

# *Engineering Guide*

*All Products*

BELT CODE	Bakery	Meat	Poultry	Seafood	Fruit & Vegetables	Snackfood	Beverages & Bottling	Can Manufacturing	Tire Manufacturing	Automotive	Corrugated Cardboard	Packaging	Printing & Paper	Material Handling	Textile	Postal
MP80 C	*	*	*	*							*					
MP80 FG	*	*	*	*							*					
MP80 NS	*	*	*	*							*					
MP80 NP	*	*	*	*							*					
MD127 GAP%50	*			*	*										*	
HC127 C		*	*		*	*										
EC127 C	*	*	*	*	*	*	*	*	*		*	*	*	*		
EC127 FG	*	*		*	*	*	*	*			*	*	*	*		
EC127 GT	*	*	*	*	*	*	*	*			*	*	*	*		
XP254 C	*	*	*	*	*	*	*	*	*	*	*	*	*	*		
XP254 PR%22		*		*	*	*									*	
XP254 FG			*	*	*	*		*							*	
XP254 FLT CR							*	*		*	*	*	*	*		*
XP254 CR							*			*	*		*	*		*
EC254 C		*	*		*	*										
EC254 PR%16					*											
EC254 NT		*	*		*											
MD254 C	*	*	*	*	*	*	*	*			*	*	*	*		
MD254 FG	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*
MD254 RR					*		*	*			*	*	*	*		
MD254 GT	*	*	*	*	*	*	*				*	*	*	*		
MD254 GAP%48	*			*	*										*	
MD508 C					*	*		*	*							*
MD508 FG					*	*										
MD508 PR%25					*	*										
EC508 C		*	*	*	*	*					*	*	*	*		
EC508 PR%22			*	*	*	*					*	*	*	*		
EC508 PR%11					*	*					*	*	*	*		
EC508 PR%13				*	*						*	*	*	*		
EC508 FG				*	*	*		*			*	*	*	*		
EC508 DT			*	*	*	*										
EC508 NT		*	*	*	*	*										
EC508 FG-NT		*	*	*	*	*										
HP508 C					*		*	*	*	*	*	*	*	*		
HP508 RR					*		*	*			*	*	*	*	*	
HP508 FG									*		*	*	*	*		
EC254 R	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
EC254T R (Tight Radius)	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

## BELT RAW MATERIAL / PINS RAW MATERIAL COMBINATION

	Applications	Belt Modules	Rods Pins
Standart	General Use Dry General Use Wet Chemical Resistance Low Temperature Low Temperature High Load Dry	PP PP PP PE POM POM	PP - POM - PA or PBT POM - PP or PBT PP or PBT PE - POM or PBT PE - POM or PBT PA or PBT
High Temperature	High Load Dry Wet 55 to 108 °C Temperature up to 180 °C	POM PPH (special) PA	PA or PBT PPH (Special) / Steel or PBT PA / Steel or PBT
Abrasive Conditions	Dry Wet up to 55 °C	POM PP	PA or PBT POM or PBT

STANDARD BELT MATERIALS WITH MODUTECH CODE				
Material	Description	Code	Food Approved	Temperature
Polypropylene	<ul style="list-style-type: none"> <li>- Standard material for the most common conveying applications .</li> <li>- Excellent chemical resistance.</li> </ul>	PP	FDA - EU	+5 to +80 °C
Polyethylene	<ul style="list-style-type: none"> <li>- Excellent chemical resistance .</li> <li>- Well suited for very low temperature with good impact resistance .</li> <li>- Not suitable for abrasive conditions.</li> </ul>	PE	FDA - EU	-70 to +60 °C
Polyacetal	<ul style="list-style-type: none"> <li>- Good strength and low coefficient of friction .</li> <li>- Not suitable for chemical environment.</li> <li>- Suitable for heavy duty applications.</li> </ul>	POM	FDA - EU	Dry Conditions -38 to +90 °C Wet Conditions -35 to +60 °C

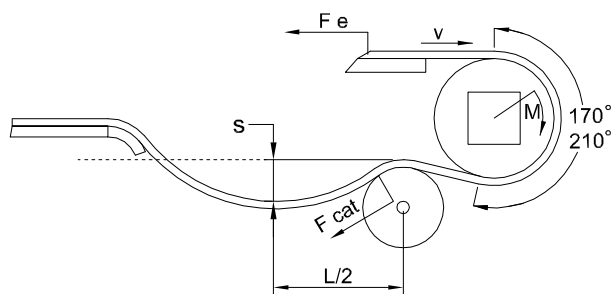
STANDARD BELT RAW MATERIALS WITH MODUTECH CODE				
Material	Description	Code	Food Approved	Temperature
Polyamide6	<ul style="list-style-type: none"> <li>- High strength and abrasion resistance.</li> <li>- Suitable for heavy duty applications.</li> <li>- Not suitable for wet conditions.</li> </ul>	PA6	FDA - EU	Dry Conditions -35 to +120 °C Wet Conditions Not Recommended
Polyamide6.6	<ul style="list-style-type: none"> <li>- Better strength and abrasion resistance.</li> <li>- Suitable for heavy duty applications.</li> <li>- Not suitable for wet conditions.</li> </ul>	PA6.6	FDA - EU	Dry Conditions -35 to +120 °C Wet Conditions Not Recommended
Antistatic Polyacetal	<ul style="list-style-type: none"> <li>- Reduced electrical surface to reduce belt charge up and dust accumulation.</li> <li>- Suitable for heavy duty applications and low temperature.</li> </ul>	POM	-	Dry Conditions -35 to +80 °C Wet Conditions Not Recommended
Detectable Polyacetal	<ul style="list-style-type: none"> <li>- Polyacetal with a special additive, which makes the material very well detectable for X-ray and metal detectors.</li> </ul>	POM	FDA - EU	Dry Conditions -38 to +90 °C
Detectable Polypropylene	<ul style="list-style-type: none"> <li>- Polypropylene with a special additive, which makes the material very well detectable for X-ray and metal detectors.</li> </ul>	PP	FDA - EU	+5 to +90 °C
Hot Water Resistant Polypropylene	<ul style="list-style-type: none"> <li>- Polypropylene with a special additive to improved temperature resistance.</li> <li>- Suitable for wet conditions.</li> </ul>	PPH	FDA - EU	+5 to +115 °C
Low Friction Acetal	<ul style="list-style-type: none"> <li>- Better strength and low coefficient of friction.</li> <li>- Not suitable for chemical environment.</li> <li>- Suitable for heavy duty applications.</li> </ul>	POM LF	FDA - EU	+5 to +108 °C
High Performance Acetal (PBT)	<ul style="list-style-type: none"> <li>- Extra wear resistance, strength and, low coefficient of friction.</li> <li>- Not suitable for chemical environment.</li> <li>- Suitable for heavy duty applications.</li> </ul>	POM HP	FDA - EU	-35 to +90 °C
Extra High Temperature (EHT)	<ul style="list-style-type: none"> <li>- Excellent heat resistance.</li> <li>- Suitable for light-medium duty applications at elevated temperatures.</li> </ul>	PA EHT	-	Dry Conditions +4 to +210 °C Wet Conditions No Request
Flame retardant Polypropylene	<ul style="list-style-type: none"> <li>- Flame retardant thermoplastic material for low-flammability.</li> <li>- High impacts below 10 °C must be avoided.</li> </ul>	PP FR	-	+5 to +105 °C
Electrically conductive Polyoxymethylene (Acetal)	<ul style="list-style-type: none"> <li>- Low electrical surface and volume resistance.</li> <li>- Electrical surface resistivity (ps) below 50'000 Ohm/sq.</li> <li>- High strength and low coefficient of friction.</li> <li>- Suitable for heavy duty applications and low temperatures.</li> </ul>	POM EC	-	Dry Conditions -40 to +93 °C Wet Conditions No Request
Impact and cut resistant Polyoxymethylene (Acetal)	<ul style="list-style-type: none"> <li>- Advanced impact and cut resistant surface.</li> <li>- Suitable for meat cutting conveyors and high impact applications.</li> <li>- Good chemical resistance to oil and alkalines, but not suitable for long-term contact with high concentration of acids and chlorine.</li> </ul>	POM ICR	FDA - EU	Dry Conditions -40 to +93 °C Wet Conditions -40 to +60 °C

By its construction, the modular belt length varies according to various factors such as tension, temperature and wear. It is therefore not possible to apply tension to the belt by stretching it between fixed shafts.

Belt tension on the drive sprocket is necessary to avoid the belt jumping on the sprocket itself. This tension is obtained by leaving a portion of belt suspended immediately after the sprocket. This belt portion forms a dip that in addition to providing the return tension ( $F_{cat}$ ) also allows the recovery of belt elongation between sections.

Values "L" and "S" determine the value of  $F_{cat}$ . Values of "S" too small or "L" too large lead to excessive belt tension.

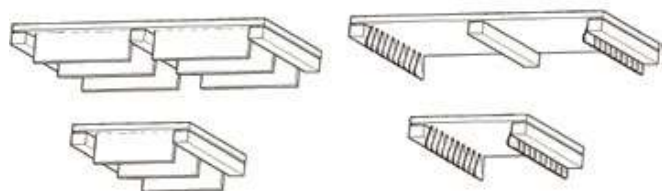
The belt weight and the geometry of the dip determine  $F_{cat}$ . It is also important to ensure that the wrapping angle of the belt on the sprocket is between  $170^\circ$  and  $210^\circ$ .



For a correct belt tension that optimizes the belt wear and tear it is important to verify that the "L" and "S" dimensions are in the following range. The return path of the belt may be supported in different ways or not supported, depending on the belt length.

S Range Suggested Values (mm)					
L (m)	Belt Weight (Kg/m <sup>2</sup> )				
-	4	8	10	12	14
0,9	20-40	25-60	30-70	40-90	50-100
1,1	25-50	40-90	50-100	60-120	70-130
1,3	30-70	50-100	60-120	70-150	80-160

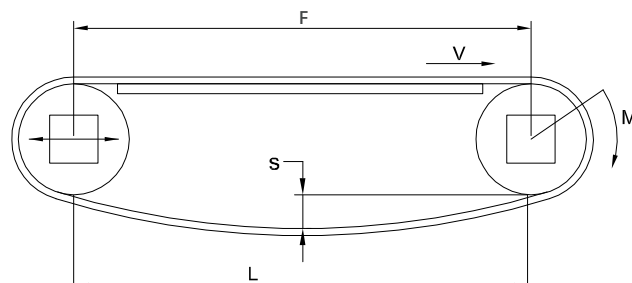
If the belt has guides, it may be necessary to have an indent for the guides in the return path (if it is needed:  $F$  over 2 m). In case of particularly wide strips, it is appropriate to provide the interruption of the flights also in the central part to allow the belt suspension with a further guide.



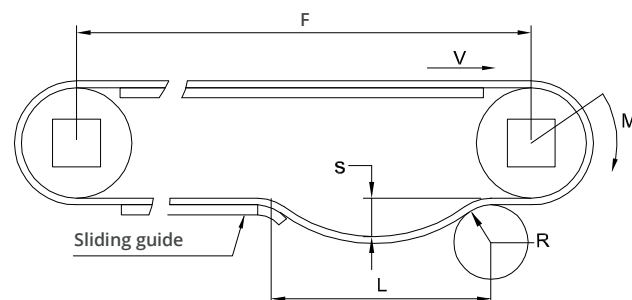
"R" minimum in (mm)	127 Series	254 Series	508 Series
Max. belt width not supported	800	1000	1000

## Horizontal Conveyors

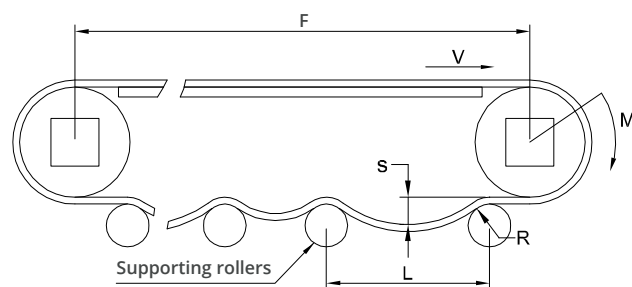
Case of maximum center distance  $F$  2 meters.



Case of center distance  $F$  between 2 - 4 meters.



Case of center distance  $F$  over 4 meters (if over 20 meters it is suggested a gravity tensioner device after the drive shaft since the belt length variation can be too large to guarantee a correct dip amount).



"R" minimum in (mm)		
Belt Series	Belt with flights	Belt without flights
127 Series	25	120
254 Series	25	150
508 Series	50	200

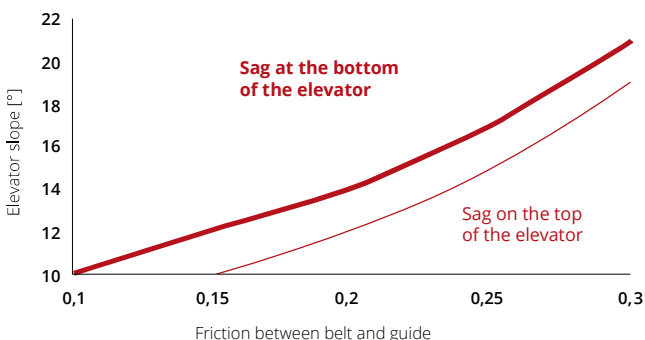
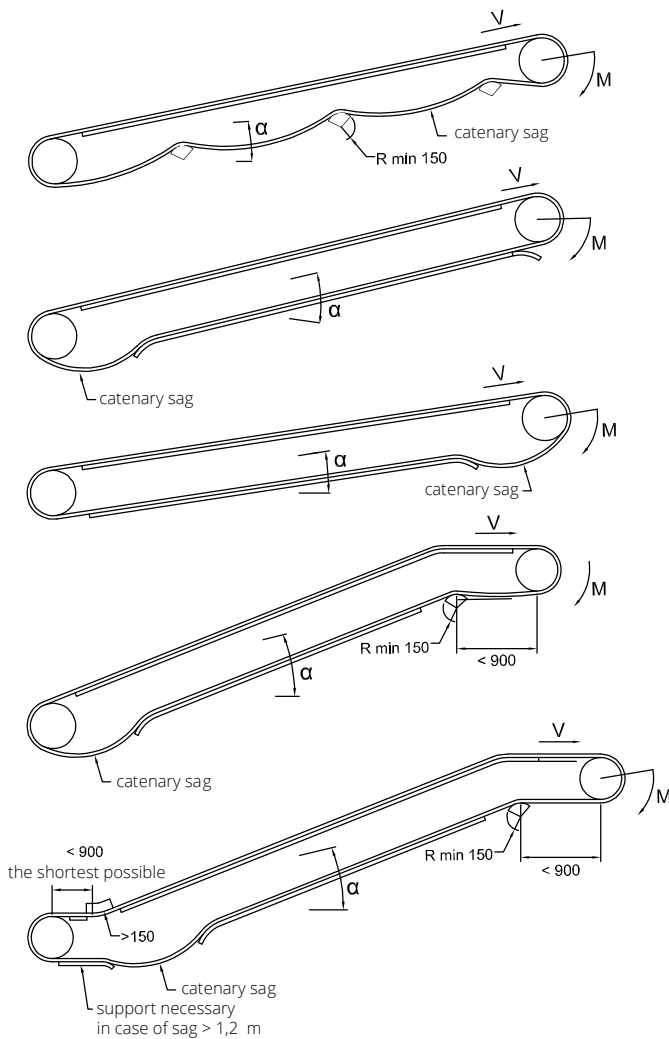
(\*)  $900 < L < 1200$  mm

It is recommended that the distances between the supporting rollers vary between  $L_{max}$  and  $L_{min}$ .

**Escalators**

For all escalator configurations, the guiding principles are still valid, it is necessary to ensure a minimum tension on the return stroke, a dip sufficient for the belt length variation and able to support the belt on the return stroke.

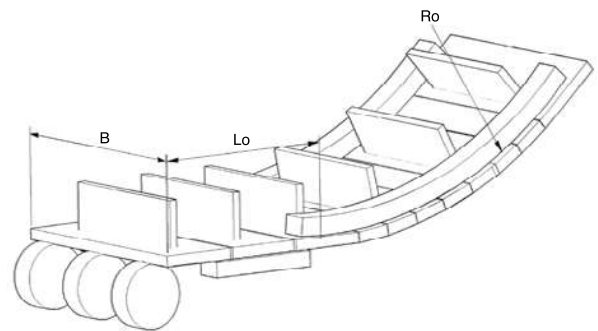
The position of the dip in most cases should be placed at the base of the escalator, but if the friction of the belt is such that it does not allow it to slide on the return path, the dip will be at the top immediately after the drive shaft.



Frequently, belts with guides are used for escalators. In this case, as with horizontal conveyors, the belt edges must allow space for the guides, and if the width exceeds the width limit values, a central support should also be provided.

In case the belt does have sidewalls, the minimum back bending diameters must be checked. In the case of lifting with back bending closed to the driven shaft, the horizontal section has to be as short as possible.

Additionally, since it is not possible to support the belt in the area of the guide, it is suggested to limit the belt width as shown in the following table:



Series	127 Series				254 Series			
Load	<50%		>50%		<50%		>50%	
Length Lo [mm]	<800	800 - 2000	<800	800 - 2000	<800	800 - 2000	<800	800 - 2000
Width B max [mm]								
Slope <45°	1500	1200	1000	800	1200	1000	800	600
Slope >45°	1050	NR	700	NR	850	NR	550	NR

Ro = minimum radius = 150 mm  
NR = Not Recommended

Series	508 Series			
Load	<50%		>50%	
Length Lo [mm]	<800	800 - 2000	<800	800 - 2000
Width B max [mm]				
Slope <45°	700	550	500	400
Slope >45°	500	NR	300	NR

Ro = minimum radius = 150 mm  
NR = Not Recommended

# Horizontal conveyors

• **Common drive configuration**

Slider support on return way, or rollers alternatively. For proper sprocket engagement maintain approx. 180° arc of contact.

• **Uni-directional drive**

One motor (M) at conveyor end, pull action (driving sprockets are pulling the belt). Catenary sag (CA) only required on drive end.

• **Lower head drive**

For tight transfer with nosebar or with small idling rollers the motor with the drive shaft can be arranged as illustrated.

• **Bi-directional drive**

Two motors (M), one at each conveyor end. Only one motor is pulling, the other motor remains disengaged (clutch). Catenary sag (CA) at both conveyor ends.

• **Bi-directional center drive**

Only one motor (M) placed in the middle of the belt return. This system works well for bi-directional conveyors. In case of high loads a gravity take-up may be necessary for positive sprocket engagement. Optional solutions: pneumatic or spring-loaded tensioning device. Solutions: pneumatic or spring-loaded tensioning device. Center drives are not recommended for radius applications.

Since the driving force is applied on the return way of the belt, the shaft load will be two times the calculated belt pull:

$$F_w = 2 \cdot F'_e$$

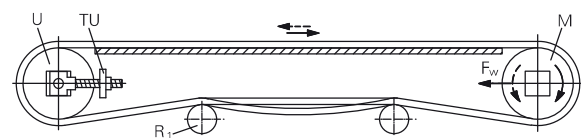
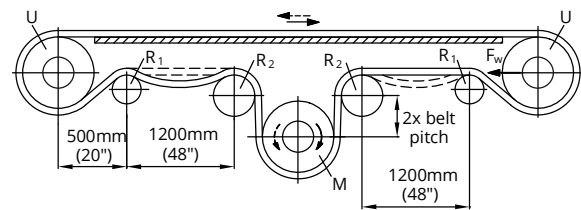
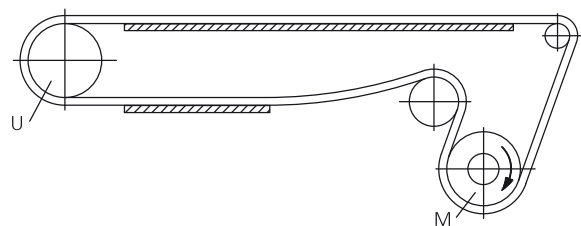
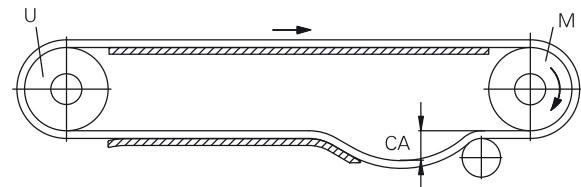
Bi-directional conveyor and pusher drive (push/pull action) It is possible to apply one head drive motor for bi-directional reversible driving.

For reverse driving (push action = pusher drive), a screw type take-up (TU), or a spring or a pneumatic tensioning device with 110% pretension of the expected belt load is recommended. The shaft load will increase to:

$$F_w = 2.2 \cdot F'_e$$

In case of a bi-directional pusher drive with tensioning device, the shaft load can increase to:

$$F_w = 3.2 \cdot F'_e$$



CONVEYOR LENGTH - MAXIMUM SPEED

Conveyor Length	Max. Speed
up to 15 m (45 ft)	50 m/min (150 ft/min)
15 m - 25 m (45 - 75 ft)	30 m/min (90 ft/min)
over 25 m (75 ft)	15 m/min (45 ft/min)

# Belt Guiding

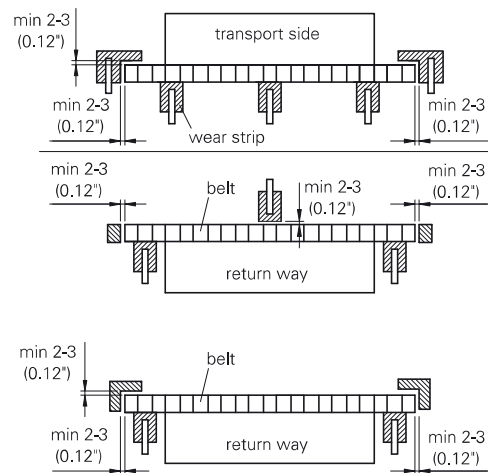
**• Belt guides and hold-down tabs**

Radius belts running around curves are radially pressed against the inner guide rail of the curve. Since the conveyors usually cannot be built at very high geometrical accuracy, the belt may tend to flip over at high loads or angles > 90°. At the inner edge the belt may move upwards while it is radially pressed against the guide rail and slip off.

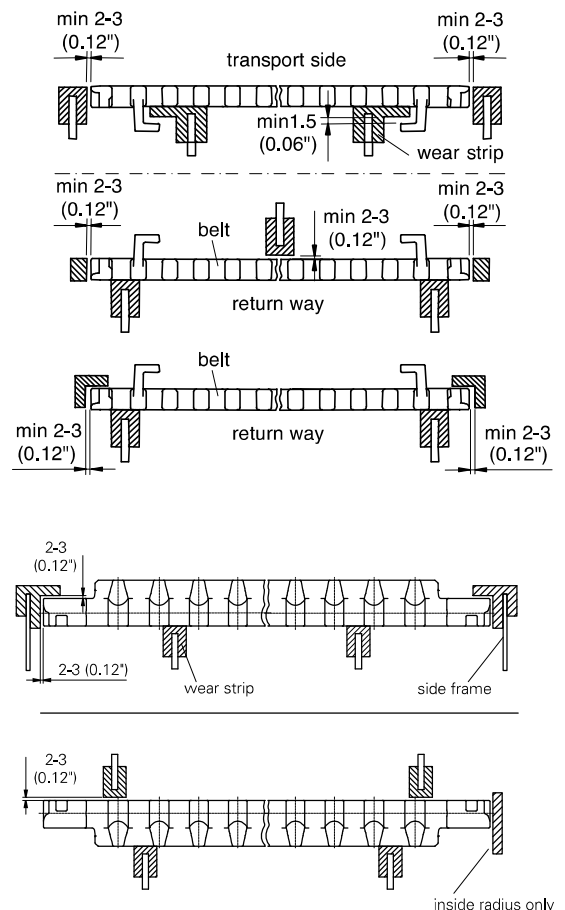
For this reason hold-down edge guides must be used for the in- and outside guide of a curve. If the product is larger than the belt width or if side transfer over the belt edge is required, hold-down modules or side tabs are used instead of hold-down guides.

**• Standard application (hold-down edge guides)**

If no side transfer is required, L-shaped hold-down edge guides can be used. Respect the min. gap between belt and guides. For safety reasons (danger of injuries at end of profile) it is advisable to apply this profile uninterrupted over the complete belt length. The material used for edge guides needs to be low friction in contact with the particular belt material. Generally, UHMW PE is recommended. On the return way, hold-down tabs are needed as well. An economic solution is shown on the illustration beside. For belts wider 600 mm hold-down edge guides or 2 hold-down tabs near the edges should be used.



Hold-down guides for belt with flights. Belts without flights follow the same design.



**• Belts for product side transfer**

Belts with hold-down tabs, side tabs or raised deck can be used for all application where products must be moved transversally across the belt edge (side transfer) and in case where the product is wider than the belt itself.

For application with side guards belts with hold-down tabs are conditionally possible and belts with side tabs or raised deck are not applicable.

**• Note**

The hold-down or side tabs should not be used for radial guidance or to support (guide) the belt on its return way. They can be worn away too quickly.

**• High speed applications**

For speeds > 40 m/min it is recommended to use prelubricated materials or stainless steel for radius guides. To keep the temperature low, prefer guide material with best possible heat conduction properties (e. g. PA prelubricated or stainless steel).

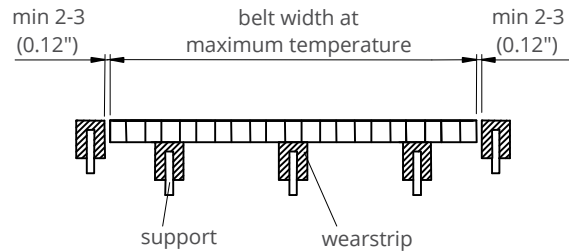
**• Tensioner**

On Z-conveyors catenary sags may not be accepted, neither on the upper nor on the lower horizontal belt section. This may be due to lack of space under the bottom conveyor end or too short horizontal sections. It must be strongly recommended to use a self-adjusting tensioner device.

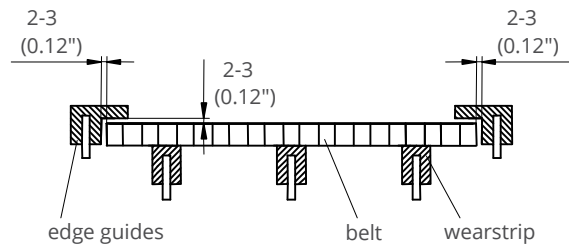
This can be a soft spring type, gas loaded spring or pneumatic tensioner type.

The optimal layout of the spring or pneumatic cylinder is depending on the belt type, conveyor width and temperature conditions. The minimum free movement of the tensioner must be min. 20% more than the calculated belt elongation between lowest and highest process temperature. The belt elongation due to abrasion should also be considered.

For straight running belts:

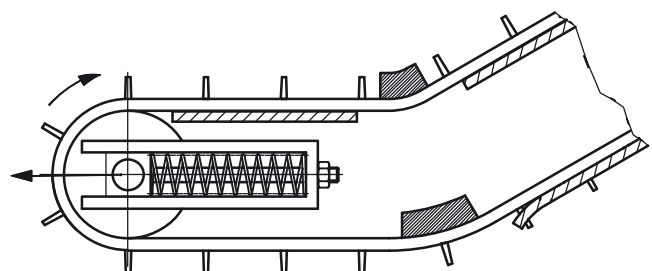


For radius belts:

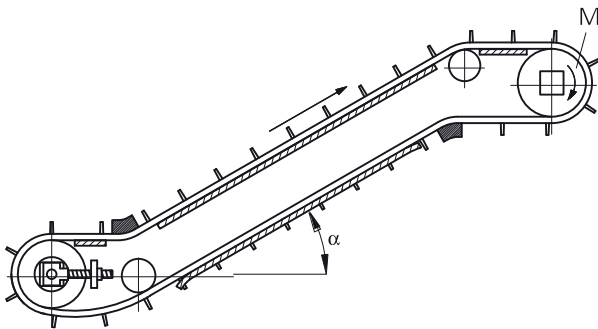
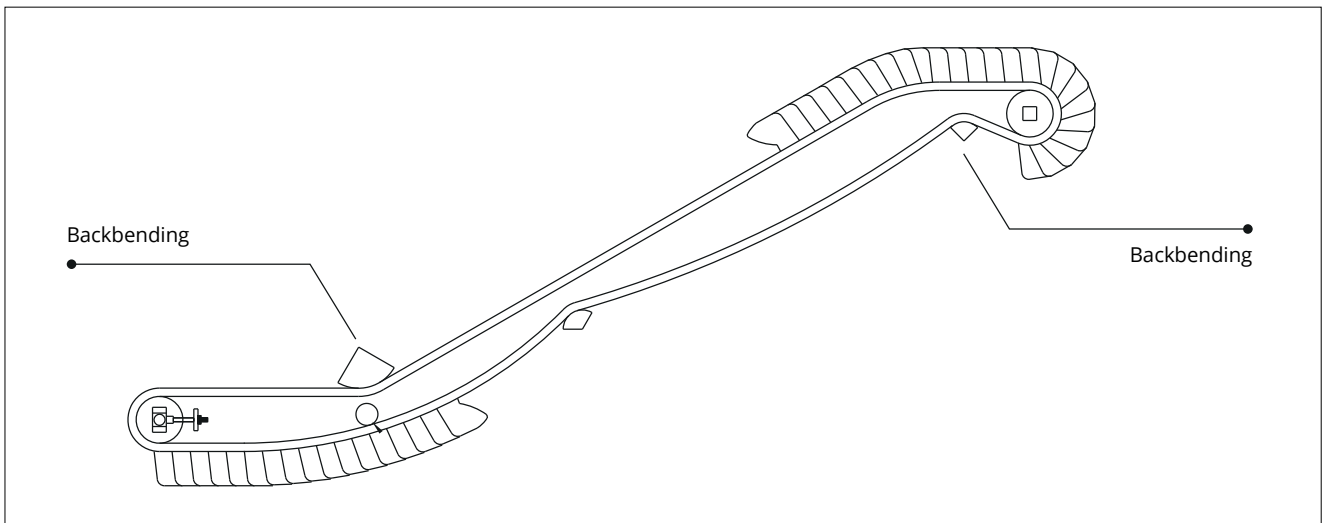


The force should be as low as possible, but high enough to overcome eventual friction forces of the belt on its return way, to straighten it and to engage the sprockets safely. As a general rule the following tensioner force is proposed:

Belt type	Tensioner force per m(ft) of belt width
127 Series	15 kg / 10 lb
245 Series	15 kg / 10 lb
508 Series	30 kg / 20 lb







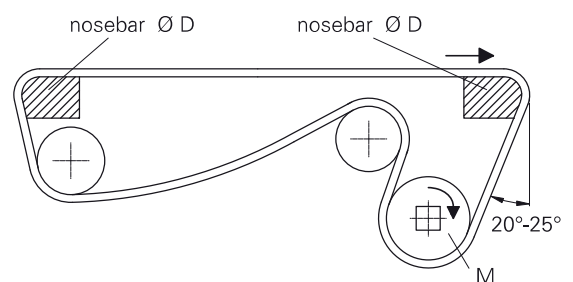
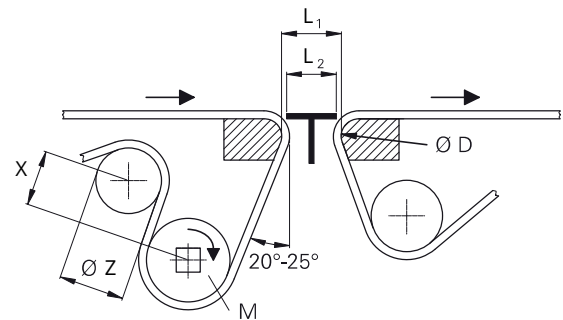
Belt Series	Nosebar Diameter		Minimum backbending roller diameter		Backbending radius for elevators Z-conveyor without sidewalls		Backbending radius for elevators Z-conveyor with sidewalls	
	mm	inch	mm	inch	mm	inch	mm	inch
MP80	6,0	0.28	50,0	2.0	-	-	-	-
MD127	18,0	0.7	75,0	3.0	-	-	-	-
HC127	18,0	0.7	75,0	3.0	-	-	-	-
EC127	18,0	0.7	75,0	3.0	150,0	6.0	-	-
EC254	-	-	100,0	4.0	150,0	6.0	250,0	10.0
XP254	-	-	100,0	4.0	150,0	6.0	250,0	10.0
MD254	-	-	100,0	4.0	150,0	6.0	250,0	10.0
EC508	-	-	150,0	6.0	200,0	8.0	250,0	10.0
HP508	-	-	150,0	6.0	200,0	8.0	250,0	10.0
MD508	-	-	150,0	6.0	200,0	8.0	250,0	10.0

**Tight transfer**

For 127 Series "pitch," sliding bars" can be used to minimize space between two belts or between belt and table. The sliding bar can be placed on one or both ends of the belt.

The back bending roller should be larger than the regular roller support.

In this case, it is also important to ensure the presence of the dip and the contact arc on the sprockets.



Series	MP80 Series		HC127 & MD127 Series		EC127 Series	
	mm	inch	mm	inch	mm	inch
Minimal backbending roller diameter Z	50,0	2.0	75,0	3.0	75,0	3.0
Minimal straight belt section X between drive and snub roller	50,0	2.0	50,0	2.0	50,0	2.0
Distance L1 between nosebars	16,0	0.6	22,0	0.9	30,0	1.2
Distance L2 Max. width of transport plate	-	-	16,0	0.6	25,0	1.0
Recommended nosebar diameter D	6,0	0.24	12,7	0.5	18,0	0.7
Minimal nosebar diameter D min	6,0	0.24	12,7	0.5	16,0	0.6

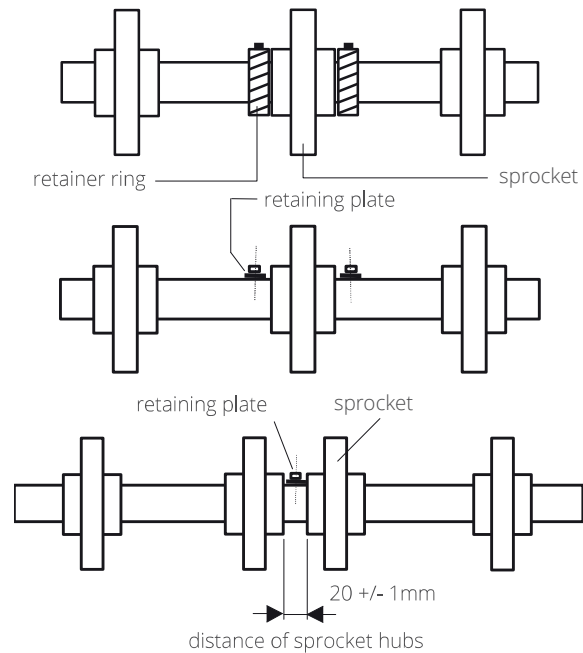
**General Sprocket Installation**

To allow the belt to expand/contract only the central sprocket on each shaft is fixed. For shafts with 2 sprockets, the sprockets on the drive shaft is fixed.

Different locking methods are possible:

- **Set the collars and screws**  
Commonly used in round shafts with keyways
- **Retainer Rings**  
Commonly used in square shafts
- **Retaining Plate**  
Low cost method for square shafts

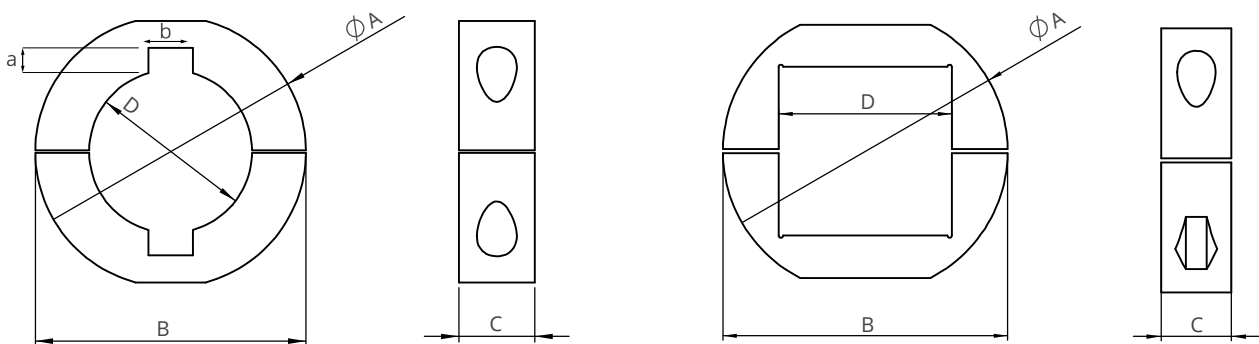
There should be 0.3 mm / 0.01 inch between sprocket and retainer ring. Please be sure all the retainer rings securely fastened.



Metric		Keyway Table									
ØD	mm	20,0	25,0	30,0	35,0	40,0	50,0	60,0	70,0	80,0	90,0
a	mm	2,80	3,30	3,30	3,30	3,30	3,80	4,40	4,90	5,40	5,40
b	mm	6,0	8,0	8,0	10,0	12,0	14,0	18,0	20,0	22,0	25,0

Imperial		Keyway Table									
ØD	inch	0.75	1.0	1.25	1.50	2.0	2.50	2.75	3.25	3.50	4.50
a	inch	0.098	0.130	0.130	0.193	0.256	0.319	0.319	0.370	0.429	0.488
b	inch	0.17	0.25	0.25	0.375	0.5	0.625	0.625	0.75	0.875	1.0



Round Bore Clamp Dimensions			
D	A (mm)	B (mm)	C (mm)
SR20	39,0	39,0	14,0
SR25	44,0	44,0	14,0
SR25,4	44,0	44,0	14,0
SR30	50,0	50,0	14,0
SR31,75	50,0	50,0	14,0

Square Bore Clamp Dimensions			
D	A (mm)	B (mm)	C (mm)
SQ25	51,0	51,0	14,0
SQ25,4	51,0	51,0	14,0
SQ38,1	67,5	67,5	16,0
SQ40	67,5	67,5	16,0
SQ60	100,5	100,5	16,0
SQ63,5	100,5	100,5	16,0

# Effective Tensile Force

• **Horizontal straight belt without accumulation**

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

• **Horizontal straight belt with accumulation, simplified**

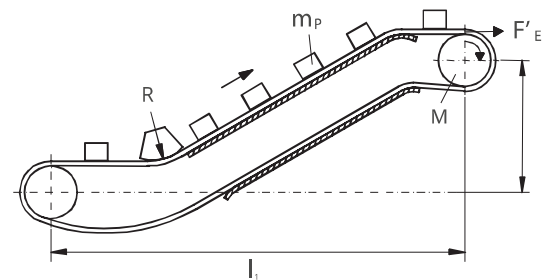
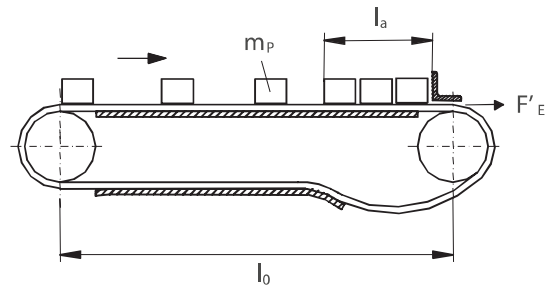
$$F'_E = [(2 m_B + m_P) l_0 \cdot \mu_G + m_P \cdot \mu_P \cdot l_a] g \text{ [N/m]}$$

• **Inclined conveyor without accumulation**

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

• **Inclined conveyor with accumulation, simplified**

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



Further analyses of tensile forces caused by accumulated products above equations with accumulation are based on the simplification that the product load per m<sup>2</sup> of belt is the same over the accumulation length as when moving with the conveyor. This is generally not the case. In reality the density of the product distribution over the accumulation length  $l_a$  will be higher (can be double or 3 times). Since this value will often not be known it is common practice to use the same product load value for product load value for conveying. In this case the above formulas are used. The calculated force is somewhat too low, but normally not critical for straight belts. If the accumulated product load per m<sup>2</sup> is known, and for more accurate calculation, it is proposed to replace  $m_p$  in the term  $m_p \cdot \mu_p \cdot l_p$  by  $m_{pa}$

The following formulas result:

• **Horizontal straight belt with accumulation**

$$F'_E = [(2 m_B + m_P) l_0 \cdot \mu_G + m_{pa} \cdot \mu_P \cdot l_a] g \text{ [N/m]}$$

• **Inclined conveyor with accumulation**

$$F'_E = [(2 m_B + m_P) l_1 \cdot \mu_G + m_{pa} \cdot \mu_P \cdot l_a + m_P \cdot h_0] g \text{ [N/m]}$$

- $F'_E$  = Effective tensile force [N/m]
- $m_B$  = Weight of belt [kg/m<sup>2</sup>]
- $m_P$  = Weight of conveyed product [kg/m<sup>2</sup>]
- $m_{pa}$  = Weight of accumulated product [kg/m<sup>2</sup>]
- $\mu_G$  = Coefficient of friction belt to slider support
- $\mu_P$  = Coefficient of friction belt to product
- $l_0$  = Conveying length [m]
- $l_a$  = Length of accumulation [m]
- $h_0$  = Height of elevation [m]
- $g$  = Acceleration factor due to gravity (9.81 m/s<sup>2</sup>)

# Effective Tensile Force

• **Radius belts**

Radius belts have higher friction losses than straight belts due to the radial forces directed to the inside of the curve. It also has to be taken into account, that in the belt curves the tensile forces are not distributed over the edge.

For calculation of radius belts please ask your Modutech@ representative.

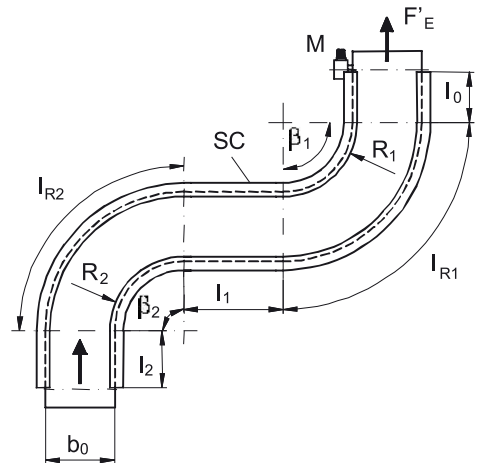
• **Note**

Due to the concentration of the belt pull (tensile forces) on the outer belt edge at curve end, the applicable number of curves is very limited. In practice 1 to 2 curves are often used. For long radius belts it is advisable to place the curve as near to the idling shaft as possible. This way the belt pull at the outer curve edge is minimized.

• **Nominal strength for radius belts in curve**

The nominal strength for radius belts in curve increases with wider belts (bigger radius). Due to the smaller angle between the modules the forces are distributed on more links. In case of high loads the application of steel rods may be advisable to increase the belt stiffness. Please contact your Modutech@ representative for detailed information.

Appropriate quality of the conveyor especially smooth and low coefficient of friction inside wear strips and smooth start-up are important. Belt at return way must be properly held down by wear strips or hold-down tabs .



$F_{SR}$  = Absolute tensile force [N]  
 $F'_E$  = Effective tensile force [N/m]  
 $b_0$  = Belt width [m]  
 $c_s$  = Service factor

FRICTION FACTORS									
Friction Factors	Friction between wearstrip and belt material				Friction between product and belt product material (used in backup conditions)				
Belt Material	UHMW WET (DRY)	HDPE WET (DRY)	NYLATRON WET (DRY)	STEEL (CS & SS) WET (DRY)	GLASS WET (DRY)	STEEL WET (DRY)	PLASTIC WET (DRY)	CARDBOARD WET (DRY)	ALUMINUM WET (DRY)
Polypropylene (S)	0.11 (0.13)	0.09 (0.11)	0.24 (0.25)	0.24 (0.25)	0.18 (0.19)	0.26 (0.32)	0.11 (0.17)	— (0.21)	0.40 (0.40)
Polypropylene (A)	NR	NR	0.29 (0.30)	0.29 (0.30)	0.18 (0.19)	0.26 (0.32)	0.11 (0.17)	— (0.21)	0.40 (0.40)
Polyethylene (S)	0.24 (0.32)	NR	0.14 (0.13)	0.14 (0.13)	0.08 (0.09)	0.10 (0.13)	0.08 (0.08)	— (0.15)	0.20 (0.24)
Acetal (S)	0.10 (0.10)	0.09 (0.08)	0.13 (0.15)	0.13 (0.15)	0.13 (0.14)	0.13 (0.13)	0.13 (0.16)	— (0.18)	0.33 (0.27)
EC Acetal (S)	0.10 (0.10)	0.09 (0.08)	0.13 (0.15)	0.13 (0.15)	0.13 (0.14)	0.19 (0.20)	0.13 (0.16)	— (0.18)	0.33 (0.27)
UV Resistant PP	0.11 (0.13)	0.09 (0.11)	0.24 (0.25)	0.24 (0.25)	0.18 (0.19)	0.26 (0.32)	0.11 (0.17)	— (0.21)	0.40 (0.40)

(S) = Smooth, Clean Conditions. (A) = Abrasive, Dirty Conditions. NR = Not Recommended.

a. Friction factor values are highly dependent on environmental conditions. The low value of the friction factor range is an experimentally derived friction factor for new belting on new wearstrip. This value should only be used in the cleanest environments or where water or other lubricating agents are present. Most applications should be adjusted based on the environmental conditions surrounding the conveyor.

b. Friction Factors for friction between product and belt only apply for Flat Top (Closed), Perforated Flat Top, Nub Top, Flush Grid and Raised Rib belts.

c. Polyethylene is not recommended for container handling.

Opening condition Note: Drive with soft start is recommended and is mandatory for frequent start/stops and start-up with full load.	SERVICE FACTORS						
	Standard straight belts				Micropitch with nosebar (**)		Radius belt curves with 90° (*)
	Standard head drive	Lower head drive	Pusher drive (uni- and bi-directional)	Center drive (uni- and bi-directional)	Head Side	Both ends	Standard head drive and lower head drive
Start-up prior to loading	1	1.1	1.4	1.2	1.6	2	1.6 (*)
Frequent start/stops during process (more than once per hour)	+ 0.2	+ 0.2	+ 0.2	+ 0.2	+ 0.2	+ 0.2	+ 0.2
Z-conveyors inclination <20° hold-down shoes only hold-down tabs	+ 0.2 + 0.3	+ 0.2 + 0.3	+ 0.2 + 0.3	+ 0.2 + 0.3	+ 0.2 + 0.3	+ 0.2 + 0.3	+ 0.2 + 0.3
inclination 20°-60° hold-down shoes only hold-down tabs	+ 0.4 + 0.6	+ 0.4 + 0.6	+ 0.4 + 0.6	+ 0.4 + 0.6	+ 0.4 + 0.6	+ 0.4 + 0.6	+ 0.4 + 0.6
inclination 60°-70° hold-down shoes only hold-down tabs	+ 1.1 + 1.4	+ 1.1 + 1.4	+ 1.1 + 1.4	+ 1.1 + 1.4	+ 1.1 + 1.4	+ 1.1 + 1.4	+ 1.1 + 1.4
inclination 70°-90° hold-down shoes only hold-down tabs	+ 1.8 + 2.2	+ 1.8 + 2.2	+ 1.8 + 2.2	+ 1.8 + 2.2	+ 1.8 + 2.2	+ 1.8 + 2.2	+ 1.8 + 2.2
Speed greater 30 m/min					+ 0.2	+ 0.2	+ 0.2

(\*) The radius belt service factor depends on the angle of the curve.

(\*\*) Z-conveyors with nosebar are not recommended.

# Chemical Resistance

Factors like temperature, concentration of the driving forces, duration and mechanical load are important criteria for the examinations of chemical resistance. In the following table, you can see the materials resistance to different chemicals.\*

-  Limited Resistance
-  Resistant
-  Not Resistance

\*Resistance also dependent upon concentration, time, and temperature

AGENTS, CONCENTRATION: WEIGHT-%

MATERIAL	ABS	Acetal (copolymer)	Acetal (homopolymer)	Polyphenylene Ether	Nylon 6	PBT	PEEK	PET	Polycarbonate	Polyethylene	Polypropylene (homopolymere)	PPS	PPSU	PSU (polysulfone)	PTFE	PVDF
Acetamide 50%	Resistant		Limited Resistance		Resistant										Resistant	Resistant
Acetic acid, aqueous solution 5%	Resistant	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Acetic acid, aqueous solution 10%	Resistant	Resistant	Limited Resistance	Resistant	Not Resistance	Limited Resistance	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Acetic acid, concentrated	Not Resistance	Limited Resistance	Not Resistance	Resistant	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Acetone	Not Resistance	Resistant	Resistant	Not Resistance	Limited Resistance	Not Resistance	Resistant	Not Resistance	Not Resistance	Limited Resistance	Resistant	Resistant	Not Resistance	Not Resistance	Resistant	Limited Resistance
Ammonia solution 10%	Resistant	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Not Resistance	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Resistant	Resistant
Anone			Resistant	Resistant	Resistant				Not Resistance	Limited Resistance	Resistant				Resistant	Limited Resistance
Benzene	Not Resistance	Resistant	Resistant	Not Resistance	Resistant	Limited Resistance		Limited Resistance	Not Resistance	Limited Resistance	Limited Resistance	Limited Resistance	Limited Resistance	Not Resistance	Resistant	Resistant
Benzine	Limited Resistance	Resistant	Resistant	Not Resistance	Resistant	Resistant	Resistant	Resistant	Not Resistance	Limited Resistance	Limited Resistance	Limited Resistance	Limited Resistance	Resistant	Resistant	Resistant
Bitumen			Resistant		Limited Resistance				Not Resistance	Limited Resistance	Limited Resistance				Resistant	Resistant
Boric acid, aqueous solution 10%	Resistant	Not Resistance	Resistant		Resistant		Resistant		Resistant	Resistant	Resistant				Resistant	Resistant
Butyl acetate	Not Resistance	Resistant	Resistant		Resistant			Resistant	Not Resistance	Limited Resistance	Limited Resistance			Limited Resistance	Resistant	Resistant
Calcium chloride, solution 10%		Limited Resistance	Resistant		Resistant				Resistant	Resistant	Resistant				Resistant	Resistant
Carbon trachloride	Not Resistance	Resistant	Limited Resistance	Not Resistance	Resistant			Resistant	Not Resistance	Not Resistance	Not Resistance			Limited Resistance	Resistant	Resistant
Chlorobenzene	Not Resistance	Resistant	Resistant		Resistant	Not Resistance		Not Resistance	Not Resistance	Not Resistance	Not Resistance	Limited Resistance			Resistant	Resistant
Chloroform	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Not Resistance		Not Resistance	Not Resistance	Not Resistance	Limited Resistance	Limited Resistance		Not Resistance	Resistant	Resistant
Citric acid, aqueous solution 10%	Resistant	Limited Resistance	Not Resistance	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant			Resistant	Resistant	Resistant
Clophene A60, 50%		Resistant	Limited Resistance		Resistant			Resistant	Resistant	Resistant	Resistant				Resistant	Resistant
Cupric sulphate 10%	Resistant	Resistant	Not Resistance		Resistant		Resistant		Resistant	Resistant	Resistant				Resistant	Resistant
Cyclohexane	Resistant	Resistant	Resistant		Resistant				Not Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Cyclohexanone	Not Resistance	Resistant	Resistant		Resistant				Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance
Decalin	Not Resistance	Resistant	Resistant		Resistant				Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Diesel Oil	Resistant	Resistant	Resistant		Resistant	Resistant		Resistant	Limited Resistance	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant
Dimethyl formamide	Not Resistance	Resistant	Not Resistance		Resistant				Not Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Diocetyl phthalate		Resistant	Resistant		Resistant				Limited Resistance	Resistant	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant

 Limited Resistance

 Resistant

 Not Resistance

\*Resistance also dependent upon concentration, time, and temperature

AGENTS, CONCENTRATION: WEIGHT-%

MATERIAL	ABS	Acetal (copolymer)	Acetal (homopolymer)	Polyphenylene Ether	Nylon 6	PBT	PEEK	PET	Polycarbonate	Polyethylene	Polypropylene (homopolymer)	PPS	PPSU	PSU (polysulfone)	PTFE	PVDF
Dioxane		○	□	○	□	○		○	▲	○	□	□			□	□
Edible fats, Edible oils		□	□	□	□				□	□	□	□			□	□
Ethanol 96%	□	□	□	□	□	□	□	□	○	□	□	□	□	□	□	□
Ethyl acetate		○	□	□	□	○		○	▲	□	□			▲	□	□
Ethyl ether		□	□		□	□		□	▲	□	□		□	□	□	□
Ethylene chloride	▲	▲	▲			▲			▲	○	□					
Formaldehyde, aqueous solution 30%	□	□	▲	□	□		□		□	□	□	□		□	□	□
Formamide			○		□					○						
Formic acid, aqueous solution 10%	□	□	▲		▲			□	□	□	□	□			□	□
Freon, Frigen, Liquid	○		□	□	□		▲		▲	○	▲	□		□	□	□
Fruit juices	□	□	□	□	□			□	▲	□	□	□			□	□
Glycerine	□	□	□	□	□				○	□	□	□			□	□
Glykol	□	□	□	□	□				□	□	□	□			□	□
Glysantin, aqueous solution 40%		□	□	□	□				□	□	□	□			□	□
Heating oil	□	□	□	□	□				○	□	○				□	□
Heptane, Hexane	□	□	□	□	□					▲	□	□			□	□
Hydrochloric acid, aqueous solution 2%	□	▲	▲		▲			□	□	□	□	○	□	□	□	□
Hydrochloric acid, aqueous solution 36%	□	▲	▲		▲	▲		▲	□	□	□	□	○		□	□
Hydrofluoric acid, 40%	○	▲	▲	□	▲	▲		▲	○	□	□			○		□
Hydrogen peroxide, aqueous solution 0.5%	□	○	□		▲	□		□	□	□	□	□	□	□	□	□
Hydrogen peroxide, aqueous solution 30%	□	▲	□		▲	▲		▲					○	□	□	□
Hydrogen sulphide saturated	▲		▲	□	□		□		□	□	□	□			□	□
Ink	□	□	□		□	□		□	□	□	□	□			□	□
Iodine solution, alcohol solution	□	○	□		▲				□	○	□			□	□	□
Iso-octane	□		□	□	□				□	□	□	□	□	□	□	□
Isopropanol	○	□	□	□	□	□		□	○	□	□	□	□	○	□	□
Lactic acid, aqueous solution 10%	□	□	○	□	□		□		□	□	□	□			□	□
Lactic acid, aqueous solution 90%	▲	□	▲	▲	▲				□	□	□	□			□	□
Linseed oil	□	□	□	□	□	□		□	□	□	□	□			□	□
Methanol	○	□	□	□	□	□		□	▲	□	□	□	○	□	□	□





AGENTS, CONCENTRATION: WEIGHT-%	MATERIAL															
	ABS	Acetal (copolymer)	Acetal (homopolymer)	Polyphenylene Ether	Nylon 6	PBT	PEEK	PET	Polycarbonate	Polyethylene	Polypropylene (homopolymere)	PPS	PPSU	PSU (polysulfone)	PTFE	PVDF
Sodium thiosulphate 10%	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Styrene	Resistant	Resistant	Resistant	Not Resistance	Resistant	Resistant	Resistant	Resistant	Not Resistance	Limited Resistance	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant
Sulphur dioxide	Not Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Resistance	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sulphuric acid, aqueous solution 2%	Resistant	Not Resistance	Resistant	Resistant	Not Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Sulphuric acid, concentrated 98%	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Limited Resistance	Resistant	Resistant	Resistant	Not Resistance	Resistant	Limited Resistance
Tar	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Tartaric acid	Resistant	Limited Resistance	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Tetrahydrofurane	Not Resistance	Limited Resistance	Not Resistance	Resistant	Resistant	Not Resistance	Resistant	Not Resistance	Not Resistance	Limited Resistance	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant
Tetralin	Not Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Not Resistance	Limited Resistance	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant
Toluene	Not Resistance	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Resistant	Limited Resistance	Not Resistance	Limited Resistance	Limited Resistance	Limited Resistance	Limited Resistance	Not Resistance	Resistant	Resistant
Transformer oil	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Trichlorethylene	Not Resistance	Not Resistance	Not Resistance	Not Resistance	Limited Resistance	Not Resistance	Resistant	Not Resistance	Not Resistance	Not Resistance	Limited Resistance	Limited Resistance	Resistant	Not Resistance	Resistant	Resistant
Triethanolamine	Resistant	Resistant	Not Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Not Resistance	Resistant	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant
Trion B, aqueous solution 10%	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Urea, aqueous solution	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Vaseline	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Water, cold	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Water, warm	Resistant	Limited Resistance	Not Resistance	Resistant	Limited Resistance	Not Resistance	Resistant	Not Resistance	Limited Resistance	Resistant	Resistant	Limited Resistance	Limited Resistance	Resistant	Resistant	Resistant
Wax, molten	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Limited Resistance	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant
Wine, Brandy	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant
Xylene	Not Resistance	Resistant	Resistant	Not Resistance	Resistant	Limited Resistance	Resistant	Limited Resistance	Not Resistance	Not Resistance	Not Resistance	Resistant	Resistant	Not Resistance	Resistant	Resistant
Zinc chloride, aqueous solution 10%	Resistant	Not Resistance	Resistant	Resistant	Limited Resistance	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant	Resistant

\*Resistance also dependent upon concentration, time, and temperature