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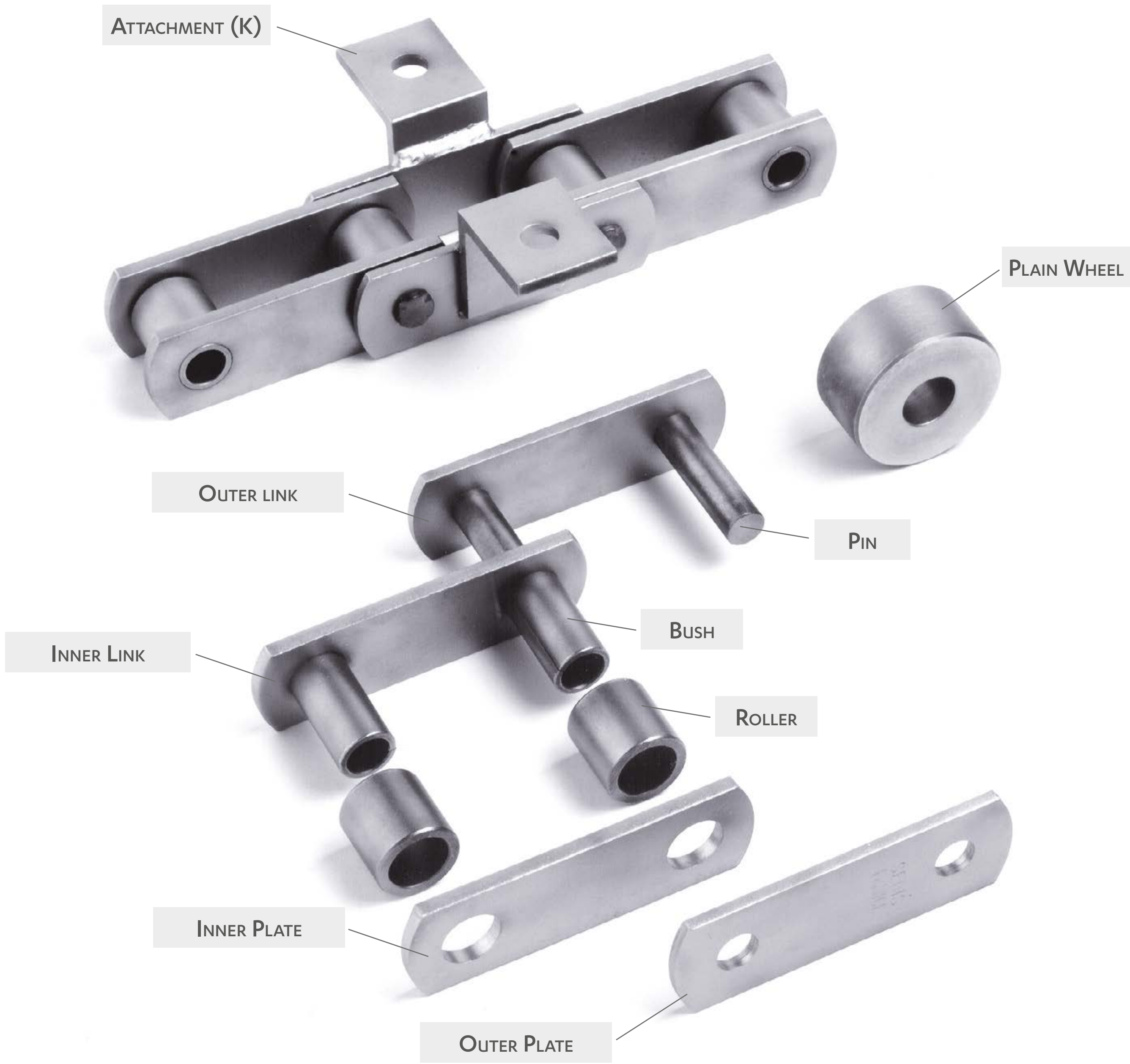
WHITE PAPER

Conveyor chains

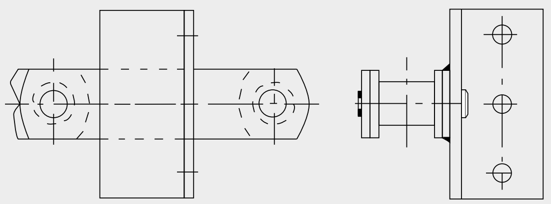
- COMPONENTS OF A CONVEYOR CHAIN
- TECHNICAL INFORMATION ON CONVEYOR CHAINS
- OPERATION MODE OF CONVEYOR CHAINS
- SELECTING A CONVEYOR CHAIN
- LUBRICATION
- SYMBOLS, UNITS AND MAIN FORMULAS
- SEDIS TECHNICAL SOLUTIONS

ISO 9001

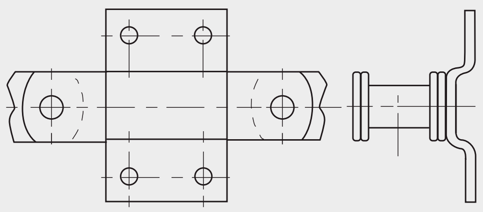
COMPONENTS OF A CONVEYOR CHAIN



OTHER ATTACHMENTS



Type F



Type G
(bent or straight side plates)

1 - TECHNICAL INFORMATION ON CONVEYOR CHAINS

Like all chains, conveyor chains consist of pins and bushes joined together by plates. Their main distinguishing feature is their ability to be equipped with various means of accessories suitable for the type of conveyor used and the nature of the load to be moved. Their pitch, which is generally considerable, is not unique but can be chosen from a wide range.

1.1- ISO STANDARD CONVEYOR CHAINS

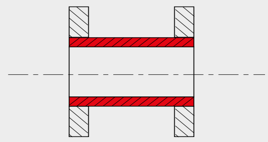
• STANDARD BASE CHAINS

The SEDIS chains conform to ISO 1977 standard. This range is based on the minimum tensile strength, the pitch, the type of pin and roller and the features of the plates. These characteristics are included in their designation.

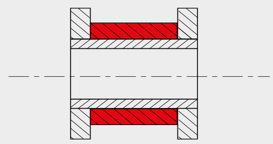
- The minimum tensile strength, according to a series based on preferred numbers, ranges from 20 to 900 kN.
- The pins of these chains are usually solid, but the standard allow them to be produced with hollow pins so that accessories as cross bars fixed to them when two chains are working in parallel.
- The pitch needs to be chosen on the basis of the operating conditions, the type of product to be conveyed, the frequency of accessories, the space available, etc... All pitch values that are also established according to a normal series are not necessarily available. Pitches with intermediate values or pitches in inches can be made.

These basic chains can be :

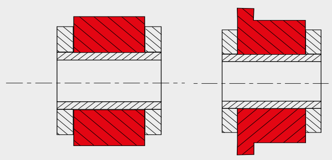
▶ **Bush chains**
(without roller) for low speeds (conveyor belts, feeders, scrapers etc) and in some specific cases where the chain accessories are load-bearing, the chain becoming mainly a traction part.



▶ **Roller chains**
in elevators where the chain speed is higher and causes shocks to the gearing. The rollers, made from case-hardened steel or steel with some other treatment, protect the bushes and prevent tooth wear.



▶ **Wheels chains** (rollers with a diameter greater than the height of the plates).
They enable the chain to run on a flat surface. The wheels may be straight or flanged to provide lateral guiding. The straight or flanged wheels are made from treated steel.



• CHAINS FOR LOAD SUPPORTS AND FASTENERS

In addition to hollow pins, there are many options to provide the support or attachment of the loads carried, directly or with the help of accessories :

- **Drilled plates** with one, two or three holes to receive attachment plates or spacer bars. If these bars cross the chain, clearance must be made on the sprocket teeth.

- **Deep link side plates** allowing the loads to rest directly on the chain rolling on straight wheels. These chains are normally used in parallel to form a belt and spread the loads.

- <u>Attachment plates</u> formed either by folding or in the form of brackets welded or riveted:

▶ **G attachments** with or without holes forming an attachment plane parallel to the plates.

▶ **F attachments** forming an attachment plane perpendicular to the plates.

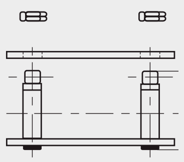
▶ **K attachments** with one or more holes forming an attachment plane perpendicular to the plates with a choice between three centre distance values (K2 with short, medium and long centre distance), the width of the attachments consequently varying. These attachment plates can be fitted on the inner plates, the outer plates, on one or both sides, according to a frequency that should be specified.

▶ **Special attachments** can be made on request if the quantities are sufficient.

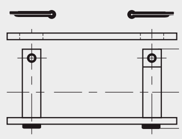
• CONNECTING LINKS

There are three types of connecting links:

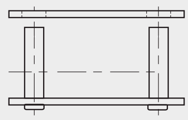
▶ **<u>with self-locking nuts:</u>** the two pins are riveted to one plate at one end, the other end receiving a connecting plate held by self-locking nuts



▶ **<u>with cottered pins:</u>** the outer plate is held on one side by cotters to facilitate dismantling. For some applications, we can deliver chains with plates cottered every pitch on one side.



▶ **<u>with riveted pins:</u>** the connecting plate is held by pins riveted both sides after assembly of the chain.



• DESIGNATION

ISO solid pin conveyor chains are designated by the letter **M**. Chains with hollow pins are designated by the letters **MC**, and chains with deep link side plates by the letters **MD.** The reference is followed by the following information:

▶ the **minimal tensile strength in kN**
▶ a **letter** indicating the **type of chain** :

- **B** for bush chains
- **P** for plain wheels
- **S** for roller chains
- **F** for flanged wheels

▶ **the pitch (in mm)**

<u>Example</u> : the chain **M160F200** is a standard solid pin conveyor chain, with a minimum tensile strength of 160 kN, with flanged wheels and a pitch of 200mm.

Drilled plates should be specified clearly on the order: on inner / outer plates, number of holes, and frequency of these plates on the chain.

1.2- BS STANDARD CONVEYOR CHAINS

These chains are designed according to the **British standard** (BS 4116) in terms of **tensile strength and dimensions**.
Their designation is similar to the ISO range. Each chain has the following adaptations:
drilled plates, deep side plates, K type attachment plates, scraper attachment plates and hollow pins.

- BS chains - **factory standard** : metric dimensions and pitches (in mm).
- BS chains - **British standard** : Imperial dimensions and pitches (in inches).

1.3- FRENCH SERIES CONVEYOR CHAINS

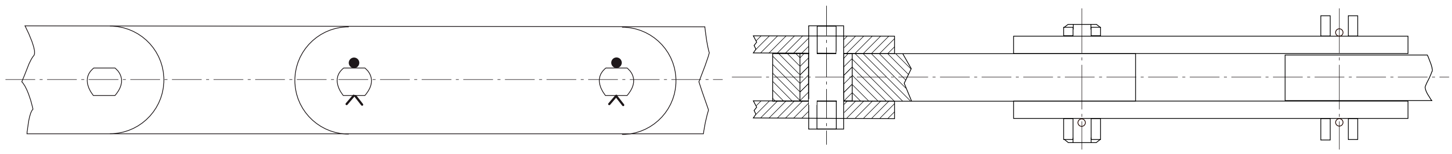
The special feature of French series chains lies in their **articulation** (pin/bush) which enable the chains to resist the **jolts and shocks** that are sometimes inevitable. There are three series of chains (light, normal and high resistance).

High resistance chains (treated plates) are used for demanding applications (high loads, transport of abrasive products, etc...).

The **accessories** for French series conveyor chains are: K, G and F type attachment plates.

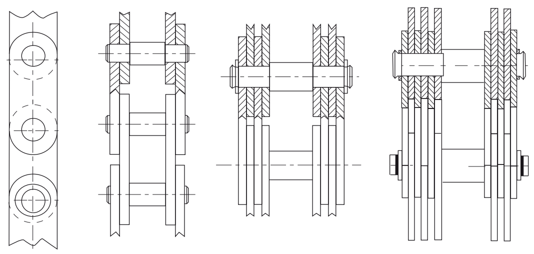
1.4- BLOCK CHAINS

Block chains have a **high tensile strength for a reduced width**. They are used to convey heavy loads, abrasive loads or when violent shocks are expected (e.g.: draw benches).
To increase the service life of the chain (better wear resistance), the blocks are sometimes bushed.



1.5- GALLE CHAINS

Galle chains are composed of **waisted or straight side plates and of flanged pins.** The flanges on the pins maintain the spacing between the plates and allow the chain to mesh on the sprocket. Chains are designated as single, double or triple link chains depending on the requested tensile strength.



Galle chains can transmit forces varying from a few hundred Newtons to more than 1000 kilo Newton; on the other hand the **speed should not exceed 20 m/min**.

Galle chains are used for **low speed transmission** (draw benches) or to **handle oscillating movements** (freight elevators, sluice gates, etc...).

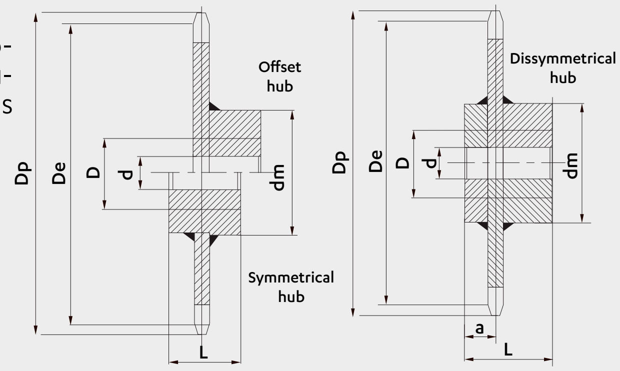
1.6- CHAIN WHEELS & SPROCKETS

The wheels used with conveyor chains are either made from machine-welded steel or of cast iron.
The teeth are usually raw casting or flame-cut, but they can be supplied on order with machined teeth (necessary when using bush chains).
The hubs are offset from the tooth plane except when a symmetrical hub is specifically ordered. Chain wheels can be supplied bored and keyed. In the case of a sloping groove on an offset hub, the entry point is placed on the same side as the teeth unless specified otherwise.

• NUMBER OF TEETH AND DIMENSIONS

The tables of sizes specify the standard number of teeth normally produced. However, to order, we can supply chain wheels with a different number of teeth. These tables also give the main dimensions of chain wheels for the most common pitches :

- **Pitch diameter Dp** and **outer diameter De**
- **Hub diameter Dm** and the **width L**
- Dimension **a : position of the tooth plane** on an offset hub
- Standard **tooth width** and width for flanged wheels
- Minimum **bore diameter** d and maximum **bore diameter** D
- Approximate **weight**



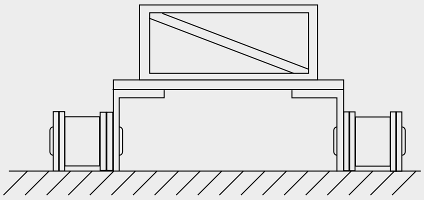
2 - OPERATION MODE OF CONVEYOR CHAINS

A conveying installation includes a drive chain wheel, as in the case of power transmission.
The force on the chain comes from the weight and the friction of the load to be transported and of the chain itself.

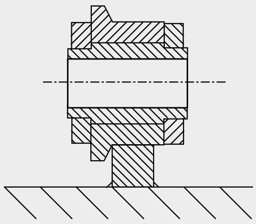
2.1- CHAIN SUPPORT

The chain can be supported between chain wheels in various ways:

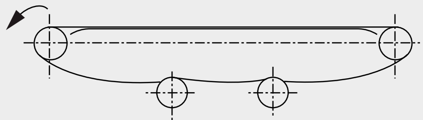
▶ The chain **slides on a guide and rests on the edge of its plates.**



▶ The chain **rolls on a guide by resting on its rollers** or more often on its plain or flanged wheels.



▶ The chain is **supported by one or more idler wheels**, either plain or toothed, in contact with the edge of the plates or the wheels. This configuration is only used for the **slack strand**. The chain contact on the tight and the slack side are not necessarily the same.



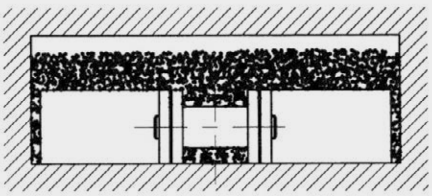
In a vertical system it may be possible to do without any support or guiding device for the chain which is then supported by the top sprocket, which is usually the driver one.

2.2- TYPE OF LOAD

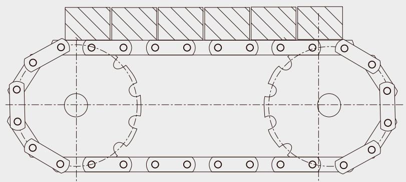
The conveyed loads may be very different, what leads to a wide variety of conveyor installations:

▶ The load is continuous over the whole length of the conveyor, this load being:

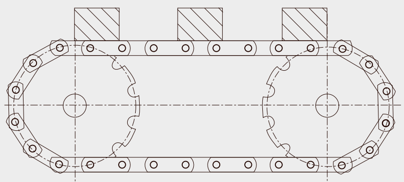
• **bulk** (coal, grain, etc...)



• **separate objects touching each other** (boxes, cases...)



▶ The load is not continuous. These are objects spread more or less regularly along the conveyor.



2.3- LOAD SUPPORT

Regardless of the nature of the load, it can be supported during transport in various ways:

▶ The load is not supported by the chain which in this case only has a drive function. The chain rests on a guiding surface on which it slides or rolls. This situation is encountered most often in bulk transport in a chute in which the chain is submerged

▶ The load is supported by the chain:

• either **directly**, generally on deep link side plates,

• or **by means of various accessories** attached by one of the means described in the previous paragraph (hollow pins, drilled plates, K type attachment plates, etc).

2.4- CHAIN ROUTE

The origin and the value of the forces on the chain depend not only on the chain support method and the load support, but also on the route:

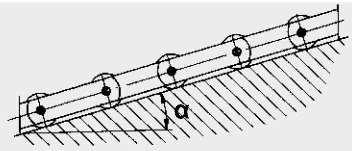
▶ **Straight horizontal route:** (the simplest situation) : In principle, the traction forces on the chain are only caused by friction:

- **Sliding and/or rolling** of the two strands of the chain on its guides,
- Possible **friction** between the load and it contact points,

In addition, the chain is loaded perpendicularly to its direction by the masses (chain and load), a force which can be exercised on the wheels.

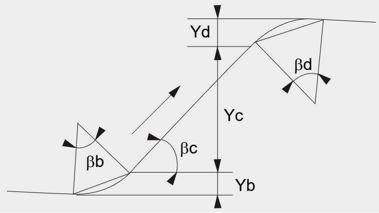
▶ **Straight inclined route** the forces mentioned above have to be weighted:

- the **elevation of the mass** is added to the friction,
- the mass only acts by its normal part



▶ **Curved route**: the laws of mechanics enable calculation of the effect of the curve in the guide on the chain friction. This only needs to be taken into account for small curvature radius and large deviations.

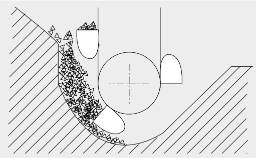
▶ **Mixed route**: naturally, one installation can contain sectors of routing combining the configurations described.



2.5- OTHER WORKING CONDITIONS

Various working conditions can be added to the basic conditions described above. It is important to take them into account when describing the conditions of use of the chain (next paragraph). These are mainly mechanical parameters, but may also be the nature of the working environment.

▶ **Drag** : an extra force is applied to the chain when the transported load is exercised by excavation as it is often the case in bucket elevators.



▶ **Shock loading** : independently of jerks which can happen on starting up, the arrival of loads on the moving conveyor can also cause overloads which need to be taken into account.

▶ **Torsion** : the forces applied to the chain must not have a torsion component. It is not always possible to avoid it completely. In this case it must be taken into account.

▶ **Polygonal effect** : when the number of teeth on a sprocket is reduced, which is often the case in conveying, their polygonal shape causes transverse oscillations and speed variations which can cause overloads and be prohibitive in certain conditions.

▶ **Speed** : as the masses in movement are generally high, the average value and the variations in speed of the chain are important parameters. The table here shows the speed values commonly used in the principal applications of conveyor chains.

Use of the chain	Speed
Conveyor with wood or metal pallets	0,10 to 0,50 m/s
Vertical elevator with spaced buckets	0,60 to 1,75 m/s
Inclined elevator with spaced buckets	0,60 to 0,95 m/s
Vertical elevator with continuous buckets	0,30 to 0,70 m/s
Inclined elevator with continuous buckets	0,15 to 0,40 m/s
Bar conveyors	0,10 to 0,60 m/s
Skip hoist	0,10 to 0,30 m/s
Scraper conveyor	0,20 to 0,50 m/s

▶ **Environment** : it is not unusual for conveyor chains to work in difficult conditions. It is often a question of chemical aggression (humidity, acid vapours, etc) and temperature (high or low). See chapter «Sedis solutions» for the recommended treatments.

3 - SELECTING A CONVEYOR CHAIN

3.1- SELECTION PROCESS

▶ Collect the maximum amount of data, and in particular:
• The way the chain will work must be perfectly defined by referring to the possibilities explained above.
• **Masses at stake** (including mass of the chain which will need to be estimated initially), friction from the chain and the transported load, lengths, angles, information about any bends, etc...

▶ Calculate the forces exerted on the chain :
• **traction forces** due to the masses and the friction (as well as any bending) cause traction stresses in the plates and sheer in the pins as well as contact pressure between pins and bushes.
• **normal forces** (due to the masses and any curves) which cause contact pressure between the rollers (or wheels) and bushes, and the contact surface.

▶ Choose the chain according to its working mode and the result of the calculations according to one or more of the following criteria:
• **tensile strength** of the chain
• **Wear resistance** of the **articulations** and the **wheels**.

▶ Redo the calculations introducing the **mass of the chain selected**, if this mass is significantly different from the mass estimated for the first calculation.

▶ **Complete the technical details of the assembly and installation** referring to the recommendations explained in paragraph 3.8 and making sure that the working conditions initially planned have not changed to the point of affecting the calculations.

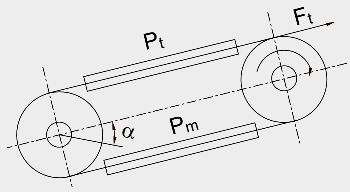
3.2- CALCULATION OF FORCES

GENERAL FORMULAS

All the symbols and units in the following formulas are listed in the chapter « symbols, units and main formulas».

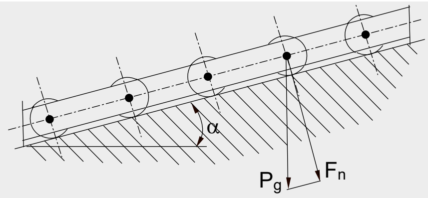
▶ Maximum traction force in Newtons (at the entry to the drive chain wheel) :

$$F_t = (P_t - P_m)\sin\alpha + (P_t \cdot f + P_m \cdot f')\cos\alpha + F_p$$



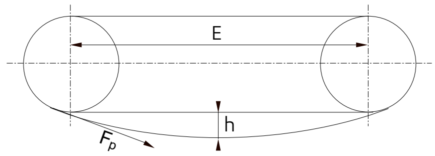
▶ Maximum normal force in Newton (pressure on the guiding surface) :

$$F_n = P_g \cdot \cos\alpha$$



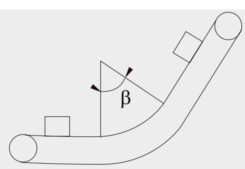
With:
• P_t and P_m : total loads (in N) supported by the tight strand and the slack strand respectively (see chapter 3.6)
• f and f' : the coefficient of friction encountered on the tight strand and on the slack strand (see chapter 3.7)
• α : the angle (in degrees) of the average direction of the chain in relation to the horizontal (positive value for climbing)
• P_g : the maximum weight (in N) acting on the wheel
• F_p : catenary force (in N) on the slack strand if it is not supported, given by the relation below:

$$F_p = P_m\left(\frac{E}{8h} + \frac{h}{E}\right)$$



▶ Influence of a curve

In a first approximation which is generally sufficient, when the direction of the chain is changed by an angle ß (in radians) on a slope with a coefficient of friction f, a correction has just to be made to the forces calculated with the following formulas:



Corrections : - multiply F_t by $e^{\beta f}$
- multiply F_n by : $(1+e^{2\beta f}-2e^{\beta f}\cos\beta)^{0.5}$

3.3- SELECTION FOR TENSILE STRENGTH

This is only a check, because in conveying installations it is only in exceptional cases where chains are subject to high forces continuously or in jerks that we may fear their failure by breakage before they wear out..

We calculate the maximum force Ft applied on the chain with the relations given in the previous chapter. This force must be corrected to take into account working conditions. we have the following values for **coefficient k**:

- moderate shocks .... k = 1,2
- violent shocks .... k = 1,4
- excavation .... k = 1,4

We then check that the tensile strength Rr is above 5 times the corrected force Ftc. We call the safety factor Kg (here it equals at least 5).

3.4- SELECTION FOR WEAR RESISTANCE OF THE ARTICULATIONS

For the service life usually required in industrial applications (50,000 hours) and/or when the conditions are aggressive (e.g. abrasive dust), the risk of failure of a chain is in the wearing of rubbing parts, especially pins and bushes.

To prevent wear in the articulations (with abnormal elongation of the chain disrupting its operation) and to avoid seizure causing an increase in the required power, it is necessary to **limit the contact pressure in the articulations**.

▶ **Pressure in the articulations** : $P_a = \frac{Ft}{Sa}$ N/mm² or MPa

▶ **Articulation surface area** (with a pin of diameter d_a and a bush of length l_d) : $S_a = d_a . l_d$ mm²

▶ **Admissible pressure for normal conditions of operating duration** (chain length and speed) **and maintenance** (lubrication):

$$P_a < 35 \text{ MPa}$$

WE CHOOSE A CHAIN WITH AN ARTICULATION SURFACE AREA AT LEAST EQUAL TO THE VALUE GIVEN BY THE RELATION:: $S_a > \frac{Ft}{35}$

Contact us for more severe operating conditions.

3.5- SELECTION FOR WEAR RESISTANCE OF THE WHEELS

When the load supported by the wheels, directly or indirectly, is significant, their wearing is likely to limit the service life of the chain.

The wheels support the normal component Fn which is calculated by the relation given in chapter 3.2, eventually corrected by the effects of a bend.

To find the average value of Pg, we use the weight calculation given in chapter 3.6, related to the pitch p of the chain.

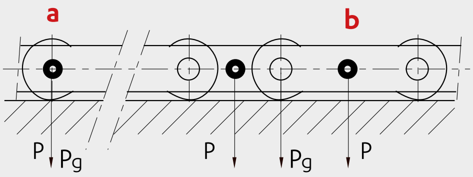
$$P_g = P_t . \frac{P}{E} = \left[P_c + \frac{P_{ac} + P_u}{n_c} \right] x \frac{P}{E}$$

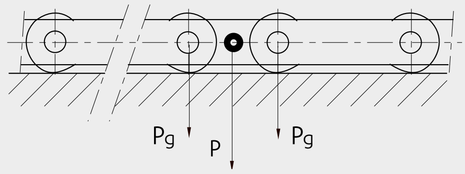
n_c = number of chains in parallel on the conveyor. But locally Pg can be much higher than the average figure.

The weight of the payload P has to be added to the weight of the chain and accessories:

▶ **Payload applied directly to the articulation** (hollow or extended pin as per schema **a** below) **or applied to the plates** (drilled plates or K attachments):

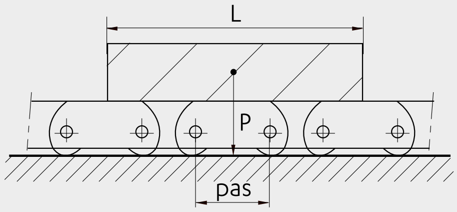
- on consecutive links (**b**) : $P_g = \dfrac{P}{n_c}$
- on an isolated link : $P_g = \dfrac{P}{2n_c}$





▶ **Payload P of length L on a chain with pitch p:**

$$P_g = \frac{P \cdot p}{L \cdot n_c}$$



▶ **Bush/ wheel contact pressure:** $P_g = \dfrac{F_n}{S_g}$ MPa

▶ **Contact area in mm² of a bush with an outer diameter dg and a wheel of length lg:** $S_g = d_d \cdot l_g$ mm²

Admissible pressure for normal working conditions (length of the chain and its speed) and maintenance (lubrication):

- For an untreated steel wheel:	$P_g < 2$ MPa
- For a plastic wheel (POM):	$P_g < 2{,}2$ MPa
- For a treated steel wheel:	$P_g < 2{,}5$ MPa
- For a case-hardened steel wheel:	$P_g < 3$ MPa

3.6- WEIGHTS USED IN THE FORMULAS

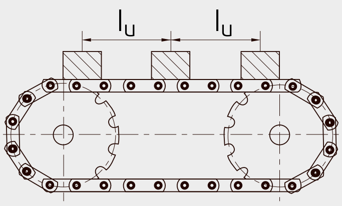
▶ **The weight Pc of the chain (in N)** which is calculated from its mass per unit length Mc (in kg/m) given in the catalogue, the acceleration of gravity g (around 9,81 m/s) and from the length of the strand (which we can take to be equal to E: the centre distance between the wheels in mm): $P_c = M_c \cdot g \cdot E$

▶ **The weight of the accessories Pac (in N)** (not included in the weight of the chain). It is calculated from their mass per unit length Puac (in N), their distance Iac (in m) and the length E of the strand: $P_{ac} = P_{uac} \cdot \dfrac{E}{l_{ac}}$

▶ **The weight Pu of the carried load.** Different possible situations:

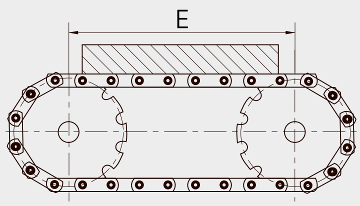
- **Distinct loads with unit weight** P_u (in N) at a distance of l_u (in m) :

$$P_u = p_u \cdot \frac{E}{l_u}$$



- **Continuous loads** (bulk or objects) with mass per unit length Mu (in kg/m):

$$P_u = M_u \cdot g \cdot E$$



- **Distinct or continuous loads** of which we know the **mass flow** Q (in N/min), or the **number No of objects** of weight Pu to be transported per minute at speed V (in m/min):

$$P_u = Q \cdot \frac{E}{V}$$

or

$$P_u = N_o \cdot p_u \cdot \frac{E}{V}$$

If there are n_C chains working in parallel:

- **Tight strand** : $P_t = P_c + \dfrac{(P_{ac} + P_u)}{n_c}$
- **Slack strand** : $P_m = P_c + \dfrac{P_{ac}}{n_c}$

3.7- FRICTION

The coefficients of friction f and f' corresponding respectively with the friction of the tight strand and the slack strand (see chapter 3.2) are:

- to be chosen directly in **table 1** in the case of **a chain sliding on its plates:**

$$f \text{ ou } f' = f1$$

- to be established according to the coefficients given in **table 2** and the diameters of the parts in contact, in the case of **the chain running on its wheels** with an outside diameter Dext and bore diameter Dint:

$$f \text{ ou } f' = \frac{f2 \,.\, Dint + f3 \,.\, \sqrt{Dext}}{Dext}$$

In the case of bulk transport, it is the friction of the transported product in the chute that is taken into account, whereas the friction of the chain is generally negligible. The table 2 gives the density and the friction coefficient of several materials generally handled in bulk.

Table 1

Friction parameters		Minimum: smooth and lubricated areas	Maximum: rough and dry areas
Sliding of the plates	on a steel guide	f1 = 0,08	f1 = 0,40
	on a plastic guide	f1 = 0,10	f1 = 040
Sliding between bush and roller or wheel		f2 = 0,10	f2 = 0,20
A roller or a wheel rolling	on a steel guide	f3 = 0,05	f3 = 0,10
	on a plastic guide	f3 = 0,07	f3 = 0,15

Table 2

Materials sliding in a steel chute	Apparent density	material friction coefficient f	Materials sliding in a steel chute	Apparent density	material friction coefficient f
Clay	0.77	0.63	Calcium carbonate	0.88	0.49
Asbestos	0.19	0.58	Ammonium chloride	0.67	0.79
Limestone	1.00	0.47	Charcoal	0.44	0.41
Cement	0.94	0.54	Coal	0.30	0.53
Lime	1.53	0.46	Pine wood	0.70	0.41
Aluminium ore	0.83	0.55	Wood chips	0.36	0.74
Iron ore	2.99	0.47	Barlez	0.39	0.71
Nickel ore	0.92	0.45	Rice - wheat	0.77	0.40
Lead ore	3.026	0.77	Sugar	0.68	0.47
Zinc ore	1.93	0.79	Polyethylene	0.34	0.52
Scrap iron - selected scrap	0.54	0.73	Rubber powder	0.39	0.53
Slag	0.90	0.48	Chromium powder	1.14	0.51

3.8- RECOMMENDATIONS FOR THE DESIGN OF THE INSTALLATION

▶ Number of teeth on the sprockets:

As conveyor chains normally have a fairly large pitch to allow the plates to be fitted with accessories, the designer will wish to reduce the number of teeth on the sprockets to reduce their size. The polygonal effect becomes significant below 12 teeth and even beyond that for high rotation speeds. In addition, for a chain wheel with a small number of teeth and a large pitch, follow the **recommendations in the catalogue concerning the maximum diameter of the hub in order to avoid its interference with the plates**.

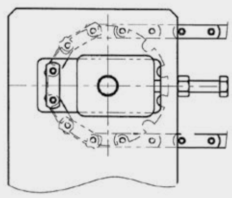
▶ Adjustment of the center distance :

The centre distance needs to be adjustable for several reasons:

- to facilitate the installation of the chain
- for maintenance, and to compensate for elongation over time.

A system of adjustment for taking up wear must be provided, either with:

- screws (see opposite drawing)
- springs
- conterweight
- jacks

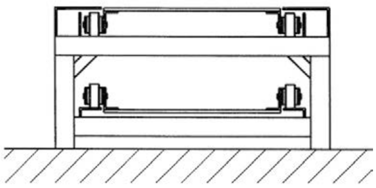


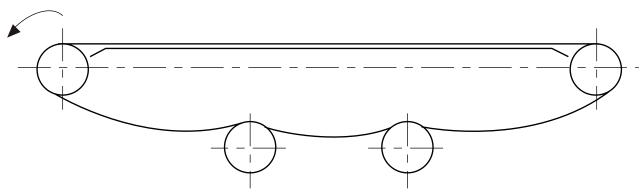
WARNING: by its principal a chain operates without tension in the slack strand because the drive by the chain wheels is positive. However in certain special cases, tension is necessary. The value of the tension force should not exceed 10% of the working load of the chain or 1% of the tensile strength.

▶ Chain strand supports and guides

- **The tight strand** which normally carries the load is supported by sliding or rolling on a guiding surface. Remember to use flanged wheels for large centre distances and in the case of a transverse force.

- **The slack strand** may be supported by sliding because it is carrying less load, but it is also possible to use rolling on the wheels (if they exist) or support by a series of idler wheels. Absence of support is only a solution for short centre distances as the catenary force becomes prohibitive for long centre distances. In any case, **the sag should never exceed 0.4% of the centre distance.** This condition may need an excessive tension force if the strand is not supported.





On both sides the meshing of the chain on the chain wheels should be performed with care: **guiding must be perfectly aligned with the teeth**. Provide **rounding at the end of the guide** to facilitate chain entry.

▶ Chain wheel alignment defect: (where b1 is the inner width of the inner link of the chain)

< b1 ÷ 2 : for lengths below 10m **< b1 : for lengths above 10m**

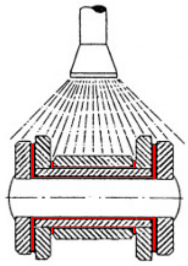
▶ Parallelism defect between the tooth planes: the sprockets must be parallel **(< 40')**

▶ Tolerance on the length of conveyor chains: **between 0 and + 0,25 %**

This tolerance needs to be reduced if two chains are working in parallel and are joined by cross parts or other accessories (to be precised on the order).

4 - LUBRICATION

4.1- PURPOSE

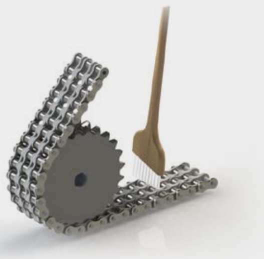


- **To introduce lubricating fluid between contacting surfaces** (see opposite drawing) : pin/bush, pin/plate, pin/roller, plate/plate or roller, etc. To reduce wear and prevent seizure.
- **To protect the chain against corrosion**
- **To reduce noise** by interposing fluid between faces subject to impact
- **To remove the heat** from the energy dissipated in friction**.**

4.2- METHOD OF APPLICATION

It depends on the use. Application methods can be grouped in 2 types for conveyor chains:

MANUAL LUBRICATION
(brush, oil, etc...)



CONTINUOUS DRIP FEEDLUBRICATION

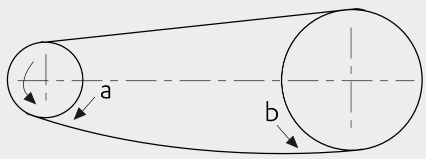
These two modes are more generally used but there are also automatic devices using rubbing brushes, spray or projection.

4.3- FREQUENCY OF APPLICATION

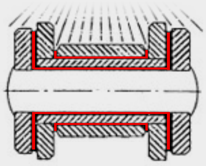
The frequency and volume of applications should be determined with the lubricant or lubrication system suppliers.

4.4- WHERE TO LUBRICATE ?

▶ longitually: in a zone where the articulations are under a light load in order to facilitate penetration by the lubricant (slack strand: a & b: recommanded areas)



▶ Transversally: between plates to feed the articulations with lubricant, and between inner plates and rollers or wheels.



4.5- WHAT LUBRICANT TO USE?

The lubricant should be adapted to the operating conditions. In the majority of cases, we use a mineral oil with a viscosity depending on the working temperature.

Viscosity in accordance with the operating temperature

Operating temperature (°C)	recommanded viscosity (ISO -VG)
-15 to 0 °C	15 to 32
0 to 50°C	46 to 150
50 to 80°C	220 to 320

The user should find a compromise between excessively low viscosity which tends to result in the lubricant being lost by gravity or centrifugal force, and excessively high viscosity which prevents the lubricant from penetrating to the rubbing surfaces. To guide his choice he could consult the mechanical chain lubrication guide edited by CETIM.

For special cases, especially where lubrication is not possible, please contact us.

UNLESS WE RECOMMEND OTHERWISE.GREASE IS TOTALLY PROHIBITED.

SYMBOLS, UNITS AND MAIN FORMULAS

SYMBOLS & UNITS

Description	Symbol	Unit
Angle from the horizontal	α	radian
Angle of inflexion of the chain	β	radian
Global friction coefficient : tight strand	f	-
Global friction coefficient : slack strand	f'	-
Pin diameter	d_a	mm
Bush outer diameter	d_d	mm
Chain wheel pitch circle diameter	D_p	mm
Distance between attachments	l_{ac}	m
Traction force	F_t	N
Normal force	F_n	N
Centrifugal force	F_p	N
Center distance	E	m
Slack on section of chain	h	mm
Bush length	l_d	mm
Wheel length	l_g	mm

Description	Symbol	Unit
Acceleration of gravity (= around 9,81)	g	m/s
Linear mass of the chain	M_c	kg/m
Linear mass of the continuous load	M_u	kg/m
Number of chains in parallel on the conveyor	n_c	-
Chain pitch	p	mm
Weight of the chain	P_c	N
Weight of attachments	P_{ac}	N
Unit weight of the attachments	P_{uac}	N
Weight supported by a wheel	P_g	N
Weight of the transported load	P_u	N
Total weight supported by the tight strand	P_t	N
Total weight supported by the slack strand	P_m	N
Pressure in the articulation	p_a	MPa
Articulation surface	S_a	mm²
Bush/wheel surface	S_g	mm²

MAIN FORMULAS

▶ Maximum traction force: $F_t = (P_t - P_m) \sin \alpha + (P_t.f + P_m.f') \cos \alpha + F_p$

▶ Weight of one side of the chain (tight or slack): $P_c = M_c \,.\, g \,.\, E$

▶ Weight of the accessories: $P_{ac} = P_{uac} \,.\, \dfrac{E}{l_{ac}}$

▶ Weight of the tight strand: $P_m = P_c + \dfrac{P_{ac} + P_u}{n_c}$

▶ Weight of the slack strand: $P_m = P_c + \dfrac{P_{ac}}{n_c}$

▶ Pressure in the articulations: $P_a = \dfrac{F_t}{S_a}$

EXAMPLES OF APPLICATIONS

THE CHAIN AND THE MATERIAL SLIDE IN THE CHUTE:

▶ Effort maximal de traction: $F_t = P_t \,.\, f + P_m \,.\, f_1$ ou $F_t = (P_c \,.\, P_u) \,.\, f + P_c \,.\, f1$

Avec f : coefficient de la matière transportée dans la goulotte & f1 : coefficient de glissement des plaques de la chaîne dans la goulotte.

THE CHAINS RUN, THE LOAD IS CARRIED:

▶ Maximum traction force: $F_t = P_c + \left[\dfrac{P_u + P_{ac}}{n_c}\right] . f + \left(\dfrac{P_c + P_{ac}}{n_c}\right) . f'$

where f and f': rollability coefficients which depend on the bore and the outside diameter of the wheel

The normal force of the wheel is: $P_g = \dfrac{P.\,P_u}{L.n_c}$ (where L : length of the load)

SEDIS TECHNICAL SOLUTIONS

SOLUTIONS AGAINST WEAR FOR CONVEYOR CHAINS

NORMAL OPERATING CONDITIONS

▶ **Case-hardening :**
Carburization is a thermochemical treatment that enriches the carbon on the surface. This carburization is followed by quenching to obtain **surface hardening** of the carburized layer and help **improve wear resistance**.

All our standard chains have case hardened pins and bushes, plates made of weldable carbon steel and hardened rollers that can be **case hardened on request** for greater wear resistance.

DIFFICULT CONDITIONS (FRICTION AND SEIZURE PROBLEMS)

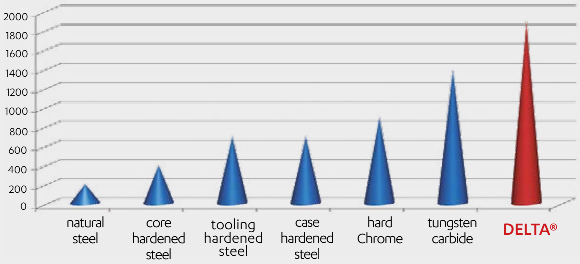
▶ **Mos2 :**
The pins are treated with Mos2 to facilitate running-in and reduce wear. This treatment **limits the friction** in the articulations and **reduces seizing**, in particular when heavy loads are concerned. Consult us.

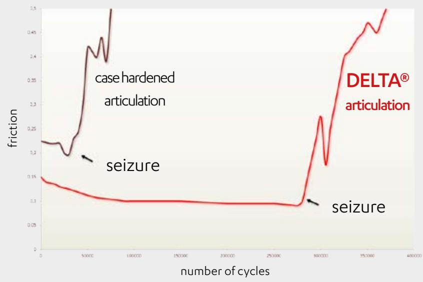
SEVERE APPLICATIONS (ABRASION, WASTE…)

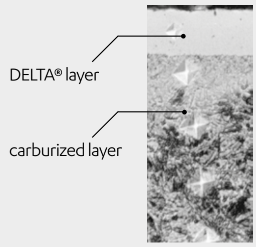
▶ **DELTA® PINS:** When a **superior resistance to wear and to abrasion of articulations** is required, for an improved lifetime of the chain.

DELTA® pins are thermochemically treated to achieve **surface hardness two or three times greater** than that obtained by case hardening, for **unrivalled abrasion and wear resistance** (1800 Vickers compared with 700 Vickers for conventional carburization).

COMPARISON OF HARDNESS (IN VICKERS)







- **Significantly reduced friction** in the links to **push seizing back to the limit**.
- **Increased protection of the pins against corrosion** thanks to its chemical inertness, thus guaranteeing **better wear resistance over time.**

In addition to the pins, it is possible to **treat the bushes** to provide the chain with even greater resistance to wear: consult us.

SEDIS TECHNICAL SERVICES CAN RECOMMEND
THE MOST ADAPTED CHAIN AND TREATMENT
TO YOUR APPLICATION.

DON'T HESITATE TO CONSULT US AND SEND YOUR SPECIFICATIONS !

SOLUTIONS AGAINST CORROSION FOR CONVEYOR CHAINS

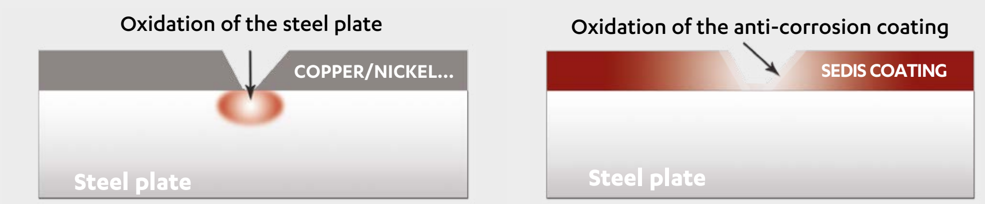
APPLICATIONS REQUIRING AN ANTI-CORROSION PROTECTION

▶ **Galvanization:**
Electrolytic treatment that improves corrosion resistance thanks to the depositing of a layer of zinc on the surface: for applications requiring a minimal degree of anti-corrosion protection.
Other types of zinc plating are possible on request (hot galvanizing, etc.). Consult us.
WARNING : Do not use stainless steel wheels with galvanized chains, to avoid any galvanic (dissimilar metal) corrosion.

SEVERE APPLICATIONS REQUIRING REINFORCED ANTI-CORROSION PROTECTION

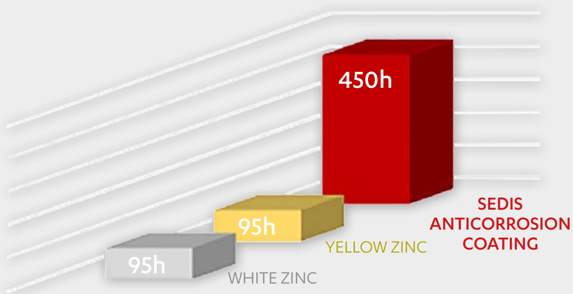
▶ **SEDIS ANTI-CORROSION TREATMENT :** For any severe application where a superior corrosion resistance is needed, and which doesn't allow use of a standard or galvanized chain.

The chain's metallic parts (excluding the pins) are **protected against corrosion by a mineral coating based on zinc and lamellar aluminum**. It is the zinc that oxidizes in preference to the steel:



The corrosion resistance provided by this SEDIS treatment is significantly better than that offered by other conventional treatments such as galvanization. We owe its **higher performance to its cathodic protection** characteristics.

RESISTANCE OF THE ANTICORROSION COATING IN SALT SPRAY AS PER ASTM B117



WARNING :
Do not use stainless steel wheels with anti-corrosion treated chains, to avoid any galvanic (dissimilar metal) corrosion.

This anti-corrosion treatment of the parts can be associated with Delta® pins to combine anti-corrosion protection and resistance to wear for a longer service life.

▶ **Stainless steel:**
It is the presence of chrome in the steel that gives it increased corrosion resistance.
We can propose every type of stainless steel according to your application's specific problems (corrosion, wear, etc.). Consult us.

SEDIS TECHNICAL SERVICES CAN RECOMMEND
THE MOST ADAPTED CHAIN AND TREATMENT
TO YOUR APPLICATION.

DON'T HESITATE TO CONSULT US AND SEND YOUR SPECIFICATIONS !

MAINTENANCE-FREE SOLUTIONS FOR CONVEYOR CHAINS

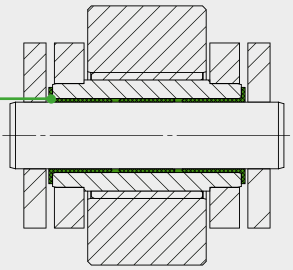
In many applications lubrification of the chain is hazardous or even impossible. Examples :

- **Risk of oil projection** which can damage the transported items
- **Risk of fire** if oil can be in contact with flame or products at high temperature (like escalators)
- **Operation in fluid environments** (water in particular)
- **risk of pollution by the lubrication** oil

APPLICATIONS WHERE LUBRICATION IS DIFFICULT OR IMPOSSIBLE

▶ VERTE® CHAIN : self-lubricating

A standard chain will have a limited service life if it is not correctly lubricated.
The solution is therefore the VERTE® chain which **does not require lubrication**, thanks to its self-lubricating composite bushings placed between the pins and bushes and/or between the bushes and rollers.



THE SELECTION OF VERTE® CHAINS SUITED TO THEIR UTILIZATION WILL BE MADE BY THE SEDIS TECHNICAL DEPARTMENT IN COMPLIANCE WITH THE APPLICATION'S TECHNICAL REQUIREMENTS, IN LINE WITH THE OPERATING CHARACTERISTICS AND THE NEEDS TO BE MET.

The VERTE® chain composite bushes can be associated with Delta® pins and the SEDIS anti-corrosion treatment for a higher performance and resistance.

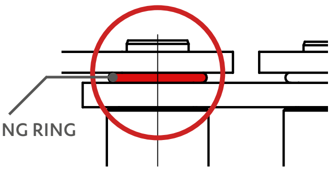
In this case, the wheels designed for these chains are made of galvanized steel, or of chromate-passivated galvanized steel with light lubrication of the treated teeth to avoid premature wear. Wheels with inserted plastic teeth can also be used if no lubrication of the gears is permitted.

WARNING **:** Do not use stainless steel wheels with VERTE® chains that have received an anti-corrosion treatment.

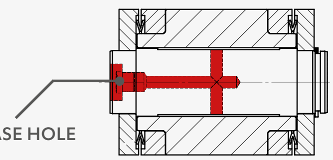
For applications that are even **more severe in chemical terms** (dairies, nuclear, etc.) it is possible to make VERTE® chains with **stainless steel (austenitic, martensitic, ferritic)**. In this case the wheels are either made of stainless steel of the same type or of plastic. Consult us.

MAINTENANCE-FREE APPLICATIONS FOR WHICH VERTE® CHAINS CANNOT BE USED

▶ Sealing ring chains: when the application does not permit the use of a VERTE® chain (because of the pressure or speed for example), **sealing rings** can be used (V-ring, O-ring, etc.) between the inner and outer plates to **seal the articulation off from the external environment** and confine the lubricant. Maintenance is therefore not required.



▶ Axial greasing: Greasers can be integrated in the chain's pins in order to distribute the lubricant in the articulations.
This process makes it possible to lubricate the chain from the inside outwards.
This solution can be associated with rings for even better sealing with respect to the surroundings.



sedis
we make you stronger

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