MECTROL

URETHANE TIMING BELTS

MECTROL TIMING BELTS

A better answer to synchronized conveying and positioning

Mectrol is a leading manufacturer of urethane timing belts for synchronized conveying and linear positioning.

Using the most modern manufacturing technology, Mectrol's belts are produced to the industry's highest standards.

Mectrol's wide product range offers properties which fulfill important industrial needs: exact synchronization; exceptional strength; abrasion and chemical resistance; easy and quick customization; low cost and minimum maintenance; clean and quiet operation.

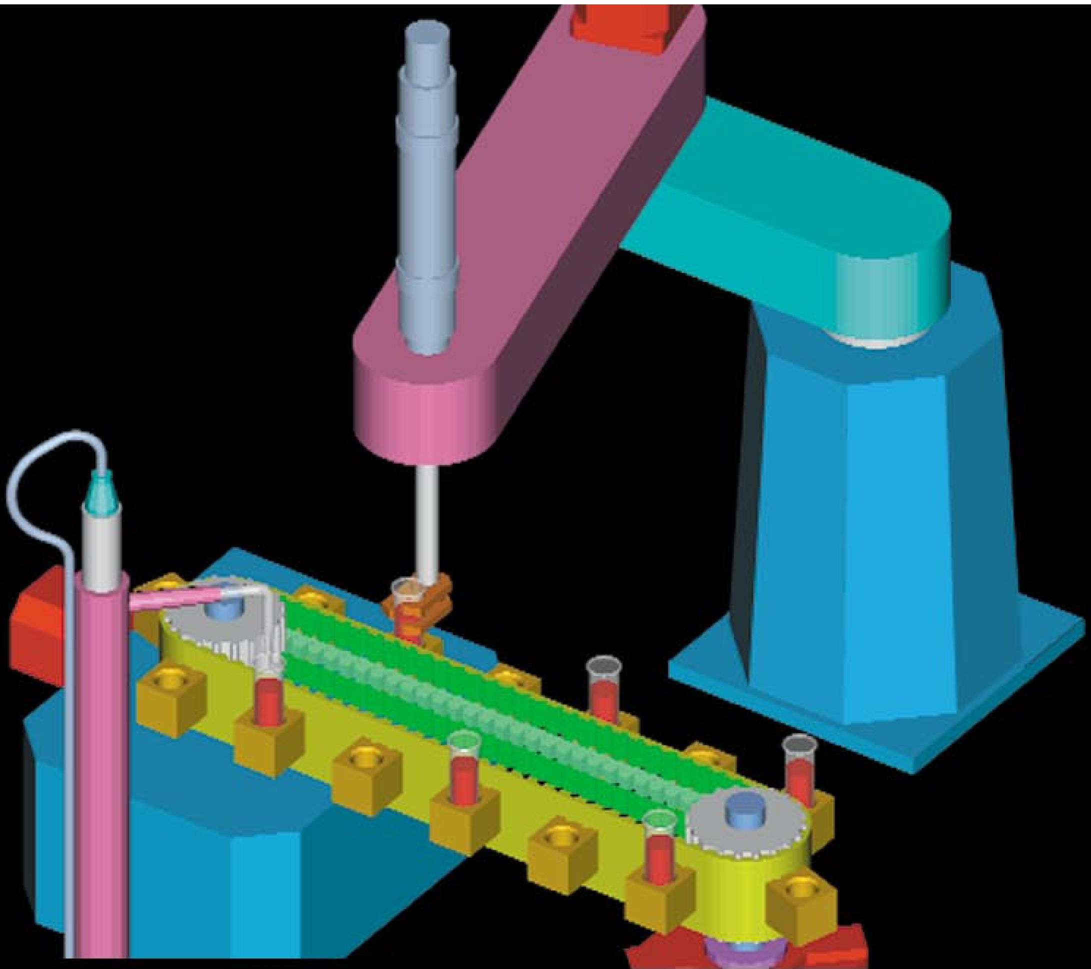
Mectrol Belts

- ☐ offer precise synchronization for conveying and linear motion applications.
- ☐ can be welded endless to any length up to hundreds of feet.
- ☐ are available in open-ended rolls to lengths beyond 500 feet.
- ☐ are produced in widths ranging from 1/4 inch to 18 inches.
- ☐ can be custom fabricated with complex molded profiles.
- ☐ can be laminated with various surface materials for special applications.
- ☐ are available in high or low volume runs at a surprisingly low cost.

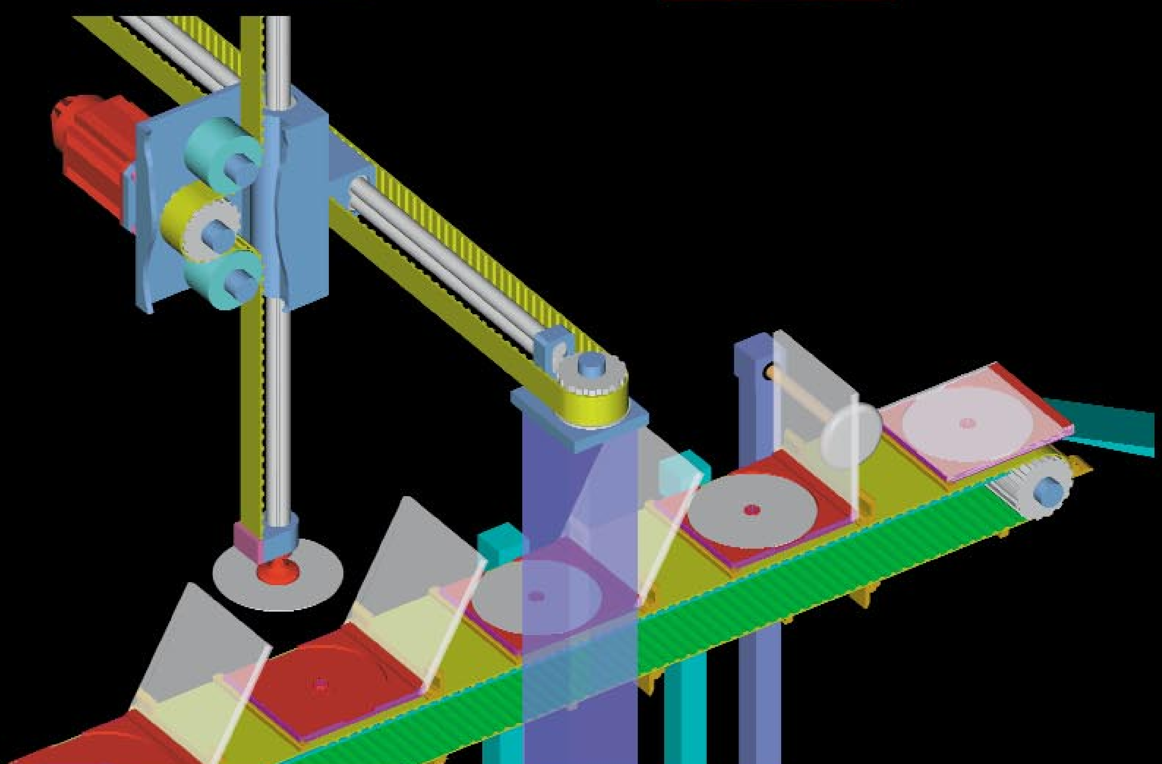
INDEX

APPLICATIONS

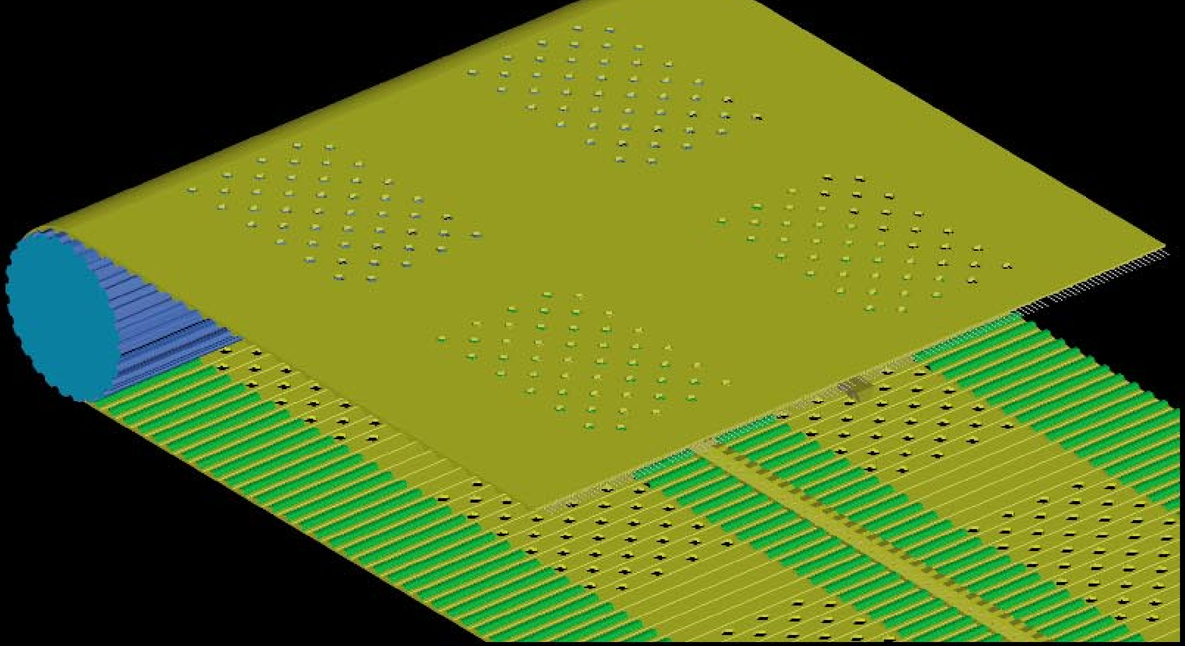
Mectrol belts offer many advantages over chains, flat belts, mesh belts and other systems



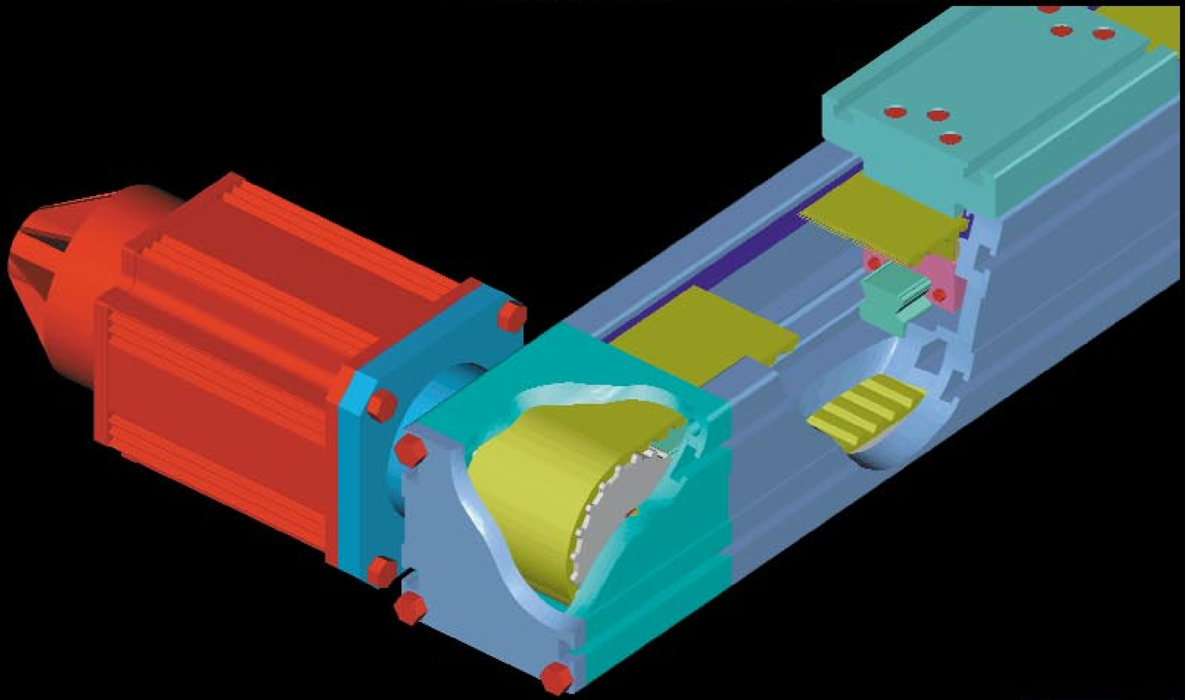
Automated Blood Sampling



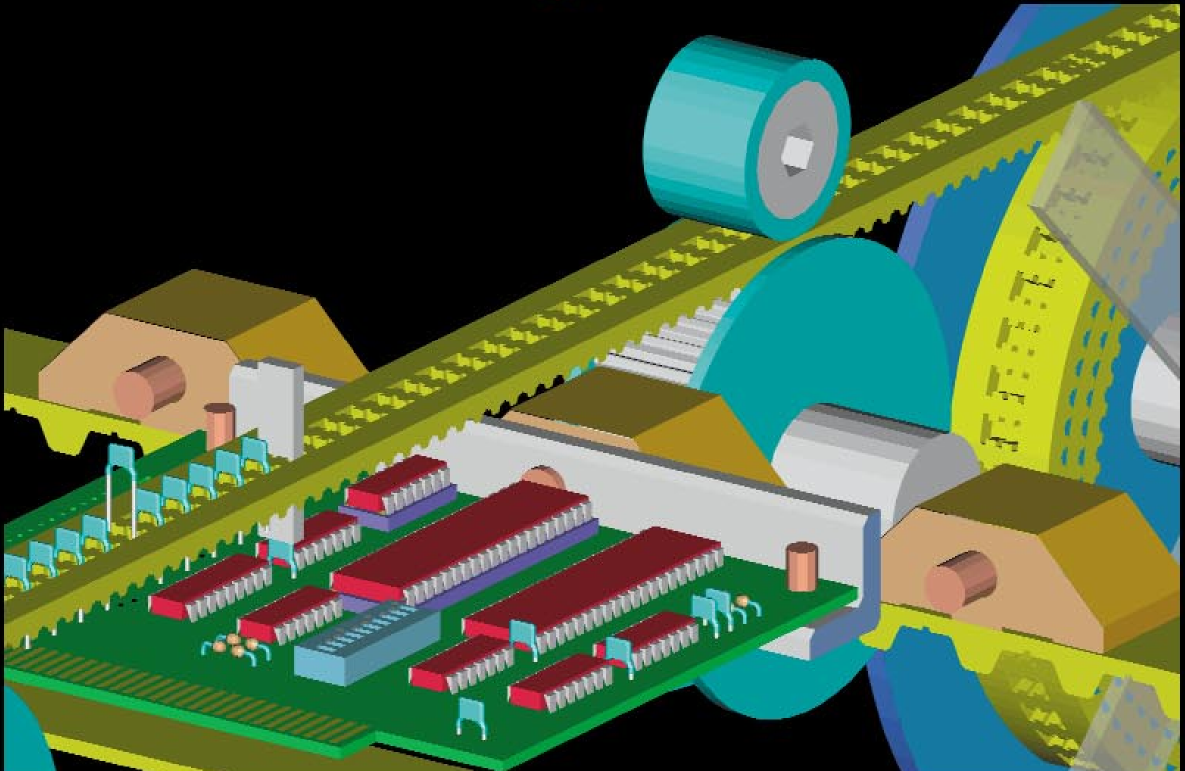
Compact Disc Packaging



18 Inch Wide Vacuum Conveyer Belt



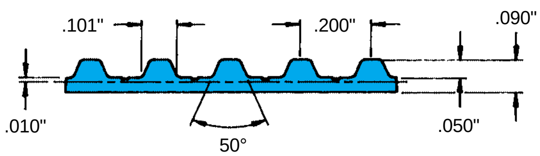
Linear Positioning Belt



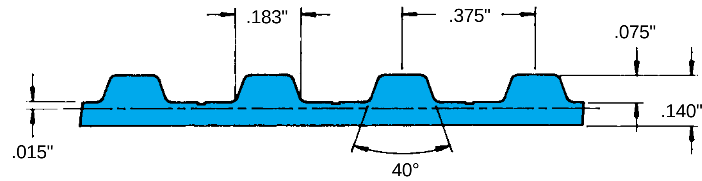
Automated Electronic Assembly
with belt utilized for packaging and delivery.

INCH PITCH BELTS

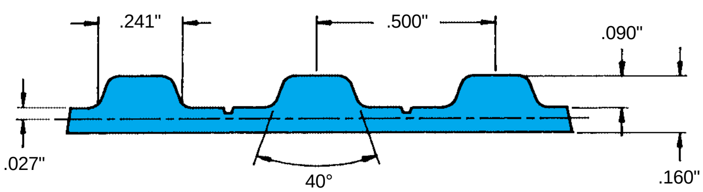
XL .200" Pitch—Extra Light



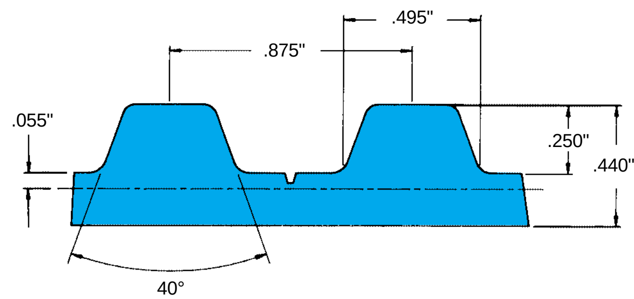
L .375" Pitch—Light



H .500" Pitch—Heavy
H-HF .500" Pitch—High Flex
WH .500" Pitch—From 6" to 18" Wide



XH .875" Pitch—Extra Heavy



Belt Section		XL	L	H	H-HF	WH	XH
Min. Welded Belt Length	Inch	17		18		30	42
	mm	432		457		762	1067
Standard Roll Lengths	feet	200					100
	meters	61					30

Consult factory for length on rolls with fabric.

To Order Inch Pitch Belts

600 H 200 ( ) ( )

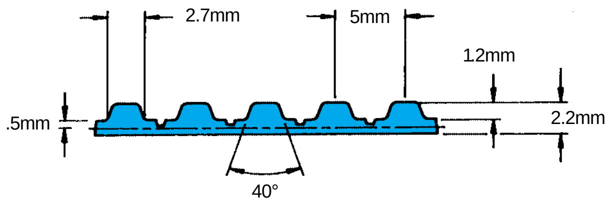
- ( ): Insert "NT" for Nylon Teeth, "NB" for Nylon Back, "NTB" for Nylon on Both Sides, "HB" for Heavy Backing, "FDA" for FDA, USDA Approved
- ( ): Insert "K" if specifying Kevlar
- 200: Width: 2.0" x 100 = 200
- H: Pitch: H (1/2")
- 600: Length: 60.0" x 10 = 600

Standard Width			Belt Section						Width Tolerances			
									Length 17" to 60" (432mm to 1524mm)		Length over 60" (1524mm)	
code	inch	mm	XL	L	H	H-HF	WH	XH	XL, L, H, WH	XH	XL, L, H	XH
025	1/4	6.35	X						+.020" +0.5mm		+.030" +0.8mm	
031	5/16	7.94	X									
037	3/8	9.53	X	X	X	X			–.030" –0.8mm		–.030" +0.8mm	
050	1/2	12.7	X	X	X	X		X	+.030" +0.8mm		+.030" +0.8mm	
075	3/4	19.05	X	X	X	X		X				
100	1	25.4	X	X	X	X		X	–.030" –0.8mm	+.080" +2mm	–.050" –1.3mm	+.190" +4.8mm
150	1 1/2	38.1	X	X	X	X		X	+.030" +0.8mm		+.050" +1.3mm	
200	2	50.8	X	X	X	X		X	–.050" –1.3mm	–.080" –2mm	–.060" –1.5mm	–.190" –4.8mm
300	3	76.2		X	X	X		X	+.060" +1.5mm		+.060" +1.5mm	
400	4	101.6		X	X	X		X	–.060" –1.5mm		–.080" –2mm	
600	6	152.4			X	X	X	X	+.060" +1.5mm		+.060 +1.5mm	
900	9	228.6					X		–.100" –2.5mm		–.120" –3.1mm	
1200	12	304.8					X		+.060" +1.5mm		+.060" +1.5mm	
1500	15	381					X					
1800	18	457.2					X		–.125" –3.2mm		–.125" –3.2mm	

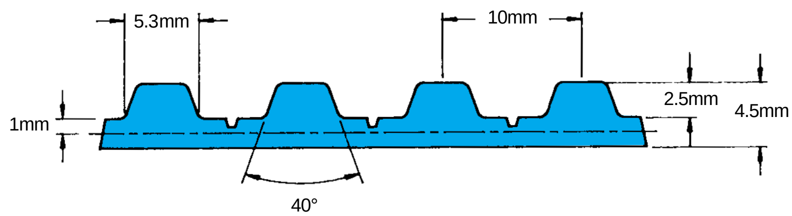
All belts are available in any width between the minimum and maximum listed width. All roll lengths are ±1%.

METRIC "T" PITCH BELTS

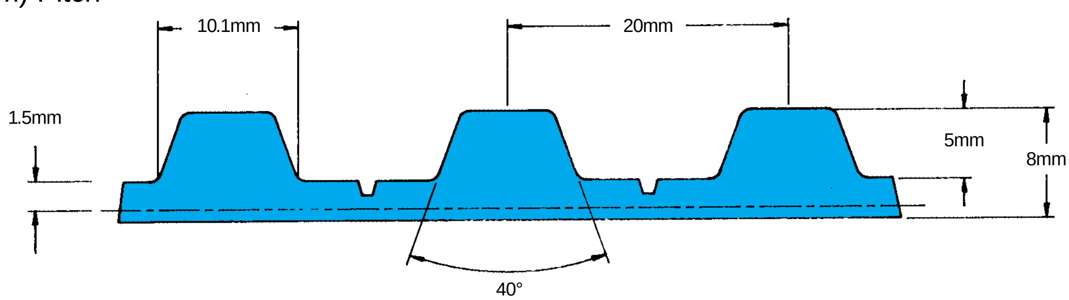
T5 (5mm) Pitch



T10 (10mm) Pitch
T10-HF (10mm) Pitch—High Flex
WT10 (10mm) Pitch from 150 to 450mm wide



T20 (20mm) Pitch



Belt Section		T5	T10	T10-HF	WT10	T20
Min. Welded Belt Length	mm	450			840	1000
Standard Roll Lengths	meters	50 or 100				30

Consult factory for length on rolls with fabric.

To Order Metric Pitch Belts

50 T10/ 1080 ( ) ( )

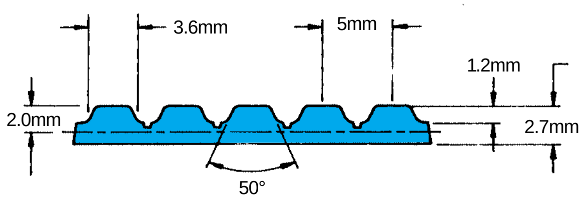
- Insert "NT" for Nylon Teeth, "NB" for Nylon Back, "NTB" for Nylon on Both Sides
- Insert "K" if specifying Kevlar
- Length: 1080 (108 Teeth x 10mm)
- Pitch: T10 (10mm)
- Width: 50mm

<table>
<tr><th rowspan="3">Standard Width
mm</th><th colspan="5" rowspan="2">Belt Section</th><th colspan="4">Width Tolerances</th></tr>
<tr><th colspan="2">Length 450 to 1525mm</th><th colspan="2">Length over 1525mm</th></tr>
<tr><th>T5</th><th>T10</th><th>T10-HF</th><th>WT10</th><th>T20</th><th>T5, T10, T10-HF, WT10</th><th>T20</th><th>T5, T10, T10-HF, WT10</th><th>T20</th></tr>
<tr><td>4</td><td>X</td><td></td><td></td><td></td><td></td><td rowspan="4">+0.5mm
–0.75mm</td><td rowspan="7"></td><td rowspan="4">+0.75mm
–0.75mm</td><td rowspan="7"></td></tr>
<tr><td>6</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>8</td><td>X</td><td></td><td></td><td></td><td></td></tr>
<tr><td>10</td><td>X</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>12</td><td>X</td><td>X</td><td>X</td><td></td><td></td><td rowspan="4">+0.75mm
–0.75mm</td><td rowspan="4">+0.75mm
–1.27mm</td></tr>
<tr><td>16</td><td>X</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>20</td><td>X</td><td>X</td><td>X</td><td></td><td></td></tr>
<tr><td>25</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td rowspan="6">+2.0mm
–2.0mm</td><td rowspan="6">+4.8mm
–4.8mm</td></tr>
<tr><td>32</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td rowspan="2">+0.75mm
–1.27mm</td><td rowspan="2">+1.27mm
–1.52mm</td></tr>
<tr><td>50</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td></tr>
<tr><td>75</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td><td rowspan="2">+1.52mm
–1.52mm</td><td rowspan="2">+1.52mm
–2.0mm</td></tr>
<tr><td>100</td><td>X</td><td>X</td><td>X</td><td></td><td>X</td></tr>
<tr><td>150</td><td></td><td>X</td><td>X</td><td>X</td><td>X</td><td rowspan="2">+1.52mm
–2.5mm</td><td rowspan="2">+1.52mm
–3.18mm</td></tr>
<tr><td>225</td><td></td><td></td><td></td><td>X</td><td></td><td rowspan="4"></td><td rowspan="4"></td></tr>
<tr><td>300</td><td></td><td></td><td></td><td>X</td><td></td><td rowspan="3">+1.52mm
–3.18mm</td><td rowspan="3">+1.52mm
–3.18mm</td></tr>
<tr><td>380</td><td></td><td></td><td></td><td>X</td><td></td></tr>
<tr><td>450</td><td></td><td></td><td></td><td>X</td><td></td></tr>
</table>

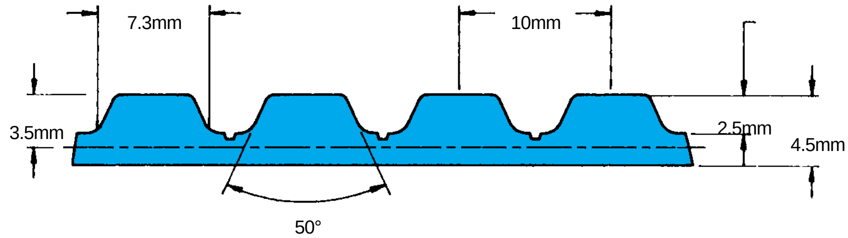
All belts are available in any width between the minimum and maximum listed width. All roll lengths are ±1%.

METRIC "AT" PITCH BELTS

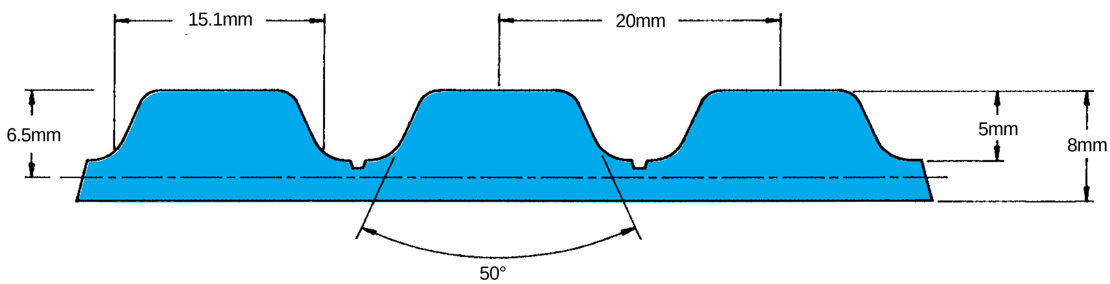
AT5 and ATL5 (5mm) Pitch



AT10, ATL10, and ATL10HF (10mm) Pitch



AT20 and ATL20 (20mm) Pitch



Belt Section		AT5, ATL5	AT10, ATL10, ATL10-HF	AT20/ ATL20
Min. Welded Belt Length	mm	450	600	1000
Standard Roll Lengths	meters	50 or 100		30

Consult factory for length on rolls with fabric.

To Order AT Metric Pitch Belts

50 AT10/ 1080 ( ) ( )

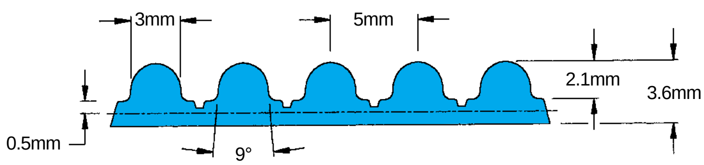
- Insert "NT" for Nylon Teeth, "NB" for Nylon Back, "NTB" for Nylon on Both Sides
- Insert "K" if specifying Kevlar
- Length: 1080 (108 Teeth x 10mm)
- Pitch: AT10 (10mm)
- Width: 50mm

Standard Width	Belt Section			Width Tolerances			
				Length 450 to 1525mm		Length over 1525mm	
mm	AT5, ATL5	AT10, ATL10, ATL10-HF	AT20, ATL20	AT5, AT10, ATL10, ATL10-HF	AT20, ATL20	AT5, AT10, ATL10, ATL10-HF	AT20, ATL20
4	X			+0.5mm –0.75mm		+0.75mm –0.75mm	
6	X						
8	X						
10	X	X					
12	X	X		+0.75mm –0.75mm		+0.75mm –1.27mm	
16	X	X					
20	X	X					
25	X	X	X		+2.0mm –2.0mm		+4.8mm –4.8mm
32	X	X	X	+0.75mm –1.27mm		+1.27mm –1.52mm	
50	X	X	X				
75		X	X	+1.52mm –1.52mm		+1.52mm –2.0mm	
100		X	X				
150		X	X				

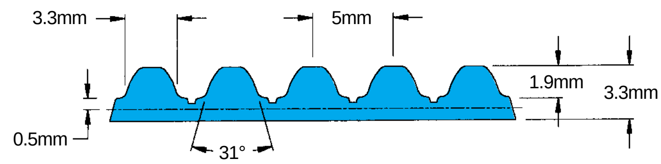
All belts are available in any width between the minimum and maximum listed width. All roll lengths are ±1%.

"HTD" & "STD" PITCH BELTS

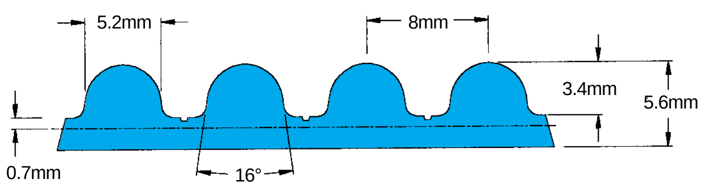
HTD 5 (5mm) Pitch



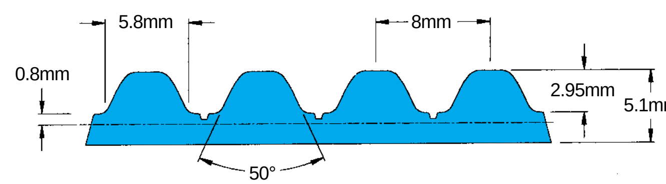
STD 5 (5mm) Pitch



HTD 8 (8mm) Pitch



STD 8 (8mm) Pitch



Belt Section		HTD 5	HTD 8	STD 5	STD 8
Min. Welded Belt Length	mm	450	456	450	456
Standard Roll Lengths	meters	50 or 100			

Consult factory for length on rolls with fabric.

To Order Metric Pitch Belts

50 HTD 5/1080 ( ) ( )

- Insert "NT" for Nylon Teeth, "NB" for Nylon Back, "NTB" for Nylon on Both Sides
- Insert "K" if specifying Kevlar
- Length: 1080 (216 Teeth x 5mm)
- Pitch: HTD 5 (5mm)
- Width: 50mm

Standard Width	Belt Section				Width Tolerances	
					Length 450 to 1525mm	Length over 1525mm
mm	HTD 5	HTD 8	STD 5	STD 8	HTD 5, HTD 8, STD 5, STD 8	HTD 5, HTD 8, STD 5, STD 8
5	X		X		+0.5mm –0.75mm	+0.75mm –0.75mm
10	X	X	X	X		
15	X	X	X	X	+0.75mm –0.75mm	+0.75mm –1.27mm
20		X		X		
25	X	X	X	X		
30		X		X	+1.75mm –1.27mm	+1.27mm –1.52mm
50	X	X	X	X		
85		X		X	+1.52mm –1.52mm	+1.52mm –2.0mm
100		X		X		

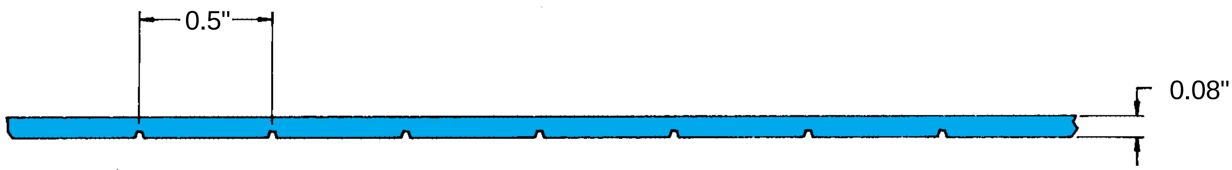
All belts are available in any width between the minimum and maximum listed width. All roll lengths are ±1%.

FLAT BELTS

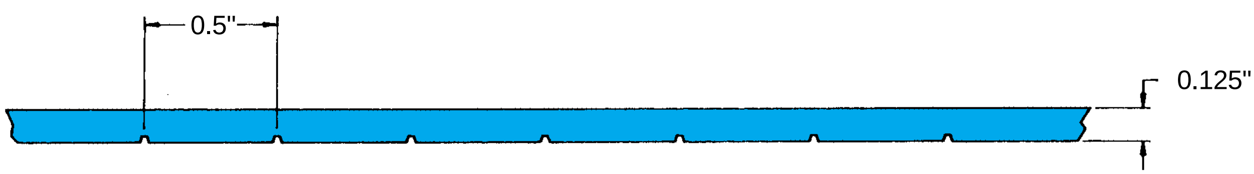
Supported Urethane Flat Belts

Available in rolls or welded endless construction. Also available in thicknesses other than the standards shown below.

F-8 .080" Thick. Available 1/2" to 4" wide.



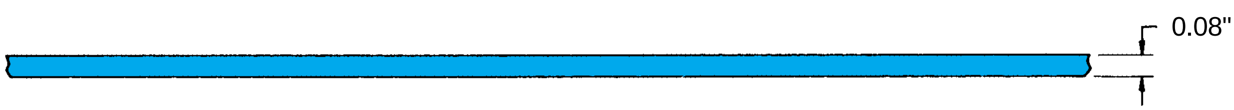
F-12 .125" Thick. Available 1/2" to 4" wide.



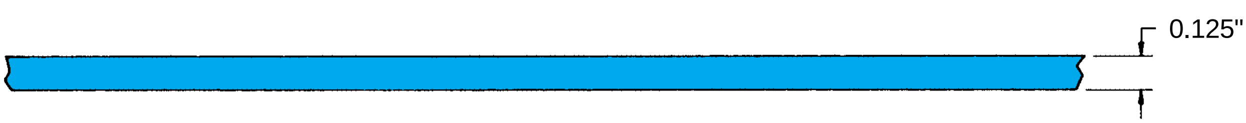
Unsupported Urethane Flat Belts

No steel or Kevlar tension members. Choose either 85 or 92 Shore-A Urethane.

F-8U .080" Thick. Available 1/2" to 4" wide.



F-12U .125" Thick. Available 1/2" to 4" wide.



To Order Inch Pitch Belts

600 F-12 200 ( ) ( )

- Insert "FDA" for FDA, USDA Approved
- Insert "K" if specifying Kevlar
- Width: 2.0" x 100 = 200
- Pitch: F-12
- Length: 60.0" x 10 = 600

WIDE TIMING BELTS

Creating new application opportunities up to 18 inches wide

Mectrol is the exclusive manufacturer of this new product which brings true synchronized conveying to a much broader range of applications.

The belt is ideal for applications handling any materials wider than six inches—formerly the industry's maximum width.

Mectrol wide belt, designated WH and WT10 offers these advantages over other products.

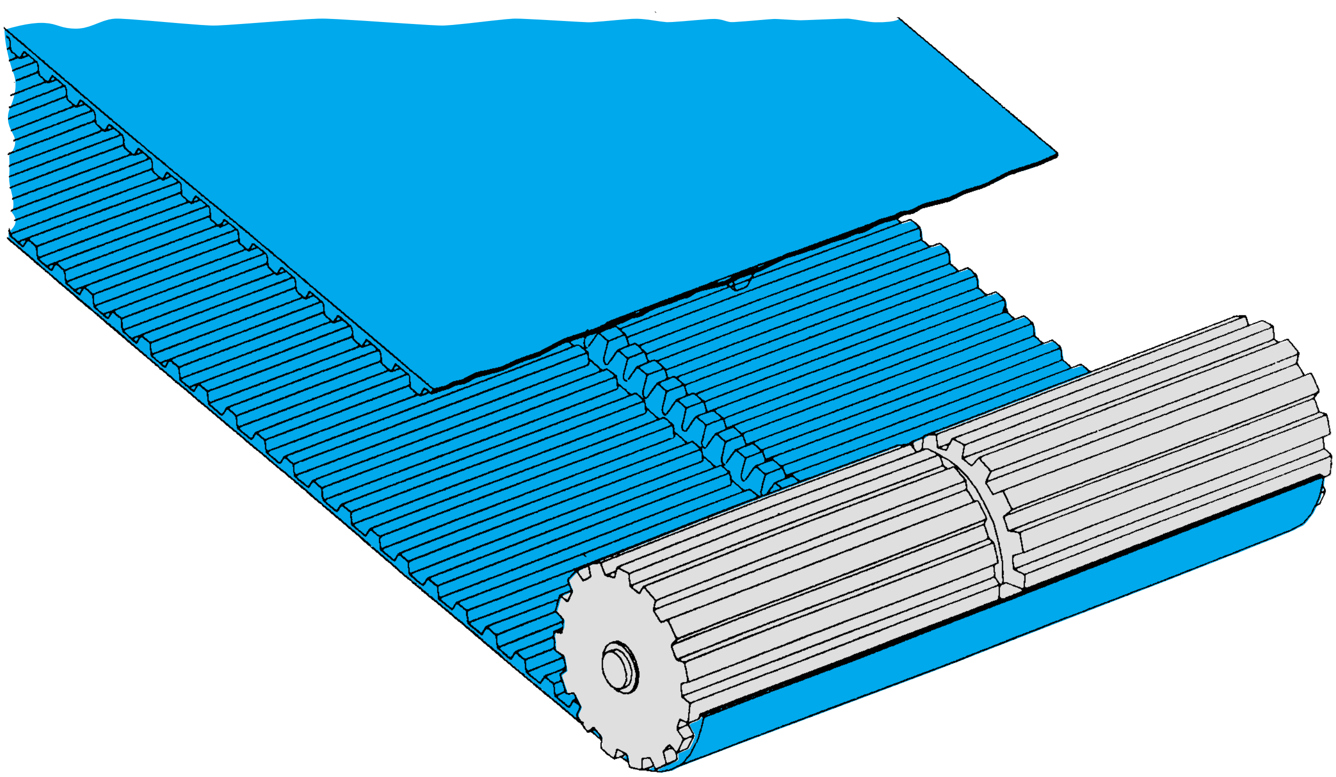
- ☐ It completely eliminates the need to re-tension and removes all slippage and creep problems associated with flat conveyor belts.
- ☐ It is less expensive, requires little or no maintenance, cleans easily, and has no stretch when compared to plastic modular-type belting.
- ☐ It operates quietly and handles products more gently than chain conveyors.

When designing wide timing belts into applications, the basic design calculations outlined in pages 24 through 34 can be used. It is important to consider that the per-inch-width tensile-strength of WH & WT10 be lower than that of standard H & T10-pitch belts.

Design considerations

Tracking—Generally, pulleys with flanges are suitable for tracking. However, on conveyors with center distances more than 10 times the width of the belt, a self-tracking V-guide may be required. Also, belts with a center distance equal to or less than the width of the belt will also require a self-tracking V-guide.

Perforations—When a belt is perforated, the tensile strength is reduced due to the cutting of the cords. In some cases, however, it may be possible to position the cords so that they are not in the area of the perforations. Please consult with an applications engineer for details.



BELT SPECIFICATIONS

Use this chart to determine the specifications of the belts you need.

Table 1.

BELT SECTION				XL	L	H	H-HF	WH	XH	T5	AT5
Pitch (inch and metric)				.200"	.375"	.500"	.500"	.500"	.875"	5mm	5mm
Ultimate Tensile Strength per inch or 25mm belt width	Steel		lb/in N/25mm	730 3250	1340 5965	1500 6675	2300 10235	N/A N/A	3020 13435	730 3250	1450 6450
	Kevlar		lb/in N/25mm	1370 6095	2140 9520	1830 8145	N/A N/A	830 3695	N/A N/A	1370 6095	N/A N/A
Max allowable belt tension (T_{1all}) per inch or 25mm belt width *(Safety factor >4)*	Steel and Kevlar	Open Ended	lb/in N/25mm	185 825	335 1495	375 1670	575 2560	N/A N/A	755 3360	185 825	365 1625
		Welded	lb/in N/25mm	140 625	200 890	245 1090	290 1290	115 515	380 1695	140 625	225 1005
Allowable effective tension for the belt teeth T_{eall} (15 and more teeth in mesh)	Open Ended		lb/in N/25mm	180 790	360 1580	440 1930	440 1930	N/A N/A	880 3855	200 880	290 1270
	Welded		lb/in N/25mm	135 595	270 1185	330 1445	330 1445	330 1445	660 2890	150 660	220 965
Specific belt weight w_b	Steel		lb/ft² Kg/m²	0.432 2.10	0.721 3.50	0.793 3.90	0.864 4.20	N/A N/A	2.15 10.5	0.438 2.15	0.67 3.30
	Kevlar		lb/ft² Kg/m²	0.39 1.90	0.62 3.00	0.68 3.30	N/A N/A	0.67 3.25	N/A N/A	0.416 2.00	N/A N/A
Specific belt stiffness c_{sp}	Steel		lb/in N/mm	47950 8400	92800 16255	89950 15755	133600 23400	N/A N/A	213600 37410	47950 8400	100500 17605
	Kevlar		lb/in N/mm	52250 9155	71950 12605	60700 10635	N/A N/A	N/A N/A	N/A N/A	52250 9155	N/A N/A
Minimum No. of pulley teeth z_{min}				10	10	14	12	14	18	10	12
Minimum diameter of tensioning idler running on back of belt			in mm	1.125 30	2.375 60	3.125 80	2.375 60	3.125 80	5.875 150	1.125 30	2.375 60
Available in FDA/USDA construction *(FDA/USDA 85 shore A Urethane.)*				Y	Y	Y		Y		Y	
Stock Colors (C=clear, W=white)				C	C	C	C	C,W	C	C	W
Temperature range	–30°C to +80°C (-22°F to 176°F)										
Durometer	92 Shore A										
Coefficient of friction	Urethane vs. steel (dry)			0.5 to 0.7							
	Urethane vs. UHMW (dry)			0.2 to 0.4							
	Nylon vs. steel (dry)			0.2 to 0.4							
	Nylon vs. UHMW (dry)			0.1 to 0.3							

All belt is available with Nylon Fabric on either or both sides.
For Nylon on the tooth side, specify “NT”
For Nylon on the back side, specify “NB”
For Nylon on both sides, specify “NTB”
For Special colors, consult with an Applications Engineer.
Belting produced to specific length tolerance is available on request.

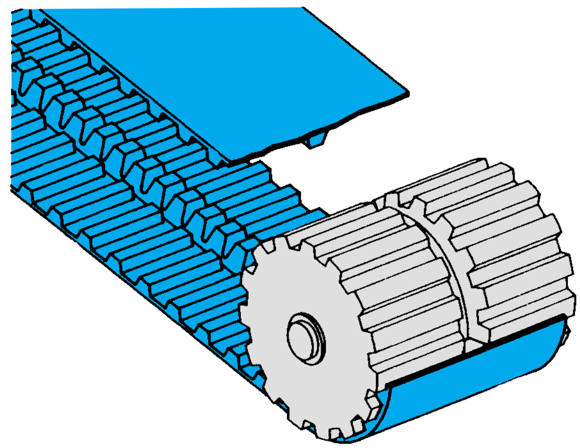
H-HF and T10-HF are high flex cords.
WH designates belt wider than 6".
WT10 designates belt wider than 150mm.

ATL5	T10	T10-HF	WT10	AT10	ATL10	ATL10HF	T20	AT20	ATL20	HTD 5	HTD 8	STD 5	STD 8	F8	F12
5mm	10mm	10mm	10mm	10mm	10mm	10mm	20mm	20mm	20mm	5mm	8mm	5mm	8mm	N/A	N/A
2300 10235	1500 6675	2300 10235	N/A N/A	3020 13435	5160 22955	5400 24020	3020 13435	5160 22955	6900 30760	2300 10235	3020 13435	2300 10235	3020 13435	1500 6675	1500 6675
N/A N/A	1830 8145	N/A N/A	830 3695	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	1830 8145	1830 8145
575 2560	375 1670	575 2560	N/A N/A	755 3360	1290 5740	1350 6005	755 3360	1290 5740	1725 7690	575 2560	755 3360	575 2560	755 3360	375 1670	375 1670
N/A N/A	245 1090	290 1290	115 515	380 1695	645 2870	675 3000	380 1695	645 2870	863 3845	290 1290	380 1695	290 1290	380 1695	245 1090	245 1090
290 1270	380 1665	380 1665	N/A N/A	585 2565	585 2565	585 2565	715 3135	1220 5345	1220 5345	230 1010	425 1865	220 965	410 1800	N/A N/A	N/A N/A
220 965	285 1250	285 1250	285 1250	440 1930	440 1930	N/A N/A	535 2345	915 4010	915 4010	160 705	270 1185	155 680	255 1120	N/A N/A	N/A N/A
0.744 3.60	0.885 4.305	0.956 4.65	N/A N/A	1.15 5.60	1.13 5.50	1.40 6.81	1.51 7.35	2.04 9.95	2.69 13.03	0.785 3.83	1.02 5.00	0.775 3.78	0.913 4.45	0.64 3.10	0.92 4.50
N/A N/A	0.772 3.80	N/A N/A	.768 3.75	0.76 N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	0.511 2.50	0.789 3.85
133600 23400	89950 15755	133600 23400	N/A N/A	213600 37410	334600 58600	290000 50790	213600 37410	334600 58600	417000 73250	133600 23400	213600 37410	133600 23400	213600 37410	89950 15755	89950 15755
N/A N/A	60700 10635	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	60700 10635	60700 10635
10	16	12	16	18	25	20	15	18	30	10	16	10	16	(2.0")	(2.0")
2.375 60	3.125 80	2.375 60	3.125 80	4.750 120	5.875 150	5.875 150	4.750 120	7.125 180	7.875 200	2.375 60	4.750 120	2.375 60	4.750 120	3.125 80	3.125 80
	Y		Y										Y	Y	
W	C	C	C,W	W	W	W	C	W	W	W	W	W	W	C	C

Many linear positioning applications require belts of a specific length tolerance, or a "minus pitch tolerance." Mectrol can produce belts to specific minus tolerances. Consult with a Mectrol applications engineer to determine the proper length tolerance calculation.

SELF TRACKING BELTS

A special notched V-guide gives you maximum flexibility



Mectrol self tracking timing belts utilize our standard timing belts coupled with a specially designed urethane V-guide which is notched for optimum flexibility characteristics.

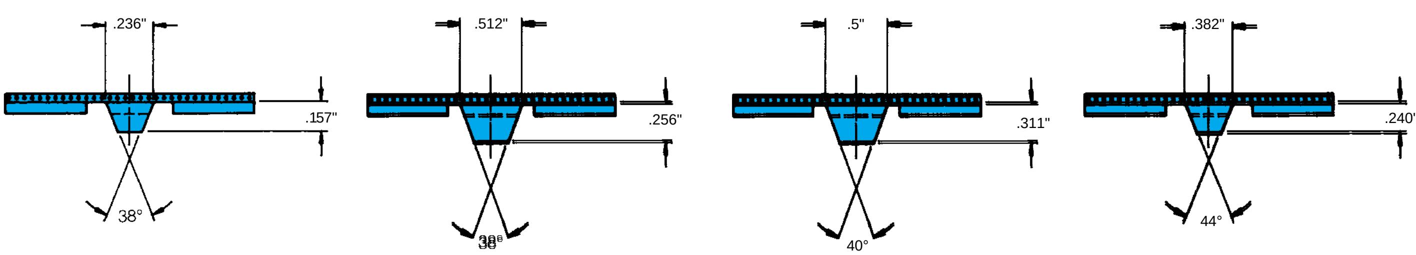
These self tracking belts are ideal for the following:

- ☐ conveyors where pulley flanges would interfere with the product being conveyed.
- ☐ applications where a side load is caused by cross loading or unloading of product.
- ☐ conveyors with long center distance where true tracking is critical.
- ☐ linear positioning and conveyor applications where the belt is run on its edge in a vertical position vs. lying flat on a conveyor surface.

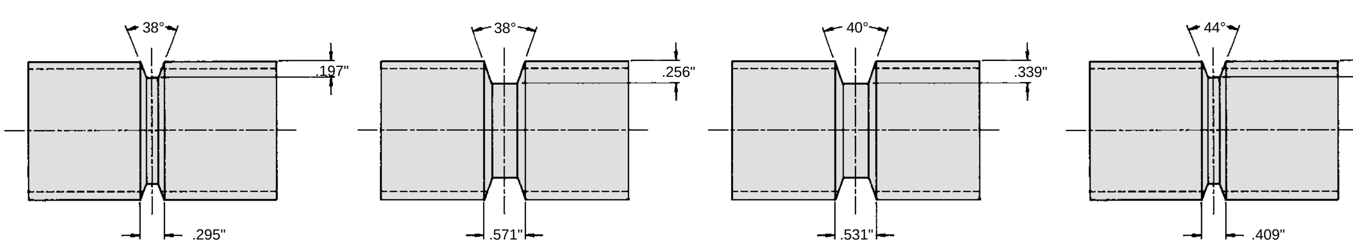
K6 SECTION   K13 SECTION   A SECTION   O SECTION

for metric pitch belts   for inch pitch belts

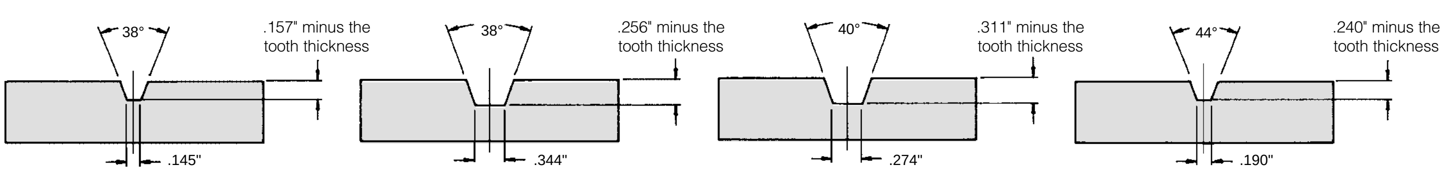
Belt Dimensions



Pulley Dimensions

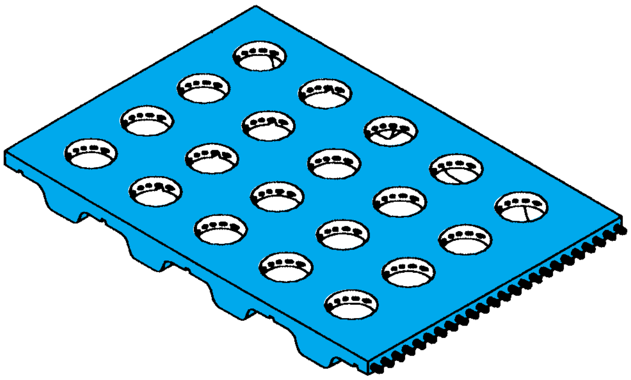


Slider Dimensions



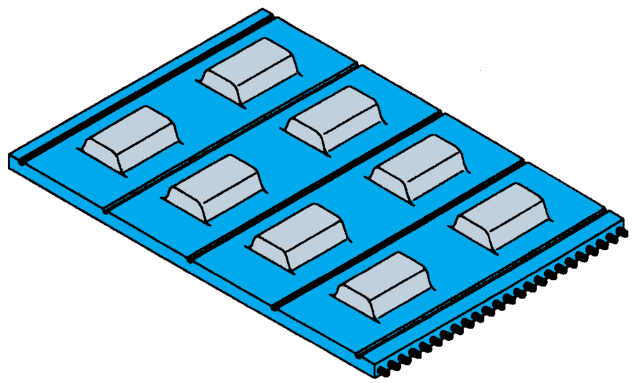
FABRICATED & SPECIALTY BELTS

For our customers who require custom modifications



Perforated Belts

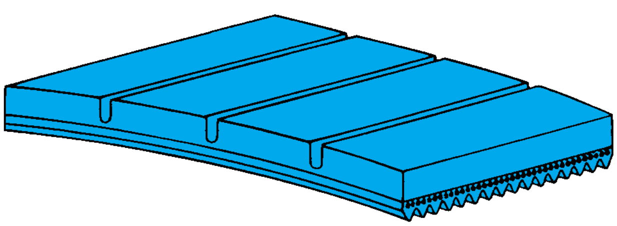
Belts can be perforated with round or odd-shaped holes to allow for holding or carrying specific products as well as for vacuum conveying applications.



Ground Surfaces

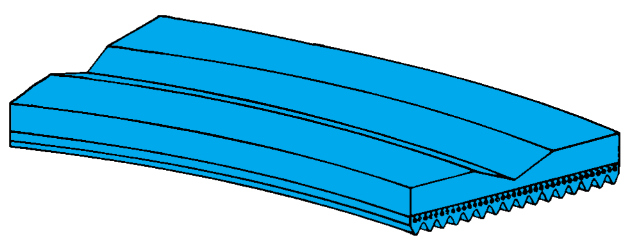
Frequently, tight tolerances or custom configurations can be attained through grinding techniques:

- ☐ Edges can be ground for tight tolerances.
- ☐ Belt backings can be ground to tight overall thickness tolerances.
- ☐ Teeth or grooves can be removed and ground on the back side of the belt in cross direction.



Serrating

- ☐ Incision cuts can be added for more flexibility of thick backings.
- ☐ Special formed cross grooves for conveying applications.



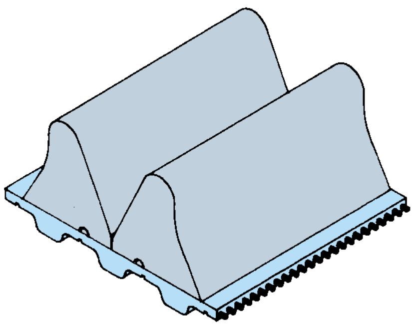
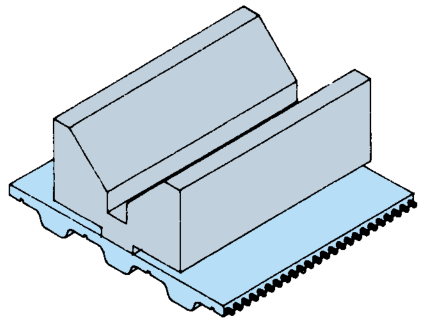
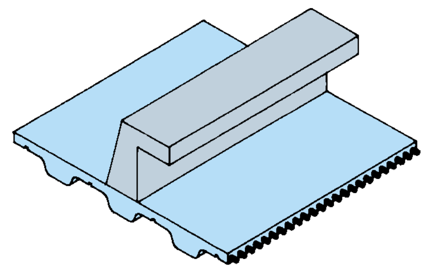
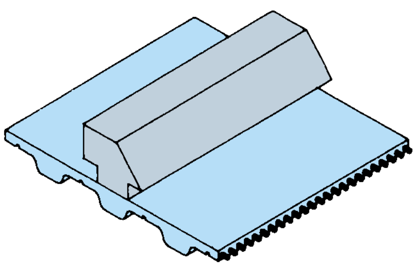
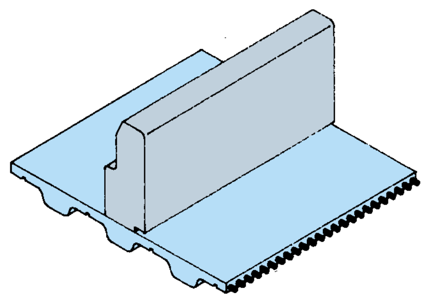
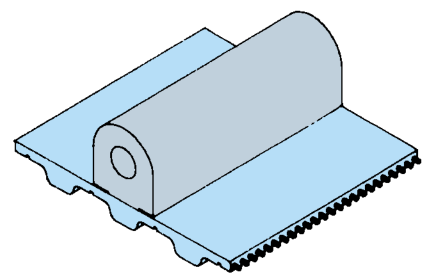
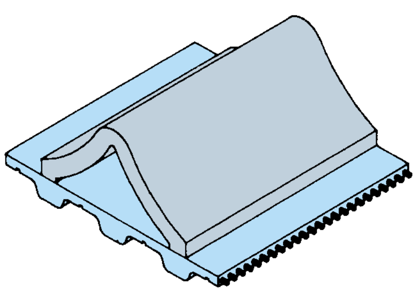
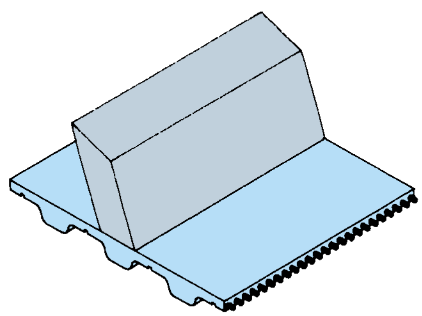
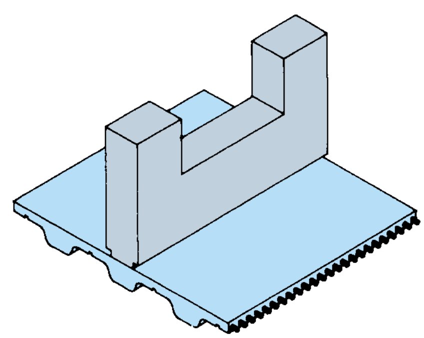
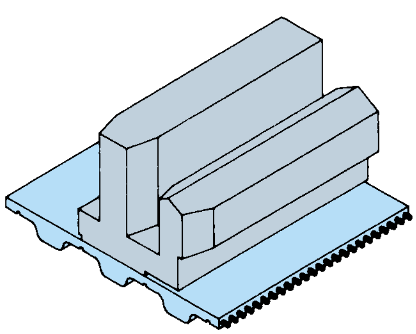
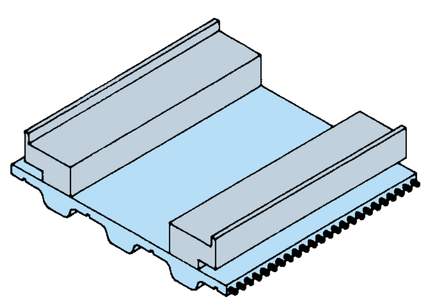
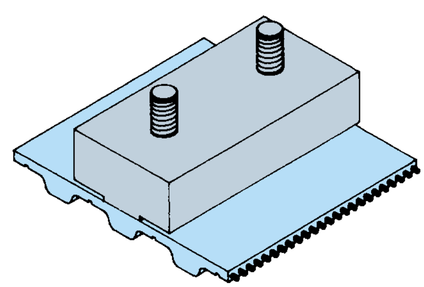
Longitudinal Profiling

- ☐ Belt backing materials can be ground longitudinally for custom applications.

PROFILES

Molded profiles perform a wide variety of functions

such as carriers, pushers and actuators

Mectrol timing belts can be customized with welded-on profiles to meet the specific demands of a customer's application.

Welded profiles are used as carriers, pushers and actuators. They are made from the same high-performance urethane as the body of the belt. The profiles are thermally bonded and become an integral part of the base belt.

These profiled belts are ideal for assembly, packaging, inserting and other automation equipment applications.

Urethane-profiled belts offer many advantages.

- ☐ Non-marking, gentle handling of finished products. They are far superior to attachment chain.
- ☐ Precise indexing with accurate placement on synchronous base belt. This synchronization is not attainable with flat belts.
- ☐ Complete design freedom for engineers. Virtually any profile design is possible.

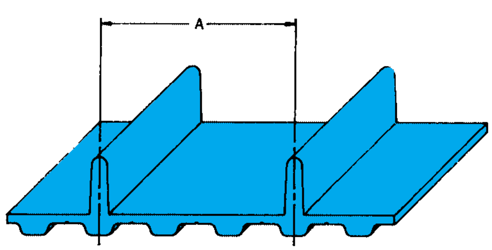
Hundreds of profile designs are available from Mectrol's extensive mold inventory. Our applications engineers can work with you to design any profile to meet your specific requirements. Tooling charges are minimal for most customized designs.

Although it is possible to have nearly any design utilizing welded profiles, ultimate performance can be achieved by following the design guidelines outlined below.

1. Spacing of Profiles

It is recommended that the profile spacing, A, correspond with the pitch of the belt teeth. This allows for the best spacing tolerances, and minimizes the effects of the belt's overall length tolerance on the profile spacing.

Profiles can be spaced on other than pitch increments. However, if non-pitch spacing is used, the cumulative tolerance of the belt length must be considered.



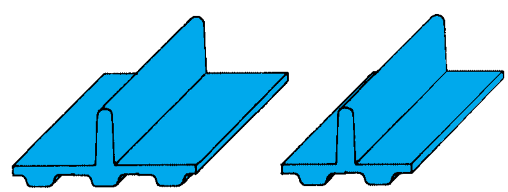
PROFILE SPACING TOLERANCE		
Profile Spacing	Over tooth Non-cumulative	Not over tooth
0.2"≤A<1.0" 5mm≤A<25.4mm	±0.015" ±0.38mm	±0.020" ±0.5mm
1.0"≤A<9.0" 25.4mm≤A<228.6mm	±0.020" ±0.5mm	±0.025" ±0.6mm
9.0"≤A<18.0" 228.6mm≤A<457.2mm	±0.025" ±0.6mm	±0.030" ±0.8mm
18.0"≤A<27.0" 457.2mm≤A<685.8mm	±0.030" ±0.8mm	±0.035" ±0.9mm
27.0"≤A<36.0" 685.8mm≤A<914.4mm	±0.035" ±0.9mm	±0.040" ±1.0mm

For spacing greater than 36.0", add 0.006" per ft.
For spacing greater than 914.4mm, add 0.15mm per 305mm.
Tighter tolerances on profile spacing are available. Please contact a Mectrol Applications Engineer for more information.

2. Dimensions of Profiles

The most important consideration while dimensioning a profile are the size of the base of the profile, (the "foot" of the profile), and the position of the profile on the belt.

The profile thickness can affect the flexibility of the belt, and can determine the minimum allowable pulley diameter. The flexibility of the belt can be maximized, however, by positioning the profile directly over the tooth of the belt.



Over tooth Not over tooth

As the thickness of the foot of the profile increases, the minimum pulley diameter in the system must be increased according to the table on the next page.

The molded tolerances of the profile itself i.e. thickness, height, length, etc. may be controlled within ±.005". The installed height tolerance of a profile is typically +.010",–.020".

Where tolerances in all regards are an issue, please consult with one of our applications engineers.

PROFILES CONT'D

MINIMUM NUMBER OF PULLEY TEETH FOR PROFILES OVER A TOOTH*											
Profile "Foot" Thickness	Inch mm	1/16 1.60	1/8 3.00	3/16 5.00	1/4 6.00	5/16 8.00	3/8 10.00	7/16 11.00	1/2 13.00	5/8 16.00	3/4 19.00
Pitch XL		10	10	18	25	40	50	60	100		
L		12	12	12	18	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 & AT5		12	12	18	25	40	50	60	100		
T10, AT10, ATL10 & ATL10HF		16	16	16	16	18	25	35	45	80	100
T20, AT20 & ATL20		18	18	18	18	18	18	18	20	35	50
HTD 5 & STD 5		12	12	16	25	40	50	60	100		
HTD 8 & STD 8		14	14	14	18	30	40	50	60	100	

MINIMUM NUMBER OF PULLEY TEETH FOR PROFILES NOT OVER A TOOTH*											
Profile "Foot" Thickness	Inch mm	1/16 1.60	1/8 3.00	3/16 5.00	1/4 6.00	5/16 8.00	3/8 10.00	7/16 11.00	1/2 13.00	5/8 16.00	3/4 19.00
Pitch 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, AT5 & ATL5		12	30	45	50	60	100				
T10, AT10, ATL10, ATL10HF		16	20	30	40	45	50	55	65	80	100
T20, AT20 & ATL20		18	18	20	30	40	45	50	54	58	60
HTD 5 & STD 5		14	30	45	50	60	100				
HTD 8 & STD 8		14	20	40	45	55	60	70	80	100	

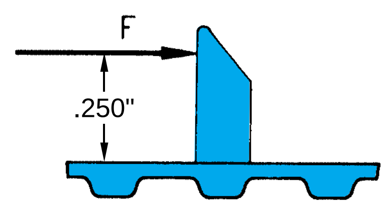
*Minimum number of pulley teeth must be equal to or greater than minimum shown on pages 12 and 13.

3. Profile Strength.

The strength, and therefore capacity of the profile, depends primarily on the size of the welded profile foot.

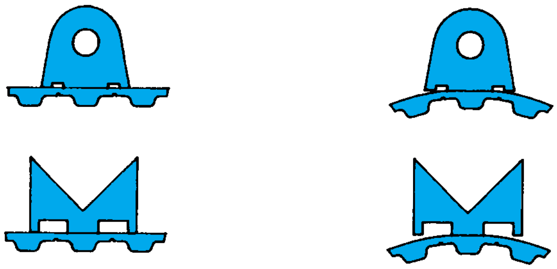
The strength of the profile is affected by the type and direction of the force applied to it. Under high loads, the failure mode will normally be either bending and distortion of the profile and belt, or in some cases, the polyurethane may actually tear.

With a load introduced against the profile at a point 1/4" above the belt surface, the strength of the profile is 2,500 lbs. per square inch of welded foot area, or 1724 N/cm^2.



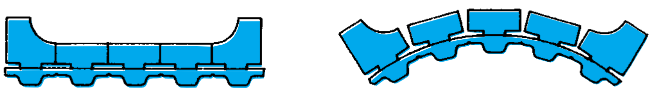
4. Wide Base Profiles, and Profiles With Relief

For profiles requiring a wide base, such as pushers, one foot should be left unwelded. This allows for flexing around the pulley yet it remains rigid when loaded.



5. Segmented Profiles

When large profiles are required as carriers, they must be either segmented or slotted. This is necessary to allow flexing around the pulley. On the flat conveyor surface, the profiles remain intact.

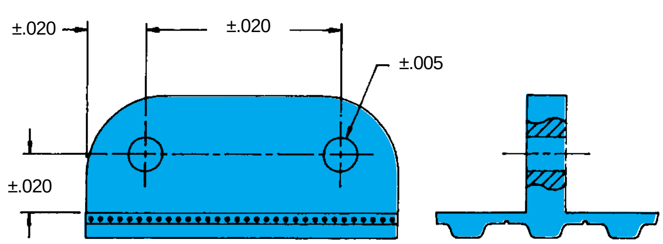


6. Profiles With Holes

Profiles with holes for securing paddles or other attachments can be produced. Holes are either drilled before bonding, or are molded into the profile depending upon the volume and requirements of the application.

Tolerances of the hole placement depends upon whether the holes are drilled or molded. The tolerance of the hole from the belt surface is subject to the melting process of the foot of the profile and the surface of the belt.

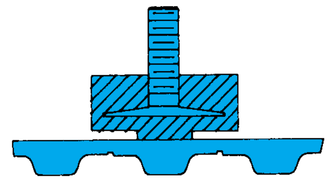
Generally, tolerances are as shown below. However, tighter tolerances are possible. Please consult our Applications Engineering Department.



7. Profiles With Inserts

Profiles can be molded with metallic inserts. These are particularly useful in some applications to replace attachment chain.

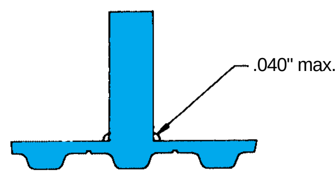
The actual inserts can either be manufactured by Mectrol or provided by the customer.



8. Flash Bead

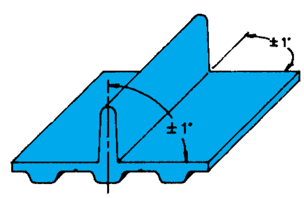
During the welding process, a bead of urethane develops at the meeting point of the profile and belt.

For a minimal charge, the welding bead can be removed—"de-flashed."



9. Perpendicularity

All profiles are perpendicular to 1°.



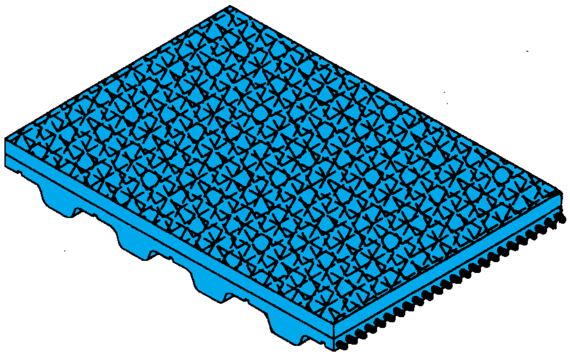
10. Ordering

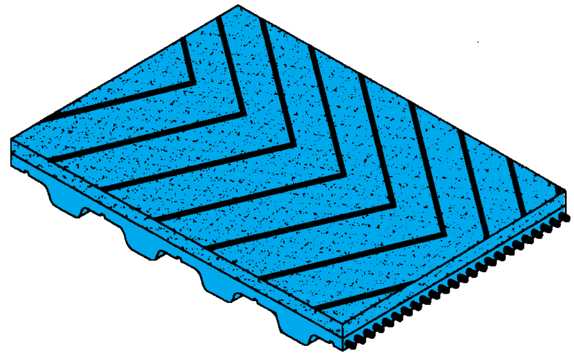
When ordering a profiled belt, it is advisable to submit a drawing of the profiled belt. For your convenience, standard drawing forms are available from our Applications Engineering Department.

Once a design is finalized, Mectrol will submit a drawing to the customer for approval. This custom belt-drawing number should then be used for future ordering.

BACKING MATERIALS

Perform a wide variety of functions





Many applications require belts with unique surface characterisitcs. A wide variety of co-extruded as well as post-laminated backings are available

- ☐ Special nylon fabric can be added to the belt back or tooth side during the manufacturing process. This reduces the coefficient of friction for sliding surfaces or product accumulation
- ☐ High friction surfaces
- ☐ A variety of materials can be added for vibration dampening
- ☐ An antistatic surface is available with a resistivity of less than 10^5 Ohms/Square

Most common utilized backings:

Polyurethane film (foil)

- ☐ Polyurethane offers excellent abrasion resistance
- ☐ Excellent resistance to oils and greases
- ☐ Medium to high friction for conveying applications
- ☐ Hardness range from 60 to 92 shore A
- ☐ Operating temperature range between -30 and +80˚ C
- ☐ Thickness between 0.5 and 4 mm

Polyurethane foam

- ☐ Are compressible–abrasion resistant–absorb or dissipate energy
- ☐ Different cell structure–open cell to fine closed cell
- ☐ Hardness ranges between 40 and 60 Shore A
- ☐ Operating temperature range between -15 and +70˚ C

PVC Backings

- ☐ Acid resistant
- ☐ Good weatherability
- ☐ High friction
- ☐ Hardness range from 40 to 80 Shore A
- ☐ Operating temperature range between -10 and +80˚ C
- ☐ FDA approved backings are available
- ☐ Available in various surface contours:
  Dimple
  Herringbone
  Saw Tooth

Rubber Backings

- ☐ Excellent temperature resistance
- ☐ Greater operating temperature range
- ☐ High friction
- ☐ Available in different durometers
- ☐ Excellent low temperature flexibility
- ☐ Abrasion resistant
- ☐ Operating temperature range between -50 and +150˚ C
- ☐ Available as solid or foam backing

A wide range of surface finishes can be obtained with a variety of post machining processes. Contact our application department for details.

BACKING MATERIALS CONT'D

Polyurethane Backing

☐ High Abrasion Resistance
☐ Good resistance to most chemicals, lubrications, oils and greases

	Extruded Heavy Back Belt	Extruded Polyurethane Film	Caste Polyurethane Film
Durometer (Shore A)	92, 85	85, 80, 75	90 to 50
Temperature range	-30 up to +80˚ C	-30 up to 80˚ C	-30 up to 80˚ C
Features	• Abrasion-resistant • High Strength • Medium friction	• Welded to belt • Abrasion-resistant • High strength • Medium to high friction	• Chemically bonded to belt • Wear-resistant • Medium to high strength
Typical Applications	• Ceramic Industry	• Wood Processing • Glass Industry	• Wood Processing

Polyurethane Foam Backings

☐ Good resistance to most chemicals, lubrications, oils and greases
☐ Good abrasion resistance in wet applications

	Polyurethane Foams
Density (kg/m<)	160-650
Temperature range	-15 up to +70˚ C
Features	• Abrasion-resistant • Compressible • Open and closed cell structure
Typical Applications	• Glass Industry • Paper Industry • Labeling equipment • Pulling belt • Packaging equipment

BACKING MATERIALS CONT'D

PVC Backings

☐ Good resistance to most acids and chemicals
☐ Good weatherability
☐ High friction

	Roughtop	PVC blue	PVC white	PVC, Saw Tooth Herringbone
Durometer (Shore A)	40	65	80	40
Temperature Range	-10 up to +80˚ C	-10 up to +70˚ C	-10 up to +80˚ C	-10 up to +80˚ C
Features	• Elastic driving • Self cleaning • Point bearing	• Flat structure • Adhesive	• Flat structure • FDA approved	• Different structures
Typical Applications	• Wood Processing • Glass Industry • Ceramic Industry	• Paper Industry • Sheeting Industry • Labeling equipment • Pulling belt	• Paper Industry • Sheeting Industry • Labeling equipment • Packaging Industry	• Glass Industry • Paper Industry • Labeling equipment • Packaging Industry

Rubber Backings

☐ Greater operating temperature range
☐ High friction

	Natural Rubber	Chloroprene	Foam Rubber
Durometer (shore A)	37	45	
Density (kg/m<)			165
Temperature range	-15 up to+75˚ C	-40 up to +70˚ C	-15 up to +80˚ C
Features	• Wear-resistant • Cold flexible	• Abrasion resistant • Low temperature flexibility	• Compressible • Open Pores • Abrasion resistant
Typical Applications	• Wire Cable Industry • Wood Processing Industry • Packaging Industry	• Cable Industry • Packaging Industry • Pulling belts	• Labeling equipment • Pulling belts • Packaging Industry • Incline Conveying • Soft packaging

Special Backings

Custom backings are available for your application. Please contact Mectrol for more information.

CHEMICAL RESISTANCE

Mectrol urethane belts offer excellent resistance to most chemicals, solvents, oils and other corrosive products

Solvent/Chemical	Level	Solvent/Chemical	Level
Acetic Acid, 20%	2	ASTM#1 Oil	1
Boric Acid, 4%	1	ASTM #3 Oil	1
Phosphoric Acid, 20%	2	10W40 Motor Oil	1
Methyl Alcohol	3	Mineral Oil	1
Brake Fluid	3	Dioctyl Phthalate	1
Type A Transmission Fluid	1	Tricresyl Phosphate	1
Base, 20% NaOH	2	Cyclohexanone	4
Bleach, undiluted	1	Dimethyl Formamide	4
Detergent, undiluted	1	Tetrahydrofuran	4
Ethylene Glycol, 100% @ 23 C @ 70 C	 2 3	Methyl Ethyl Ketone	3
		Salt Solution ($CaCl_2$ in water, saturated)	1
Freon II	2	Salt Solution (NaCl in water, saturated)	2
ASTM Fuel A	1		
ASTM Fuel B	2	Water, Sea	2
ASTM Fuel C	3	Water, Distilled @ 23 C, 28 days submerged @ 23 C, 360 days submerged @ 70 C, 28 days submerged	 1 1 3
Kerosene	1		
Gasoline High Test	2		
Silicon Grease	1	WD40	1
Ozone	1	Isopropyl Alcohol	2

Legend	% change, volume	% change weight	% change, elongation break	% change tensile break
1 = Little or no effect	<5%	<5%	<10%	<10%
2 = minor	5–15%	5–15%	10–20%	10–20%
3 = moderate	15–30%	15–30%	20–30%	20–30%
4 = severe (not rec.)	>30%	>30%	>30%	>35%

This chart is intended to be used as a guideline only. The actual performance of Mectrol's timing belts may be better or worse than this chart indicates depending on temperature, concentration and duration of exposure. Since Mectrol cannot control the exact environment that the belt may be exposed to it is up to the customer to determine the appropriateness of the belt in any specific application. Other belts are available that resist a wider range of chemicals. Please call an applications engineer for more information.

BELT SELECTION GUIDE

This section gives you a simple yet comprehensive tool for designing and selecting timing belts.

(Note: For a detailed theoretical explanation of timing belt drives, as well as a more extensive selection and design guide, ask for Mectrol's "Complete Design Manual.")

Many conveying timing belts operate at low speeds and minimal loads. This eliminates the need for extensive calculations and a simplified approach to belt selection can be used. For these lightly loaded applications, the belt can be selected according to the dimensional requirements of the system, product size, desired pulley diameter, conveyor length, etc.

The belt width ***b*** is often determined according to the size of the product conveyed, and as a rule, the smallest available belt pitch is used. For proper operation, the pre-tension T_i should be set as follows:

$$T_i \approx 0.3 \cdot b \cdot T_{1all}$$

where: T_i = belt pre-tension
T_{1all} = max allowable belt tension for 1" or 25mm wide belt Table 1)

U.S. customary units: T_i [lb], T_{1all} [lb/in], b [in]
Metric units: T_i [N], T_{1all} [N/25mm], b [mm].

For all applications where the loads are significant, the following step-by-step procedure should be used for proper belt selection:

Step 1 • Determine Effective Tension.

The effective tension T_e at the driver pulley is the sum of all individual forces resisting the belt motion. The individual loads contributing to the effective tension must be identified and calculated based on the loading conditions and drive configuration. However, some of the loads cannot be calculated until the layout has been decided on.

To determine the effective tension T_e use one of the following methods for either conveying or linear positioning:

Conveying

T_e for conveying application is primarily the sum of the following forces (see Figs. 1 and 2).

1. The friction force F_f between the belt and the slider bed resulting from the weight of the conveyed material.

$$F_f = \mu \cdot w_m \cdot L_m \cdot \cos\beta$$

where: μ = coefficient of friction between the slider bed and the belt (see Table 1)
w_m = load weight per unit length over conveying length
L_m = conveying length
ß = angle of conveyor incline

U.S. customary units: F_f [lb], w_m [lb/ft], L_m [ft].
Metric units: F_f [N], w_m [N/m], L_m [m].

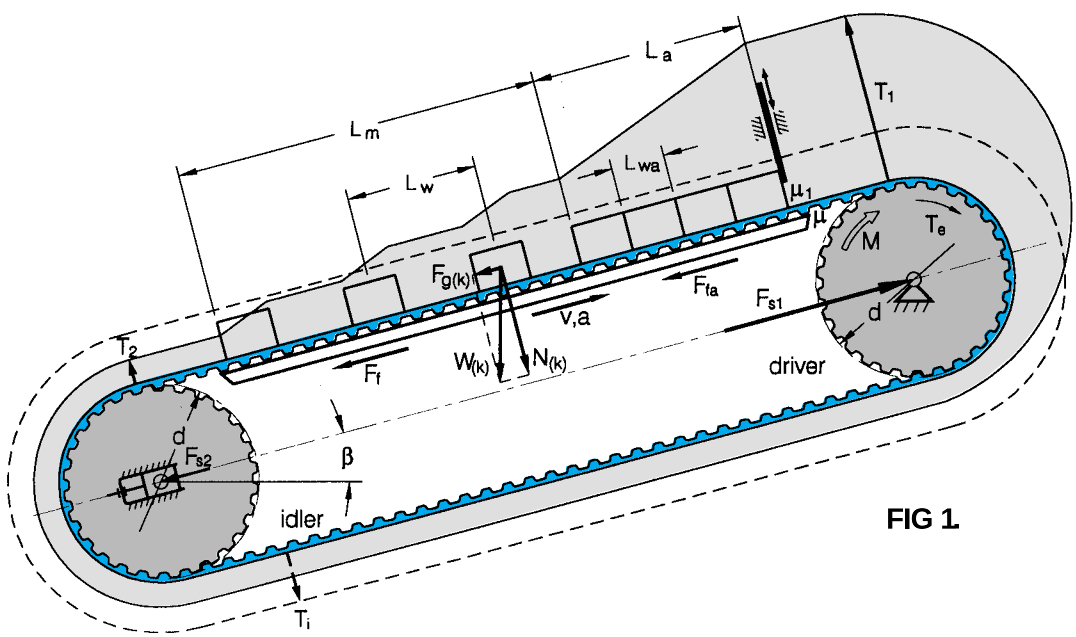


FIG 1.

2. The gravitational load F_g to lift the material being transported on an inclined conveyor.

$$F_g = w_m \cdot L_m \cdot \sin\beta$$

3. The friction force F_{fv} resulting from vacuum in vacuum conveyors.

$$F_{fv} = \mu \cdot P \cdot A_v$$

where: P = pressure (vacuum) relative to atmospheric
A_v = total area of vacuum openings

U.S. units: F_{fv} [lb], P [lb/ft^2], A_v [ft]
Metric units: F_{fv} [N], P [Pa], A_v [m]

The formula above assumes a uniform pressure and a constant coefficient of friction.

4. The friction force F_{fa} over the accumulation length in material accumulation applications.

$$F_{fa} = (\mu + \mu_a) \cdot w_{ma} \cdot L_a \cdot \cos\beta$$

where: L_a = accumulation length
μ_a = friction coefficient between accumulated material and the belt (see Table 1)
w_{ma} = material weight per unit length over the accumulation length

U.S. customary units: L_a [ft], w_{ma} [lb/ft].
Metric units: L_a [m], w_{ma} [N/m].

5. The inertial force F_a caused by the acceleration of the conveyed load (see linear positioning).

6. The friction force F_{fb} between belt and slider bed caused by the belt weight.

$$F_{fb} = \mu \cdot w_b \cdot b \cdot L_c \cdot \cos\beta$$

where: w_b = specific belt weight (see Table 1)
b = belt width
L_c = conveying length

U.S. customary units: w_b [lb/ft^2], b [ft], L_c [ft].
Metric units: w_b [N/m^2], b [m], L_c [m].

For initial calculations, use belt width which is required to handle the size of the conveyed product.

Thus for conveyors, T_e is expressed by:

$$T_e = F_f + F_g + F_{fv} + F_{fa} + F_a + \left(F_{fb}\right) + \ldots$$

F_{fb} can be calculated by estimating the belt mass. In most cases, this weight is insignificant and can be ignored.

Note that other factors, such as belt supporting idlers, or accelerating the material fed onto the belt, may also account for some power requirement. In start-stop applications, acceleration forces as presented for linear positioning, may have to be evaluated.

Linear positioning

T_e for a linear positioning application is primarily the sum of the following six factors (see Fig. 3).

1. The force F_a required for the acceleration of a loaded slide with the mass m_s (replace the mass of the slide with the mass of the package in conveying).

$$F_a = m_s \cdot a$$

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

$$a = \frac{v_f - v_i}{t}$$

where: v_f = final velocity
v_i = initial velocity
t = time

U.S. customary units: F_a [lb], a [ft/s^2], v_f and v_i [ft/s] t[s]. The mass is derived from the weight W_s [lb] and the acceleration due to gravity g (g = 32.2 ft/s^2):

$$m_s = \frac{W_s}{g} = \frac{W_s}{32.2}\left[\frac{lb \cdot s^2}{ft}\right]$$

Metric units: F_a [N], a [m/s^2], v_f and v_i [m/s], t [s], m_s [kg].

2. The friction force F_f between the slide and the linear rail is determined experimentally, or from data from the linear bearing manufacturer. Other contributing factors to the friction force are bearing losses from the yolk, piston and pillow blocks (see Fig. 3).

3. The externally applied working load F_w (if existing).

4. The weight W_s of the slide (not required in horizontal drives).

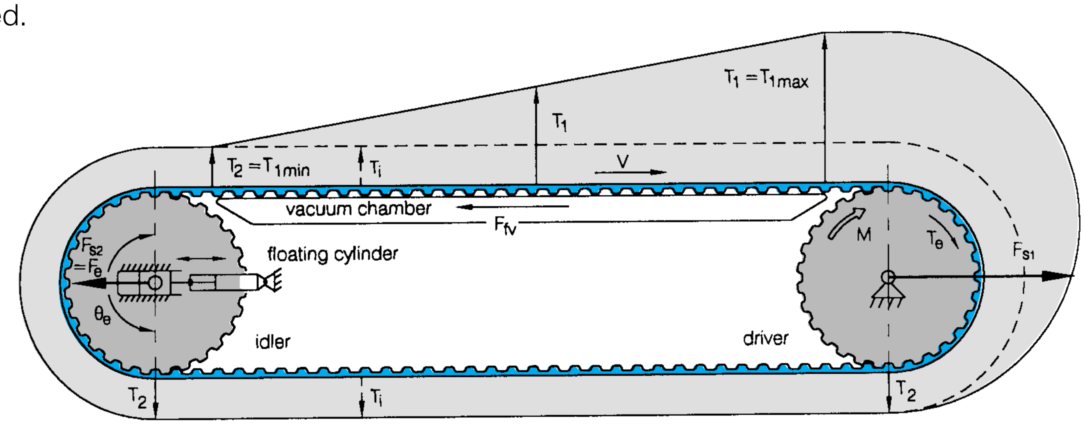


FIG. 2.

5. The force F_{ai} required to accelerate the idler.

$$F_{ai} = \frac{J_i \cdot \alpha}{r_o} = \frac{m_i \cdot r_o^2}{2 \cdot r_o} \bullet \frac{a}{r_o} = \frac{m_i \cdot a}{2}$$

where: $J_i = \frac{m_i \cdot r_o^2}{2}$ = inertia of the idler
m_i = mass of the idler
r_o = idler outer radius
$\alpha = \frac{a}{r_o}$ = angular acceleration

In the formula above, the mass of the idler m_i is approximated by the mass of a full disk.

$$m_i = \rho \cdot b_i \cdot \pi \cdot r_o^2$$

where: ρ = density of idler material
b_i = width of the idler

U.S. units: ρ [lb•s²/ft⁴], b_i and r_o [ft].
Metric units: ρ [kg/m³], b_i and r_o [m].

6. The force F_{ab} required to accelerate the belt mass.

$$F_{ab} = m_b \cdot a$$

The belt mass m_b is obtained from the specific belt weight w_b and belt length and width (see Table 1 on pages 12–13).

$$m_b = \frac{w_b \cdot L \cdot b}{g}$$

U.S. units: F_{ab} [lb], m_b [lb•s²/ft], a [ft/s²], w_b [lb/ft²], L and b [ft], g = 32.2 ft/s².
Metric units: F_{ab} [N], m_b [kg], a [m/s²], w_b [N/m²], L and b [m], g = 9.81 m/s².

Thus for linear positioners, T_e is expressed by:

$$T_e = F_a + F_f + F_w + W_s + [F_{ai}] + [F_{ab}]$$

Note that the forces in brackets can be calculated by estimating the belt mass and idler dimensions. In most cases, however, they are negligible and can be ignored.

Step 2. Select Belt Pitch.

Use Graphs 2a, 2b, 2c or 2d (pages 27–30) to select the nominal belt pitch p according to T_e. The graphs also provide an estimate of the required belt width. (For H pitch belts wider than 6" (152.4mm) and T10 pitch belts wider than 150mm, use Graph 1 on page 26).

Step 3. Calculate Pulley Diameter.

Use the preliminary pulley diameter $\tilde{d}$ desired for the design envelope and the selected nominal pitch p to determine the preliminary number of pulley teeth $\tilde{z}_p$.

$$\tilde{z}_p = \frac{\pi \cdot \tilde{d}}{p}$$

Round 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 pitch given in Table 1, page 12 and 13.

Determine the pitch diameter d according to the chosen number of pulley teeth z_p.

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

Step 4. Determine Belt Length and Center Distance.

Use the preliminary center distance $\tilde{C}$ desired for the design envelope to determine a preliminary number of belt teeth $\tilde{z}_b$.

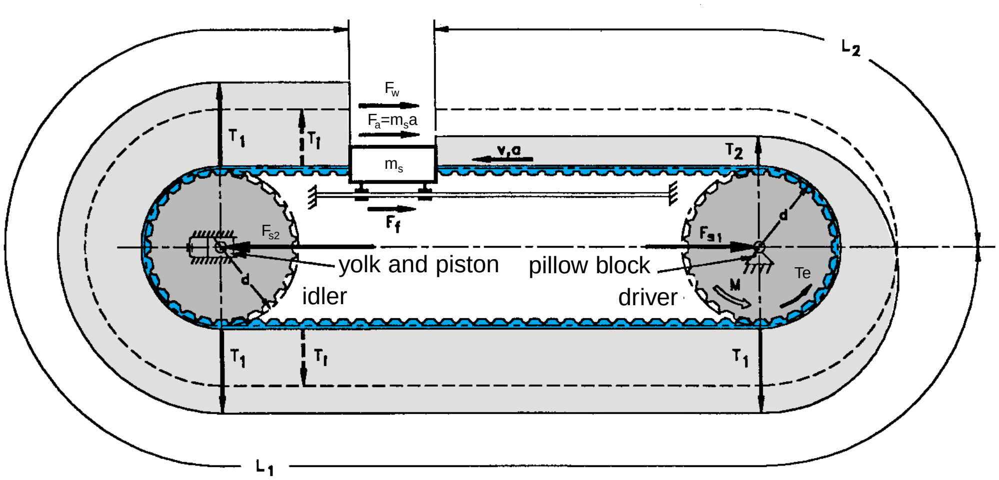


FIG. 3.

For equal diameter pulleys:

$$\tilde{z}_b = 2 \cdot \frac{\tilde{C}}{p} + z_p$$

For unequal diameter pulleys: (See Fig. 4)

$$\tilde{z}_b \approx 2 \cdot \frac{\tilde{C}}{p} + \frac{z_{p_2} + z_{p_1}}{2} + \frac{p}{4\tilde{C}} \cdot \left(\frac{z_{p_2} - z_{p_1}}{\pi}\right)^2$$

Choose a whole number of belt teeth z_b. If you have profiles welded to the belt, consider the profile spacing while choosing the number of belt teeth.

Determine the belt length ***L*** according to the chosen number of belt teeth.

$$L = z_b \cdot p$$

Determine the center distance ***C*** corresponding to the chosen belt length.

For equal diameter pulleys:

$$C = \frac{L - \pi \cdot d}{2}$$

For unequal diameter pulleys:

$$C \approx \frac{Y + \sqrt{Y^2 - 2\left(d_2 - d_1\right)^2}}{4}$$

where: $Y = L - \frac{\pi \cdot (d_2 + d_1)}{2}$

Step 5. Calculate The Number of Teeth in Mesh of the Small Pulley.

Calculate the number of teeth in mesh z_m, using the appropriate formula.

For two equal diameter pulleys:

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

For two unequal diameter pulleys:

$$z_m \approx z_{p_1} \cdot \left(0.5 - \frac{d_2 - d_1}{2\pi \cdot C}\right)$$

Step 6. Determine Pre-tension.

The pre-tension, T_i, defined as the belt tension in an idle drive, is illustrated as the distance between the belt and the dashed line in Figs. 1, 2, and 3. The pre-tension prevents jumping of the pulley teeth during belt operation. Based on experience, timing belts perform best with the slack side tension as follows:

$$T_2 = (0.1,...,0.3)\ T_e$$

Drives with a fixed center to center distance

Drives with fixed center distances have the position of the adjustable shaft locked after pre-tensioning the belt (see Figs. 1 and 3). Assuming tight and slack side tensions are constant over the respective belt lengths, and a minimum slack side tension in the range of the above relationship (uni-directional load only), the pre-tension is calculated utilizing the following equation:

$$T_i = T_2 + T_e \left(\frac{L_1}{L}\right)$$

where: L = belt length = $L_1 + L_2$
L_1 = tight side belt length
L_2 = slack side belt length

U.S. units: L_1 [ft], and L_2 [ft].
Metric units: L_1 [m], and L_2 [m].

Drives with a fixed center to center distance are used in linear positioning, conveying and power transmission applications. In linear positioning applications, the maximum tight side length is inserted in the equation above.

The pre-tension for drives with a fixed center distance can also be approximated using the following formulas:

Conveying
(see Figs. 1 and 2)

$$T_i = (0.45,...,0.55)\ T_e$$

Linear Positioning
(see Fig. 3)

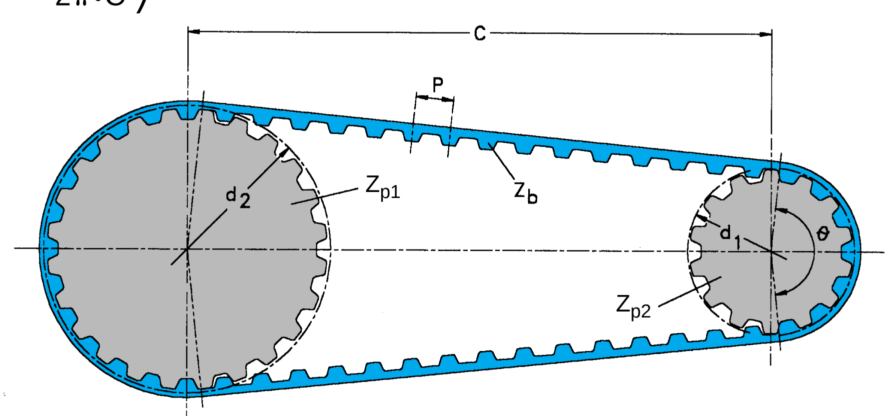


FIG. 4.

$T_i = (1.0,...,1.2)\ T_e$

$T_i = (1.0,..., 2.0)\ T_e$ => for ATL series only

Drives with a constant slack side tension

Drives with constant slack side tension have an adjustable idler, tensioning the slack side, which is not locked (Figs. 2 and 5). During operation, the consistency of the slack side tension is maintained by the external tensioning force, F_e. Drives with a constant slack side tension may be considered for some conveying applications, they have the advantage of minimizing the required pre-tension.

The minimum pre-tension can be calculated from the analysis of the forces at the idler in Fig. 5:

$$T_i \approx T_2 = \frac{F_e}{2\sin\frac{\theta_e}{2}}$$

where θ_e = the wrap angle of the belt around the back bending idler (Fig. 5).

Step 7. Calculate Tight Side Tension and Slack Side Tension.

Conveying

(see Figs. 1 & 2)

The tight side tension T_1 and the slack side tension T_2 are obtained by:

$T_1 \approx T_i + 0.75T_e$

$T_2 = T_1 - T_e$

Linear positioning

(see Fig. 3)

The maximum tight side tension T_{1max} is obtained by:

$T_{1max} \approx T_i + T_e$

The respective minimum slack side tension T_{2min} is obtained by:

$T_{2min} \approx T_i - T_e$

for a fixed center distance.

Step 8. Calculate Belt Width.

Determine the allowable tension T_{1all} for the cords of a 1" (or 25 mm) wide belt of the selected pitch given in Table 1. Note that T_{1all} is different for open end (positioning) and welded (conveying) belts. Determine the necessary belt width to withstand T_{1max}.

$$b \geq \frac{T_{1max}}{T_{1all}}$$

U.S. units: T_1 [lb], T_{1all} [lb/in], b [in].
Metric units: T_1 [N], T_{1all} [N/25mm], b [mm].

Determine the allowable effective tension T_{eall} for the teeth of a 1" (or 25 mm) wide belt of the selected pitch from Table 1. Note that T_{eall} is different for open end (positioning) and welded (conveying) belts.

Use Table 2 on page 26 to determine the tooth-in-mesh-factor t_m corresponding to the number of teeth in mesh z_m.

Determine the speed factor t_v using Table 3 on page 26.

Calculate the width of the belt teeth b necessary to transmit T_e using the following formula:

$$b \geq \frac{T_e}{T_{eall} \cdot t_m \cdot t_v}$$

U.S. units: T_e [lb], T_{eall} [lb/in], b [in].
Metric units: T_e [N], T_{eall} [N/25mm], b [mm].

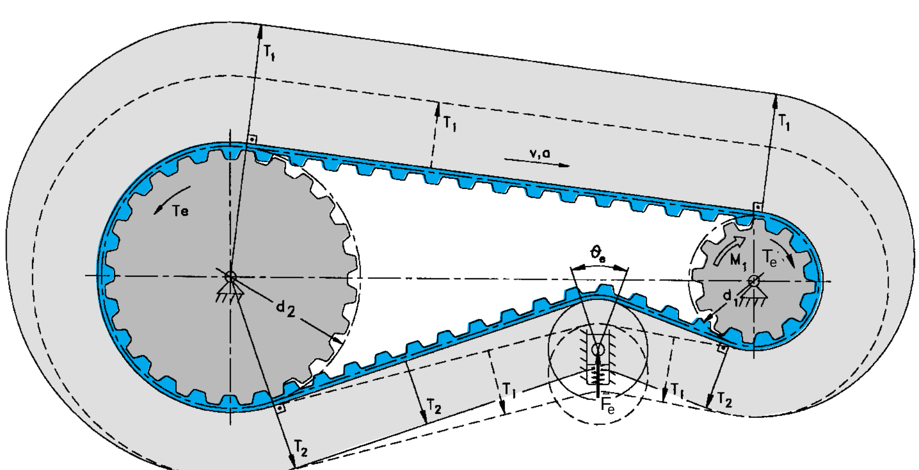


FIG. 5.

Select the belt width that satisfies the last two conditions, giving preference to standard belt widths. However, belts of nonstandard widths are also available.

The factors t_m and t_v prevent excessive tooth loading and heat build up.

The forces contributing to T_e, which in Step 1 were estimated, can now be calculated more accurately. Evaluate the contribution of these forces to the effective tension and, if necessary, recalculate T_e and repeat steps 6, 7 and 8.

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

Step 9. Calculate Shaft Forces.

Determine the shaft force F_{s1} at the driver pulley:

For angle of wrap $\theta = 180°$:

$F_{s1} = T_1 + T_2$

For angle of wrap around the small pulley $\theta < 180°$ (unequal diameter pulleys):

$$F_{s1} = \sqrt{T_1^2 + T_2^2 - 2T_1 \cdot T_2 \cos\theta}$$

$$\text{where } \theta = 2 \cdot \pi \cdot \left(0.5 - \frac{d_2 - d_1}{2 \cdot \pi \cdot C}\right)$$

Determine the shaft force F_{s2} at the idler pulley:

For angle of wrap $\theta = 180°$:

$F_{s2} = 2 \cdot T_2$ when load moves toward the driver pulley, and

$F_{s2} = 2 \cdot T_1$ when load moves away from the driver pulley.

For angle of wrap around the small pulley $\theta < 180°$ (unequal diameter pulleys):

$F_{s2} = T_2 \cdot \sqrt{2(1 - \cos\theta)}$ when load moves toward the driver and

$F_{s2} = T_1 \cdot \sqrt{2(1 - \cos\theta)}$ when the load moves away from the driver.

Step 10. Calculate the Stiffness of a Linear Positioner.

The total stiffness of the belt depends mainly on the stiffness of the belt strands between the pulleys. In most cases, the influence of belt teeth and belt cords in the tooth-in-mesh area can be ignored.

Calculate the resultant stiffness coefficient of tight and slack sides k, as a function of the slide position (Fig. 6).

$$k = c_{sp} \cdot b \cdot \frac{L}{L_1 \cdot L_2}$$

where: L_1 = tight side length
L_2 = slack side length
c_{sp} = specific stiffness (Table 1).

U.S. units: k [lb/in], C_{sp} [lb/in], b [in], L [in].
Metric units: k [N/mm], C_{sp} [N/mm], b [mm], L [mm].

Note that k is at its minimum when the tight and slack sides are equal.

Determine the positioning error Δx due to belt elongation caused by the remaining static force F_{st} on the slide:

$$\Delta x = \frac{F_{st}}{k}$$

In Fig. 6, for example, F_{st} is comprised of F_f and F_w and is balanced by the static effective tension T_{est} at the driver pulley.

Note that Δx is inversely proportional to the belt width. If you want reduced Δx, increase the belt width or select a belt with stiffer cords and/or with a larger pitch.

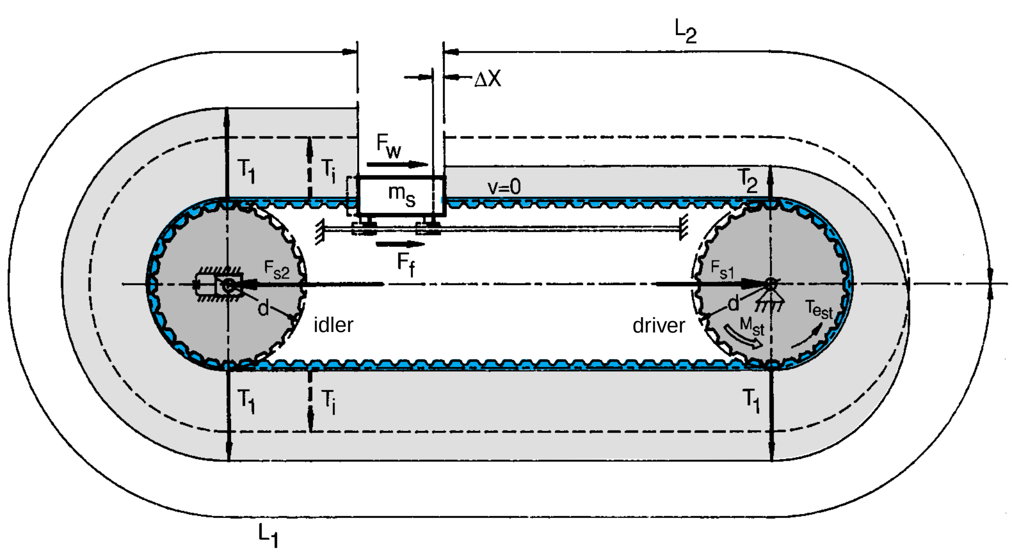
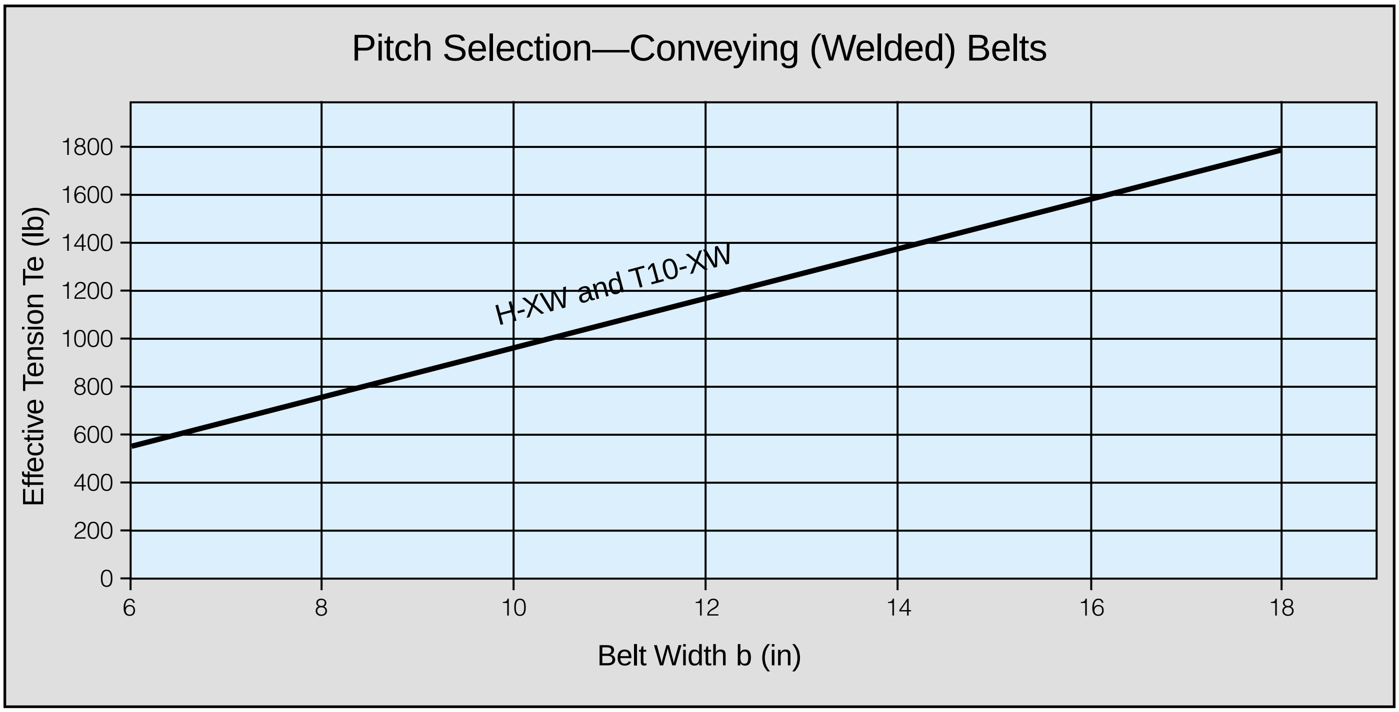


FIG. 6.



GRAPH 1

TOOTH IN MESH FACTOR

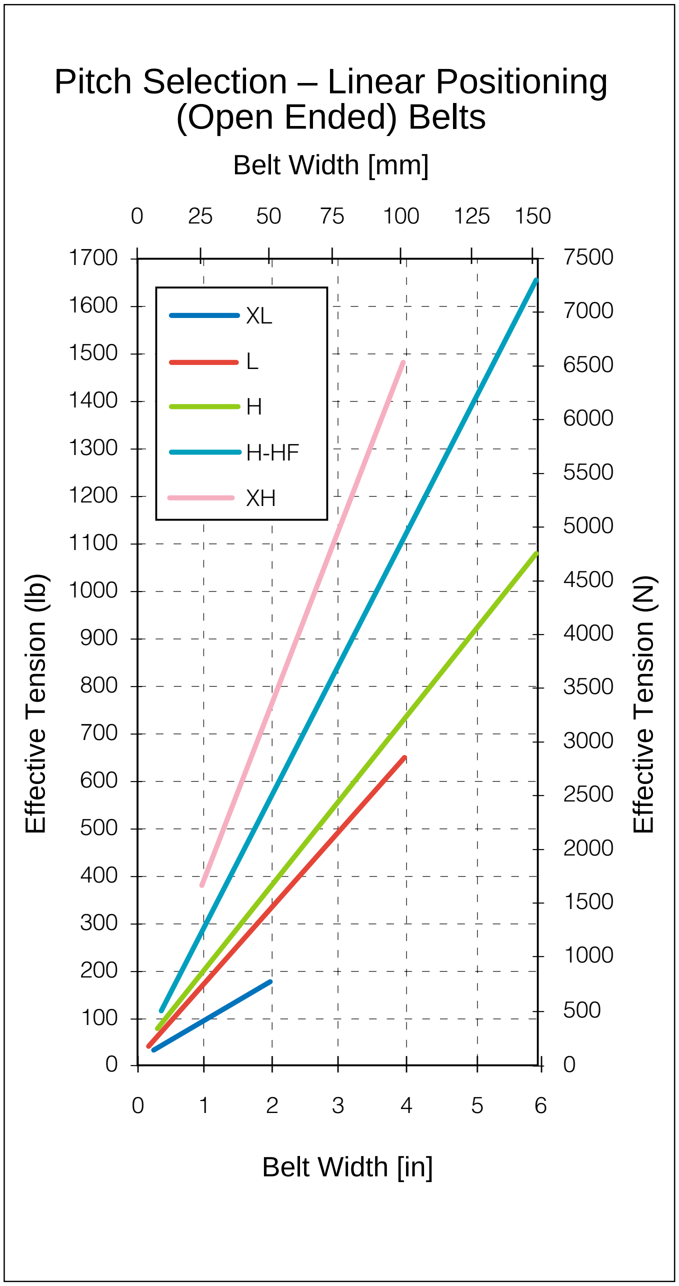
No. of Teeth in Mesh zm	Tooth in Mesh Factor tm
3	0.39
4	0.5
5	0.59
6	0.67
7	0.74
8	0.8
9	0.85
10	0.89
11	0.92
12	0.95
13	0.97
14	0.99
15	1

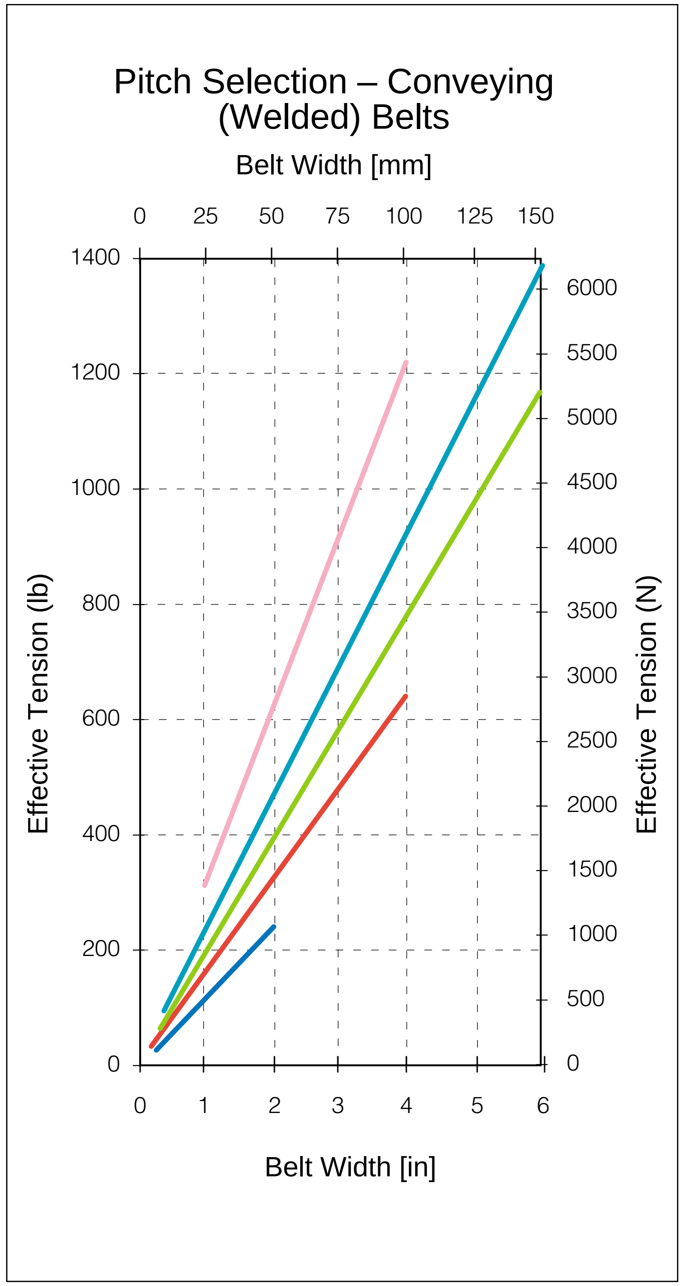
TABLE 2

SPEED FACTOR

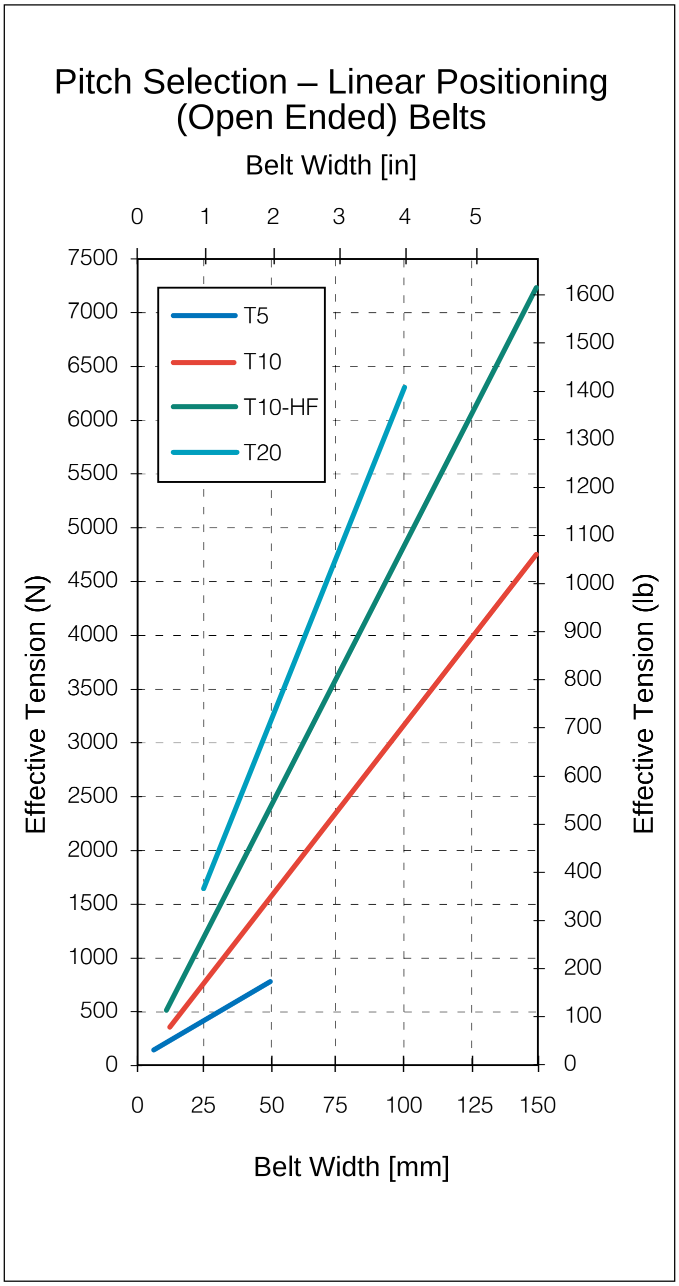
Speed		Speed Factor
ft/min	m/s	tv
0	0	1
200	1	0.99
400	2	0.98
600	3	0.97
800	4	0.95
1000	5	0.93
1200	6	0.9
1400	7	0.87
1600	8	0.84
1800	9	0.81
2000	10	0.77

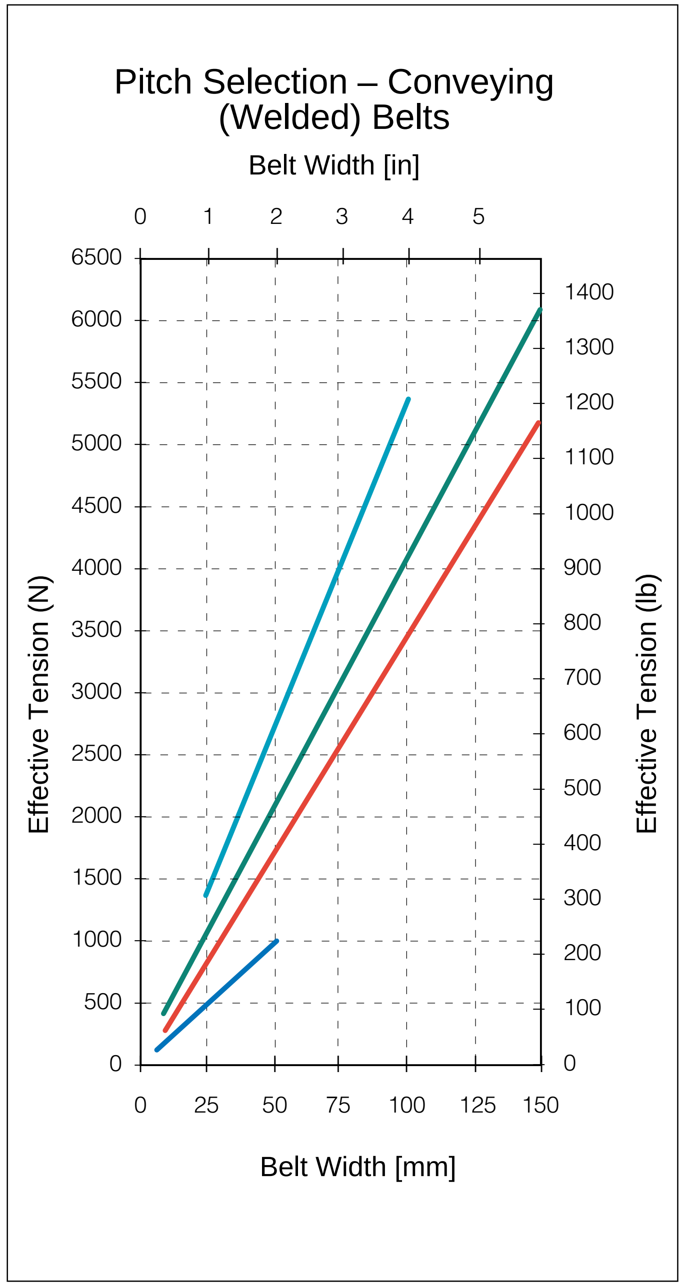
TABLE 3


Pitch Selection – Linear Positioning (Open Ended) Belts
Belt Width [mm]
0 25 50 75 100 125 150
1700 1600 1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0
Effective Tension (lb)
7500 7000 6500 6000 5500 5000 4500 4000 3500 3000 2500 2000 1500 1000 500 0
Effective Tension (N)
XL
L
H
H-HF
XH
0 1 2 3 4 5 6
Belt Width [in]

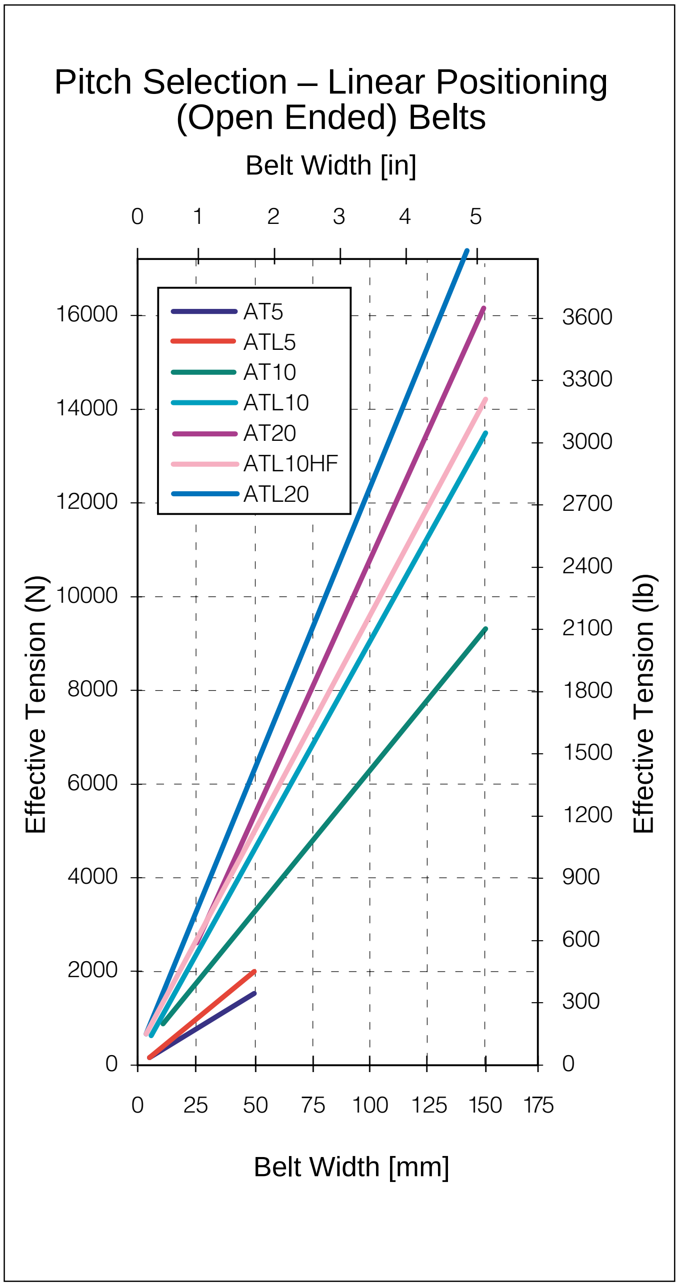

Pitch Selection – Conveying (Welded) Belts
Belt Width [mm]
0 25 50 75 100 125 150
1400 1200 1000 800 600 400 200 0
Effective Tension (lb)
6000 5500 5000 4500 4000 3500 3000 2500 2000 1500 1000 500 0
Effective Tension (N)
0 1 2 3 4 5 6
Belt Width [in]

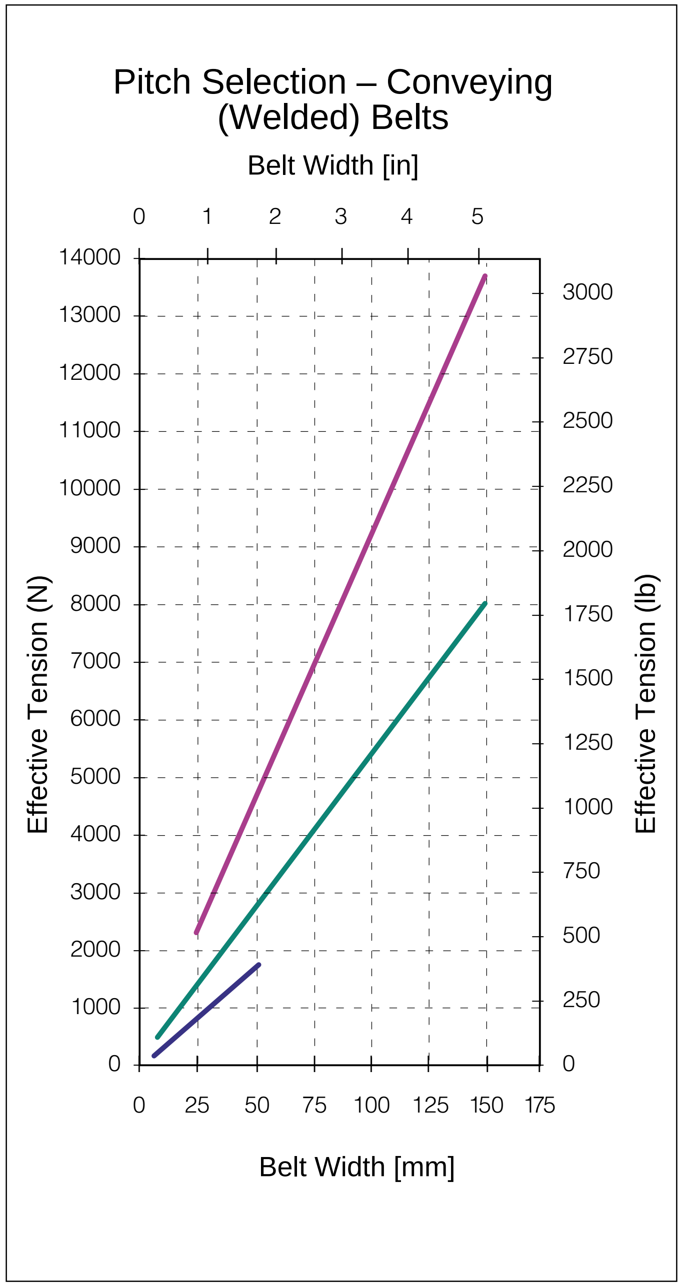
GRAPH 2a


Pitch Selection – Linear Positioning (Open Ended) Belts
Belt Width [in]
0 1 2 3 4 5
T5
T10
T10-HF
T20
Effective Tension (N)
7500 7000 6500 6000 5500 5000 4500 4000 3500 3000 2500 2000 1500 1000 500 0
Effective Tension (lb)
1600 1500 1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0
0 25 50 75 100 125 150
Belt Width [mm]

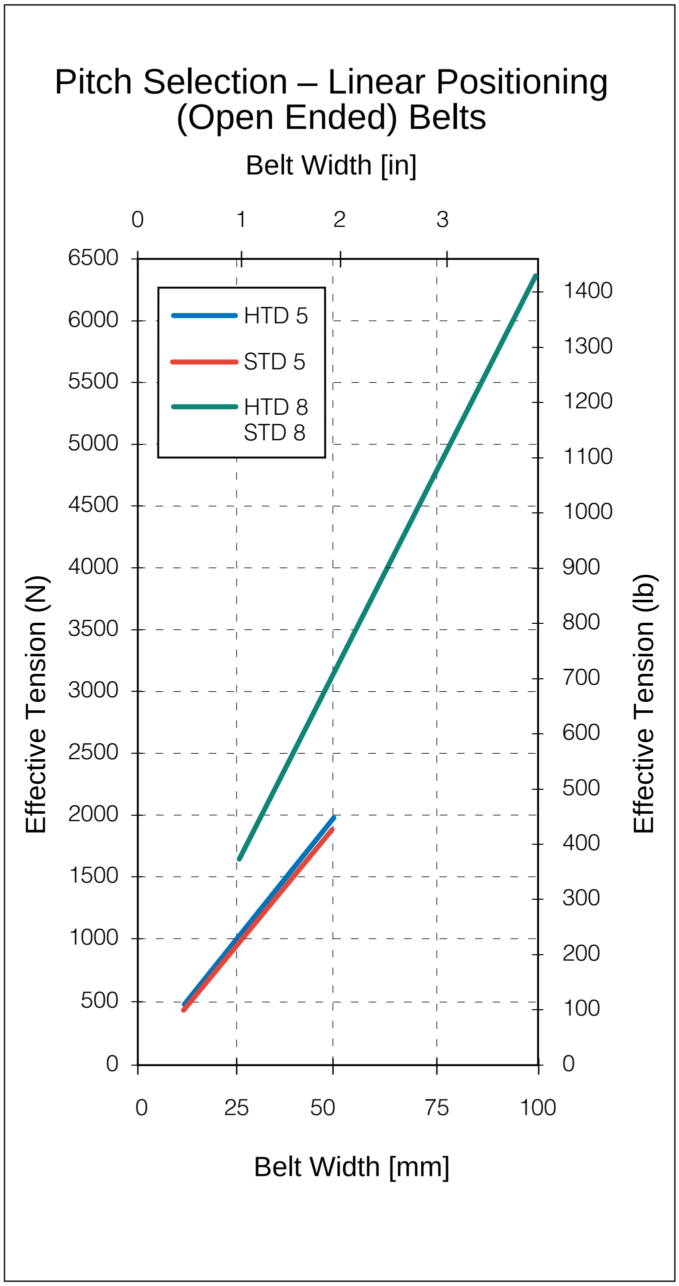

Pitch Selection – Conveying (Welded) Belts
Belt Width [in]
0 1 2 3 4 5
Effective Tension (N)
6500 6000 5500 5000 4500 4000 3500 3000 2500 2000 1500 1000 500 0
Effective Tension (lb)
1400 1300 1200 1100 1000 900 800 700 600 500 400 300 200 100 0
0 25 50 75 100 125 150
Belt Width [mm]

GRAPH 2b

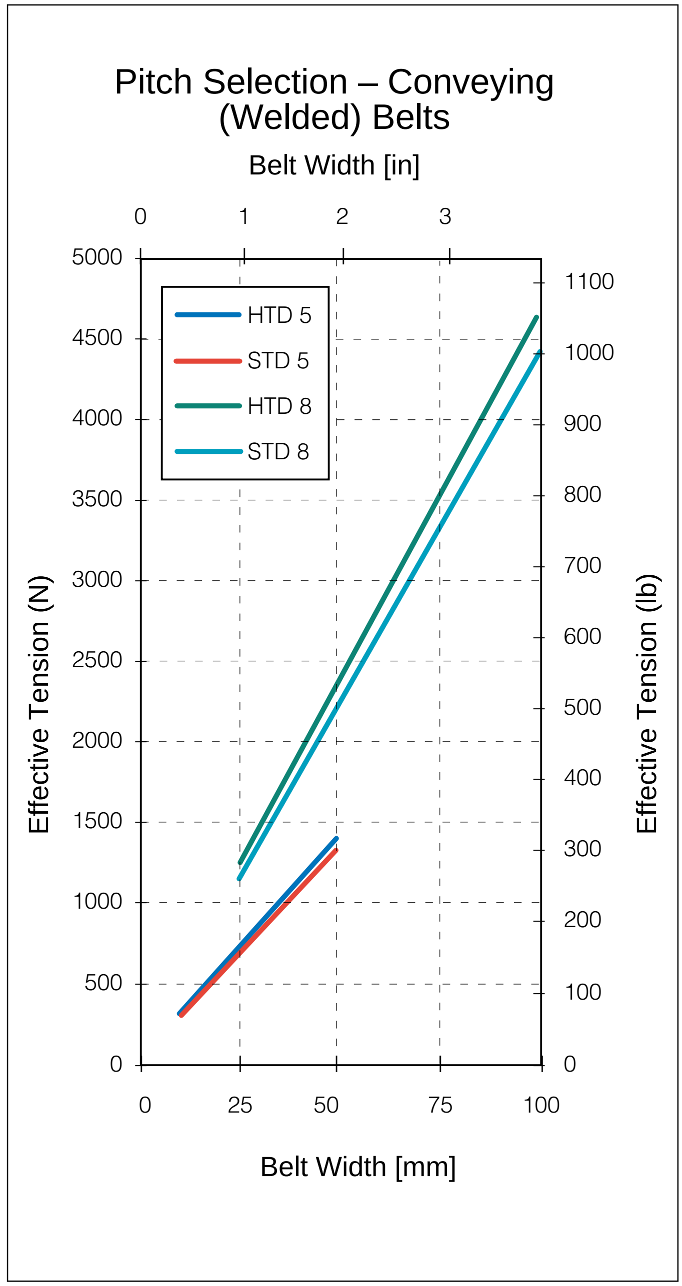

Pitch Selection – Linear Positioning (Open Ended) Belts
Belt Width [in]
Effective Tension (N)
Effective Tension (lb)
Belt Width [mm]
AT5
ATL5
AT10
ATL10
AT20
ATL10HF
ATL20


Pitch Selection – Conveying (Welded) Belts
Belt Width [in]
Effective Tension (N)
Effective Tension (lb)
Belt Width [mm]

GRAPH 2c



Pitch Selection – Linear Positioning (Open Ended) Belts
Belt Width [in]
0
1
2
3
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
HTD 5
STD 5
HTD 8
STD 8
Effective Tension (N)
Effective Tension (lb)
0
25
50
75
100
Belt Width [mm]



Pitch Selection – Conveying (Welded) Belts
Belt Width [in]
0
1
2
3
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1100
1000
900
800
700
600
500
400
300
200
100
0
HTD 5
STD 5
HTD 8
STD 8
Effective Tension (N)
Effective Tension (lb)
0
25
50
75
100
Belt Width [mm]

GRAPH 2d

EXAMPLES

Here are two examples of how to make a belt selection

Conveying

v	= 120 ft/min	Speed
W	= 60 lb	Box weight
18" x 12"		Box bottom size
C	= 28 ft (336 in)	Center distance
β	= 15°	Conveyor angle of incline
d_o	≈ 3.5"	Pulley outside diameter

slider bed made of steel
belt teeth covered with nylon fabric

Considering only the box size, a belt width of approximately 12" would be necessary. Instead of using one 12" wide belt, however, we decide to build a conveyor with two parallel running belts. The minimum belt width will be determined.

Step 1

The boxes are carried lengthwise on 2 ft centers

Weight distribution over conveyor length $w_m = 30$ lb/ft.

Friction force

$$F_f = \mu \cdot w_m \cdot L_m \cdot \cos\beta$$

$$F_f = 0.3 \cdot 30 \frac{lb}{ft} \cdot 28\ ft \cdot \cos 15° \qquad F_f = 243.4\ lb$$

(coefficient of friction μ = 0.3 obtained from Table 1)

Gravitational load

$$F_g = w_m \cdot L_m \cdot \sin\beta$$

$$F_f = 30 \frac{lb}{ft} \cdot 28\ ft \cdot \sin 15° \qquad F_f = 217.4\ lb$$

Effective tension $T_e = F_f + F_g$

$$T_e = 243.4\ lb + 217.4\ lb \qquad T_e = 460.8\ lb$$

Step 2

Selected belt pitch =>H (Graph 2a)

An effective tension of 460.8 lb can be transmitted by either L or H pitch belt. We choose H pitch (0.5"). The minimum belt width to transmit the load will be approximately 2.5 inches.

Step 3

Approximate number of pulley teeth $\tilde{z}_p = \frac{\pi \cdot \tilde{d}}{p}$

$$\tilde{z}_p = \frac{\pi \cdot 3.5\ in}{0.5\ in} = \tilde{z}_p = 21.99$$

Choosen number of teeth $z = 22$

(chosen number of teeth is greater than the recommended minimum number of pulley teeth for H pitch belt [$z_{min} = 14$] given in Table 1)

Pulley pitch diameter $d = \frac{p \cdot z_p}{\pi}$

$$d = \frac{0.5\ in \cdot 22}{\pi} \qquad d = 3.501\ in$$

Step 4

Preliminary number of belt teeth $\tilde{z}_b = 2 \cdot \frac{\tilde{C}}{p} + z_p$

$$\tilde{z}_b = 2 \cdot \frac{336\ in}{0.5\ in} + 22 \qquad \tilde{z}_b = 1366$$

Chosen number of belt teeth $z_b = 1366$

Belt length $L = z_p \cdot p$

$$L = 1366 \cdot 0.5\ in \qquad L = 683\ in$$

Step 5

Number of teeth in mesh $z_m = \frac{z_p}{2}$

$$z_m = \frac{22}{2} \qquad z_m = 11$$

Step 6

Pre-tension $T_i = 0.5T_e$

$$T_i = 0.5 \cdot 460.8\ lb \qquad T_i = 230.4\ lb$$

Step 7

Tight side tension

$$T_1 \approx T_i + 0.75T_e$$

$$T_1 \approx 230.4\ lb + 0.75 \cdot 460.8\ lb \qquad T_1 = 576\ lb$$

Slack side tension $T_2 = T_1 - T_e$

$$T_2 = 576 - 460.8\ lb \qquad T_2 = 115.2\ lb$$

Step 8

Allowable belt tension (from Table 1) $T_{1all} = 245$ lb/in

Belt width b to withstand T_{1max} $\quad b \geq \frac{T_{1max}}{T_{1all}}$

$$b \geq \frac{576\ lb}{245 \frac{lb}{in}} \qquad b \geq 2.35\ in$$

Allowable effective tension (from Table 1) $T_{eall} = 330$ lb/in

Tooth in mesh factor (from Table 2; for $z_m = 11$) $t_m = 0.92$

Speed factor (from Table 3; for v = 120 ft/min) $t_v = 1$

Belt width to transmit T_e $\quad b \geq \frac{T_e}{T_{eall} \cdot t_m \cdot t_v}$

$$b \geq \frac{460.8\ lb}{330 \frac{lb}{in} \cdot 0.92 \cdot 1} \qquad b \geq 1.52\ in$$

Chosen belt width—boxes will be conveyed on two belts 1.5" wide each

(Note that each belt is loaded by half of the calculated forces)

Step 9

Shaft force at driver

$F_{s1} = T_1 + T_2$

$F_{s1} = 576\text{ lb} + 115.2\text{ lb}$ $\quad F_{s1} = 691.2\text{ lb}$

Shaft force at idler

$F_{s2} = 2T_2$

$F_{s2} = 2 \cdot 115.2\text{ lb}$ $\quad F_{s2} = 230.4\text{ lb}$

Linear positioning

v	$= 3.5$ m/s	Speed
a	$= 20$ m/s²	Slide acceleration
m_s	$= 30$ kg	Slide mass
F_f	$= 50$ N	Friction force
Δx	≤ 0.1 mm	Positioning error
d_o	≈ 50mm	Pulley diameter
C	$= 3000$ mm	Center distance
S	$= 2500$ mm	Travel
L_p	$= 160$ mm	Platform length

Step 1

Force to accelerate the slide $\quad F_a = m_s \cdot a$

$F_a = 30\text{ kg} \cdot 20\text{ m/s}^2$ $\quad F_a = 600\text{N}$

Friction force $\quad F_f = 50\text{N}$

Effective tension

$T_e = F_a + F_f$

$T_e = 600\text{N} + 50\text{N}$ $\quad T_e = 650\text{N}$

Step 2

Selected belt pitch =>AT5 (Graph 2c)

For linear positioning, belts of the AT series are preferred, because of the higher cord and tooth stiffness.

Step 3

Approximate number of pulley teeth $\quad \tilde{z}_p = \frac{\pi \cdot \tilde{d}}{p}$

$\tilde{z}_p = \frac{\pi \cdot 50\text{mm}}{5\text{mm}}$ $\quad \tilde{z}_p = 31.4$

Chosen number of teeth $\quad z_p = 32$

(greater than the recommended minimum number of pulley teeth for an AT5 belt [$z_{min} = 12$] given in Table 1)

Pulley pitch diameter $\quad d = \frac{p \cdot z_p}{\pi}$

$d = \frac{5\text{mm} \cdot 32}{\pi}$ $\quad d = 50.93\text{mm}$

Step 4

Preliminary number of belt teeth $\quad \tilde{z}_b = 2 \cdot \frac{\tilde{C}}{p} + z_p$

$\tilde{z}_b = \frac{2 \cdot 3000\text{mm}}{5\text{mm}} + 32$ $\quad \tilde{z}_b = 1232$

Chosen number of belt teeth $\quad z = 1232$

Belt length $\quad L = z_b \cdot p$

$L = 1232 \cdot 5\text{mm}$ $\quad L = 6160\text{mm}$

(incl. 160mm over the slide)

Step 5

Number of teeth in mesh $\quad z_m = \frac{z_p}{2}$

$z_m = \frac{32}{2}$ $\quad z_m = 16$

Step 6

Belt pre-tension $\quad T_i = 1.1 \cdot T_e$

$T_i = 1.1 \cdot 650\text{N}$ $\quad T_i = 715\text{N}$

Step 7

Maximum tight side tension $\quad T_{1max} \approx T_i + T_e$

$T_{1max} \approx 715\text{N} + 650\text{N}$ $\quad T_{1max} = 1365\text{N}$

Maximum slack side tension $\quad T_{2max} \approx T_{1max} - T_e$

$T_{2max} \approx 1365\text{N} - 650\text{N}$ $\quad T_{2max} = 715\text{N}$

Step 8

Allowable belt tension (from Table 1) $\quad T_{1all} = 1615\text{N}/25\text{mm}$

Belt width b to withstand T_{1max} $\quad b \geq \frac{T_{1max}}{T_{1all}}$

$b \geq \frac{1365\text{N}}{1615\text{N}} \cdot 25\text{mm}$ $\quad b \geq 211\text{mm}$

Allowable effective tension (from Table 1) $\quad T_{eall} = 1270\text{N}/25\text{mm}$

Tooth in mesh factor (from Table 2; for $z_m = 16$) $\quad t_m = 1$

Speed factor (from Table 3; for $v = 3.5$ m/s) $\quad t_v = 0.96$

Belt width to transmit T_e $\quad b \geq \frac{T_e}{T_{eall} \cdot t_m \cdot t_v}$

$b \geq \frac{650\text{N}}{\frac{1270\text{N}}{25\text{mm}} \cdot 1 \cdot 0.96}$ $\quad b \geq 13.3\text{mm}$

Chosen belt width (for increased stiffness a wider belt is chosen) $\quad b = 50\text{mm}$

Step 9

Maximum shaft force at driver $\quad F_{s1max} = T_{1max} + T_{2max}$

$F_{s1max} = 1365\text{N} + 715\text{N}$ $\quad F_{s1max} = 2080\text{N}$

Maximum shaft force at idler $\quad F_{s2max} = 2 \cdot T_{1max}$

$F_{s2max} = 2 \cdot 1365\text{N}$ $\quad F_{s2max} = 2730\text{N}$

Step 10

Belt stiffness $\quad k = c_{sp} \cdot b \cdot \frac{L_1 + L_2}{L_1 \cdot L_2}$

$$k = 17600 \cdot \frac{\text{N}}{\text{mm}} \cdot 50\text{mm} \cdot \frac{6000\text{mm}}{3290\text{mm} \cdot 2710\text{mm}}$$

$$k = 592.2 \frac{\text{N}}{\text{mm}}$$

Slide displacement $\quad \Delta x = \frac{F_{st}}{k}$

$\Delta x = \frac{50\text{N}}{592.2 \frac{\text{N}}{\text{mm}}}$ $\quad \Delta x = 0.084\text{mm} < 0.1\text{mm}$

Static load on the slide F_{st} is equal to the friction force ($F_{st} = F_f = 50\text{N}$)

OTHER PRODUCTS BY MECTROL

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Mectrol offers a wide assortment of products to meet all your motion control needs. Please contact us for more information on any of these products.

Endless Flex-Belts (left)

These belts, produced in a truly endless form, are designed for power transmission and positioning applications. Having no splice or seams, they are ideal for higher torque drives. For complete information, ask for Mectrol's Flex-Belt catalog.

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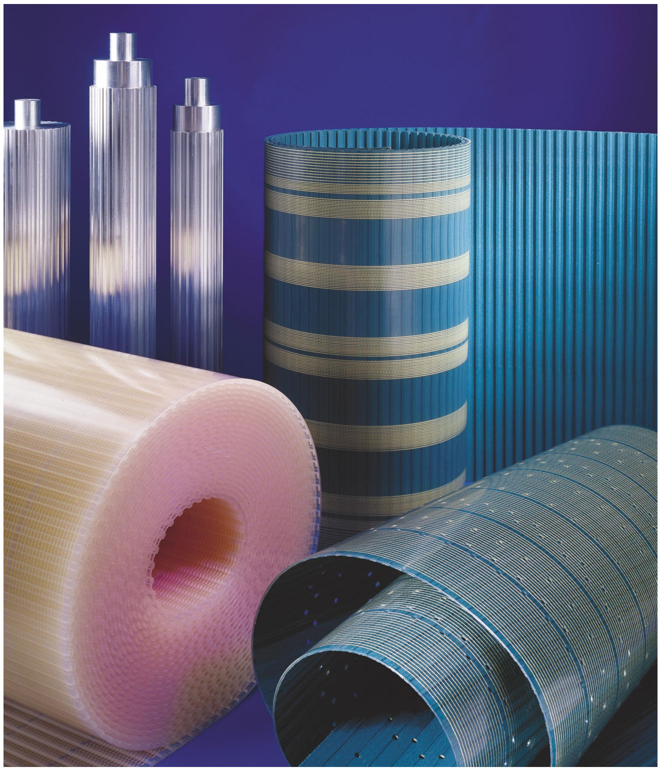
Available in all pitches, standard and custom. Choose from several available materials and special coatings. We can handle any size order, large or small. For complete information, ask for Mectrol's pulley catalog.



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Mectrol Corporation is the first company in the United States devoted exclusively to the manufacture of linear urethane timing belts. Its rapid growth to being the market leader is testimony to the quality of its products and its ability to efficiently service the demands of industry worldwide.

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Mectrol's new headquarters in Salem, New Hampshire is shown below.

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