



KEILRIEMENLATH



RUBBER

Open end



MEGADYNE

INTRODUCTION TO RUBBER OPEN END BELTS

Megadyne Rubber Open End Belts are rubber based timing belts manufactured with high quality materials and state of the art production process. As a result of this Megadyne offers belts which have been designed to respond the high demands of today's industrial market.

Megadyne Rubber Open End Belts are specially suitable for reversing drives and applications when rotational movements need to be transformed into linear motions and high positioning accuracy is required.



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INTRODUCTION TO RUBBER OPEN END BELTS

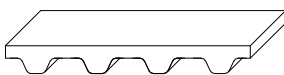
Megadyne Rubber Open End Belts are a great solution when substituting expensive conventional linear systems. Noise level improvement will be obtained as well as economic benefits due to the reduction of the initial investment and the maintenance costs.

Taking into account the advantages and the available products range, these belts can be considered as a solution for a very wide field of applications in industrial equipments. Few examples of typical applications can be:

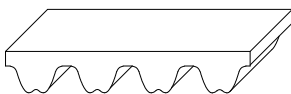
- Automatic doors for garage
- Automatic sliding doors
- X-Y tables on tooling machines
- Level control on elevators
- Fitness machines
- Printers
- Linear positioning systems



STANDARD RANGE



MXL XL L H



RPP3 RPP5 RPP8 RPP14 SILVER5 SILVER8



STD8

CLASSIFICATIONS

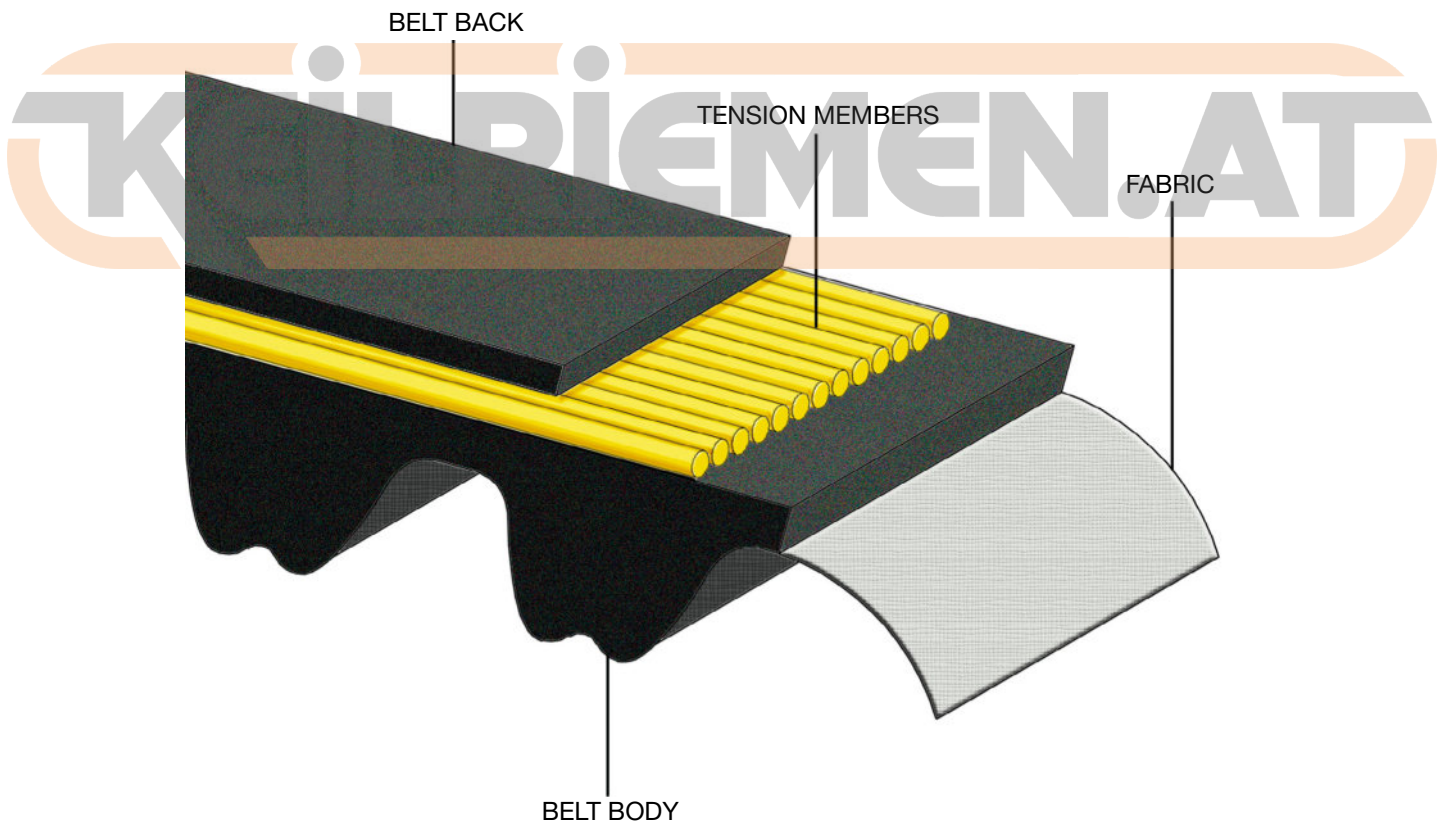
CLASSIFICATIONS

Megadyne Rubber Open End Belts are manufactured in rubber compound. They come from sleeves for spiral cut belts and from press for straight cut belts.

The belt is made by:

- BELT BACK** The back side cushion protects the tensile member and permits the use of backside idlers thanks to its elasticity.
- TENSION MEMBERS** Fiberglass or steel tensile member of the latest technology grants the longitudinal rigidity and resistance of the belt.
- BELT BODY** The belt body is made of special polychloroprene-based or EPDM rubber compound. These compounds guarantee the highest tooth share resistance.
- FABRIC** Hard wearing nylon fabric is bonded on tooth surface to improve torque carrying capacity. In addition a special graphite impregnation process gives self-lubricating action and increases drive efficiency.

BELT CONSTRUCTION



The advantages of Megadyne Rubber Open End Belts are:

- High positioning accuracy on reverse drives
- To cover a wide range of applications
- Low noise level due to vibration absorbing characteristic of rubber
- Low operation costs due to free of maintenance and long lasting service life
- Compact and light drives are feasible due to high specific belt performances.

MECHANICAL AND CHEMICAL CHARACTERISTICS

- Constant dimensions
- Noiseless
- Free maintenance
- High flexibility with fiberglass cords
- Linear speed up to 50 m/s
- Low pretension
- Constant length
- High abrasion resistance
- Standard working temperature -25 /+80 °C

BODY

Megadyne Rubber Open End Belts are manufactured with polychloroprene compound. Special compounds (different hardness, special properties) are available on request. Here under some compound's characteristics:

Resistance to	Standard Belt's Resistance
Mineral oils	LOW
Water	MEDIUM
Acids / Alkalis	NONE
Solvents	NONE
Oils	LOW
Greases	MEDIUM
Fuels	NONE
Environment agents	MEDIUM
Temperature	
Min T (°C)	-25
Max T (°C)	80
Max peak T (°C)	100

IDENTIFICATION CODE

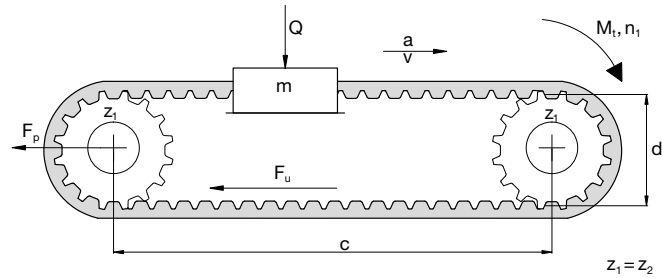
Using the information in the table below, it is possible to identify the correct belt for every application. The code is composed of letters and numbers as the following example:

1		2
H	+	200
RPP5	+	15
SILVER8	+	25

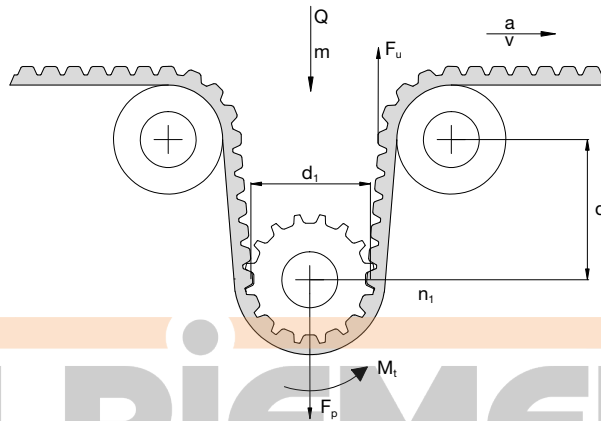
- 1) This code composed by letters and numbers indicates the selection of profile.
- 2) This number indicates the width of the requested belts. The value is in mm for belts with metric pitch and in inches for belts with imperial pitch.

TECHNICAL CALCULATION

LINEAR MOTION BELT



OMEGA LINEAR MOTION BELT



The following pages contain data, formulae and tables that are required to design a new belt drive.

For critical and difficult drives, it is recommended that you contact our Application Department for advice.

Symbol	Unit	Definition	Symbol	Unit	Definition
b	mm	belt width	F_p	N	pretension
L	mm	belt length	F_u	N	peripheral force
c	mm	centre distance	F_{p spec}	N/cm	transmittable force per tooth per unit
d_i	mm	pitch diameter of pulley i	M_t	Nm	drive torque
m	kg	total conveyed mass	n₁	1/min	revs/min (RPM)
a	m/s²	acceleration	P	kW	drive power
v	m/s	belt speed	Q	N	force exerted by mass (m)
C_s	-	safety factor	z_i		number of teeth on pulley i
g	m/s ²	gravity (9.81)	z_m		number of teeth in mesh on driver pulley
μ	-	coefficient of friction ⁽¹⁾	z_s		number of teeth on small pulley
p	-	belt pitch	z_L		number of teeth on largest pulley
MTL	N	Max Traction Load	BS	N	Breaking Strength

Max Traction Load is maximum acceptable traction on cords

Breaking Strength is necessary load to break belt cord

⁽¹⁾ Between the belt and the guide

USEFUL FORMULAE AND CONVERSION FACTORS

$$V = \frac{d_1 \cdot n_1}{19100}$$

$$n_1 = \frac{V \cdot 19100}{d_1}$$

$$d_1 = \frac{V \cdot 19100}{n_1}$$

$$Q = m \cdot g$$

$$P = \frac{M_t \cdot n_1}{9550}$$

$$M_t = \frac{9550 \cdot P}{n_1}$$

$$M_t = \frac{F_u \cdot d_1}{2000}$$

CALCULATION OF THE PERIPHERAL FORCE ON THE TIMING BELT

Knowing mass	→ For horizontal & conveying drives	$F_u = (m \cdot a) + (m \cdot g \cdot \mu)$
	→ For vertical drives	$F_u = (m \cdot a) + (m \cdot g)$
Knowing drive torque	→	$F_u = 2000 \cdot M_t / d_1$
Knowing drive power	→	$F_u = 19,1 \cdot 10^6 \cdot P / (d_1 \cdot n_1)$

BELT WIDTH AND PROFILE ESTIMATION

With the result of F_u select the belt type profile and approximate the belt width according to DIAGRAM 1 page 10 on "Belt width selection".

CHOICE OF PULLEYS

Choose the closest standard pulley according to the data sheet of each belt type

$$z = \frac{\pi \cdot d_1}{p} \quad n_1 = \frac{6000 \cdot v}{p \cdot z_1}$$

Always verify that the chosen z is higher or equal to z_{\min} written in belt data pages.

DETERMINATION OF BELT WIDTH

The belt width b should be calculated using the following formula

$$b = \frac{F_u \cdot F_s \cdot 10}{F_{p, \text{spec}} \cdot z_m}$$

where:

- F_u from above calculation
- F_s is the safety factor from page 10
- $F_{p, \text{spec}}$ is the transmittable force per tooth per cm, from belt data pages
- z_m is the number of teeth in mesh on driver pulley, that you can calculate as per below:

$$z_m = \left\{ 0,5 - \left[\frac{4 \cdot p}{79 \cdot c} \cdot (z_1 - z_s) \right] \right\} \cdot z_s$$

This value z_m can't be higher than 12.

From the calculated width b , choose the next higher available width; you can check available widths in belt data page.

PRE-TENSIONING

The suggested installation tension is $F_p = F_u \cdot 1,2$

MESHING CHECK

In order to guarantee the correct function of the drive check the safety factor against break as per below:

$$\sigma_{BS} = \frac{BS}{F_u + \frac{F_p}{2}}$$

where:

- BS is the Breaking Strength (see tables on belt data pages)
- F_u from above calculation
- F_p is the tension, from above calculation

The σ_{BS} outcoming value has to be higher than 11 for fiberglass and 8 for steel cords. If it is lower, please retry with the next wider belts till you will get a value higher than 11 or 8.

ELONGATION

You can find belt elongation from Belt Elongation diagrams in belt data pages at Load equal to $F_p/2$ using the formula:

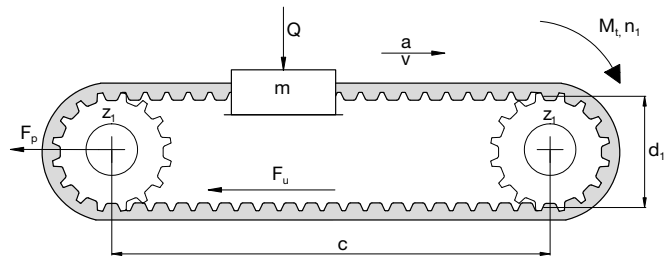
$$\Delta_{v00} = \frac{\text{Belt's Max Elongation} \cdot F_p/2}{BS}$$

TRANSMISSION CALCULATION EXAMPLE

DRIVE CALCULATION PROCEDURE FOR HORIZONTAL CONVEYING DRIVES

DRIVE DATA

Type of application	Automatic door
Type of load	Low fluctuation load
Hours of daily service	12 hours
Desired pulley pitch diameter	$d_1 = 38,2 \text{ mm}$
Centre distance	$c = 3 \text{ m}$
Mass to carry	$m = 100 \text{ kg}$
Coefficient of friction	$\mu = 0,3$
Speed	$v = 1,5 \text{ m/s}$
Acceleration	$a = 1,5 \text{ m/s}^2$
Deceleration	$a_b = 1,5 \text{ m/s}^2$



CALCULATION OF THE PERIPHERAL FORCE ON THE TIMING BELT

Since the mass is known, F_u can be calculated:

$$F_u = m \cdot a + m \cdot g \cdot \mu = 100 \cdot 1,5 + 100 \cdot 9,8 \cdot 0,3 = 444 \text{ N}$$

BELT WIDTH AND PROFILE ESTIMATION

With the result of F_u select the belt type profile and approximate the belt width according to DIAGRAM 1 page 10 on "Belt width selection". The first estimation is for a RPP5M15.

CHOICE OF PULLEYS

Knowing the pitch diameter

$$z_1 = \frac{\pi \cdot d_1}{p} = \frac{\pi \cdot 38,2}{5} = 24 > 14$$

where 14 is z_{\min} as per belt data page.

Always verify that the chosen z is higher or equal to z_{\min} written in belt data pages.

Knowing the linear speed

$$n_1 = \frac{6000 \cdot v}{p \cdot z_1} = \frac{6000 \cdot 1,5}{5 \cdot 24} = 750 \text{ rpm}$$

DETERMINATION OF BELT WIDTH

To calculate the belt width b we need to find out the service factor F_s first:

$$F_s = \frac{F_1 + F_3 + F_4}{F_2} = \frac{1,4 + 0 + 0}{1} = 1,4$$

where:

- F_1 , from table page 10, according to input data
- $F_2 = 1$ because $z_m = \frac{z_1}{2} = \frac{24}{2} = 12$
- $F_3 = 0$ because $n_2 / n_1 = 1$
- $F_4 = 0$ because no reverse bending

Then, the belt width b should be calculated using the following formula

$$b = \frac{F_u \cdot F_s \cdot 10}{F_{p, \text{spec}} \cdot z_m} = \frac{444 \cdot 1,4 \cdot 10}{28,5 \cdot 12} = 12,17 \text{ mm}$$

TRANSMISSION CALCULATION EXAMPLE

We will choose the next higher available width: $20 > 18,7$

PRE-TENSIONING

The suggested installation tension is $F_p = 2 F_u = 2 \cdot 444 = 888 \text{ N}$

MESHING CHECK

$$\sigma_{BS} = \frac{BS}{F_u + \frac{F_p}{2}} = \frac{7780}{444 + \frac{888}{2}} = 8,76$$

This value is lower than 11, that is the required minimum. Because of this you should check with the next wider available belt, that is 25 mm. This is the correct width as demonstrated by below calculation

$$\sigma_{BS} = \frac{BS}{F_u + \frac{F_p}{2}} = \frac{11150}{444 + \frac{888}{2}} = 12,55$$

where 11150 is the BS for a RPP5M25.

ELONGATION

From Belt Elongation diagram at page 24 we will find:

$$\Delta_{/100} = \frac{\text{Belt's Max Elongation} \cdot \frac{F_p}{2}}{BS} = \frac{3,00 \cdot 444}{11150} = 0,12 \text{ mm}$$

where Max Elongation is for the elongation of the specific length at BS.

FINAL SELECTION

The selected belt is RPP5M25.

CALCULATION PARAMETERS

SERVICE FACTOR

- F_s: Service Factor
- F₁: Load Factor
- F₂: Teeth in mesh Factor
- F₃: Ratio Factor
- F₄: Reverse Bending Factor

$$F_s = \frac{F_1 + F_3 + F_4}{F_2}$$

LOAD FACTOR (F₁)

Uniform load	1,0		
	Daily service in hours		
	3-8 hours	8-16 hours	16-24 hours
With low peak load	1,2	1,4	1,6
With high peak load	1,5	1,7	1,9
With very high peak load	1,8	2,0	2,2

TEETH IN MESH FACTOR (F₂)

Teeth in mesh	F ₂
12	1,0
10	0,8
8	0,6
6	0,4

RATIO FACTOR (F₃)

Speed ratios	F ₃
1 / 1,24	0
1,25 / 1,74	0,10
1,75 / 2,49	0,20
2,50 / 3,49	0,30
3,50 and above	0,40

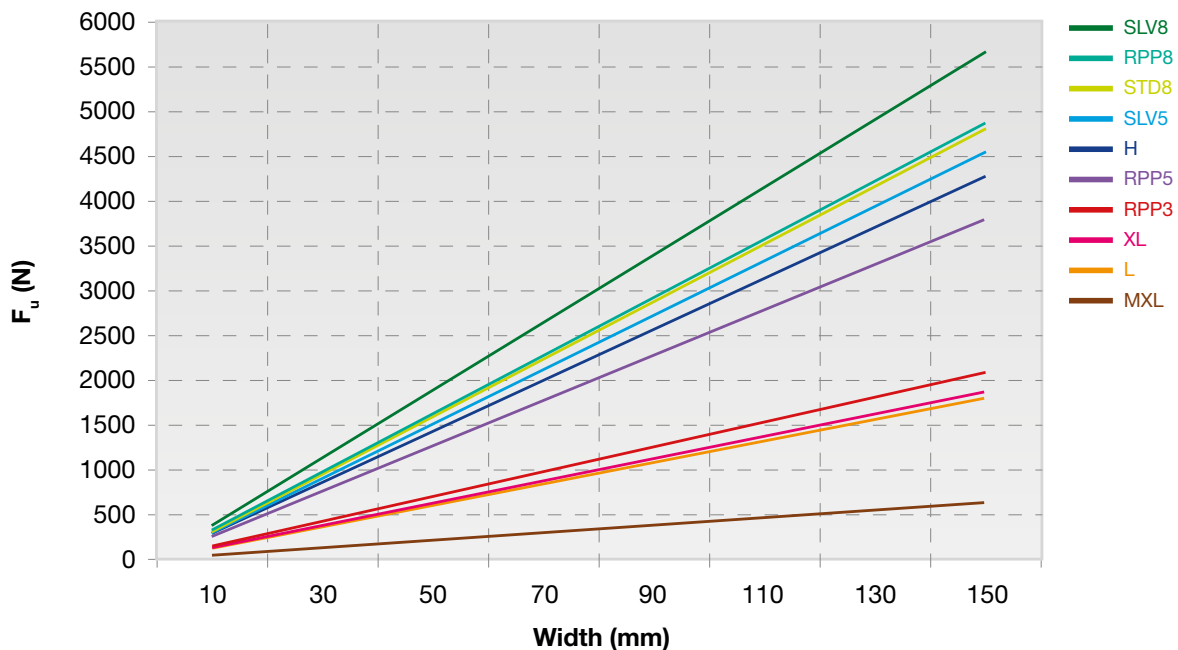
REVERSE BENDING FACTOR (F₄)

with reverse by back idler

F ₄
0,2

BELT WIDTH SELECTION

DIAGRAM 1



BELT INSTALLATION AND FEASIBILITY TABLE

PROCEDURE TO MEASURE

The procedure to measure the tension of the belt is to use a Belt Tension Gauging Equipment. 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 vibration 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:



$$f = \frac{1}{2t} \cdot \sqrt{\frac{T_s}{m}} \quad \text{or} \quad T_s = 4 \cdot m \cdot t^2 \cdot f^2$$

Where :

T_s = static tension (N)

f = Frequency of vibration in Hertz (Hz)

m = Belt mass per unit length (kg/m)

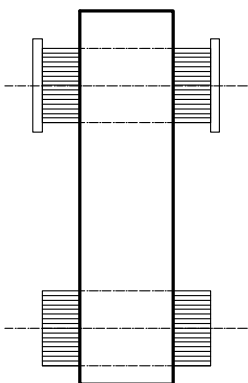
t = Free belt span length in meters (m)

BELT AND PULLEY ALIGNMENT

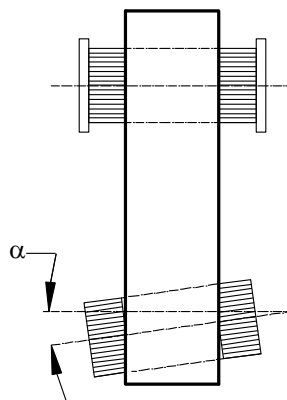
For a correct system functioning and to increase belt life, it is necessary a correct pulley installation: pulleys have to be parallel and aligned as shown in drawing 1 (correct configuration).

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

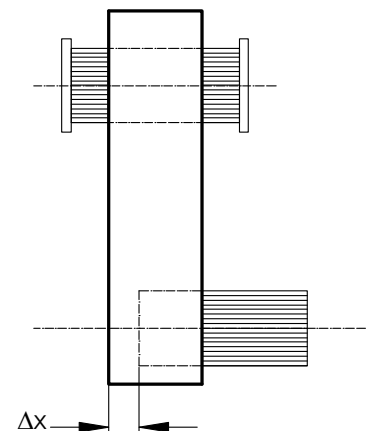
To grant a correct belt running α and Δx must be as smaller as possible. For more information, please contact our technical staff.



Drawing 1



Drawing 2



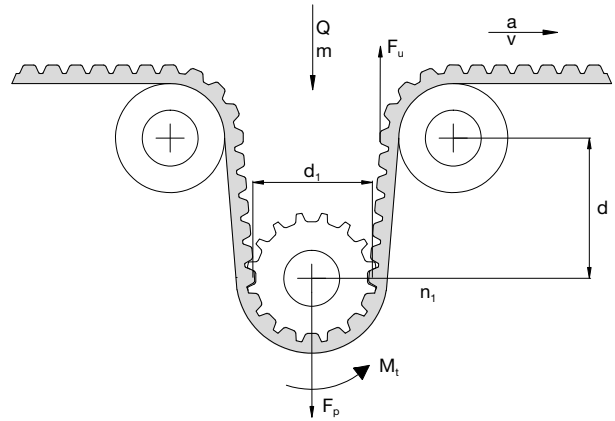
Drawing 3

BELT INSTALLATION AND FEASIBILITY TABLE

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:

$d = 4 \cdot \text{belt width}$

Suggested angle 120°



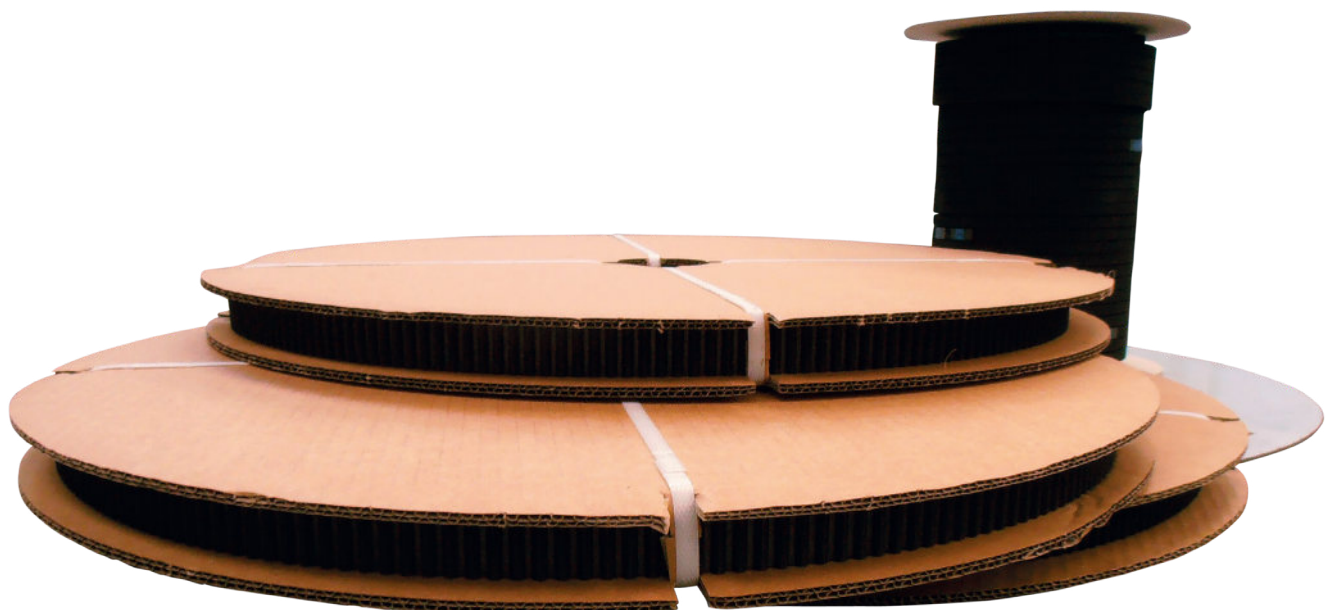
drawing 4

FEASIBILITY TABLE

MEGADYNE manufactures a wide range of Rubber Open End Belts. In the next table a general overview is shown of the today range of products and their main characteristics. For any special belt version which might not be included, please do not hesitate to contact our Application Department or check page “Special Execution Feasibility”. Please consider that special version might have different performance from what declared in belt data pages.

	Trapezoidal Profile				Parabolic Profile						Standard Profile
	MXL	XL	L	H	RPP 3M	RPP 5M	RPP 8M	RPP 14M	SILVER 5	SILVER 8	STD 8M
STANDARD	S	S	S	P	S	P	P	P	S	S	S

P = Ex stock (production process: Straight cut)
 S = Ex stock (production process: Spiral cut)



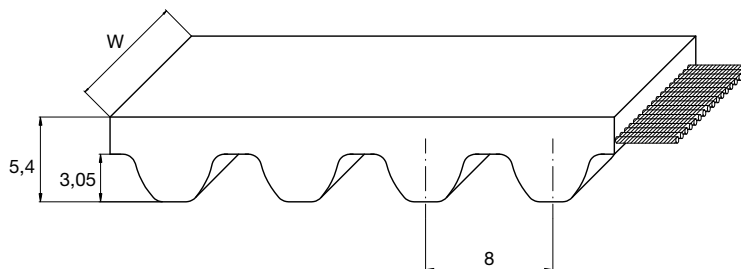
	Problems	Causes	Correction Action
Excessive Belt Wear	Unexpected wear along the complete tooth width.	Belt overload.	Use a wider belt. Use a belt of a higher performance class.
	Unexpected wear on one side of the tooth only.	Incorrect pulley execution. Incorrect pulley alignment.	Control pulley dimensions and replace if necessary. Control and adjust pulley alignment.
	Tooth bottom shows wear.	Excessive belt installation tension. Incorrect pulley execution.	Calculate and adjust the belt tension. Control pulley dimensions and replace if necessary.
	Tooth root shows signs of wear.	Incorrect diameter of pulley.	Control pulley dimensions and replace if necessary.
	The flanks of the belt show clear signs of wear.	Incorrect pulley execution.	Control pulley dimensions and replace if necessary.
		Misalignment or wrong setting of pulleys.	Control pulley dimensions and replace if necessary.
		Oscillation of the axes and/or of the bearings.	Correct the positioning of the pulleys and reinforce the bearings.
		Flanks bent.	Straighten flanks.
	Damaged belt tensile member.	Diameter of pulley is below specified minimum.	Increase the diameter of the pulleys or use belts and pulleys of smaller pitch.
		Excessive moisture.	Eliminate the moisture.
Torn tooth along the belt.	Belt overload.	Increase the number of teeth in mesh by using a bigger pulley. Use a belt of a higher performance class. Increase belt width.	
		Use a belt of a higher performance class or increase belt width.	
		Control pulley dimensions and replace if necessary.	
	Incorrect pulley execution.	Control pulley dimensions and replace if necessary.	
	Belt overload.	Use a belt of a higher performance class or increase belt width.	
Belt Damages	Rupture of tensile member.	Diameter of pulley is below specified minimum.	Increase the diameter of the pulleys
		Tooth jump due to missing belt installation tension.	Calculate and adjust the belt tension.
	Breaks or cracks in the back side of the belt.	Exposure to temperatures which are out of the admissible temperature range.	Protect the transmission by extreme temperatures.
		Diameter of pulley is below specified minimum.	Increase the diameter of the pulleys.
		Excessive exposure to UV radiation.	Reduce exposure to UV radiation.
	Softening of the top surface of the belt.	Operation with excessive amount of oil.	Protect the belt from oil.
	Apparent elongation of the belt.	Reduction of centre distance due to bearings not being firmly fixed.	Restore the initial centre distance and strengthen the bearings.
Drive Function Problems	Belt overriding the pulley flanks.	Faulty installation of the flanks.	Reinstall the flanks properly.
		Misalignment of pulleys.	Align pulleys.
	Excessive wear on the pulley teeth.	Excessive overloading.	Use a wider belt.
		Excessive belt installation tension.	Calculate and adjust the belt tension.
		Pulley material insufficient hard.	Harden the pulley surface.
	Drive excessively noisy.	Pulleys out of line.	Align pulleys.
		Excessive belt installation tension.	Calculate and adjust the belt tension.
Incorrect pulley execution.		Control pulley dimensions and replace if necessary.	

STD8 OPEN-END (SPIRAL CUT)

BELT CHARACTERISTICS

STANDARD WIDTHS (mm)	10	12	15	20	25
Weight (gr/m)	55	66	83	110	138
Standard roll length and tolerance (m)	50 ± 5	40 ± 5	45 ± 5	50 ± 5	50 ± 5

Standard compound: **Chloroprene 74 ± 4 ShA**
 Standard tooth cover: **nylon fabric**
 Standard cord: **glass**
 Standard width tolerance: **± 0,5 mm**
 Standard thickness tolerance: **± 0,40 mm**
 Standard length tolerance: **± 0,8 mm/m**

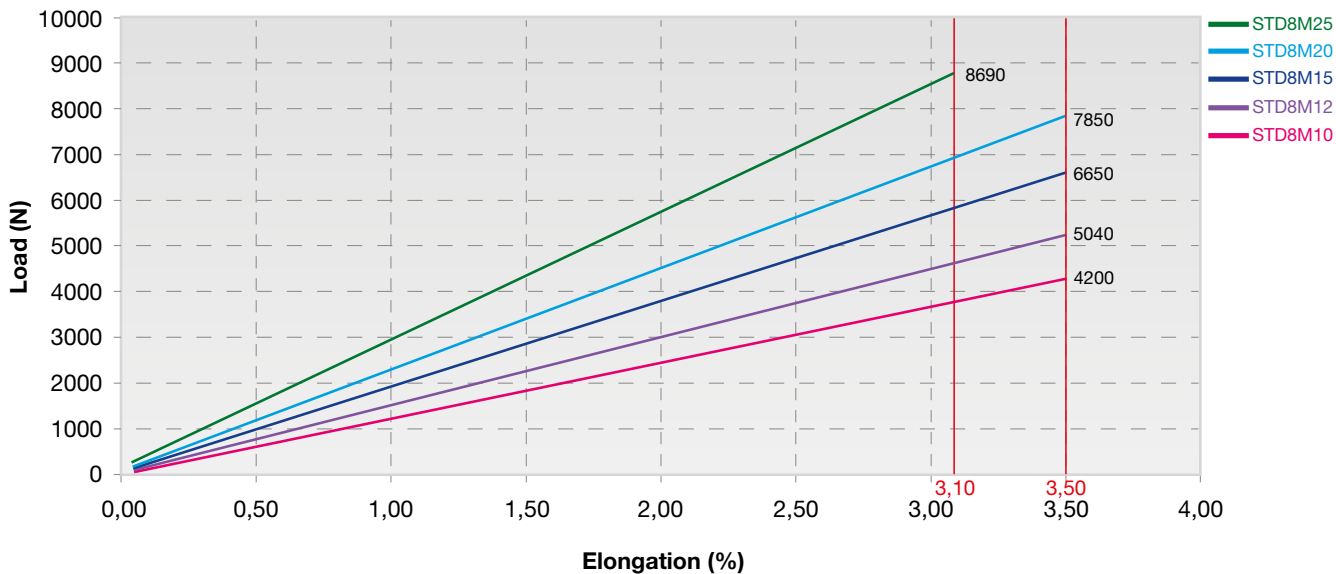


TRACTION RESISTANCE AND ELONGATION DATA

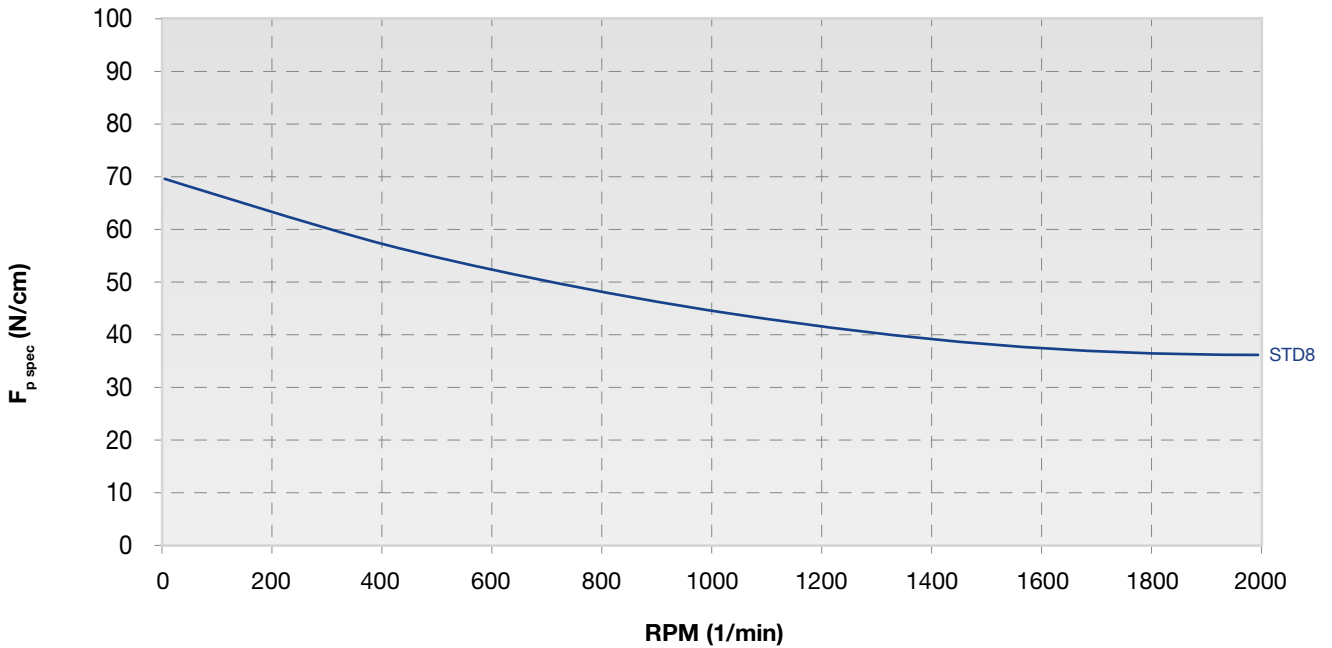
CALCULATION PARAMETERS

Belt Width (mm)	Breaking Strength (N)
10	4200
12	5040
15	6650
20	7850
25	8690

BELT ELONGATION



TOOTH RESISTANCE



RPM (1/min)	0	10	50	100	200	500	1000	1500	2000
F _{p spec} (N/cm)	70	69	65	63	61	54	44	38	36

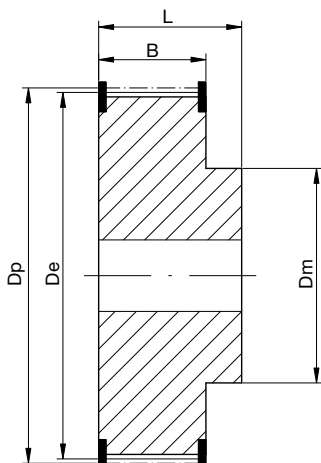
Meshing Check is very suggested because of the belt's elasticity. To safeguard the correct meshing it might be possible that Meshing Check leads to a wider belt.

FLEXION RESISTANCE



	Z _{min}	Z _{min}	Idler min dia (mm)
Glass cords	22	22	100

PULLEYS (for more details please see our pulleys catalogue)



N° of teeth	Dp	De	N° of teeth	Dp	De
22	56,02	54,62	48	122,23	120,83
24	61,12	59,72	56	142,60	141,23
26	66,21	64,81	64	162,97	160,57
28	71,30	69,90	72	183,35	181,95
30	76,39	74,99	80	203,72	202,32
32	81,49	80,09	90	229,18	227,78
34	86,58	85,18	112	285,21	283,81
36	91,67	90,27	144	366,69	365,29
38	96,77	95,37	168	427,81	426,41
40	101,86	100,46	192	488,92	487,52
44	112,05	110,65			

SPECIAL EXECUTION FEASIBILITY

Megadyne can make special execution on customer's request to improve belt properties and to better suit to special applications.

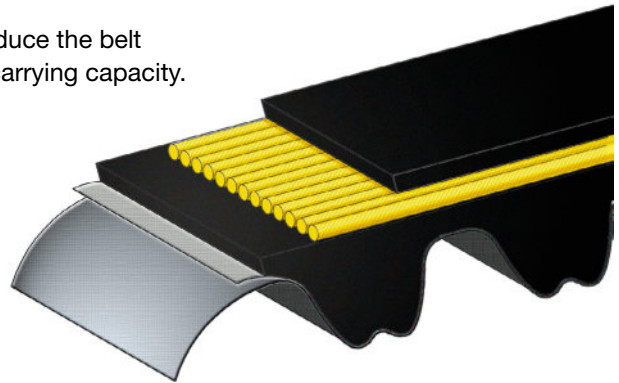
SUPER

On customer's request and with minimum quantity we can produce the belt with a double nylon fabric on teeth surface to improve torque carrying capacity.

The advantages are the following:

- Exceptional resistance to abrasion
- Low coefficient of friction
- Increased drive efficiency
- Increased belt and pulley life

From the table on this book, performances increase 10% by.



SPECIAL CONSTRUCTIONS

On customer's request and with minimum quantity we can produce GOLD5, GOLD8 and PLATINUM8 in open end version up to a width of 25 mm.

ANTISTATIC

On customer's request and with minimum quantity we can produce L, H, RPP5 and RPP8 belts in antistatic version (according to BS 2050). With minimum quantity Megadyne can also produce super-conductive belts overcoming BS 2050 parameters.

HIGH TEMPERATURE

On customer's request and with minimum quantity we can produce RPP8, STD8 and H belts suitable for temperatures up to 130°C.

SPECIAL BRANDING

On customer's request and with minimum quantity we can customize the belt's branding.

SPECIAL PACKAGING

On customer's request and with minimum quantity we can package the belts following some special indications.

SPECIAL WIDTH

On customer's request and with minimum quantity belts in special widths can be manufactured. For more information please check with our Application Department.

LOW NOISE

On customer's request and with minimum quantity we can produce soft compound belts (60 ± 3 ShA) to reduce noise problems. In this case the belt's performances will decrease by a 10% than a standard one.