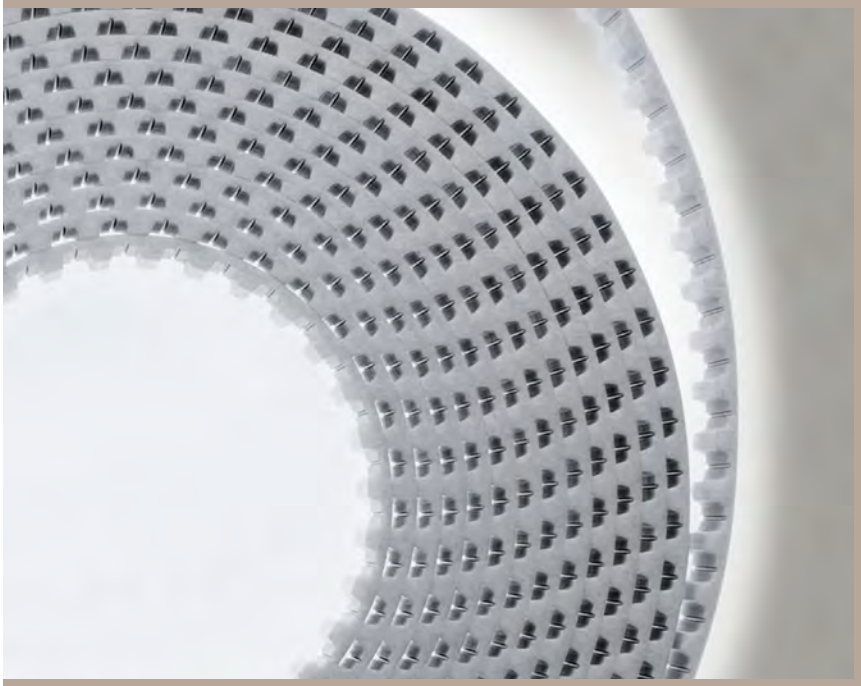
MEGADYNE



MEGALINEAR

EN

TECHNICAL HANDBOOK

CLASSIFICATIONS

COATING

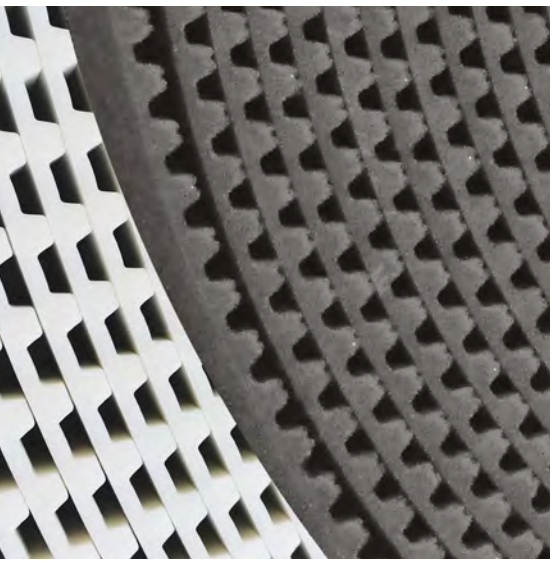
MEGALINEAR can be manufactured with special coating on the teeth or on the back. Please check on page 134 and 135.

IDENTIFICATION CODE

Using the information in the table below, it is possible to identify the correct belt for every application. The code is composed of letters and numbers as the following example:

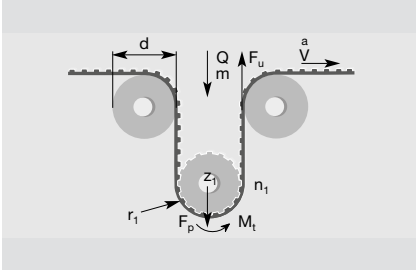
1		2		3		4		5		6
J	+	50	+	AT	+	10	+	10000	+	SPECIAL MANUFACTURES

1	**J**	Joined belt.
	ML	MEGALINEAR belt OPEN-ENDEDed.
2	**50**	This number indicates the width of requested belt. The value is in mm for a belt with a pitch in mm, and in inches for a belt with a pitch in inches.
3	**AT**	This code composed by letters indicates the selection of profile.
4	**10**	This number indicates the standard pitch of the belt. It is expressed in mm.
5	**10000**	The last number indicates the length of the belt always in mm regardless of pitch.
6	**SPECIAL MANUFACTURES**	Special cords as Kevlar or HP or HF or HPF or stainless steel
		Special compound as different hardness 85 ShA or different colours (black - red - yellow - blue)
		Extra coating NFT or NFB or AVAFC or Tenax or Linatex or Honey Comb or PU black cellulose or PU yellow or Neoprene rubber.

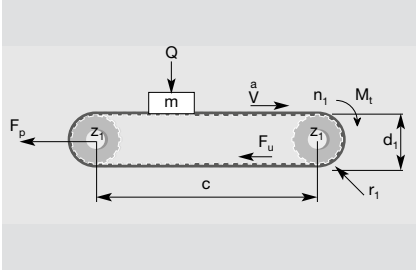


TECHNICAL CALCULATION

OMEGA LINEAR MOTION BELT



LINEAR MOTION AND CONVEYOR BELT



The following pages contain data, formulas and tables that are required to design a new belt drive. For critical and difficult drives, it is raccomended that you contact our Application Department for advice.

SYMBOL	UNIT	DEFINITION	SYMBOL	UNIT	DEFINITION
a	m/s2	ACCELERATION	**g**	m/s2	GRAVITY (9,81)
b	mm	BELT WIDTH	**μ**	–	FRICTION COEFFICIENT
C	–	SAFETY FACTOR	**m**	Kg	CONVEYED MASS
$\Delta l/_{00}$	‰	ELONGATION	**M_t**	Nm	DRIVE TORQUE
d	mm	IDLER PITCH DIAMETERS	**n_1**	1/min	REVS/MIN (RPM) OF DRIVE SPROCKET 1
d_1	mm	SPROCKET PITCH DIAMETER	**P**	KW	DRIVE POWER
F_p	N	PRETENSION	**Q**	N	FORCE EXERTED BY MASS (M)
F_u	N	PERIPHERAL FORCE	**V**	m/s	BELT SPEED
$F_{p\ spec}$	N/cm	TRANSMITTABLE FORCE PER TOOTH PER UNIT WIDTH	**Z_i**		NUMBER OF TEETH OF SPROCKET
MTL	N	MAX TRACTION LOAD	**Z_m**		NUMBER OF TEETH IN MESH ON DRIVER SPROCKET (12)
BS	N	BREAKING STRENGTH	**Z_L**		NUMBER OF TEETH OF LARGE PULLEY
c	mm	CENTRE DISTANCE	**Z_s**		NUMBER OF TEETH OF SMALL PULLEY
			p		BELT PITCH

Max traction load is maximum acceptable traction on cords.
Breaking strength is necessary load to break belt cords.
Elongation is belt elongation under load.

USEFUL FORMULAS AND CONVERSION FACTORS

$$V = \frac{d_1 \cdot n_1}{19100} \qquad n_1 = \frac{V \cdot 19100}{d_1} \qquad d_1 = \frac{V \cdot 19100}{n_1} \qquad Q = m \cdot g$$

$$P = \frac{M_t \cdot n_1}{9550} \qquad M_t = \frac{9550 \cdot P}{n_1} \qquad M_t = \frac{F_u \cdot d_1}{2000}$$

TECHNICAL CALCULATION

CHOICE OF BELT PITCH AND SPROCKETS

For optimum belt pitch see tables on page 12.
For optimum choice of sprocket size, it is desiderable to have as near to 12 teeth in mesh as possible.

Knowing mass	For horizontal & conveying drives *(Note: values of μ can be found in table 3 on page 13)*	$F_u = (m \bullet a) + (m \bullet g \bullet \mu)$
	For vertical drives	$F_u = (m \bullet a) + (m \bullet g)$
Knowing drive torque	-	$F_u = 2000\ Mt / d_1$
Knowing drive power	-	$F_u = 19.1 \bullet 10^6 \bullet P / (d_1 \bullet n_1)$

BELT WIDTH AND PROFILE ESTIMATION

The belt width b should be calculated using the following formula:

$$b = (F_u \bullet c_s \bullet 10) / (F_{p\ spec} \bullet Z_m)$$

C_s	safety factor from page 11 table 4
F_u	from above calculation
Z_m	number of teeth in mesh on driver sprocket
Z_m	$[0.5 - \frac{4 \bullet p}{79 \bullet c} (Z_L - Z_s)] \bullet Z_s$
	(if calculated $Z_m >= 12$ for an OPEN-ENDED application use $Z_m = 12$)
	(if calculated $Z_m >= 6$ for a joined application use $Z_m = 6$)
$F_{p\ spec}$	transmittable force per tooth per unit width (see table on belt data pages)

PRE-TENSIONING

The suggested installation tension:

F_p	$2 \bullet F_u$ for linear and omega linear movement applications
F_p	F_u for conveyor applications

CORD CHECK

The maximum allowable tensile load of the belt pitch/width combination selected (see tables on belt data pages):

$$\text{max traction load of choosen belt} > \frac{F_p}{2} + (F_u \bullet C_s)$$

SPROCKET AND IDLER DIAMETER CHECK

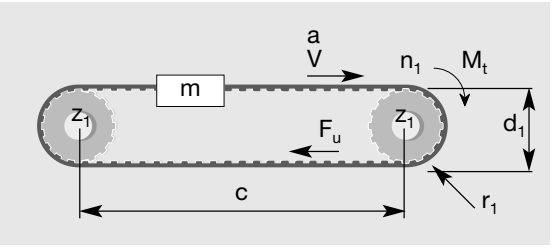
Ensure that all selected pulley and idler diameters are equal to or greater than the minimum values specified in corresponding belt data page.

ELONGATION

When the belt is operating there will be an elongation proportional to max traction load:

$$\Delta l/_{00} = (F_u \bullet 4) / \text{max traction load}$$

CALCULATION EXAMPLE (OPEN-ENDEDED BELT)



MACHINE DATA

C = 2.000 mm
d_1 = 76 mm
n_1 = 300 RPM
P = 1,8 KW
low fluctuating load

CHOICE OF BELT PITCH AND SPROCKETS

According to the belt pitch selection table n.1 on page 12 considering the values of P and n1, we select RPP8 belt.
Then we consider the pulley diameter nearest to the requested value and the corresponding n. of teeth (see technical information on page 79).
Therefore Z1 = 30 teeth (with a pitch diameter of 76,4 mm).

CALCULATION OF THE EFFECTIVE TENSION

Since the drive power is known, F_u can be calculated

$$F_u = \frac{19{,}1 \cdot 10^6 \cdot P}{d_1 \cdot n_1} = \frac{19{,}1 \cdot 10^6 \cdot 1{,}8}{76{,}4 \cdot 300} = 1500 \text{ N}$$

DETERMINATION OF THE BELT WIDTH

$$b = \frac{F_u \cdot C_s \cdot 10}{F_{p\,spec} \cdot Z_m}$$

F_u	from before (1500 N)
C_s	from page 13 table 4, for low fluctuating load Cs = 1,4
Z_m	given that driver pulley has 30 teeth and n. of teeth in mesh

$$b = \frac{1500 \cdot 1{,}4 \cdot 10}{62 \cdot 12} = 28{,}2 \text{ mm}$$

	15 but max Z_m is 12, then Z_m = 12
n_1	300 RPM (given)
$F_{p\,spec}$	62N / cm (refer page 78 at 300 RPM)

Since the next closest width is 30 mm: 30 RPP8 is choosen.

PRE-TENSIONING

$$F_p = 2 \cdot F_u$$

$$F_p = 3000 \text{ N}$$

CORD CHECK

From page 78, RPP8 pitch 30 mm wide: max traction load 4750 N

$$\text{max traction load} > \frac{F_p}{2} + (F_u \cdot C_s)$$

$$\frac{F_p}{2} + (F_u \cdot C_s) = 1500 + 1500 \cdot 1{,}4$$

4750 N > 3600 N selected belt is acceptable.

SPROCKET AND IDLER DIAMETER CHECK

Ensure that all selected pulley and idler diameters are greater than or equal the minimum values specified on page 79.

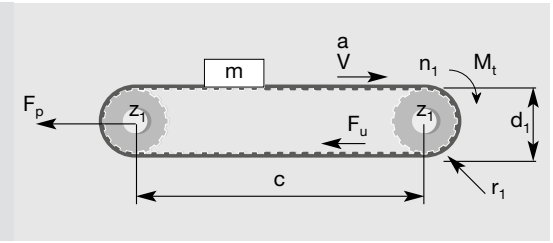
ELONGATION

$$\Delta l/_{00} = \frac{F_u \cdot 4}{\text{max traction load}} = \frac{1500 \cdot 4}{4750} = 1{,}26 \text{ mm/m}$$

In the dynamic situations you will have an elongation of 1,26 mm per meter of operating belt.

CONVEYOR BELT

CALCULATION EXAMPLE (JOINED BELT)



MACHINE DATA

C = 5.000 mm
d_1 = 100 mm
V = 0,5 m/s
a = 0,5 m/s2
Guide in nylon
Q = 4500 N
low fluctuating load

CHOICE OF BELT PITCH AND SPROCKETS

According to the belt selection table n. 2 on page 12, considering the values of Fu (for joined belts enter double of calculated Fu in table 2), we select T 10. Then we consider the pulley diameter nearest to the requested value and the corresponding n. of teeth (see technical information page 41). Therefore Z1 = 32 teeth (with a pitch diameter of 101,86 mm).

CALCULATION OF THE EFFECTIVE TENSION

Since the mass is known, F_u can be calculated

$F_u = (m \cdot a) + (m \cdot g \cdot \mu)$ | value of μ according to table 3 on page 13 = 0,35

$F_u = (460 \cdot 0,5) + (460 \cdot 9,81 \cdot 0,35) = 1810$ N

$m = Q/g = 4500 / 9,81 = 460$ kg

DETERMINATION OF THE BELT WIDTH

$$b = \frac{F_u \cdot C_s \cdot 10}{F_{p\,spec} \cdot Z_m}$$

	F_u	from before (1810 N)
	C_s	from page 13 table 4, for low fluctuating load Cs = 1,4
	Z_m	given that driver pulley has 32 teeth and n. of teeth in mesh
$b = \frac{1810 \cdot 1,4 \cdot 10}{45 \cdot 6} = 93,85$ mm		16 but max Z_m is 6, then Z_m = 6
	n_1	(Vp • 60.000) / (π • d_1) = (0,5 • 60.000) / (π • 101,86) as d_1 = 101,86 from before = 94 RPM
	$F_{p\,spec}$	45 N / cm (refer page 40, at 100 RPM)

Since the next closest width is 100 mm: 100 T10 is choosen.

PRE-TENSIONING

$F_p = F_u$ | $F_p = 1810$ N

CORD CHECK

From page 40, T10 pitch 100 mm wide joined: max traction load 5415 N

max traction load > $F_p + (F_u \cdot C_s)$ | $Fp + (Fu \cdot Cs) = 1810 + (1810 \cdot 1,4)$

5415 N > 4344 N selected belt is acceptable.

SPROCKET AND IDLER DIAMETER CHECK

Checking technical data on page 41 for pulley and idlers, it can be seen that the drive has acceptable pulley diameters.

ELONGATION

$$\Delta l/_{00} = \frac{F_u \cdot 4}{\text{max traction load}} = \frac{1810 \cdot 4}{5415} = 1,33 \text{ mm/m}$$

In the dynamic situations you will have an elongation of 1,33 mm per meter of operating belt.

CALCULATION PARAMETERS

TABLE 3 - FRICTION COEFFICIENT		
Sliding friction on dry surface	polyurethane / smooth steel	μ = 0,5
	polyurethane / rough steel	μ = 0,7
	polyurethane / abrasive steel	μ = 0,9
	polyurethane NFT / smooth steel	μ = 0,25
	polyurethane NFT / rough steel	μ = 0,35
	polyurethane NFT / abrasive steel	μ = 0,6
	polyurethane / nylon	μ = 0,35
	polyurethane NFT / nylon	μ = 0,15
	polyurethane / aluminium	μ = 0,8
	polyurethane NFT / aluminium	μ = 0,45
Rolling friction on dry surface	Bearing	μ = 0,015
	Roller / PU Belt	μ = 0,03 / 0,06
	Bush	μ = 0,15

The choice of the Safety factor's, depends on the operating conditions.

The following table shows the value to be used:

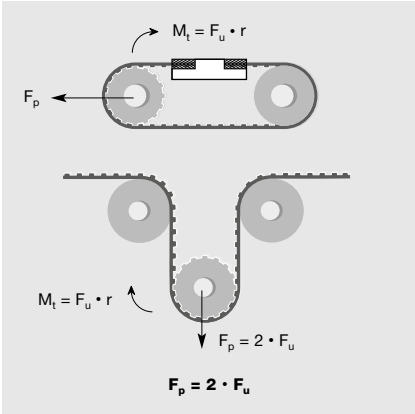
TABLE 4 - SAFETY FACTOR		
Steady Load		1
Shock Load	Low	1,4
	Average	1,7
	High	2
Elevators, hoists		1,8
Line shafts		1,6
Paper machines	Agitators, calenders, driers, winding frames,	1,6
	Willows, jordan machines, pumps, slicers, grinders	1,8
Machines for pottery and earthenware	Cutters, granulators,	1,7
	Pulping machines	2
Laundry machines	General	1,6
	Extractors, washers	1,8
Machines for rubber processing		1,8
Woodworking machines:	Lathes, band saws, cutters,	1,7
	Circular saws, planers, jointer	1,7
Printing machinery	Rotary, newspaper, linotype, cutters, folders, magazine	1,6
Textile machines	Warping machines, winders,	1,7
	Spinners, twisting frames, looms	1,8
Machines tools	Drilling machines, lathes, tread cutting machines, gears cutters, boring machines	1,6
	Millers, planers,	1,7
	Grinding machines	1,7
Conveyors	Hoists, light package	1,3
	Oven screw fleight, apron bucket, elevator, screw	1,8
Brick machinery		1,8

BELT INSTALLATION

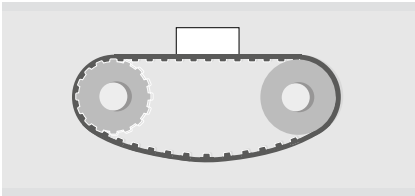
A major difficulty installing transmission belt is to achieve correct belt tension. Lifetime of support bearings and transmission belts and therefore reliability of the complete system largely depends on an optimally adjusted belt tension.

Pretension is the force needed to put tension into the system to avoid the belt jumping on the pulleys as in the example as in the scketch A.

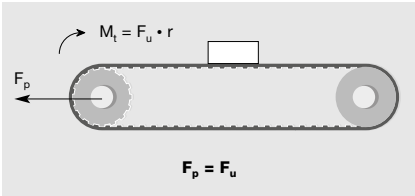
For a correct system installation, all applications with MEGALINEAR belt can be summarised according sketches B and C.



Linear and omega motion belt. *Scketch B*



Not correct belt installation.
Scketch A



Conveyor belt. *Scketch C*

SCKETCH KEYS

F_p = pretension
F_u = peripheral force
(see calculation pag. 10/11)
r = pulley radius

PROCEDURE TO MEASURE

The procedure to measure the tension of the belt is to use a Belt Tension Gauging Equipement. This device consists of a small sensing head which is held across the belt to be measured. The belt is then tapped to induce the belt to vibrate at its natural frequency. The vibrations are detected and the frequency of vibration is then displayed on the measuring unit.

The relation between belt static tension (T_S) and frequency of vibration (f) may be calculated using the following formula:

$$f = \frac{1}{2t} \cdot \sqrt{\frac{T_s}{m}} \qquad \text{or} \qquad Ts = 4 \cdot m \cdot t2 \cdot f2$$

WHERE :

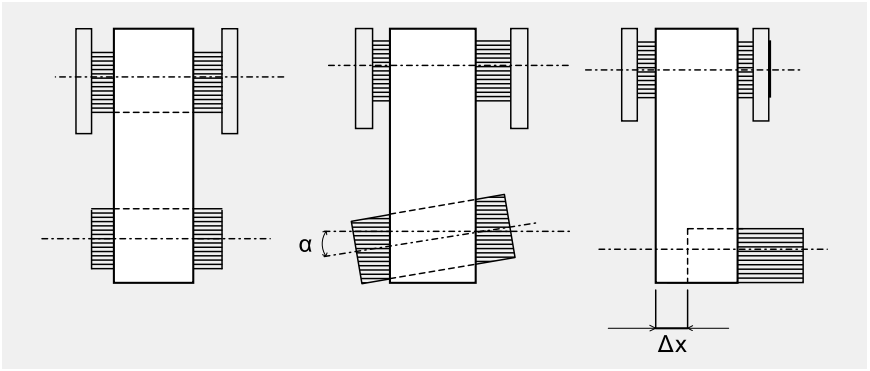
T_S = static tension (N)	f = Frequency of vibration in Hertz (Hz)
m = Belt mass per unit length (kg/m)	t = Free belt span length in meters (m)

BELT INSTALLATION

For a correct system functioning and to increase belt life, it is necessary a correct pulley installation: pulleys has to be parallel and aligned as shown in drawing 1 (correct configuration).

If pulleys are not parallel as in drawing 2, belt could fall during functioning and this can provoke damages to complete equipment.

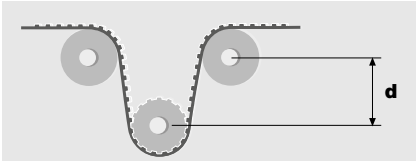
To grant a correct belt running, α and Δx must be as smaller as possible. For more information, please contact our technical staff.



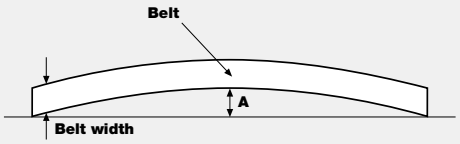
Drawing 1 *Drawing 2* *Drawing 3*

In omega application to grant good mesh between pulley and teeth and to respect belt flexibility avoiding excessive stress on cords, distance d (as Drawing 4) has to be:

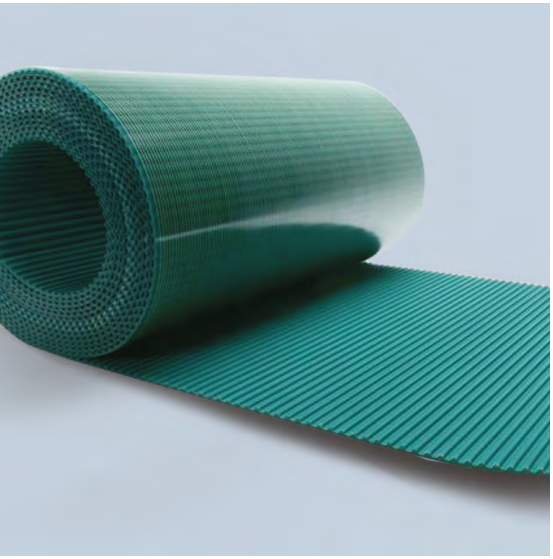
d = 4 • belt width
Suggested angle 120°



Moreover for a good drive work, it is suggested to check belt straigthness as follows:



BELT WIDTH	TESTING BELT LENGTH	MAXIMUM SUGGESTED BENDING (A)
Till to 20 mm	1 m	3 mm
Over 20 mm	2 m	4 mm



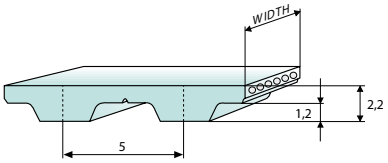
MEGALINEAR

T5 WIDE OPEN-ENDED

STANDARD WIDTHS (mm)	250	500
Weight (gr/m)	500	1000

Standard compound	**transparent polyurethane thermoplastic 90 ShA**
Standard back cover	**none**
Standard tooth cover	**none**
Standard cords	**S and Z torsion Kevlar at pitch 3,5 mm**
Standard width tolerance	**+/– 2 mm**
Standard thickness	**2,2 +/– 0,15 mm**
Standard length tolerance	**+/– 0,8 mm/m**
Standard roll length	**100 m**
Belt options on request with minimum quantity	**Nylon fabric back** **Nylon fabric teeth** **Transparent FDA compound**

TOOTH PROFILE ACCORDING TO ISO 17396

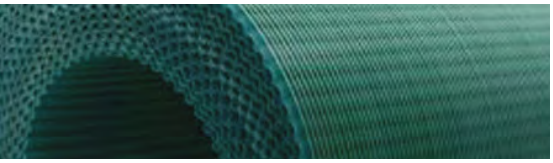


TOOTH RESISTANCE												
RPM (1/min)	0	20	40	60	80	100	200	300	400	500	750	1000
$F_{p\ spec}$ (N/cm)	17	16	16	15	15	15	14	13	13	12	12	11

Minimum suggested number of teeth in clamp for linear movement: 7

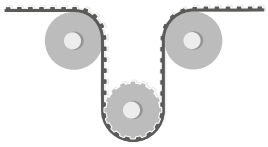
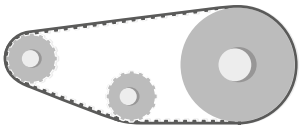
TRACTION RESISTANCE			
CORD MATERIAL	**BELT WIDTH (MM)**	**250**	**500**
Kevlar	Max Traction Load (N)	6595	13190
	Breaking Strength (N)	23085	46170
	Elongation at MTL (mm/m)	8	8

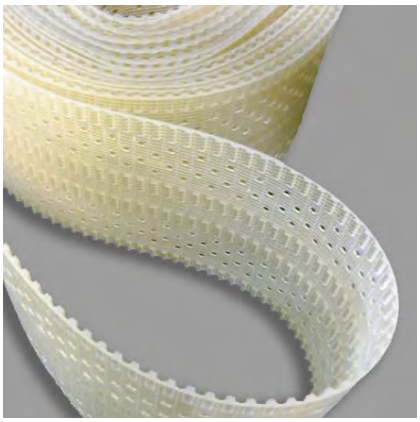
Average values



MEGALINEAR

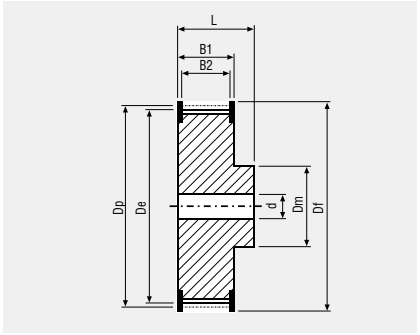
T5 WIDE OPEN-ENDED

FLEXION RESISTANCE				
				
	Z_{MIN}	IDLER MIN DIA (MM)	Z_{MIN}	IDLER MIN DIA (MM)
Kevlar cords	15	45	12	45



JOINED BELT INFORMATION:

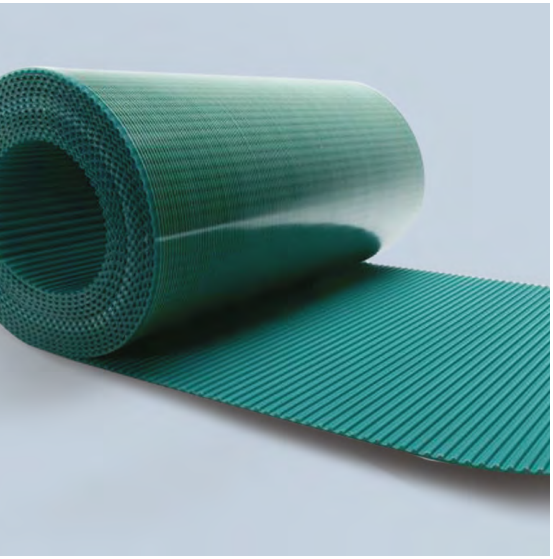
- Traction and tooth resistances = 50% less than open-ended
- Joined belt can be used only in conveyor systems
- Rolls with NFT and NFB can be joined too
- Minimum diameters according above table



PULLEYS
(FOR MORE DETAILS PLEASE SEE OUR PULLEYS CATALOGUE)

N° TEETH	DP	DE
10	15,92	15,09
12	19,10	18,275
14	22,28	21,45
15	23,87	23,04
16	25,46	24,64
18	28,65	27,82
19	30,24	29,41
20	31,83	31,00
22	35,01	34,19
24	38,20	37,37

N° TEETH	DP	DE
25	39,79	38,96
28	44,56	43,73
30	47,75	46,92
32	50,93	50,10
36	57,30	56,47
40	63,66	62,93
42	66,85	66,02
44	70,03	69,20
48	76,39	75,57
60	95,49	94,67



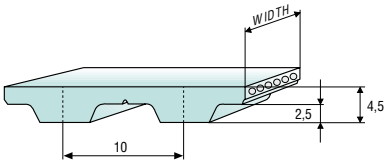
MEGALINEAR

T10 WIDE OPEN-ENDED

STANDARD WIDTHS (mm)	200	250	300	400	450	500
Weight (gr/m)	410	510	615	820	920	1020

Standard compound	**transparent polyurethane thermoplastic 90 ShA**
Standard back cover	**none**
Standard tooth cover	**none**
Standard cords	**S and Z torsion Kevlar at pitch 3,5 mm**
Standard width tolerance	**+/– 2 mm**
Standard thickness	**4,5 +/– 0,3 mm**
Standard length tolerance	**+/– 0,8 mm/m**
Standard roll length	**100 m**
Belt options on request with minimum quantity	**Nylon fabric back** **Nylon fabric teeth** **Antistatic Nylon fabric** **Transparent FDA compound**

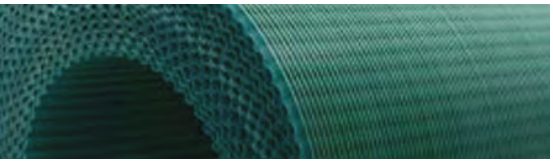
TOOTH PROFILE ACCORDING TO ISO 17396



TOOTH RESISTANCE												
RPM (1/min)	0	20	40	60	80	100	200	300	400	500	750	1000
$F_{p\ spec}$ (N/cm)	36	34	34	33	32	31	29	27	26	25	23	22

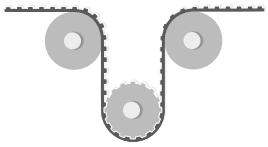
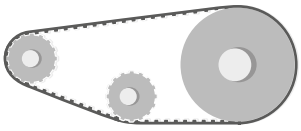
TRACTION RESISTANCE							
CORD MATERIAL	BELT WIDTH (MM)	200	250	300	400	450	500
Kevlar	Max Traction Load (N)	8530	10475	12570	16910	19005	20950
	Breaking Strength (N)	29855	36665	43995	69185	66520	73330
	Elongation at MTL (mm/m)	8	8	8	8	8	8

Average values

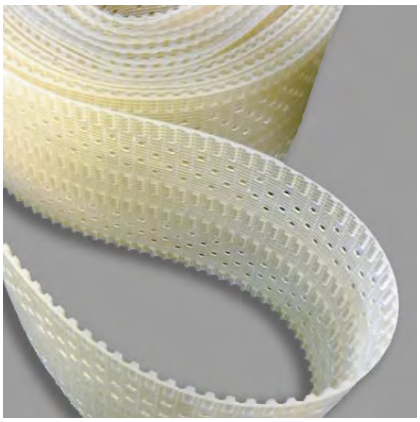


MEGALINEAR

T10 WIDE OPEN-ENDED

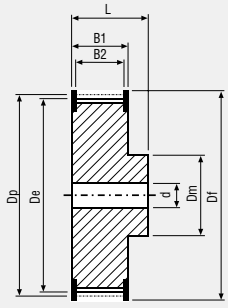
FLEXION RESISTANCE				
				
	Z_{MIN}	IDLER MIN DIA (MM)	Z_{MIN}	IDLER MIN DIA (MM)
Kevlar cords	20	60	15	60

JOINED BELT INFORMATION:



- Traction and tooth resistances = 50% less than open-ended
- Joined belt can be used only in conveyor systems
- Rolls with NFT and NFB can be joined too
- Minimum diameters according above table

PULLEYS
(FOR MORE DETAILS PLEASE SEE OUR PULLEYS CATALOGUE)



N° TEETH	DP	DE
12	38,20	36,35
14	44,56	42,71
15	47,75	45,90
16	50,93	49,08
18	57,30	55,45
19	60,48	58,63
20	63,66	61,81
22	70,03	68,18
24	76,39	74,55
25	79,58	77,73

N° TEETH	DP	DE
26	82,76	80,91
27	85,94	84,10
28	89,13	87,28
30	95,49	93,65
32	101,86	100,01
36	114,59	112,74
40	127,32	125,48
44	140,06	138,21
48	152,79	150,94
60	190,99	189,14