors	F_{Uau}	N	lb
Friction force of linear bearing	F_f	N	lb
Externally applied working load	F_E	N	lb
Mass of carried goods on total conveying length	m	kg	lb
Mass of belt carried over the slider bed	m_B	kg	lb
Mass of belt per meter (weight of belt / m; weight of belt / ft)	m'	kg/m	lb/ft
Mass of slider plus load on slider	m_s	kg	lb
Total mass to be carried over the slider bed	m_{tot}	kg	lb
Coefficient of friction belt/slider bed	μ_G	-	-
Conveying length	l_T	mm	inch
Elevating height	h_T	mm	inch
Angle of inclination	α	°	°
Belt length	l_0	mm	inch
Belt width	b_0	mm	inch
Minimum required belt width	b_{req}	mm	inch
Acceleration	a	m/s^2	ft/s^2
Belt speed	v	m/s	ft/s
Speed difference (final speed minus initial speed)	Δv	m/s	ft/s
Time required to accelerate up to speed	t	s	s
Number of pulley teeth	z_p	-	-
Number of pulley teeth of drive pulley	z_a	-	-
Arc of contact on pulley	β	°	°
Arc of contact on drive pulley	β_a	°	°
Number of belt teeth	z_b	-	-
Teeth in mesh	z_m	-	-
Tooth-in-mesh factor	t_m	-	-
Pitch diameter (effective diameter) of pulley	d	mm	inch
Pitch diameter (effective diameter) of drive pulley	d_a	mm	inch
Belt pitch	P_b	mm	inch
Center to center distance	e	mm	inch
Tensile force in the tight belt strand	F_1	N	lb
Tensile force in the slack belt strand	F_2	N	lb
Tensile force due to initial belt extension	F_0	N	lb
Initial belt extension	ε_0	%	%
Belt elongation in the tight belt strand	ε_1	%	%
Belt elongation in the slack belt strand	ε_2	%	%
Belt elongation due to peripheral force	ε_U	%	%
Length of tight belt strand	l_1	mm	inch
Length of slack belt strand	l_2	mm	inch
Tensile force for 1% elongation	$k_{1\%}$	N	lb
Admissible tensile force	F_{adm}	N	lb

Term	Symbol	Metric value	Imperial value
Shaft load	F_W	N	lb
Static shaft load on drive pulley	F_{WAs}	N	lb
Dynamic shaft load on drive pulley	F_{WAd}	N	lb
Static shaft load on tail pulley	F_{WUs}	N	lb
Dynamic shaft load on tail pulley	F_{WUd}	N	lb
Pressure force of slack side tensioning idler	F_{WT}	N	lb
Arc of contact on tensioning idler	β_T	°	°
Maximal covered distance of linear drive	l_T	mm	inch
Positioning error (absolute)	Δx	mm	inch
Positioning error (relative)	x	%	%
Random positioning error	Δx_R	mm	inch
Systematic positioning error	Δx_S	mm	inch
Belt elongation due to elasticity of belt	Δx_1	mm	inch
Deformation of teeth in mesh	Δx_2	mm	inch
Backlash due to pulley groove clearance	Δx_3	mm	inch
Deformation factor	df	-	-
Accuracy factor of belt	af	%	%
Highest possible variation of force on positioned slider	ΔF	N	lb
Required motor power, motor output	P_M	kW	PS
Mechanical power on drive pulley	P	kW	PS
Efficiency of drive (gearbox, etc.)	Eta	%	%
Highest admissible operation temperature (continuous)	T_{max}	°C	°F
Lowest admissible operation temperature (continuous)	T_{min}	°C	°F

Appendix
Conversion of units metric / imperial

Metric units	Factor to convert to imperial units		Factor to convert to 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-mm)	0.00155	in^2 (square-inch)	645.2	mm^2 (square-mm)
m^2 (square-m)	10.764	ft^2 (square-foot)	0.0929	m^2 (square-m)
Speed				
m/s (meter/sec)	3.281	ft/s (foot/second)	0.3048	m/s (meter/sec)
m/min (meter/min)	3.281	ft/min (foot/min)	0.3048	m/min (meter/min)
Mass				
kg (kilogram)	2.205	lb (pound-weight)	0.4536	kg (kilogram)
kg/m (kilogram/m)	0.672	lb/ft (pound/ft)	1.4882	kg/m (kilogram/m)
Force and strength				
N (Newton)	0.225	lb (pound-force)	4.448	N (Newton)
N/mm (Newton/mm)	5.7102	lb/in (pound/inch)	0.17513	N/mm (Newton/mm)
N/m (Newton/meter)	0.0685	lb/ft (pound/foot)	14.6	N/m (Newton/meter)
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)

Term	Explanation	Habasit symbol
Accessories	Objects or devices commonly used for belt applications (e.g. guide strips, pulleys, tensioners, belt clamps, etc.)	
Admissible tensile force	Admissible belt tensile force allowed in the tightest belt section under process conditions.	F_{adm}
Admissible tensile force, joined belt	Admissible belt tensile force allowed in the tightest belt section under process conditions for joined belts (only valid for master joint)	F_{adm} **joined endless**
Admissible tensile force, open belt	Admissible belt tensile force allowed in the tightest belt section under process conditions for un-joined belts (or for belts where the joint is never under load)	F_{adm} **open ended**
Aramide	High modulus fiber (Kevlar, Technora, Twaron)	
Balanced cords	Twist of cords of the tensile member is alternating from cord to cord (S-twist / Z-twist / S-twist .... and so on)	
Belt length	Length of belt measured along the neutral layer (length of traction member)	l_0
Belt options	Non standard surfaces, materials, colours, etc.	
Belt pitch	Distance from the center of a tooth to the center of the next tooth.	P_b
Belt width	Geometrical width of belt from edge to edge.	b_0
Bi-directional drive	Driving concept allowing to run the belt forward and backward.	
Center drive	Position of drive provides same length of tight and slack belt strands (under process conditions). Preferred design for bi-directional belt run.	
Coefficient of friction	Ratio of frictional force and contact force acting between two material surfaces.	μ
COF	Coefficient of friction	
Conveying length	Conveying length measured between the centers of head and tail pulleys.	l_T
Conveying side	Opposite side of toothed belt side (belt side which commonly supports the conveyed goods)	
Conveying side cover	Cover material (surface material) on conveying side	
Cord	Tensile member	
Counter flection	Belt is bent over pulley(s) on conveying side	
Cover	Cover material (surface material) on conveying or tooth side	
Elastomer	Comparatively soft synthetic material like rubber (thermoset elastomer) or thermo-plastic polyurethane (thermoplastic elastomer)	
Family	A and AT belts are the families of metric pitches while L, XL, H and XH are the belt series of the family of imperial pitches.	
FDA	Food and drug administration. Federal agency of the US which regulates materials that may come in contact with food.	**FDA**
Flight	Small groove in the tooth root required for cord positioning in the belt production process	
Head drive	Driven head pulley. Preferred design. However for bi-directional belt run center drive is recommended.	
Head pulley	Pulley at the end of the conveyor (referring to belt running direction)	
Height of belt	Overall thickness of timing belt	h_s
Indexing	Feeding or conveying of goods synchronously with the beat of a process. Indexing conveyors run often in a stop-and-go mode	
Joined endless	Joined endless belt	**J**
Joining code	A code which describes the preparation of belt ends of ordered belt (open ended, prepared ends or joined endless)	

Term	Explanation	Habasit symbol
Linear positioning	Linear drives (actuators) which accurately position a mass or which precisely move along a predefined curve	
Mass of belt	Belt weight in kg per m; weight in lb per ft	**m'**
Minimum clamping length	In applications where belt ends are clamped, a minimum clamping length must be considered to prevent that belt may be torn out of the clamp	
Minimum length of joined belt	Minimum belt length which can be joined	
Minimum number of teeth	Minimum number of teeth of smallest timing belt pulley	
Minimum number of teeth of joined belt	The minimum belt length which can be joined defines the respective minimum number of teeth	
Minimum pulley diameter	Minimum diameter of smallest flat pulley	$\mathbf{d_{min}}$
Modifies trapezoidal tooth shape	Trapezoidal tooth shape with strongly rounded grooves as it is used for AT belt types.	
Open ended	Open ended belt. Belt ends are not prepared for joining	**O**
Option, belt option	Non standard surfaces, materials, colors, etc.	
Outside pulley diameter	Diameter of timing belt pulley measured over the tips of teeth	$\mathbf{d_k}$
Pitch diameter	Effective diameter of timing belt pulley which defines the position of the traction member (cords) of the belt.	**d**
Pitch line	Neutral layer of the belt (line that keeps the same length when belt is bent). The traction member (cords) lay exactly in the pitch line	
Polyamide fabric facing on both sides	Both surfaces (tooth side and conveying side) are coated with a wear resistant polyamide fabric with low coefficient of friction	**PTC**
Polyamide fabric facing on conveying side	Conveying side surface is coated with a wear resistant polyamide fabric with low coefficient of friction	**PC**
Polyamide fabric facing on tooth side	Tooth side surface is coated with a wear resistant polyamide fabric with low coefficient of friction	**PT**
Polygon effect	Pulsation of the belt velocity caused by the polygon shape of the driving pulley, with rise and fall of the belt surface.	
Prepared ends	Open ended belt with prepared belt ends for joining	**P**
Required take-up	Length of take up device required to realize the initial belt extension	$\mathbf{x_\varepsilon}$
Series	Group of belts according to standardized timing belt geometries (T5, T10, T20, L, XL, etc.)	
Slider bed	Belt support plate to carry the running belt with low friction and wear.	
Standard color of elastomer	The color of elastomers is standardized in order to indicate special belt options (suitable for food applications, aramide cords, etc.)	
Tail drive	Driven tail pulley (should be prevent when ever possible)	
Tail pulley	Pulley at the beginning of the conveyor (referring to belt running direction)	
Take-up	Tensioning device for adjustment of belt tensile force. Screw type, gravity type or spring loaded type	
Tensile force for 1% elongation	Force which would theoretically be required for 1% belt extension. This figure describes the stress/strain behavior of the timing belt and must not be mixed up with "admissible elongation" which is typically only 0.4%	$\mathbf{k_{1\%}}$

Term	Explanation	Habasit symbol
Tensile member	High modulus layer (steel cords, aramide cords, etc.) responsible for the longitudinal belt strength	
Timing belt	Synchronous belt as described in ISO 5296	
Timing belt pulleys	Toothed pulleys for synchronous belt drives as described in ISO 5294	
Tooth side	Toothed belt side (opposite the belt side which commonly supports the conveyed goods)	
Truly endless	Endless produced belts (no joint)	**E**
Unprocessed	Produced belt with no belt options like fabric facings etc.	**U**
Without counter flection	Belt is only bent over pulleys on tooth side	

Austria
Habasit GmbH, Wien
Phone: +43 1 690 66
www.habasit.at

Belgium
Habasit Belgium N.V., Zaventem
Phone: +32 2 725 04 30
www.habasit.be

Canada
Habasit Canada Ltd., Oakville
Phone: +1 905 827 4131
www.habasit.ca

China
Habasit East Asia Ltd., Hong Kong
Phone: +852 2145 01 50
www.habasit.com.hk

Habasit (Shanghai) Co., Ltd.
Shanghai
Phone: +8621 3417 1228
Phone: +8621 3417 1218
www.habasit.com.hk

Czech Republic
Habasit Bohemia spol. s.r.o., Brno
Phone: +4205 41 421 651
www.habasit.cz

France
Habasit France S.A.S., Mulhouse
Phone: +33 389 33 89 03
www.habasit.fr

Germany
Habasit Rossi GmbH,
Eppertshausen
Phone: +49 6071 969 0
www.habasitrossi.de

Hungary
Habasit Hungária Kft., Esztergom
Phone: +36 33 510 610
www.habasit.hu

India
Habasit-Iakoka Pvt. Ltd., Coimbatore
Phone: +91 422 262 78 79
www.habasitiakoka.com

Italy
Habasit Italiana SpA
Customer Care:
Phone: 199 199 333
For int. calls: +39 0438 911444
www.habasit.it

Japan
Habasit Nippon Co. Ltd., Yokohama
Phone: +81 45 476 03 71
www.habasit.co.jp

Latvia
Habasit Baltic SIA, Daugavpils
Phone: +371 54 074 88
www.habasit.lv

Netherlands
Habasit Netherlands BV, Nijkerk
Phone: +31 33 24 72 030
www.habasit.nl

New Zealand
Habasit Australasia Ltd., Hornby
Phone: +64 3348 5600
www.habasit.co.nz

Norway
Habasit Norge A/S, Oslo
Phone: +47 81 55 84 58
www.habasit.no

Poland
Habasit Polska Sp. zo.o.,
Dąbrowa Górnicza,
Phone: +48 32 639 02 40
www.habasit.pl

Romania
Habasit Import/Export Romania SRL,
Bucuresti, Phone: +40 21 323 95 65
www.habasit.ro

Russia
Habasit Moscow
Phone: +7 49 59 561 508
www.habasit.ru

Singapore
Habasit Far East Pte. Ltd.,Singapore
Phone: +65 6862 55 66
www.habasit.com.sg

Spain
Habasit Hispanica S.A.,
Barberà del Vallès
Phone: +34 93 719 19 12
www.habasit.com

Sweden
Habasit AB, Hindas
Phone: +46 301 226 00
www.habasit.se

Switzerland
Habasit Schweiz, Reinach
Phone: +41 61 715 15 75
www.habasit.ch

Taiwan
Habasit Rossi (Taiwan) Ltd.
Taipei Hsien
Phone: +886 2 2267 0538
www.habasit.com.tw

Ukraine
Habasit Ukraina, Vinnica
Phone: +38 0432 58 47 35
www.habasit.ua

United Kingdom and Ireland
Habasit Rossi (UK) Ltd., Silsden
Phone: + 44 870 835 9555
www.habasitrossi.co.uk

USA
Habasit Belting LLC, Suwanee,
Georgia, Phone: +1 800 458 6431
www.habasitusa.com

Habasit Belting LLC (HABT),
Middletown, Connecticut,
Phone: +1 860 632 2211
www.habasitabt.com

KVP, Inc., Reading,
Pennsylvania, Phone: +1 610 373 1400
www.kvp-inc.com

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ROSSI MOTORIDUTTORI
Via Emilia Ovest 915/A
41100 Modena – Italy
Phone: +39 59 33 02 88
Fax: +39 59 82 77 74
www.rossi-group.com
info@rossi-group.com

Headquarters
Habasit AG
Römerstrasse 1
CH-4153 Reinach, Switzerland
Phone +41 61 715 15 15
Fax +41 61 715 15 55
E-mail info@habasit.com
www.habasit.com

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