APPLICATIONS

Inclined and declined conveyors

Maximum angles

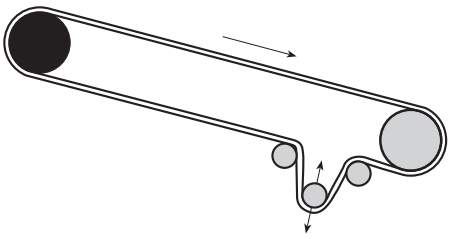
Chain type	lubricated	Dry
Stainless steel	4°	8°
Plastic chain/belt	2.5°	4.5°
High friction chains steel/plastic	12/15°	15/20°

*Dry run with steel chains is generally not recommendable

Pollution on the chain as well as on the product surface influences the maximum angles negatively.

Drive construction

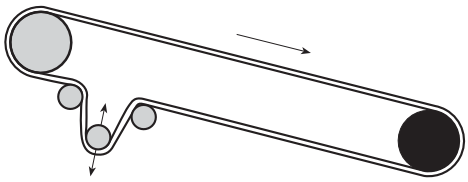
Declines



tan (critical angle) = coefficient of friction chain/belt against product, considering pollution

>8°

Soft start/stop is reccomended.

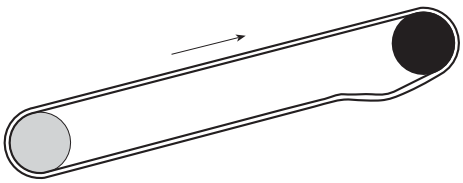


<8°

Soft start/stop is recommended.

Dynamic tensioner is in both cases recommended.

Inclines



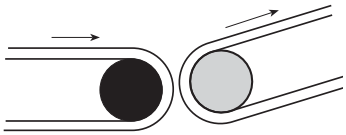
Drive is normally located at the upper end.

Soft start/stop is recommended.

Integrated transfer

Hold down guide, resp. TAB chain

separate transfer e.g. with dead plate



Curve construction in combination with inclines/declines

Sideflexing chains for Magnetic System can be used in inclined/declined conveyors only under the following restrictions:

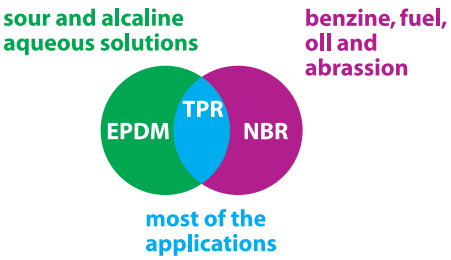
- Incline is possible before a curve
- Decline is possible after a curve

Otherwise the chain could be lifted out.

Example

Recommendation: install a separate drive for curving sections, that are located between inclined/declined sections.

High friction inserts of our chains have a Shore A hardness of 70+/-4.
Applicable temperature range –40 to +80°C.



Accumulation of products

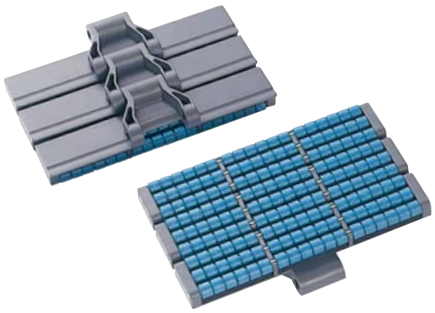
Accumulation of products results in increased load on the chain as well as in increased wear on chain/belt and product.

LBP (Low Back Pressure) chains/belts are recommended to avoid these effects.

With low noise accumulation rollers the friction and other negative resulting effects are reduced to a minimum.

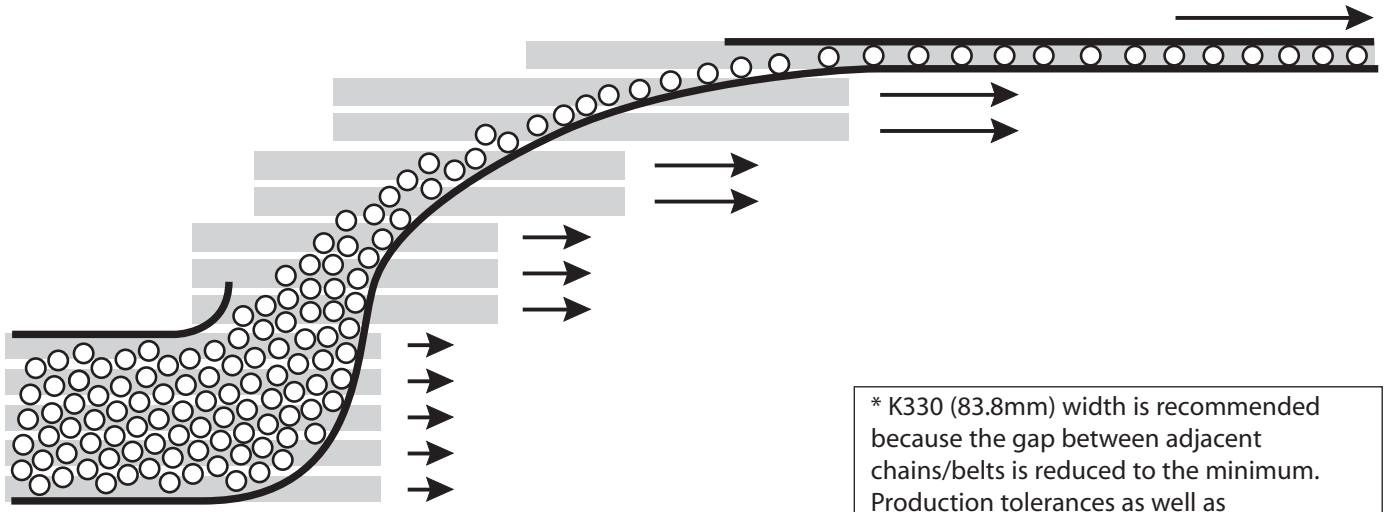
For the ***return part construction*** flat surfaces or guide shoes are recommended. Roller or serpentine wearstrips are not possible.

Frequent and thorough ***cleaning*** of LBP chains/belts is recommended to make sure that the accumulation rollers run free. Otherwise the advantages of this construction get lost.



Example

Pressureless combiner



* K330 (83.8mm) width is recommended because the gap between adjacent chains/belts is reduced to the minimum. Production tolerances as well as temperature elongation must be considered.
* K325 (82.5) width is necessary for sloped pressure less combiners.

Suitable chains/belts

Usually pressureless combiners have a track pitch of 85 mm.

Type		Characteristics	Suitable for
Stainless steel chains	* K330 ***SPEED-LINE***	Extremely close tolerances in terms of: Flatness, surface finish, no sharp edges.	Glass PET
Plastic chains	LF, XPG, NG * K330	Low friction.	PET Cans
Belts	2250 FT, FTP2 2250 FG, FGP2 2250 M FT 2250 M FG * K330	With Positioner. Closed or open surface. Low friction. Excellent stiffness. 1" pitch.	FG series: PET, Cans FT series: Glass, PET
	2251 FTP2 * K330 2252 FTP2 * K325	With Positioner. Closed surface. Heavy duty design. Low friction. Excellent stiffness. 1" pitch.	Glass PET Cans
	2120 FTP2 * K330 2121 FTP2 * K325	With Positioner. Closed surface. Low friction. Excellent stiffness. 1/2" pitch. Small transfer radius	Cans PET Glass

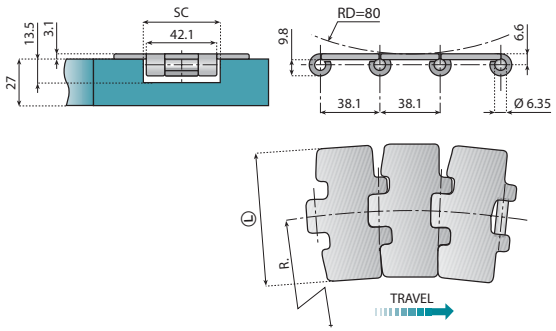
Optimised steel chains

For maximum product stability e.g. PET bottles, designer bottles and for critical applications e.g. inliners and pressureless combiners we offer the following chains.

For ***sideflexing applications:***

Stainless stell chains for Magnetic System:
SPC 881 MO
SPS 881 MO

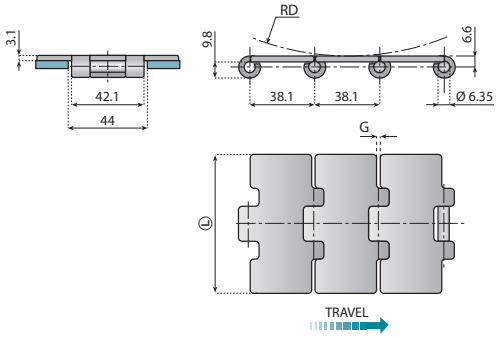
Design Features:
- ➢ Optimized plate in terms of
  - • Flat and smooth surface
  - o Defined convex shape of plate
  - • Maximum closed plate surface



For ***straight running applications:***

Standard stainless stell chains.

Our staight running stainless stell chains offer design features as mentioned above in standard execution.



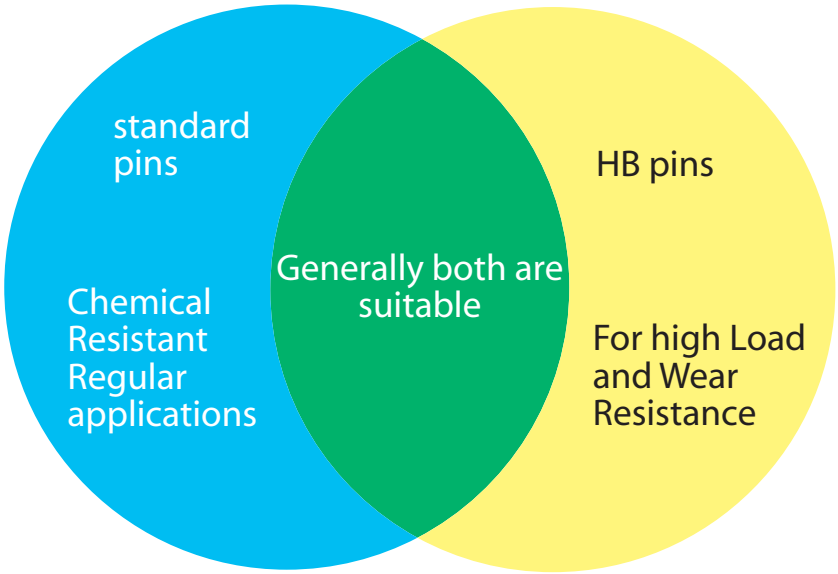
G (gap) = 1.5 mm minimum

For ***side transfer applications:***

Stainless stell chains as described above in K330 (83.8 mm) width for 85mm track distance.

The gap between adjacent tracks is reduced by approx. 50% (compared to K325 - 82.5 mm chains) to a minimum in order to avoid toppling products.

HB pins for extended wear life



- Clean environment / proper cleaning and lubrication
- Low speed and load
- Regular cleaning with aggressive chemicals

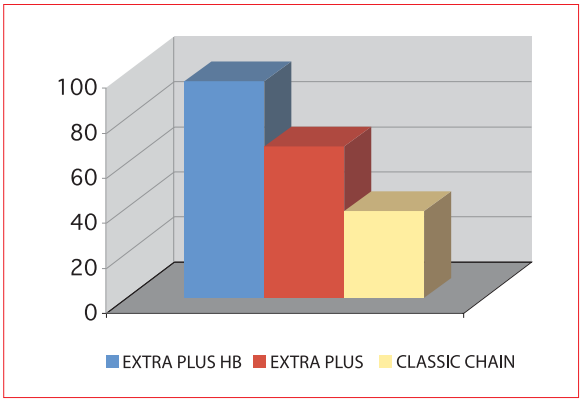
- Abrasive environment / dirt like crate conveyors / return bottles
- High speed and short conveyor like in filler area
- High speed and load
- Low speed , high load like in accumulation areas and full crate transport

Life time expectancy

Mass conveying

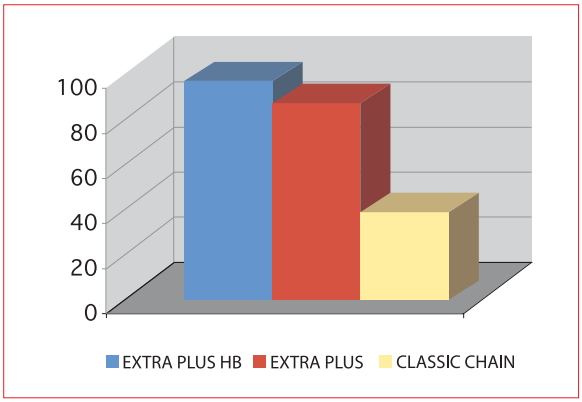
• High mechanical wear

EXTRA PLUS HB	100
EXTRA PLUS	70
Classic chains	40



• Chemical influence

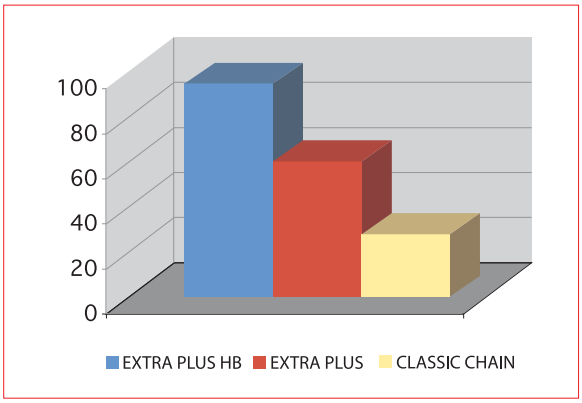
EXTRA PLUS HB	100
EXTRA PLUS	90
Classic chains	40



Pressureless inlining

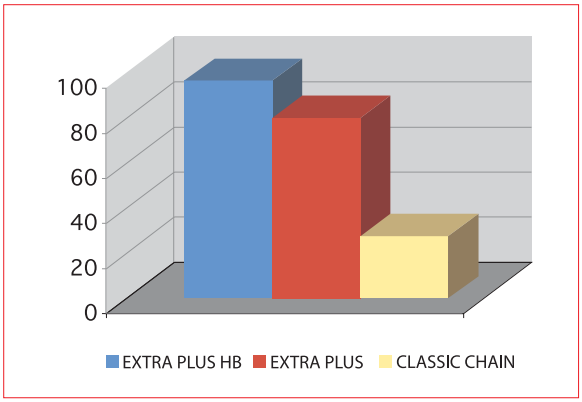
• High mechanical wear

EXTRA PLUS HB	100
EXTRA PLUS	60
Classic chains	30



• Chemical influence

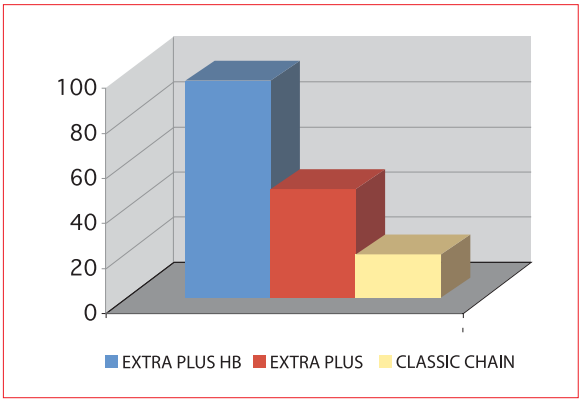
EXTRA PLUS HB	100
EXTRA PLUS	80
Classic chains	30



Have duty single line conveying

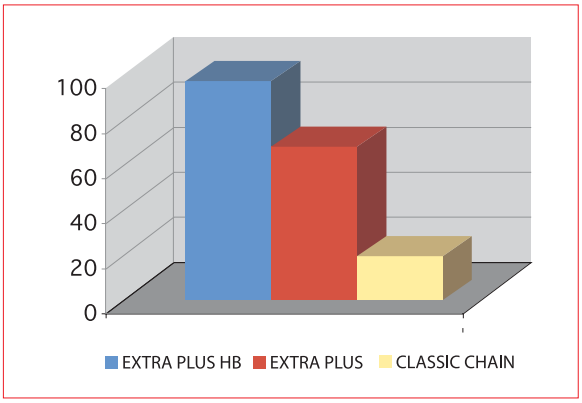
• High mechanical wear

EXTRA PLUS HB	100
EXTRA PLUS	50
Classic chains	20



• Chemical influence

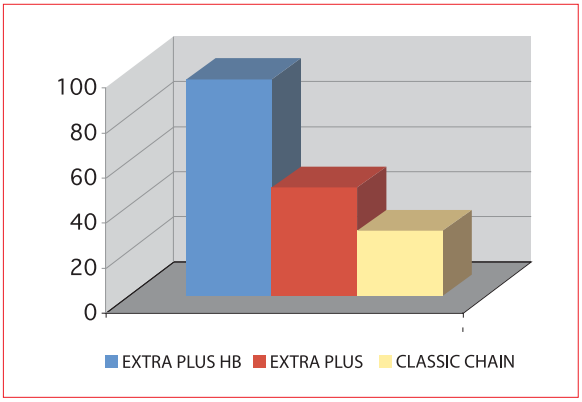
EXTRA PLUS HB	100
EXTRA PLUS	70
Classic chains	20



➢ *Life expectancy in case conveying*

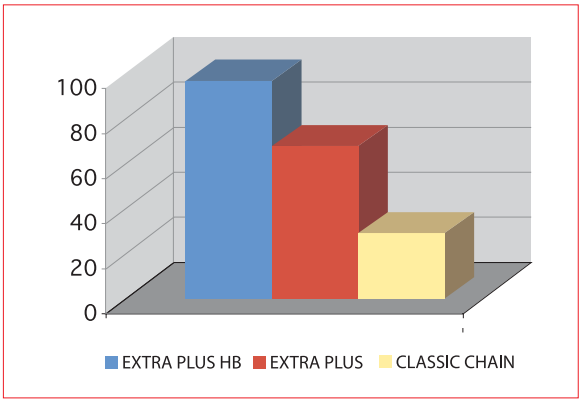
• High mechanical wear

EXTRA PLUS HB	100
EXTRA PLUS	50
Classic chains	30



• Chemical influence

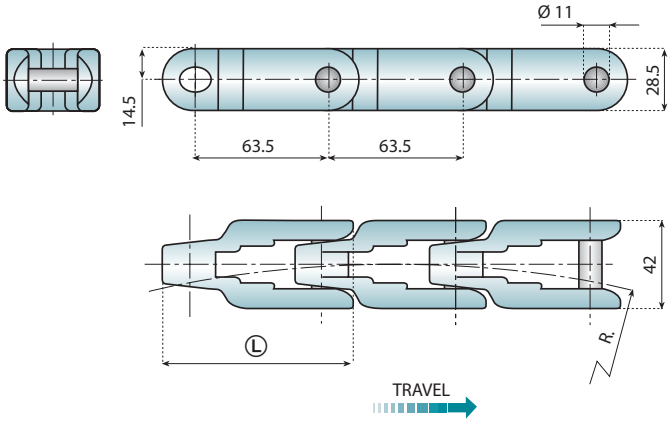
EXTRA PLUS HB	100
EXTRA PLUS	70
Classic chains	30



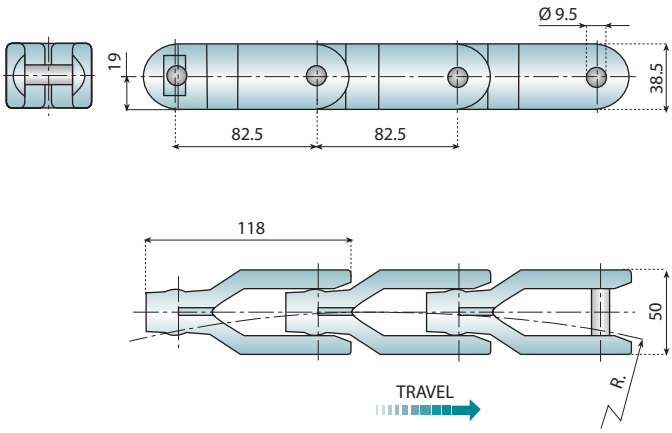
Crate conveying

Usually single track stainless steel chains 7 1/2 " wide are used for that purpose.
Two track 3 1/4 " stainless steel chains installation is also possible.

Special plastic chains are available for conveying of heavy crates, boxes and kegs especially in dirty environment under rough conditions.



CC600



CC1400

For straight sections ferritic stainless steel profiles with a surface finish of max. 1.6 µm and a hardness of 25 HRC are recommended.

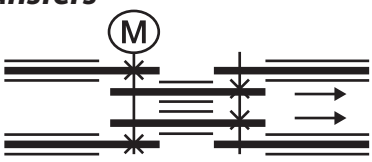
All edges should be chamfered.

To ensure proper operation and long wear life, the CC chain should not be tensioned in the return part.

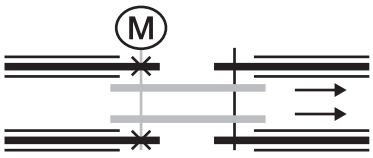
Lubrication is not recommended and in most cases not required anyway.

Curve constructions should enable easy removement of debris. Open design is recommended.
The chain should be removable out of the curve for cleaning purposes.
Inside guides can be made of plastic, however, stainless steel is recommended to avoid imbedding of dirt in the guides, that would reduce the wear life of the chain.

Transfers



Slave drive



dead plate

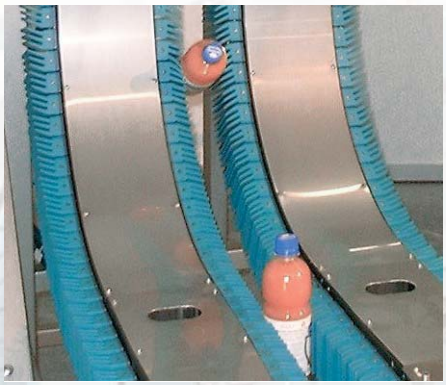
staggered conveyors

Gripper chains applications

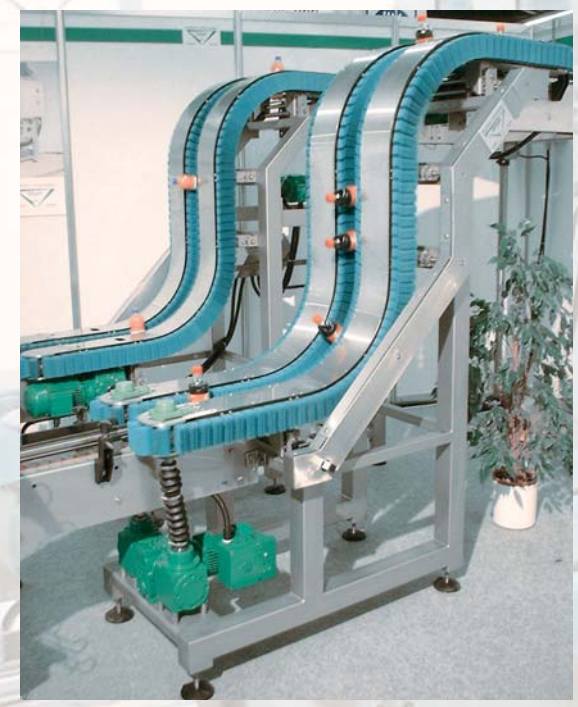
General instruction / recommendations

- Chains tracks must parallel before installing the chains.
  The tolerance for the parallel adjustment of the tracks is <2mm.
  Incorrect adjustment can lead to overloading and rapid wear.
- It is very important to regard the orientation of the gripper ribs.
  They must be bent backwards relative to the running direction of the chain.
- The control system of the conveyor must assure that no backline pressure is created.
  Backline pressure damages gripper chains.
- The clearance between the chain tracks must be adjustable.
  The gripping forces must be adjustment according to the product:
  general rule: as tight as the product can still be removed manually.
  This is usually 5 to 10 mm less than the product width / diameter.
  It must be avoied that grippers touch each other e.g. by too tight adjustment.
  Touching grippers loose their elasticity what can result in damage as weel as production stand still.
- A tensioning system is strongly recommended.
  Overstressing the chain by too strong tension must be avoided.
- It is of major importance to avoid touching products.
  If products touch each other while being clamped by the gripper chains, they cause damage.
  It is e.g. recommended to set the speed of the feeding conveyor a little slower than the speed of the gripper conveyor.This ensures a gap between the products, which is necessary.
- Summary of recommendations:
  - Continuous operations, no start / stop
  - Run the gripper elevator empty before a line stop
  - Use frequency controlled drivers with soft start / stops
  - If lubrication is necessary, PermaLub devices are preferred, grease lubrication is not recommended because the grease binds dirt and creates wear.
  - Continuous inspection is strongly recommended
  - Avoid:
  - Too tight adjustment of the tracks
  - Misaligned tracks and / or sprockets / wheels
  - Touching products
  - Collision points with parts of the conveyor construction.

Orientation of gripper ribs



Elevator



Crate turner

Gripper chain assembly instruction

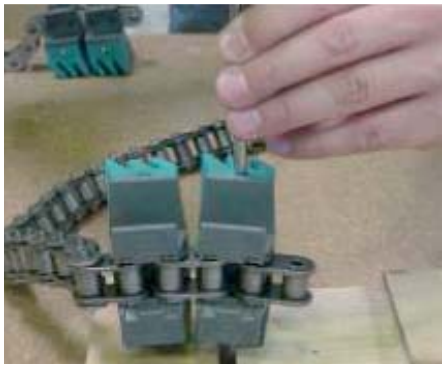
SIDEFLEXING PLASTIC PLATE TOP CHAINS WITH GRIPPERN SNAP ON

(BASE ROLLER CHAIN 19.05 mm - $^{3}/_{4}$ inch - pich - side bow type)
Instruction for the assembling/disassembling of the plate and the rubber
(GSI - for light applications,GS2 - for heavy applications,GS3 - for special applications

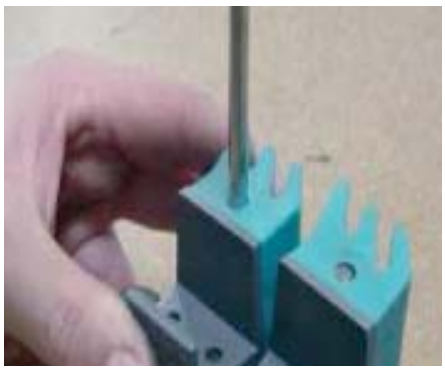
Picture 1:Connecting of two assembled chains with a connecting link

Picture 2:Assembling of the plastic plate.
Step 1:heat to about 70° centigrade heating treatment time:20 sec

Picture 3:Assembling of the plastic plate
Step 2:Assembling in the show way



Picture 4:Disassembling of the rubber
Attention! push out the pin in direction **OUT**



Picture 5:Assambling of the rubber
Attention!assemble the pin in direction **IN**

Picture 6:Cut the chain in the wished leght
Attention!use a compact base

Lubrication: You have to check the lubricationof the roller chain at regular intervals!

PRODUCT HANDLING

Conveyor length

Conveyor length depends on
- Chain/belt type
- Lubrication
- Product
- Load
- Etc.

Type	Max. advisable length [m]
Stainless steel, straight	Approx. 15
Stainless steel, sideflexing	Approx. 12
Plastic chains, straight	Approx. 9-12
Plastic chains, sideflexing	Approx. 9-12

Only valid for standard conditions.

For long conveyors it is recommended to place curves close to the idler end in order to reduce chain load resulting in longer wear life.

A phenomenon, called **slip stick effect** occurs unpredictably. It depends on speed, load, construction and lubrication. Pulsating dynamic forces are the result and affect the service life of all components of a conveyor. Long conveyors should be avoided in such cases.

Long conveyors result in high chain load, which affects all components of the conveyor and reduces their wear life.

Conveyor speed

Maximum m/min

Type	Lubrication		
	Dry	Water	Water & soap
Stainless steel, straight	50	70	130
Stainless steel, Magnet System	30	40	130
Plastic chains, straight	80	100	180
Plastic chains, sideflexing, Magnet System	50	90	180
Plastic belts, straight	80	100	180

Under abrasive conditions the maximum speed is reduced.

STM Safe Transfer Module

STModule

Safe Transfer Module

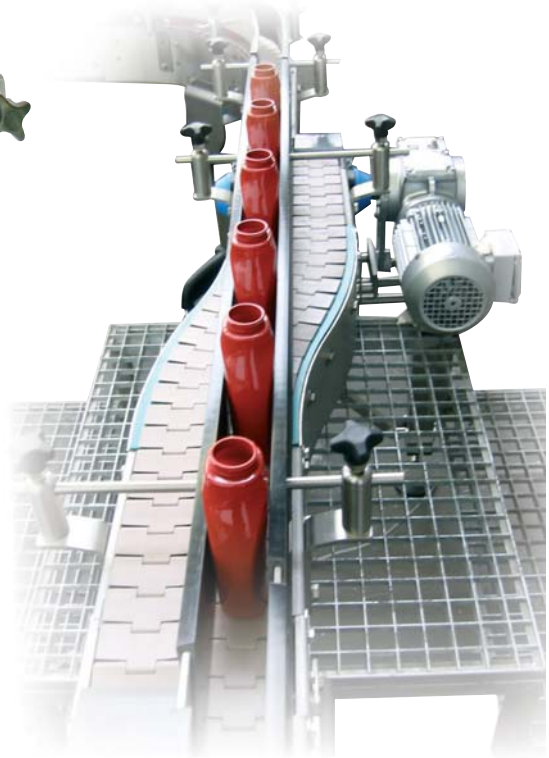
Features

- Safe and smooth Transfer of instable products
- Compact design, one solid piece, no edges
- Easy installation

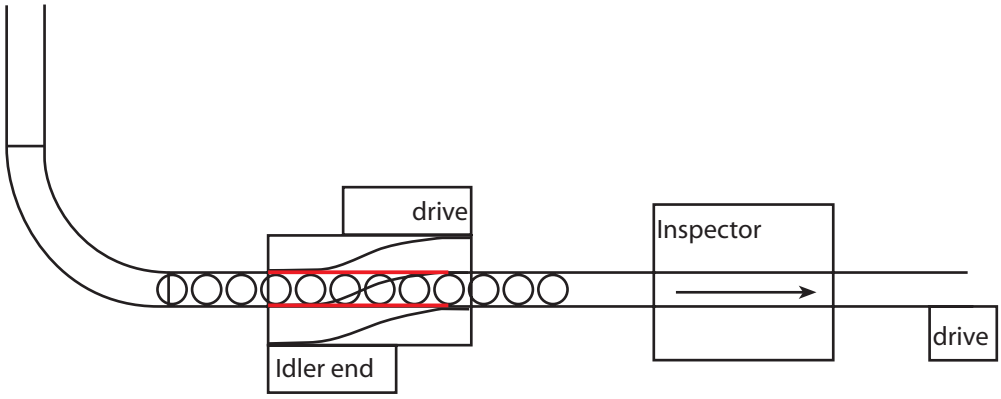
Sicherer Transfer Modul

Merkmale

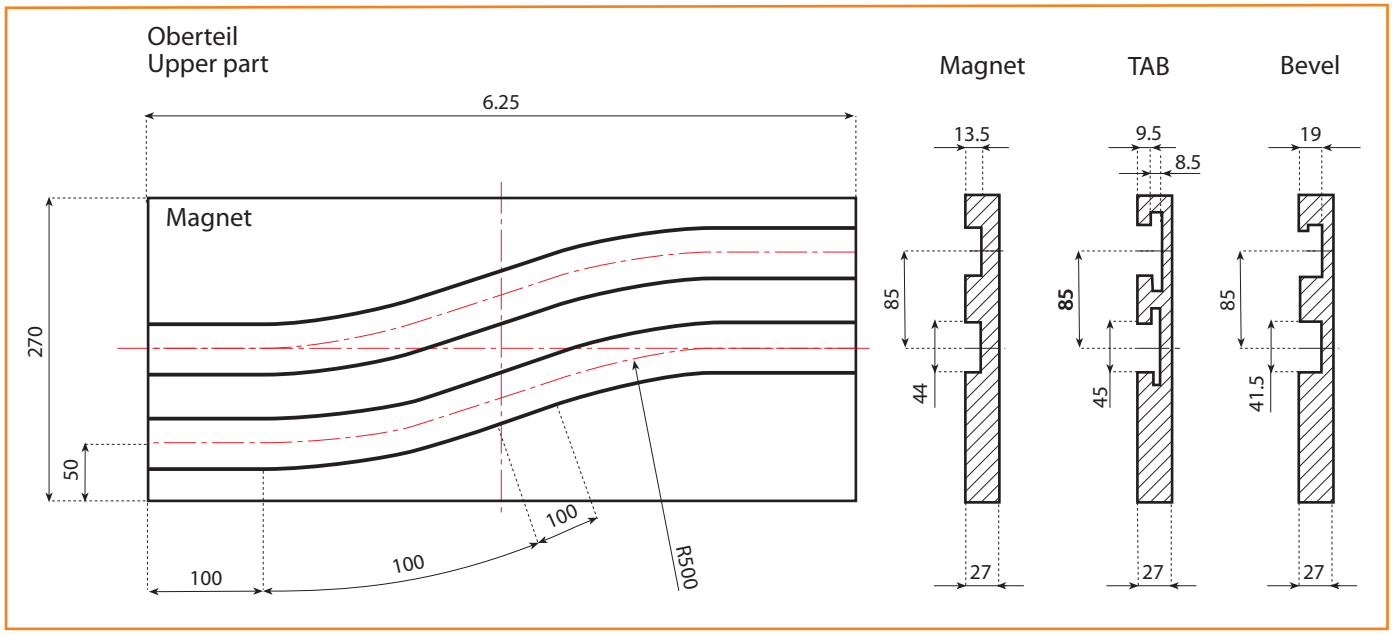
- Sicherer und sanfter Transfer instabiler Produkte
- Kompakte Ausführung einteilig, keine Kanten / Übergänge
- Einfache Installation

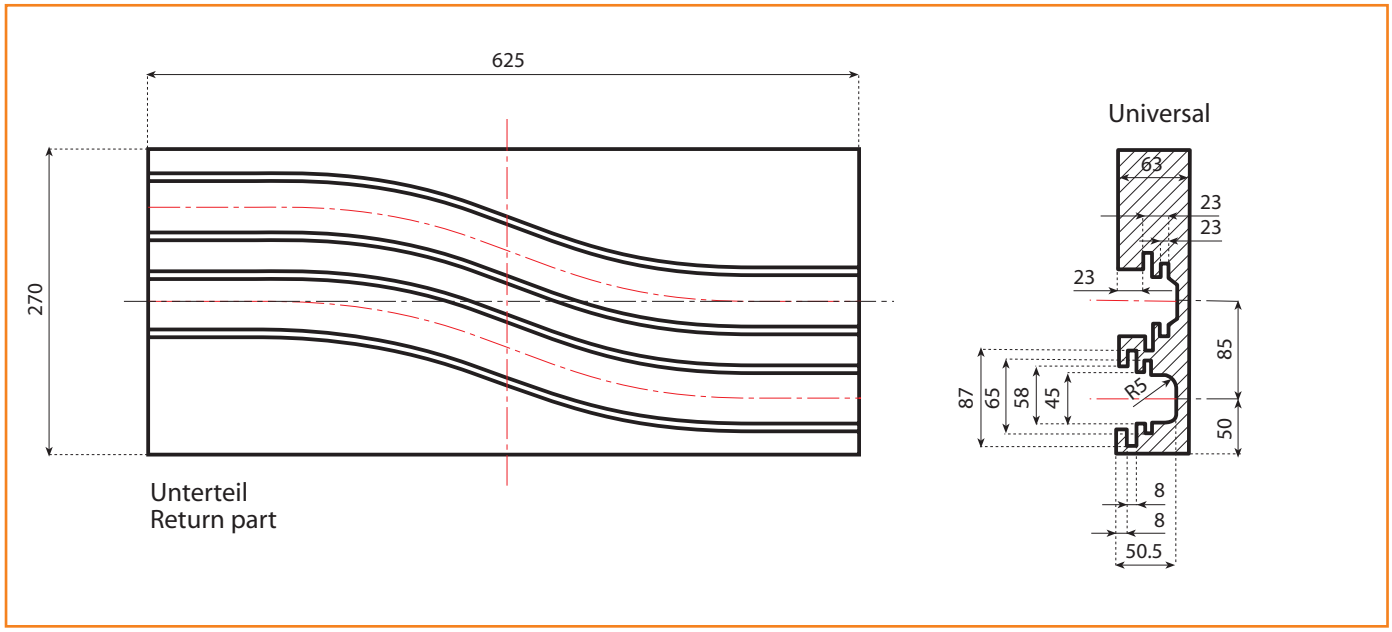


Application Example Anwendungs-Beispiel



Construction Konstruktion





Static electricity

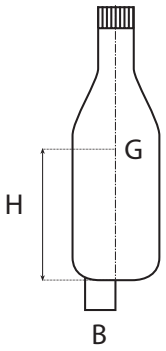
AS material has the following properties:		Surface resistivity:	10^5 Ohm
According to IEC60093 test method		Volume resistivity:	10^5 Ohm m

General instructions / recommendations:

- Caution!
- Already during transportation of the chains electric charge can be generated what can cause sparks.
- Before carrying the chains into an explosion hazardous area any electric charge must be dissipated from the chain.
- Disharging can be done for example by brushing the chains with a grounded and conductive wire brush.
- The chains must be grounded, respectively included in the potentialequalisation of the plant.
- It must be assured on site that the electric charge is dissipeted to the ground preventing any damage.
- Grounding of the chains can be achieved by appropriate wear strips and by appropriate sprockets and idler wheels.
- By means of conductive and grounded wire brushes electric charge can be removed directly from the surface of the chains.
- Wear strips must be conductive and grounded.
- Damage at chains (wear) caused by wear strips must not exceed the admissible limits.
- Caution!
  Wear at chains must not lead to lay open the metallic pin which might scratch over other metallic surfaces and generate sparks.
- Sliding properties of wear strips must admit save operation of the chains.
- Chain breakages must be avoided.
- Caution!
  Chains breakages can cause impact sparks.
- Construction, layout and control system of the conveyors must permit a save operation of the chains.
- The chain speed must not exeed 1 m/s.
- Sprockets and idler wheels must be conductive and grounded.
- In case a system of rollers is used for the return of chain the same is applicable for the return rollers as for sprockets and idler wheels. (see 16)
- The resistance of the grounding must not exeed 1MOhm (=10^6Ohm = 1000000Ohm).
- The resistance of the grounding must be checked by the assembly fitters prior to installing the chains.
- During assembly / installation of the chains sparks must be avoied.
- Appropriate tools must be used.
- Chain pin must be installed completely and carefully.
- After the chais pin installation the chain links must be checked and in case of any damage be replaced.
- Swarf and any other metallic or sparking objects must be removed from the conveyor prior to start -up.
- The total chain length of a grounding section must not exceed 333 chain links.

Product stability

A product stands stabile even in case of large speed variation if C > R.
Critical coefficient C=B/H.
Real coefficient R=real friction coefficient, measured for the application in question.
Raised edges however have to be avoided.



With the following formula the maximum admissible speed variation can be calculated:

Max. admis. speed variation MSV* = SQR(2*g*SQR(H^2+B^2)-H)
SQR = square root
g = gavitational acceleration
H = height of centre gravity
B = base radius
G = centre of gravity

*MSV indicates e.g. the max. admissible speed of a bottle being conveyed onto a dead plate without tilting

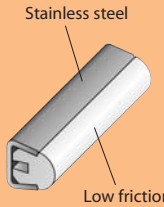
Noise reduction

Measures:

- Use curves instead of dead plate transfer.
- Install flow control devices like frequency controlled drives to adjust the conveyor speed according to actual requirements (e.g. accumulation stop).
- Cover guiderails with plastics.
- Use plastic sprockets and idlers.
- Use plastic wearstrips in combination with steel chains.
- Use return part rollers with a larger diameter than 60 mm.
- Apply lubrication.
- Use Magnetic Corner Tracks in EXTRA execution with profiled stainless steel sheet metal insert or Nolu-S material.

Product guides

The conical guide rail incorporates two outstanding materials: stainless steel and UHMW. The stainless steel sheath provides rigid streamlined support for heavy loads at any speed, plus a solid connecting point for holding the rail in place with clamps and brackets. The UHMW guiding surface is available in a wide selection of shapes. The very low friction characteristics of UHMW allow containers to move at high speed with a minimum of drag, container damage, and noise. Materials are approved by the FDA and accepted for use in USDA inspected facilities.



METAL PROFILE

Metal profile is typically in stainless steel AISI 304 (AISI 316 on the request), used for its excellent resistance to corrosion and long lasting attractive appearance. Galvanized steel can be ordered as an economical alternative to stainless steel.

Zn
Zinc plated steel

SS 304
304 Stainless steel

STANDARD VERSION

Natural UHMW *- The manufacturing process allows the use of UHMW without additives or other processing chemicals. The result is a material that resists abrasion better, is more color stable (less prone to yellowing) and of uniform consistency. Available in two colors black and white.*

PE
Polyethylene
UHMW

SELF LUBRICATED VERSION

Nolu-S UHMW *- Battleship grey color. A lubricant system is added to our standard UHMW during processing to give it reduced friction while maintaining all other physical properties. The coefficient of friction Nolu-S material is ca 35% lower as standard. The PV-limit for chain is at least 2 times the standard value for UHMW.*

NOLU S
Polyethylene
Nolu-S
UHMW

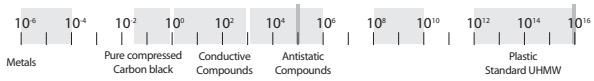
VERSION WITH IMPROVED ELECTROSTATIC CONDUCTIVITY

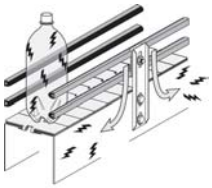
Static Dissipating UHMW *- Special formulation retains the low friction and wear characteristics of UHMW while effectively reducing problems caused by static. Color: black.*

PE as
Polyethylene
UHMW
Antistatic

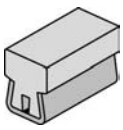
Antistatic Polythylene

Specific electrical resistance (Ohm x cm)





Static dissipative UHMW rail provides a conductive pathway to disperse the buildup of static electricity.

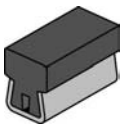


VERSION FOR HIGH TEMPERATURE

High temperature. Special developed material to operate under high temperatures. The HT profiles are designed to operate under a continuous temperature of maximum 270°C. Typical applications for HT profiles are: Ovens, cookers, hot fill area, steam chambers, furnace discharge, retorts, fryers, shrink tunnels, pasturizers and steam boxes.

For use in high temperatures

SPECIFICATIONS	HI-TEMP MATERIAL	MATERIAL PROFILE
Tensile Strength - ASTM D-1457 (N/mm²)	12.6	500
Deformation under load - ASTM D-621 (%)	3.8	-
Coefficient of thermal expansion - ASTM D-696 mm/mm/°Cx10⁻⁵)	7.47 (37°-120°C) 12.62 (120°-150°C) 7.47 (150°-270°C)	-
Coefficient of friction - ASTM D-1894	0.04	-
Continuous service temperature	270°C	-



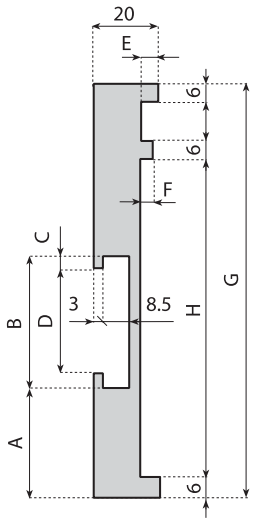
VERSION WITH NYLATRON INSERT

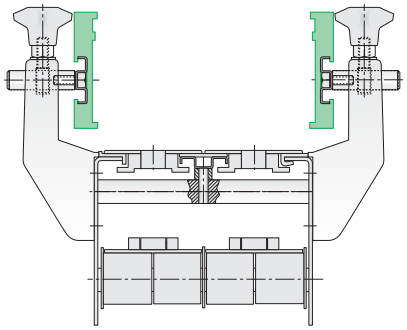
For applications such as high conveyor speeds, heavy loads or abrasive conditions. Nylatron can be used at continuous temperatures up to 93°C.

Ny
Nylatron

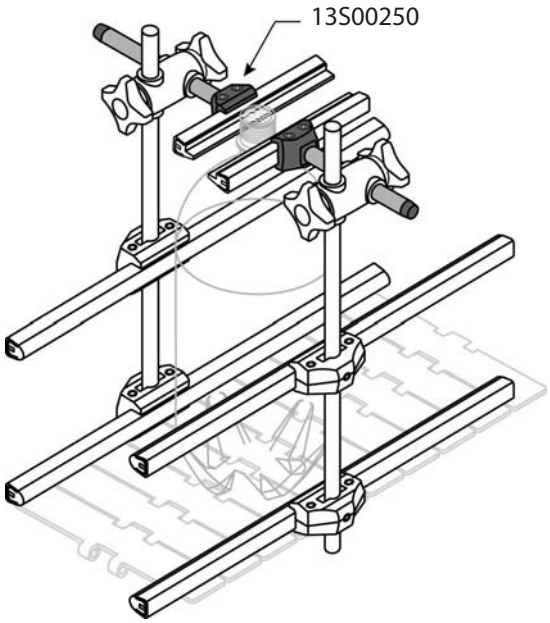
Special product guides for labelled bottles avoiding scratches

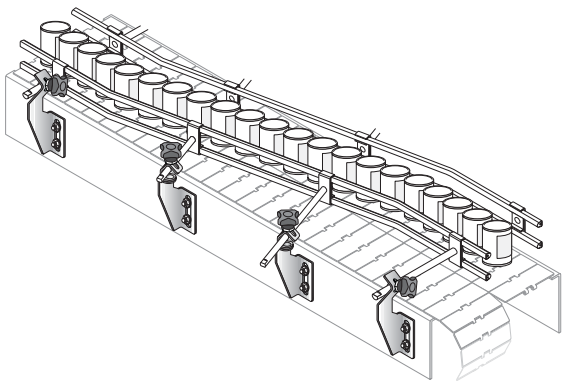
SIDE GUIDE FOR LABELLING BOTTLE

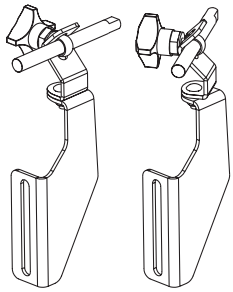




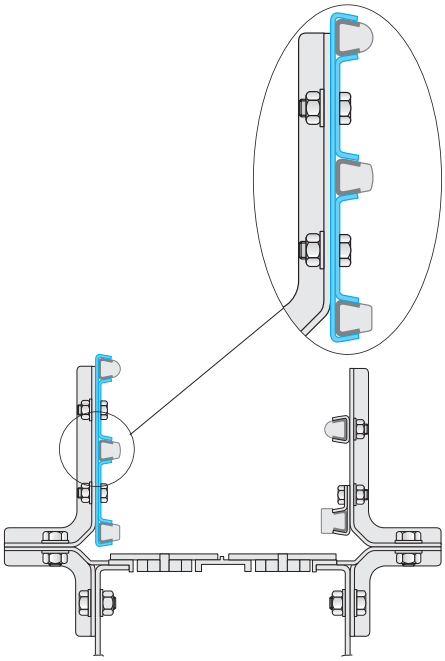
Installation example



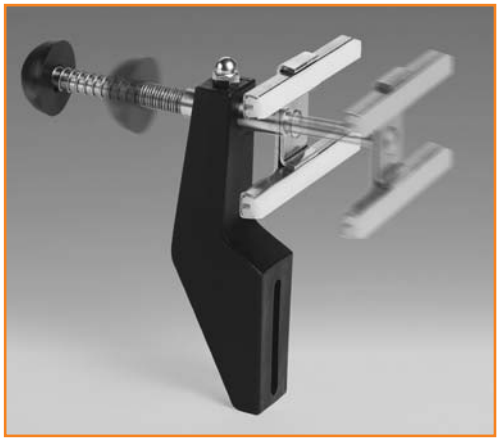




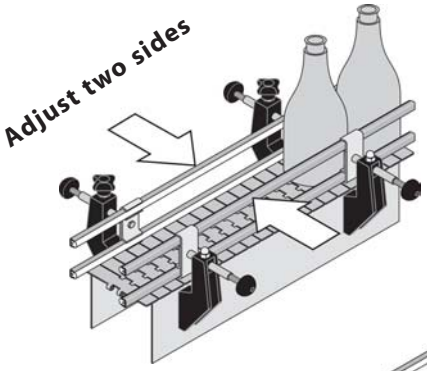
Heavy duty

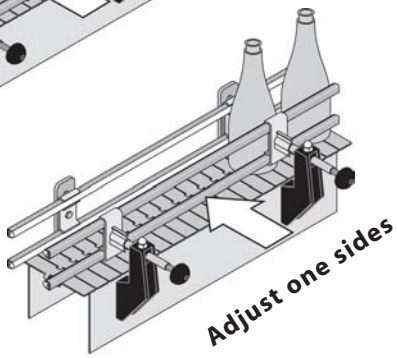


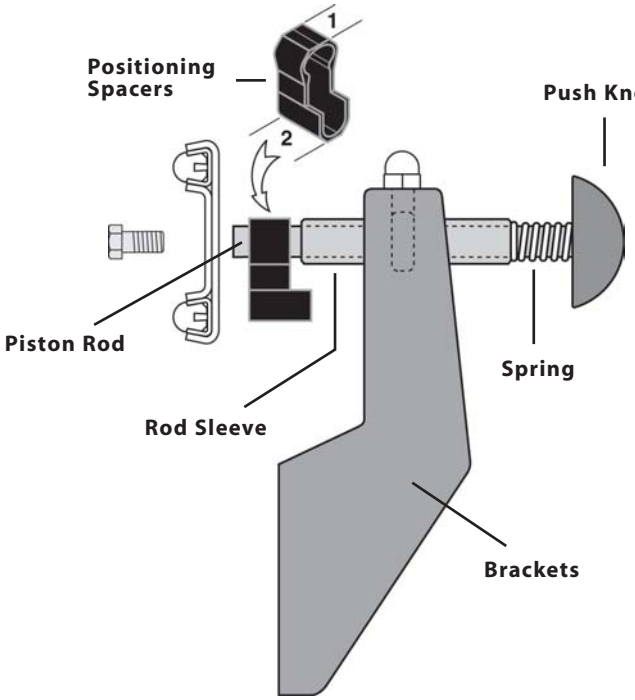
Speed set

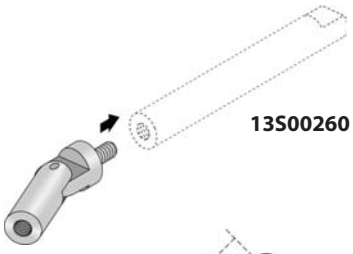


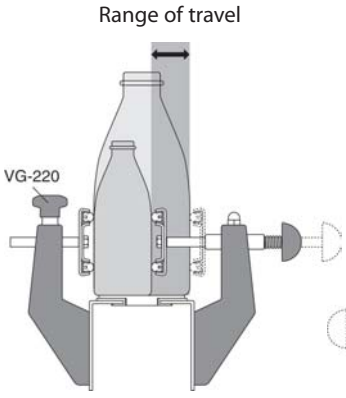
Adjusts to 3 container sizes! SpeedSet™ brackets offer preset conveyor guide rail adjustability that is fast accurate without the need for tools. A simple push on the end knob moves the pin, clamp and guide rail. Spacing blocks, cut the length needed, accurately hold the pin and guide rail in position.



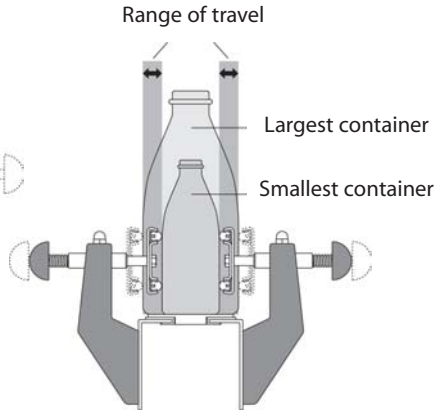




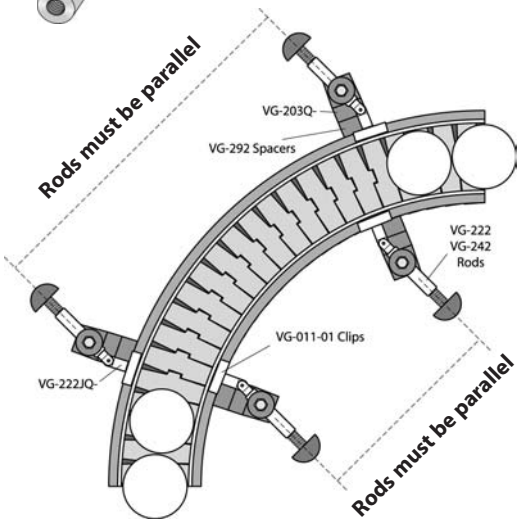




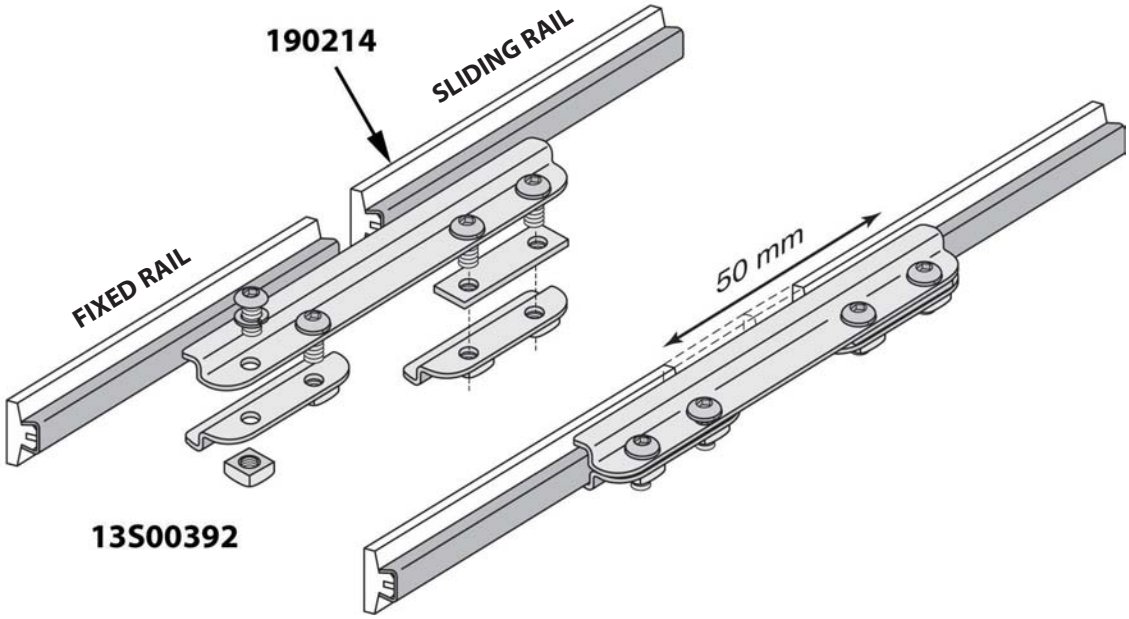
Single side adjusting



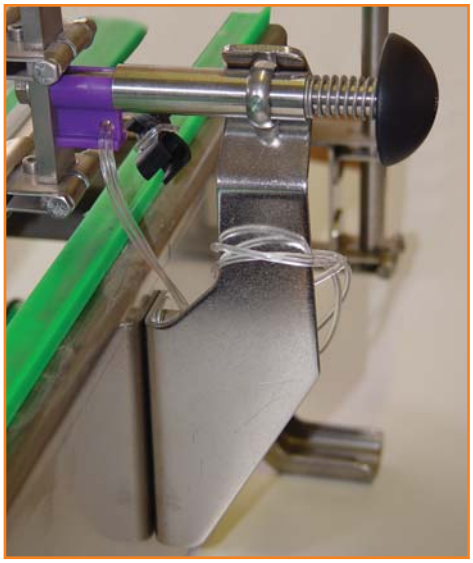
Double side adjusting



Adjustable splicing clamp
Required for adjustable curve product guides



SpeedSet



Side guides for creates

Roller side guides are recommended for shrink packs and carton packs

They avoid scratches and other damage at the packs and at the same time they reduce backline pressure

CALCULATION

Required data for chain calculation

Chain and material specification		
Chain type		
Curve material		
Material straight upper part		
Material straight return part		
Product material		
Product details and conveyor specification		
Products/hour		
Product weight	[g]	
Chain speed	[m/min]	
Lubrication		
Number of tracks		
Sprocket size	[teeth]	
Diameter product	[mm]	
Height difference	[mm]	
Power consumption	[Watt]	

Conveyor layout from idler to drive					
Section	**Length**	**Angle**	**Radius**	**Accumulation**	**Occupation**
	[mm]	[°]	[mm]	[%]	[%]
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Required operation data
Please add a sketch of the conveyor layout.
Please describe operation conditions (e.g. abrasive conditions, environmental conditions, special operation requirements) in detail.
Please describe product features in detail, add drawings/sketches.

Replacement of chain/belts
Which chain/belt was used before?
Did it work satisfactory or did problems occur?

→ SysCalc

Please contact your Flexon System Plast partner or our technical support department.

Required data for belt calculation

Belt and material specification		
Belt type		
Belt width	[mm]	
Material straight upper part		
Material straight return part		
Product material		
Product details and conveyor specification		
Products/hour		
Product weight	[g]	
Belt speed	[m/min]	
Lubrication		
Sprocket size	[teeth]	
Diameter product	[mm]	
Height difference	[mm]	
Power consumption	[Watt]	
Centre drive	[yes/no]	

Section	Length	Accumulation	Occupation	Temperature
	[mm]	[%]	[%]	[°C]
1				
2				
3				
4				
5				

Required operation data
Please add a sketch of the conveyor layout.
Please describe operation conditions (e.g. abrasive conditions, environmental conditions, special operation requirements) in detail.
Please describe product features in detail, add drawings/sketches.

Replacement of chain/belts
Which chain/belt was used before?
Did it work satisfactory or did problems occur?

Please contact your Flexon System Plast partner or our technical support department.

→ SysCalc

Conveyor calculation

If you do not have our calculation programme installed, the following calculation guide will help you to design/calculate your conveyor.

Chain pull calculation – straight running conveyors

$$T = 9{,}81 \bullet \{[(M + 2W) \bullet C_H \bullet K_1] + [M_a \bullet L_a \bullet (K_2 + K_1) - M \bullet L_a \bullet K_1] + (M \bullet C_V)\}$$

(1) (2) (3)

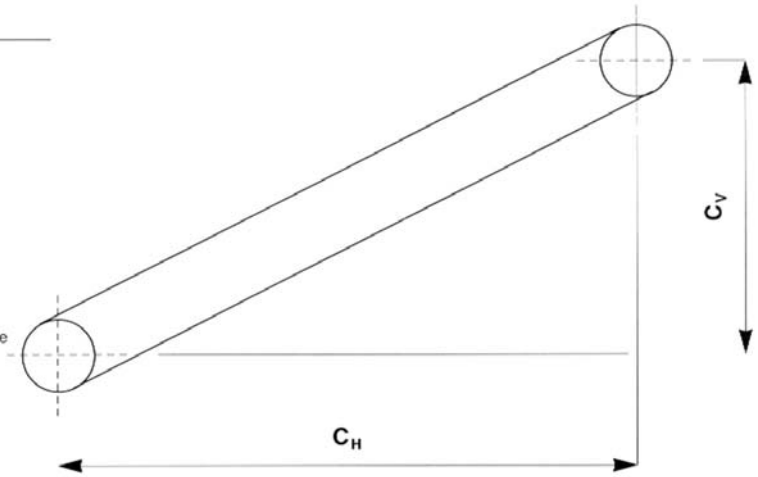
This formula applies to straight running, inclined straight running and straight running with an accumulation section.

If the conveyor is not inclined, part "3" of the formula will be equal to zero.

If the conveyor does not have the accumulation section, part "2" of the formula will be equal to zero.

The used symbols are:

- T = chain pull at the sprocket in Newtons
- M = conveyed product weight (kilograms per metre of chain)
- W = chain weight (kilograms per metre)
- C_H = horizontal length of the conveyor running (metres)
- C_v = vertical height of the conveyor running (metres)
- K_1 = coefficient of friction between chain flights and wear strips
- L_a = length in metres of the accumulating section on the conveyor
- M_a = accumulated product weight (kilograms per metre)
- K_2 = coefficient of friction between chain flights and accumulated product



Chain pull calculation – sideflexing conveyors

$$\Delta T = 9{,}81 \bullet \{[(M + W) \bullet L_H \bullet K_1] + [M_a \bullet L_a \bullet (K_2 + K_1) - M \bullet L_a \bullet K_1] + [(M \bullet W) \bullet L_V]\}$$

(1) (2) (3)

The used symbols are:

- ΔT = pull increment of the section of chain in newtons
- L_H = horizontal length of the section (in metres)
- L_V = vertical height of the section (in metres)
- M = conveyed product weight (kilograms per metre of chain)
- W = chain weight (kilograms per metre)
- K_1 = coefficient of friction between chain flights and wear strips
- L_a = length in metres of the accumulating section on the conveyor
- M_a = accumulated product weight (kilograms per metre)
- K_2 = coefficient of friction between chain flights and accumulated product

In case of sideflexing, with or without incline, with or without accumulation section, the calculation is more complex.
The formula shown above, allows the calculation of the pull increase relative to a section of the conveyor, only one way (carrying or return), including one curve.

The calculation proceeds as follows:

A) Divide the conveyor running, both carrying and return, in several sections consisting of a straight part and a sideflexing part, proceeding in direction of product flow.

B) Number the sections starting from the motor gear, in increasing order following the direction of product flow.

C) Calculate the pull in point 1 using the formula shown above, multiply the result by K_c (angle factor) relative to the first section, (see Table "p")
D) Add the pull of the previous section to the increment obtained from the application of the formula to the second section and multiply the result by the angle factorrelative to the second section (if there is a curve).
E) Repeat step D) for all other sections, untill the sprocket, which is the maximum point pull.

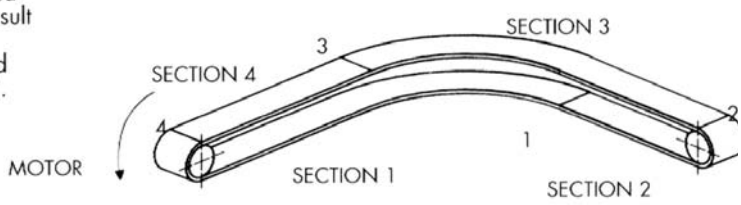


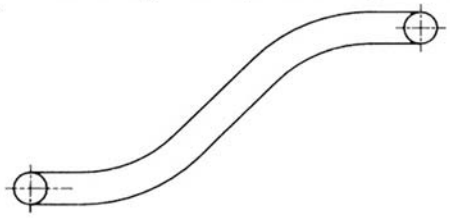
TABLE "p"

K_c ANGLE FACTOR

TURNING ANCLE	WITH TURNING DISK	COEFFICIENT OF FRICTION K_1 = 0,1	K_1 = 0,15	K_1 = 0,20	K_1 = 0,25	K_1 = 0,30	K_1=0,35	K_1 = 0,40
15°	1,15	1,03	1,04	1,06	1,07	1,08	1,10	1,12
30°	1,15	1,05	1,08	1,10	1,14	1,17	1,20	1,21
45°	1,15	1,08	1,13	1,17	1,22	1,28	1,32	1,37
60°	1,15	1,11	1,17	1,23	1,30	1,37	1,44	1,51
75°	1,15	1,14	1,22	1,30	1,39	1,48	1,58	1,69
90°	1,15	1,17	1,27	1,37	1,48	1,60	1,73	1,88
120°	1,15	1,23	1,37	1,51	1,69	1,87	2,08	2,28
150°	1,15	1,30	1,48	1,69	1,92	2,19	2 50	2,86
180°	1,15	1,37	1,60	1,87	2,19	2,56	3,00	3 50

Note that K_c (angle factor) is the same either for vertical or horizontal curves, as you will find at the beginning and at the end of an inclined conveyor.

For the example shown in the picture below you must use the formula for sideflexing even if in plan the conveyor has no curves.



Note that in the return section of an inclined conveyor, it is possible to verify a negative pull, that means that the chain moves due to gravity. In this case instead of multiplying by the angle factor you must divide by it.

If the conveyor is not inclined, part "3" of the formula will be equal to zero.

If the conveyor does not have the accumulation section, part "2" of the formula will be equal to zero.

Chain pull calculation - elevators

$$\Delta T = 9{,}81 \bullet \{(M \bullet K_G + 2W) \bullet L_H \bullet K_1] + [(1 + K_1) \frac{\propto}{\mu} M \bullet L_V] + (2W \bullet L_V)\}$$

Elevating conveyors consist of two chains with rubber pads, parallel running and assembled symmetrically one in front of the other.
The product does not lay on a horizontal plane, but is held between the pads.

The formula shown above, allows the calculation of the pull increase relative to a section of the conveyor, only one way (carrying or return), including one curve.

The calculation proceeds as follows:

The used symbols are:

- ΔT = chain pull increment in one section in newtons
- M = conveyed product weight (kilograms per metre of chain)
- W = chain weight (kilograms per metre
- L_H = horizontal length of the section (metres
- L_V = vertical height of the section (metres)
- K_1 = coefficient of friction between chain flights and wear strips
- $\propto$ = coefficient of friction between rubber and product, in most cases a precautionary value of 0,25 can be used
- K_G = mesh load factor of the rubber pad on a particular product. With $\mu = 0{,}25$ KG = 4,12

A) Divide the conveyor running, both carrying and return, in several sections consisting of a straight part and a sideflexing part, proceeding in direction of product flow.

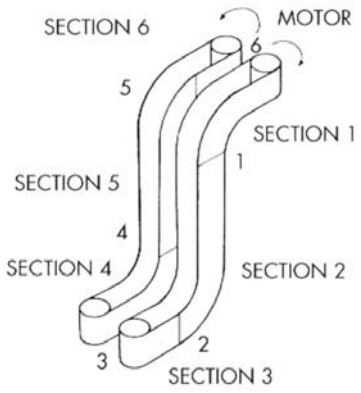
B) Number the sections starting from the motor gear, in increasing order following the direction of product flow.

C) Calculate the pull in point 1 using the formula shown above, multiply the result by Kc (angle factor) relative to the first section, (see Table "p"), or devide by K_C if the pull is negative.

D) Add the pull of the previous section to the increment obtained from the application of the formula to the second section and multiply the result by the angle factor relative to the second section (if there is a curve), or divide if the pull is negative.

E) Repeat step D) for all other sections, untill the sprocket, which is the maximum point pull.

The pull obtained is to e considered as the total pull on the pair of chains that form the elevating conveyor.



Power absorption

$$kW = T_{max}[N] \bullet speed[m/min] / 60000$$

The following formula gives the power absorbed by the chain itself on continuous operation.
To chose the power of the motor you should consider a starts and stops factor and transmission efficiency. Generally a power of 1.5 times higher is needed with continuous operation and 2 times higher with frequent stars and stops.
Anyway the correct choice of the motor depends also on its kind (electric, air, hydraulic) and the type of transmission (friction, reducer).

Coefficients of friction

Below listed coefficients can be used as a guideline. Dependent on environmental and application requirements (temperatures, lubricant, material combinations, dirt/debris, product and chain/belt surfaces, etc.) the coefficients are subject to variation. Coefficients of friction are subject to permanent tests in our laboratories.

Coefficient of friction between chain and wearstrip

Chain/belt material	Lubrication	Wearstrip material				
		Stainless steel, C-steel	UHMWPE PA	Nolu-S	Return roller	Extra With metal strip for M & TAB chains
SSE SPS	Dry	0.50	0.40	0.37	0.20	not applicable
	Water	0.40	0.30	0.28	0.15	
	Water&soap	0.20	0.20	0.19	0.10	
	Oil	0.20	0.20	0.19		
LF-Acetal (D, W)	Dry	0.30	0.25	0.22	0.20	0.19
	Water	0.23	0.21	0.19	0.15	0.17
	Water&soap	0.15	0.15	0.14	0.10	0.12
	Oil	0.10	0.10	0.10		
XPG-Acetal	Dry	0.25	0.20	0.17	0.20	0.16
	Water	0.20	0.18	0.16	0.15	0.14
	Water&soap	0.15	0.15	0.14	0.10	0.13
	Oil	0.10	0.10	0.10		
NG-PBT	Dry	0.22	0.18	0.15	0.20	0.13
	Water	0.20	0.16	0.14	0.15	0.12
	Water&soap	0.15	0.15	0.14	0.10	0.11
	Oil	0.10	0.10	0.10		

Coefficient of friction between chain and product

Chain/belt material	Lubrication	Product material					
		Paper, cartoon	Metal (steel)	Plastics incl. PET	Glass (return)	aluminium	New glass, ceramics
Stainless steel, steel	Dry	0.40	0.50	0.30	0.47	0.35	0.35
	Water		0.40	0.25	0.31	0.30	0.30
	Water&soap		0.20	0.15	0.21	0.20	0.15
Speed-Line	Dry	0.40	0.50	0.27	0.40	0.32	0.29
	Water		0.40	0.23	0.26	0.27	0.24
	Water&soap		0.20	0.13	0.18	0.19	0.13
LF-Acetal (D, W)	Dry	0.35	0.30	0.21	0.24	0.25	0.20
	Water		0.23	0.16	0.18	0.18	0.15
	Water&soap		0.15	0.13	0.14	0.14	0.12
XPG-Acetal	Dry	0.30	0.25	0.18	0.20	0.20	0.15
	Water		0.20	0.14	0.15	0.15	0.13
	Water&soap		0.15	0.12	0.12	0.13	0.12
NG-PBT	Dry	0.30	0.25	0.13	0.14	0.15	0.12
	Water		0.20	0.12	0.13	0.14	0.12
	Water&soap		0.15	0.10	0.11	0.12	0.10
LBP	Dry	0.10	0.10	0.10	0.10	0.10	0.10
VG	Dry	0.60	0.73	0.50		0.50	0.50

Parameters causing wear

Operating conditions
- Load
- Speed
- Number of starts per hour
  - Starts with/without load
  - Soft start/frequency inverter controlled drive
- Product accumulation
  - Conveyor control system (PLC)
- Lubrication
- Water quality
  - Concentration of chlorines
  - Water hardness
  - Contaminations
  - Capacity of water supply
- Lubricant
  - Suitability/performance
  - Dosing
  - Efficiency of nozzles

Cleaning
- Cleaning agent
  - Frequency
  - Intensity
  - Rinsing
- Chemical attack

Environment
- Temperature
- Humidity
- Wear increasing media/abrasives
- Corrosion
- Cleanness
  - Soil e.g. from construction work

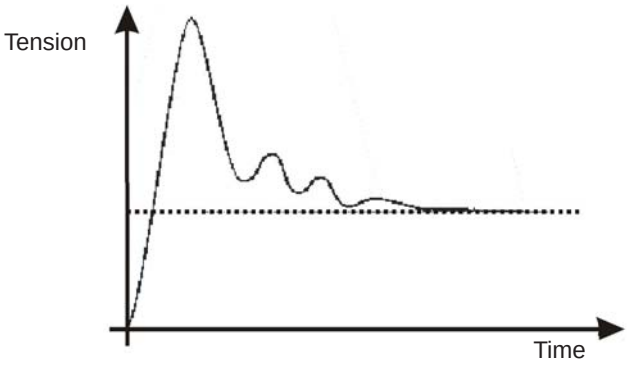
Conveyor components
- Material quality
- Construction
- Dimensional accuracy of
  - Wear strips
  - Sprockets
  - Idlers
  - Return rollers
  - Shaft alignment

Conveyor construction
- Choice of chain/belt/suitability of selected chain/belt for the application
- Catenary design
  - Tensioner
- Sprocket construction
  - Tooth geometry
  - Pitch line clearance
  - Number of teeth/polygon effect
- Return part construction
  - Smooth feed in
  - Sliding/rolling
- Mounting of wear strips
  - Flatness
  - Chamfers
  - Raised portions
  - Extension compensation gaps
- Lubrication system
- Cleaning system

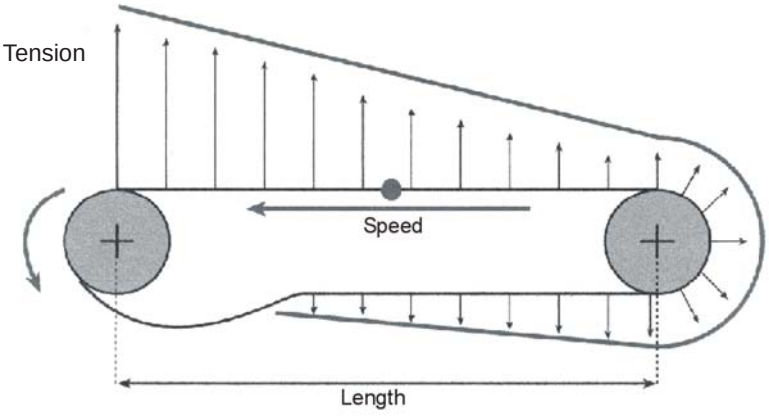
Changed/modified conditions
- Changed operating conditions
- Modification of conveyor or it's parts/components
  - Maintenance
  - Overhaul

Forces on the chain

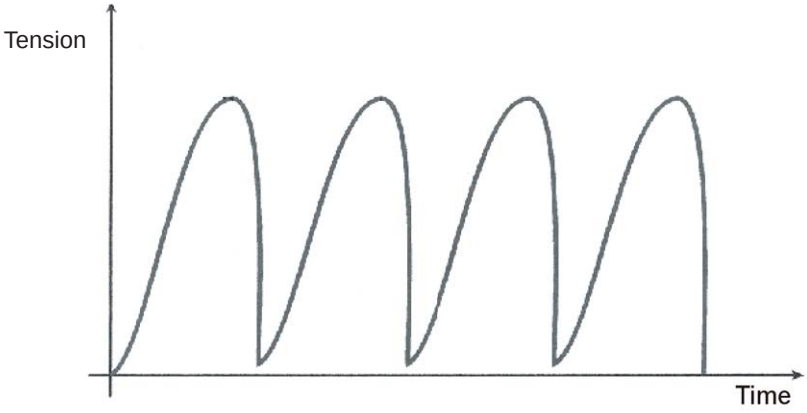
Start-up



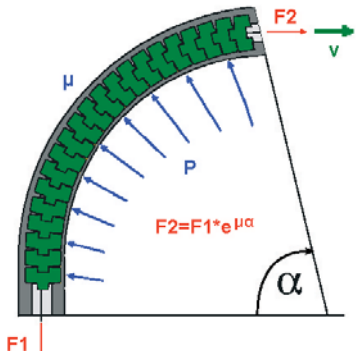
Working cycle



Force on chain link



Forces in the curve



PV

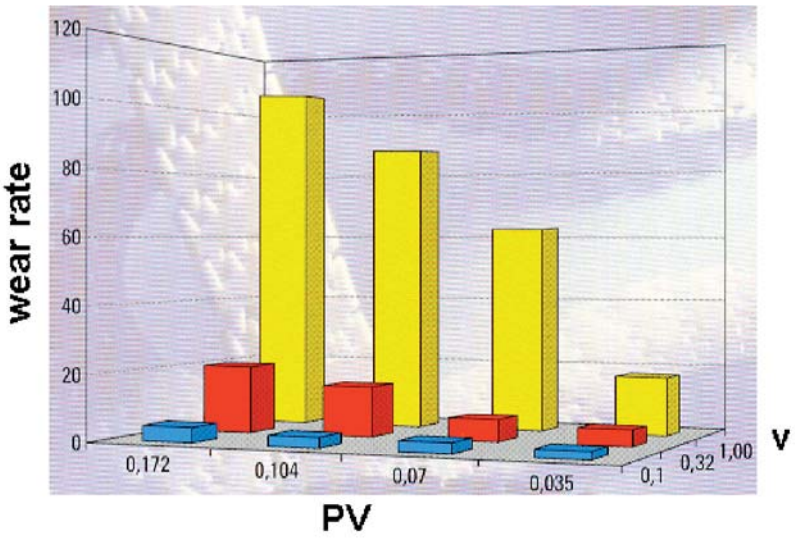
PV = pressure x velocity

PV [W] = P [N/ mm^2] x v [m / s]

P = f (F1,F2,A), A = contact surface

PV is a material property and indicates the wear resistance.

The higher the PV, the higher the generated heat, the higher the wear being a function of the heat.



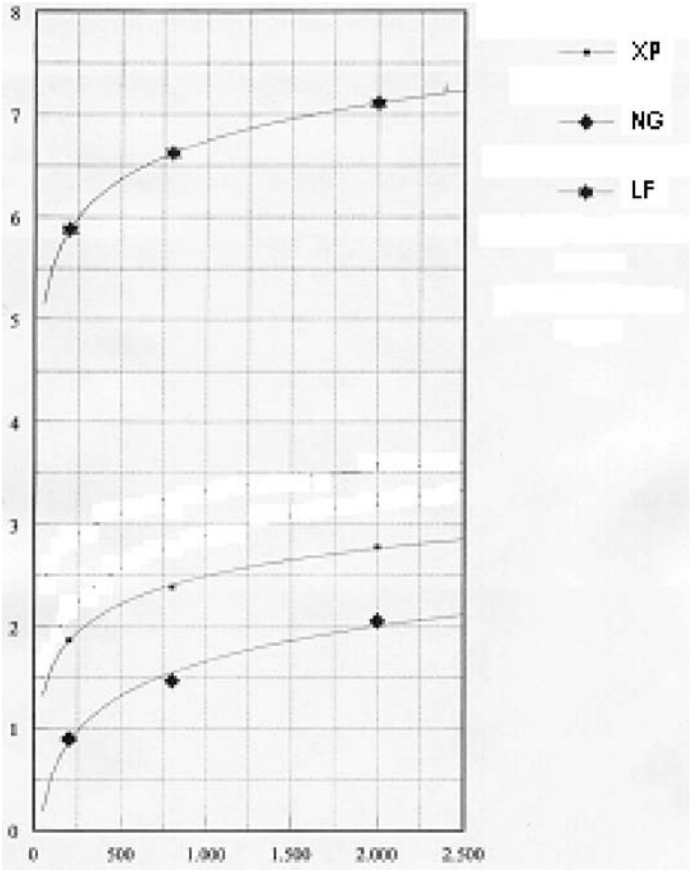
Different pressure and different velocities lead to different wear rates.

The effect is amplified dynamic operating conditions as shown above.

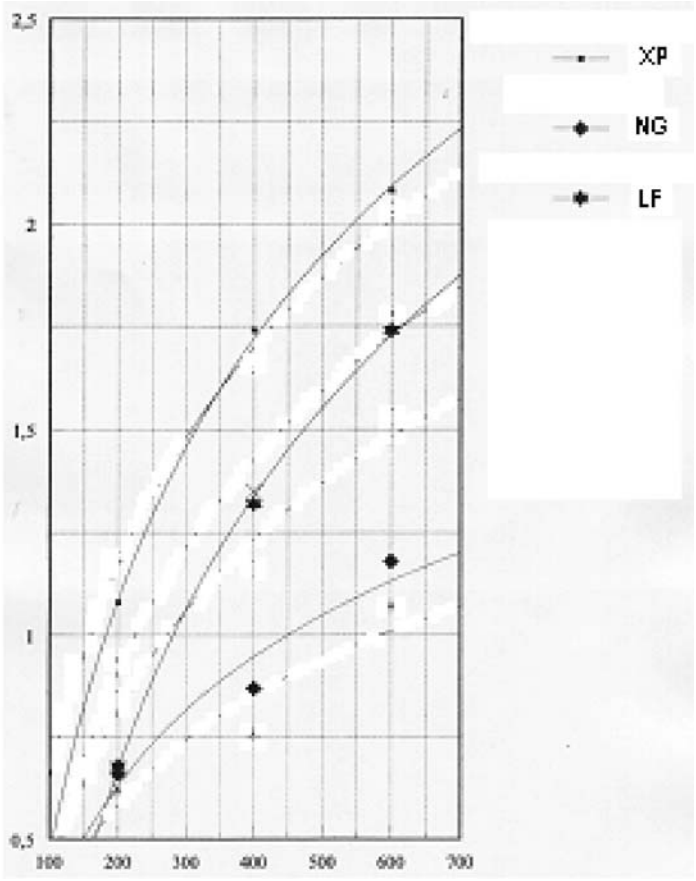
Experimental results of wear tests - NG against Acetal

The diagrams show the wear rate in 0/00 over the test duration in h.
Test performed under dry run conditions.

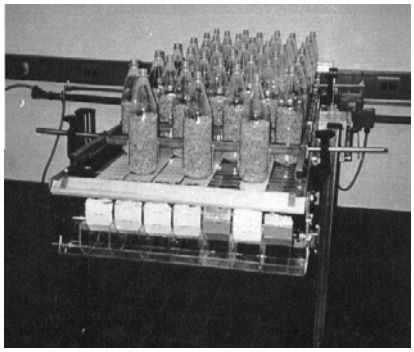
Tested with 1.5 l PET bottles



Tested with 1 l glass bottles



Test station



MAINTENANCE

Lubrication

Synthetic lubricants offer:
- Concentration independent on water properties e.g. hardness.
- Less foam.
- No slippery factory floors.
- Less bacteria growth.

Soap based lubricants offer:
- Best possible lubrication, because lubricant sticks to the chain.

Lubrication suppliers' advice is strongly recommended.

Aspects of dry running conveyors:
- Savings on investment (lubrication system, lubricant, water treatment, etc.).
- No packaging damage.
- Increased coefficient of friction and therefore wear.
- Extra cleaning required.
- Slip stick effect possible.
- Built up of electrostatic charges possible.
- Higher noise level.
- Not applicable for high speed applications.

Dirt and debris must be removed by cleaning to avoid increase of coefficient of friction and wear on all components of the conveyor.

Cleaning

Cleaning is most important in order to achieve:
- Hygienic system
- Clean products
- Reduction of friction and wear
- Removal of abrasives

Removal of remaining cleaning agents with flush water is recommended.

Cleaning dry running conveyors
With dry running conveyors there is no continuous cleaning like with lubricated conveying. All products (beer or lemonade) spilled on the chain/belt will result in pollution of the containers, increasing the friction, and the risk of products toppling over.
Therefore dry running conveyors should be cleaned even more frequently than lubricated chains. How often depends very much on the circumstances, e.g. when liqueurs are bottled and spilled, it might be necessary to clean every time the line stops for a few hours.

Cleaning stainless steel chains
This type of chain will be lubricated in most cases. Dirt etc. is flushed away continuously.
Normally, it is recommended to clean the chain regularly with hot water (max 80°C) or cold water with a cleaning agent to stop and remove any form of bacteria growth.

There are often positions where product (beer or soft drinks) is spilled on the chain. In these positions the lubrication will not function optimally, and a more frequent cleaning could be required, e.g. once every week. It could be necessary to use a brush in addition to the hot water or cleaning agent to remove e.g. broken grass etc.

Cleaning plastic chains

For lubricated plastic chains, almost the same counts as for stainless steel chains. But when using cleaning agent attention should be given to its compatibility with the chain material.

With respect to cleaning, it is obvious that the Magnet System offers great advantages because the chain can be taken out of the curve and cleaning takes less time than with conventional curve systems.

Cleaning plastic belts

Basically, cleaning of plastic belts is not different from cleaning plastic chains. Again, the chemical resistance of the materials against the cleaning agents must be checked beforehand.

Flat Top belts have to be cleaned from the top and underside. Flush Grid belts can be cleaned very effectively, due to the open area. Water can be sprayed through the belt to clean it.

Inspection

A good condition of the line can be maintained when people recognise initial signs of wear/failure and react accordingly.

Generally, all components of a conveyor should be checked at once.

Check the condition of the chain/belt regularly, and replace links/modules which are damaged. Important in this matter is to try to find the cause of the damaged links/modules. Wear patterns or damage on a chain or belt can often lead to a problem area elsewhere in the conveyor.

It is very important to replace damaged modules in plastic belts and links in plastic chains as soon as possible since small damage could lead to bigger damage if it is not repaired. If any damage is found such as pieces of plastic broken off, or a wear pattern at the side of the belt, the cause of the problem should be located.

Cleaning instructions

General remarks

Cleaning of chains and belts is necessary for the following reasons:

- ➢ Minimization of dirt / debris
- ➢ Minimization of germ formation
- ➢ Minimization of product scarp
- ➢ Maximization of production stability / continuity

Clean operating conditions substantially improve:

- ➢ Service life of chains and belts
- ➢ Service life of components e.g. wear strips and return part components
- ➢ Prevention of crashes caused e.g. by glass debris and wrapping debris
- ➢ Prevention of malfunctions caused e.g. by sticky residues.

Careful cleaning includes all components of a conveyor:

- ➢ All components which are in direct contact with chains / belts
- ➢ All components which affect indirectly the service life of chains / belts such as return shafts:

- Upper side of chains / belts
- Opposite side of chains / belts
- Wear strips / rollers in the return part
- Wear strips in the upper part
- Sprockets and idler
- Shafts of return rollers and idler
- Return guide shoes

Cleaning schedules depend on:

- ➢ Production requirements
- ➢ Actual cleanness of chains / belts

- ➢ Any case a conveyor should be cleaned before the first start-up in order to remove all dirt/debris/residues from the assembly.The same should be done when a conveyor is restarted after a longer period out of order.

We recommend permanent inspection of the actual cleanness of conveyors and chains / belts. If extraordinary cleaning is required this should be done without delay.

Regarding the choice of cleaning agents the followuing must be considered:

- ➢ Chemical resistance of the chain/belt materials
- ➢ Example:
  - pH 7 (neutral) is recommended
  - recommended pH range4-10
  - Chlorine (warm), Ammoniac (warm) should only be used in very low concentrations <7%. Only short contact time is allowed.
  - Strongly caustic agents e.g. phosphoric acid (warm) ,salt acid,formic acid,sulphuric acid,(warm),saltpetre acid,potassium hydroxide,sodium hydroxide,hydrogen peroxide (warm) and solvents like Acetone should be avoided with plastic chains / belts.

Using cleaning agents the following should be considered:

- ➢ In the actual catalogues
- ➢ On our internet site:www.systemplast.com/documenti/chemicalpg.htm
- ➢ In the Engineering Manual

In case of doubts/question don't hesistate calling us.

Cleaning process

Selection of the best suitable cleaning process can only be done by the plant operator according to the special requirements and circumstances of his production unit.

We are only able to give general recommendation based on our experience. In any case our recommendation must be checked carefully by the plant operator reading applicability.

Pre-cleaning

- Stop conveyor,remove debris e.g. broken glass,wrapping piecies,cords,wood piecies
  - Also in the return part
- means:
  - cold/warm water up to 60°C
  - brush,hose,pressure cleaner up to 80 bar
- If possible let the conveyor run.Clean it from all sides:driet dirt,germ,sticky dirt
- Sprockets,idlers
- Upper chain/belts guides
- Guides in the return part

Cleaning

- means:
  - cleaning solution and user manual of cleaning agent supplier
  - brush,perssure cleaner to apply the cleaning solution
- If possible let the conveyor run.Clean it from all sides.Make sure that all surface with cleaning solution.
- Sprockets,idlers
- Upper chains/belts guides
- Guides in the return part
- regards the recommended exposure time of the cleaning agent

Rinsing

- means:
  - cold/warm water up to 60°C (regard recommendations of the cleaning agent supplier)
  - brush,hose,pressure cleaner up to 80 bar
- If possible let the conveyor run.Rinse it from all sides.
- Sprockets,idlers
- Upper chain/belts guides
- Guides in the return part

Repeat these steps until the favoured cleaning result is reached.

Disinfection

Is necessary to prevent alternating contamination of chains/belts and product.

- means:
  - disinfection agent and user manual of the supplier
  - brush,pressure cleaner
- If possible let the conveyor run.Disinfects it from all sides.Make sure that all surface are convered with disinfection solution.
- Sprockets,idlers
- Upper chain/belts guides
- Guides in the return part
- regards the recommended exposure time of the disinfection agent

Rinsing

- means:
  - cold/warm water up to 60°C (regard recommendations of the cleaning agent supplier)
  - brush,hose,pressure cleaner up to 80 bar
- If possible let the conveyor run.Rinse it from all sides.
- Sprockets,idlers
- Upper chain/belts guides
- Guides in the return part

Drying/blowing off

Die to the fact that it most cases drying the conveyor completely is not possible it is recommended to remove at least big water residues.

Inspection

- Check the cleaning result carefully (all components) and repeat the procedure if necessary.
- Before re-starting the conveyor make sure that all cleaning means were removed.

Other components

This cleaning procedure is also applicable to other components of a conveyor which are not in direct conact with chains/belts:

- Basic construction:pads.pods.clamps
- Product guides:guide rails,side brackets,traverses, clamps
- Drives,supports,sensors,casing:regard special instructions about cleaning electric devices!

Critical sections of a conveying line which need special attention regarding cleaness

This list considers standard layouts conveying lines.In those sections ,the danger of high wear is significant.For this reason cleanness is essential to increase service life of all components and to avoid malfuctions as well as product scrap.

- Return boxes all the way to the de-cases or washer
- Return boxes all the way to the washer
- One way and return bottles in high speed section:
  - filler
  - labeller
- One way and return bottles in side transfer sections and pressure less combiners
- One way and return bottles in accumulation tables and buffer section in front of machines:
  - filler
  - labeller
  - pasteurizer
- Create conveying in the dry end

Generally it must be noticed that dry sections must be inspected very carefully regarding clean conditions.

In such sections no permanent cleaning by means of lubrication spray devices is taking place. As a consequence out of insufficent cleaning wear at the following components can be observed:

- curve guides
- wear strips
- chains/belts
- return components

Only due to the higher friction in such sections the wear rate is already higher compared to lubricated section.If cleaned properly,the service life of components can be increased significantly.

Additionally to regular cleaning cycles it is recommended to blow off particularly the curve guides in short intervals.

EXTRA curve guides with metal wear recommended anyway.

Inspection procedure

1. Inspect chains for unusual wear patterns,nicks,or damage.
2. Look for excessive gaps between chain flights.
3. Check conveying surface for flatness,bent or broken flights.
4. Inspect hold-down tabs or beveled sliding surfaces for excessive wear.
5. Review chain catenary sag for proper amount.
6. If take-ups are used,check that take-up tension is not excessive.Do not preload chain.
7. Check all idlers,rollers,turn discs and sprockets for freedom of rotation.
8. Examine sprockets for excessive wear.
9. Look for debris build up in sprocket tooth pockets.
10. Check for excessive guide ring wear.
11. Check all wear strips and fasteners for excessive wear.
12. Check all transfer points,dead plates,turn tables,turn discs and sprockets for proper elevation and alignment.
13. Review function of lubrication system.
14. Inspect general cleanliness of conveyor system.

Installation procedure

1. Check all sprockets,idlers,turn discs and rollers for proper elevation and alignment with regard to the conveyor tracks.
2. Check all wear strips (carrying and return),dead plates, dividers and transfers mechanism for proper location, elevation, spacing and flatness.
3. Check all fasteners for proper tightness (torque).Fasteners used on wear strips and dead plates must have recessed heads.
4. Check all conveyor splice points for proper elevation,alignment and fastening.
5. Inspect conveyor system for obstructions by pulling a short section of chain (1 metre) trought the entire conveyor.
6. Check lubrication system (if present).
7. Install conveyor chain, assuring that the following has been done:
   A. Check for correct direction of chain travel.
   B. Assemble chain in 3 meters sections and avoied twisting or damaging the chain.
   C. Connect chain sections on the conveyor.Insure that all pins and top plates are flush and propely secure.
   D. Adjust chain catenary (sag) to the proper elevation.Note:Readjustment is usually necessary following operation under loading conditions.
   Although not to overload the chain.
8. Insure that lubricant is evenly dispersed through conveyor system.See lubrication section for more information.
9. Start up conveyor by jogging and/or using short running periods before loading the system. Be alert to unusual noises or actions.If problem should occur ,refer to the trouble shooting guide.

Trouble shooting

Chain/belt jumps on sprocket or does not release well

Possible causes	Remedy
Chain/belt is elongated e.g. due to wear or overloading	Replace chain/belt and sprocket. Check other components as well.
Improper catenary sag	Check dimensions and adjust
Sprocket is worn	Replace sprocket
Wrong sprocket type	Install correct sprocket
Misaligned sprocket	Check and adjust
Improper sprocket position	Check and adjust position

Slip stick operation

Possible causes	Remedy
Slip stick	Use lubrication. Reduce chain/belt tension by shortening the conveyor
Return roller diameter too small	Install larger rollers
Chain/belt catches the conveyor	Remove obstructions. Check return part as well

Damaged chain hinges

Possible causes	Remedy
Overloading	Replace chain/belt. Check sprockets and other components as well
Blocking and obstructions	Check the complete conveyor
Exceeding the minimum backflex radius	Check conveyor construction

Elongation

Possible causes	Remedy
Overloading	Replace chain/belt. Check sprockets and other components as well
Wear from dirt in hinges	Improve cleaning

Rapid curve wear

Possible causes	Remedy
Overheating	Use EXTRA curve
Embedded abrasives	Replacement

Chain drifts sideways on sprocket

Possible causes	Remedy
Bad shaft/sprocket alignment	Adjust or use collars
Conveyors is not level	Adjust

Cracked hinge eyes

Possible causes	Remedy
Stress-corrosion caused by incompatible chemicals	Replacement. Check chemicals

Chains for Magnetic System come out of curve

Possible causes	Remedy
Worn curve	Replacement
Improper chamfering of the infeed Or other obstructions	Check and adjust/rework
No controlled start-up	Install frequency inverter drives
Curve not mounted level	Check and adjust

Rusted steel chain

Possible causes	Remedy
Incompatible combination of chain material and chemicals. May occur even with stainless steel.	Use only compatible chemicals Consider higher graded material

Excessive chain/belt wear

Possible causes	Remedy
Pollution	Improve cleaning
Failing lubrication	Contact lubricant supplier
Obstructions	Check all sections
Debris in return part	Cleaning. Install roller with larger diameter

Sprockets don't slide on shaft when belt extends due to temperature increase

Possible causes	Remedy
Pollution	Improve cleaning
Axial fixing incorrect	Re-adjust axial fixing according to temperature situation

Rapid wear on sprockets

Possible causes	Remedy
Abrasive conditions	Improve cleaning Use steel sprockets

Please help us completing that list by informing us of your experiences.

Replacement criteria

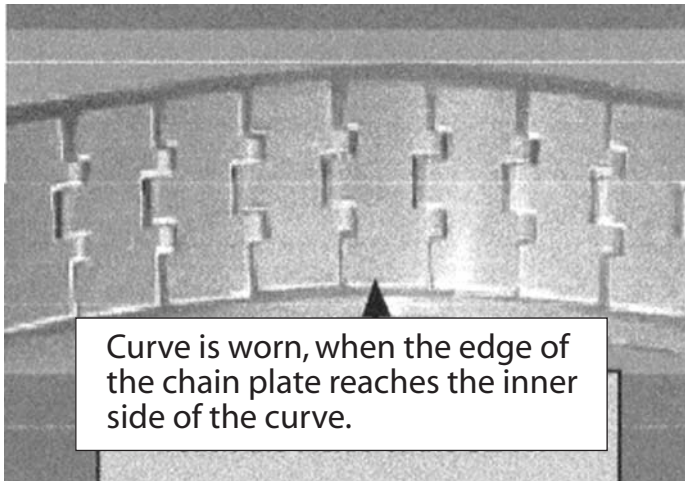
Chains must be replaced, when
- Pitch is elongated more than 3%.
- Thickness of the plate is reduced to less than 50%.
- The surface becomes very unflat/uneven or rough, dependant on application.
- Side of sideflexing chains is worn to such an extent, that the pin is exposed.
- Chain jumps on the sprocket.

Chains of inliners/pressureless combiners should be changed all at once.

Belts must be replaced, when
- Thickness of the plate is reduced by 1 mm from the top and from the underside.
- The surface becomes very unflat/uneven or rough, dependant on application.
- Belt jumps on the sprocket.
- As a guideline, 3% elongation is tolerable.

When replacing chains/belts, it is recommended to replace wearstrips and sprockets/idlers as well.

Replacement of **Dual Magnetic Corner Tracks**



In case of multitrack curves, check all tracks.

Sprockets and idlers must be replaced, when
- Teeth show hooked shape and chain releases not well.
- Teeth are damaged.
- Chain jumps on sprocket.
- Bore of idlers is worn out and idler starts oscillating.
- Hub or keaway are damaged.
- New chain is installed.

Wearstrips must be replaced, when
- Thickness is reduced to less than 50%.
- Dirt or debris is embedded.
- Fixing bolts protrude.

CHEMICAL AGENT	POLYAMIDE				POLYPROPYLENE				ACETAL RESIN				POLYETHYLENE				BRASS				RUBBER								STAINLESS STEEL			
	PA				PP				POM				PE				OT .NI.				NBR				VITON				AISI 304			
	C				C				C				C				C				C				C				C			
	Note	%	23° C		Note	%	23° C		Note	%	23° C		Note	%	23° C		Note	%	23° C		Note	%	23° C		Note	%	23° C		Note	%	23° C	
Acetic acid	S	10	★			40	●			5	★			10	●				❍				★			20	★			20	●	
Acetone		100	●				●				❍				●				●				★				★			25	●	
Acrylonitrile		100	●				●																★				★					
Aluminium chloride	S	10	●				❍														S		●		S	SA	●				❍	
Aluminium sulphate	S	10	●				●								●						S		●		S	SA	●					
Amyl alcohol		100	●				●								●												●				●	
Ammonia		10	●			30	●		S		●				●				★		S		❍		S		❍			100	●	
Ammonium chloride	S	10	●		S	10	●														S		●		S	SA	●				❍	
Aniline		100	❍				●							3	●								★				●				●	
Barium chloride	S	10	●				●														S		●		S		●				❍	
Beer			●				●				●				●				●				●				●				●	
Benzene							●				●				❍															70	❍	
Benzic acid	S	SA	❍			SA	●														S		●		S		●			100	●	
Benzol		100	●				❍				●				❍				●				★				❍				●	
Boric acid	S	10	●			SA	●							SA	●						S		●		S	SA	●			SA	●	
Brine			❍				❍								●																❍	
Butter			●				●				●				●				●				●				●				●	
Butyl acetate		100	●				❍																				★					
Butyl alcohol		100	●				●																❍				●				●	
Butyl glycole		100	●				●																									
Calcium chloride	S	10	●		S	50	●							SA	●				●		S		●		S	SA	●				❍	
Carbon sulphide		100	●				●				●												★				●				●	
Carbon tetrachloride			●				★				●								●				★				●			10	●	
Chlorine water							★				★				★																★	
Chloroform		100	★				❍				★				★				●				★				●				●	
Chromic acid	S	1	❍																		S		★			50	●			10	●	
Citric acid	S	10	❍			10	●				❍				●				★		S		●		S	SA	●			25	●	
Cyclohexane		100	●				●																●				●					
Cyclohexanol		100	●				●																●				●					
Decalin			●				❍																❍				★					
Dioxane			●				❍																★									
Distilled water			●				●				●				●				●								★				●	
Ethyl acetate		100	●				●																★				●				❍	
Ethyl alcohol		96	●			96	●				●												❍				❍			10	●	
Ethyl cloride		100	●				★								❍				❍				❍				★				●	
Ethyl ether		100	●				●																				●					
Ferric chloride	S	10	●				●														S		●		S	SA	●				❍	
Food fats			●								●				●								●				●				●	
Food oils			●				●				●				●								●				●				●	
Formaldehyde	S	30	●		S	40	●				●				❍				●			40	❍			40	★			100	●	
Formic acid	S	10	★							10	★			10	★				●				★				❍				★	
Freon 12	L		●																				●				●				●	
Fresh water			●				●				●				●								●				●				●	
Fruit juice			●				●				●				●								●				●				❍	
Gasoline			●				❍								❍				❍				❍				●				●	
Glycerine			●				●				●				●				●				●				●				●	
Hydrocloric acid	S	10	★		S	30	●			35	★			35	●				❍		S	10	❍			37	●				★	
Hydrofluoric acid	S	40	★			40	●							70	●							65	★			48	●				★	
Hydrogen peroxide	S	3	★																		S	80	★			90	●				●	
Isopropyl alcohol			●				●																				●				●	
Lactic acid	S	10	●		S	20	●				●				●				★		S		●				●				❍	
Linseed oil			●				●				●				●								●								●	

CHEMICAL AGENT	POLYAMIDE				POLYPROPYLENE				ACETAL RESIN				POLYETHYLENE				BRASS				RUBBER								STAINLESS STEEL			
	PA				PP				POM				PE				OT .NI.				NBR				VITON				AISI 304			
	Note	C %	23° C		Note	C %	23° C		Note	C %	23° C		Note	C %	23° C		Note	C %	23° C		Note	C %	23° C		Note	C %	23° C		Note	C %	23° C	
Magnesium chloride	S	10	●		S	SA	●														S		●		S	SA	●				❍	
Methyl acetate		100	●				●																★				★				❍	
Methyl alcohol		100	●								●						●						❍				❍		80		●	
Methylene chloride		100	●				❍				★				❍								★				❍				❍	
Milk			●				●				●				●		●						●				●				●	
Mineral oil			●				●				●				●								●				●				●	
Nitric acid		10	★		S		●			5	●			5	❍						S	10	★			70	●			65	●	
Nitrobenzene		100	❍				●																★				❍					
Oleic acid		100	●				●								❍		●						❍				❍				●	
Oxalic acid	S	10	❍		S	50	●														S		❍		S		●			65	●	
Paraffin											●				●																	
Petroleum			●				●				●				★		●						●				●				●	
Petroleum ether			●				●				●						●						★				●				●	
Phenol	S		★				●																★				●				●	
Phosphoric acid	S	10	★			85	●			10	★			95	●			★			S	20	❍			85	●				★	
Potassium bichromate	S	5	❍		S	10	●														S		❍		S	SA	●					
Potassium bromide	S	10	●			SA	●														S		●		S		●					
Potassium hydroxide	S	10	●			50	●			25	★			25	●						S		❍		S		●			50	●	
Potassium permanganate		1	★		S		●														S		★		S		●				●	
Sea water			●				●				❍				●		●						●				●				●	
Silicone oil			●				●																●				●					
Silver nitrate			●		S	20	●														S		❍		S		●				❍	
Sodium carbonate		10	●		S	SA	●				●				●						S		●		S		●			100	●	
Sodium chloride	S	10	●		S	SA	●				●				●			●			S		●		S	SA	●				❍	
Sodium hydroxide	S	10	●																		S		❍								●	
Sodium hypochlorite	S		●		S	20	●				★				●						S		★			5	●				★	
Sodium silicate			●																		S		●				●			100	●	
Sodium sulphate	S	10	●																		S		●		S		●			100	●	
Soft drinks			●				●				●				●								●				●				●	
Suds	S		●				●				●				●						S		●				●				●	
Sulphuric acid	S	10	★			98	●			40	★			40	❍			●			S		★			95	●				★	
Tartaric acid			●		S	10	●			30	❍				●			★			S		●				●			50	●	
Tetrahydrofuran			●				❍																★				★					
Tetralin			●				★																★				●				★	
Tincture of iodine			★				●								●			★					★				●				❍	
Toluol			●				●																★				❍					
Transformer oil			●				❍																●				●					
Trichloroethylene			❍				❍																★				●				★	
Triethanolamin			●				●																★				★					
Turpentine											★				★																●	
Vaseline			●												❍								●				●					
Vegetable juice			●				●				●				●								●				●				●	
Vegetable oils			●				●				●				●								●				●				●	
Vinegar			●				●				●				●		●						❍				★				●	
Water and soap			●				●				●				●								●				●				●	
Whisky			●				●											●					●				●				●	
Wine			●				●				●				●			●					●				●				●	
Xylol			●				★				●				❍			❍					★				●				●	

Data shown in the table was taken from laboratory tests performed on unstrained samples and are merely indicative. Chemical resistance under normal working conditions can depend on various factors, such as stress and temperature, concentration of the chemical agent and duration of its effects.

ABBREVIATION
C = concentration L = liquid
SA = saturated S = solution

● = Good resistance.
❍ = Fairly good resistance depending on use conditions
★ = Insufficient resistance (not recommended).
Blank spaces = No tests performed

CHEMICAL AGENT	*SBS*	*SEBS Thermoplastic Rubber*
WATER	• • • •	• • • •
CHLORINE	• • • •	• • • •
SODIUM HIDROXINE	• • • •	• • • •
POTASSIUM HDROXINE	• • • •	• • • •
AMMONIA	• • • •	• • • •
SULPHURIC ACID	• • •	• • • •
NITRIC ACID	• • •	• • • •
HYDROCHLORIC ACID	• • •	• • • •
ACETIC ACID	• • • •	• • • •
LACTIC ACID	• • • •	• • • •
CITRIC ACID	• • • •	• • • •
HIDROGEN PEROXIDE(6% 12%)	• •	• • •
ALCOHOL	• • • •	• • • •
FOOD STABILIZERS	• • • •	• • • •
FOOD OILS	• • •	• • • •
COSMETIC PRODUCTS	• • • •	• • • •
PETROL: Shore Scale A	•	• •
Shore Scale D	• •	• • •
EMULSIFIED WATER 70%	• •	• • •
POLYGLICOL	• • • •	• • • •
MINERAL OIL: 7 h @23° C	• • •	• • •
24 h @70° C	•	• •
HYDRAULIC OIL: 7 h @23° C	• • •	• • •
24 h @70° C	• •	• • •
TOLUENE 1h @23° C	•	• • •
PETROLEUM AETHER	• •	• • •

Leganda:	
INSUFFICIENT RESISTANCE	•
LIMITED	• •
GOOD	• • •
EXELLENT	• • • •

Data shown in the table was taken from laboratory tests performed on unstained samples and are merely indicative.Chemical resistance under normal working conditions can depend on various factors, such as stress and temperature,concentration of the chemical agent and duration of iss effects.

APPLICATION TEMPERATURES

MATERIAL	SYMBOL	MIN. TEMP. °C	MAX TEMPERATURE °C DRY ENVIRONMENT	USED FOR
Carbon Steel	C45	- 70°	+ 180°	steel chains, roller chains
Ferritic Stainless Steel	Standard	- 30°	+ 400°	steel chains
Extra Stainless Steel	Extra	- 30°	+ 440°	steel chains
Extra Plus Stainless Steel	Extra Plus	- 30°	+ 400°	steel chains
Austenitic Stainless Steel	Austic	- 30°	+ 400°	steel chains, roller chains
Acetal Resin	D, W	- 40°	+ 80°	plastic chains
Low Friction Acetal Resin	LF, LFW	- 40°	+ 80°	plastic chains
Extra Performance	XP	- 40°	+ 80°	plastic chains
New Generation	NG	- 40°	+ 120°	plastic chains
Anti-Static Acetal Resin	AS	- 40°	+ 80°	plastic chains
High Temperature Resistance	HT	- 40°	+ 120°	plastic chains
Splecial Chemical Resistance	AR	- 5°	+ 100°	plastic chains
N.B.R. Rubber	NBR	- 40°	+ 110°	rubber pad, gripper
E.P.D.M. Rubber	EPDM	- 40°	+ 80°	rubber pad, gripper
Polyamide	PA	- 10°	+ 80°	sprockets, idler wheels
Reinforced Polyamide	PA.FV	- 20°	+ 120°	sprockets, idler wheels
Polypropylene	PP	- 5°	+ 100	sprockets, idler wheels
Reinforced Polypropylene	PP.FV	- 10°	+ 110°	sprockets, idler wheels
Polyethylene	PE	- 40°	+ 80°	sprockets, idler wheels

Expansion factors

D,LF,XPG,AR (Acetal): 0.12 mm/m/°C
NG (New Generation): 0.18 mm/m/°C
AS (antistatic Acetal): 0.13 mm/m/°C
CR (Polypropylene): 0.15 mm/m/°C
Approximate values.

Calculation:
Expected expansion [mm]=(width[mm]/ 1000)
**(operation temperature [°C]-21 °C)*
** expansion factor*

CONVERSION FACTORS (SI)

TO CONVERT SI (METRICI)	SIMBOL SI	DIVIDED BY FACTOR	TO OBTAIN
LENGTH			
meter	m	0.3048	foot
centimeter	cm	30.48	foot
millimeter	mm	304.8	foot
meter	m	0.0254	inch
centimeter	cm	2.54	inch
millimeter	mm	25.4	inch
meter	m	1609.34	mile
kilometer	km	1.60934	mile
meter	m	0.9144	yard
	MASS		
gram	g	28.3495	ounce (avoirdupoids)
kilogram	kg	0.0283495	ounce (avoirdupoids)
kilogram	kg	0.45359	pound (avoirdupoids)
	VELOCITY		
meter/minute		0.00508	foot/hour
meter/hour		0.3048	foot/hour
meter/minute		0.3048	foot/minute
meter/second	m/s	0.00508	foot/minute
meter/minute		18.288	foot/second
meter/second	m/s	0.3048	foot/second
	FORCE AND FORCE/LENGTH		
newton	N	9.80665	kilogram-force
newton	N	9.80665	kilopound
newton	N	0.27801	ounce-force
newton	N	4.44822	pound-force
newton/meter	N/m	175.1268	pound/inch
newton/meter	N/m	14.5939	pound/foot

NOTES

NOTES